PART I – Candidates for Continuation Funding

PART II – New Problems
(Statements with Evaluations and Submitter Responses)

January 2018
INTRODUCTION

In formulating the fiscal year 2019 program for the National Cooperative Highway Research Program, the Special Committee on Research and Innovation will consider candidate studies in two broad categories: (1) continuations of projects initiated in earlier years and (2) new projects. Corresponding to these categories, this report is in two parts.

Part I contains write-ups for 16 continuation candidates. These write-ups were prepared by the NCHRP staff and project panels and provide the specifics of project objectives, funding, accomplishments, and recommendations for needed additional research. The continuations have been further subdivided as follows: 1.1 Annual Projects (e.g., Project 20-5), 1.2 AASHTO Committee Support Projects (e.g., Project 20-7), and 1.3 Research Projects (recommended extensions to individual objective-specific projects). You will find ‘Accountability Reports’ attached to several continuation requests under the 1.1 and 1.2 categories. Please note that recommendation from the Special Committee on Research and Innovation to end the four Committee Support Projects (8-36, 20-7, 20-65 and 25-25) will be presented to the AASHTO Strategic Management Committee in late January for concurrence. Because this matter was pending at the time this ballot was prepared, these four projects are included.

Part II contains 95 problem statements for consideration as new projects. For each candidate problem, the problem statement write-up, which was to be submitted in a format specified by NCHRP, leads off. The problem statement is then followed by evaluations that may be from among 3 sources: FHWA staff, NCHRP staff, and/or AASHTO committee. Lastly, there may be a response from the original submitter to the evaluation comments. Submitters were given the opportunity to support or rebut the evaluations or to withdraw the statement.
ACTIONS REQUIRED

This report is accompanied by a ballot for assigning priorities to both the continuation problems and the new problems. The questions to be considered in completing the ballot are:

a. Does the proposed study represent a current problem that needs researching?

b. Is the proposed study appropriate for NCHRP or should it be performed elsewhere?

c. Is the problem of nationwide interest?

d. Are similar efforts already underway elsewhere? If so, will this unnecessarily duplicate the efforts of others?

e. What is the probability of this research being successful?

f. If the research is successful, what is the anticipated return with respect to its cost?

By whatever means research committee members choose to employ, the evaluation of each problem by these questions is to be translated into a single rating number from 0 (no need) to 5 (absolute need) that will be used to rank the problem according to ballots returned by R&I and RAC.

The ballot is due on February 23, 2018, and a summary of the results will be distributed early in March. When R&I meets in March, the order in which continuation candidates and new problems will be considered will be based on the composite rankings by R&I and RAC.
Part I

CANDIDATES FOR
CONTINUATION FUNDING
# FY 2019 Candidates for Continuation Funding

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Part 1.1

ANNUAL PROJECTS
NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
Transportation Research Board
The National Academies of Sciences, Engineering, & Medicine

Continuation Request
Project 20-05, FY 1968 & Continuing
Synthesis of Information Related to Highway Problems

Present Expiration Date: Continuing
Recommended Allocation: $1,830,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended
The purpose of NCHRP Project 20-05 is to synthesize the useful knowledge and practice on particular subjects and prepare well documented state-of-knowledge and -practice reports. This is a systematic way to bring such useful information together and to make it available to the entire highway community.

With the rapid advancements that are taking place in highway and transportation planning, location, design, construction, maintenance, and operations, and as result of the broad spectrum of information input to these fields from a multitude of sources, it is imperative that a means of synthesizing this information into usable form be maintained and augmented. This service has been provided since 1967 through NCHRP Project 20-05 under the guidance of Project Panel SP20-05 and has been highly responsive to the needs of highway and transportation organizations. The synthesis program continues to be highly rated by SCOR and RAC and has consistently been ranked as a very high priority.

An appreciation of the topics that have been assigned for synthesis preparation may be gained from a reading of Research Results Digest 401 (http://www.trb.org/main/blurbs/175531.aspx) or by visiting the NCHRP website. The substantial interest that the program has generated is evidenced by the number of subjects that are proposed for synthesis each year—typically between 130 and 200. As of November 30, 2017, 514 syntheses had been published, five reports are in the final editorial and publication process, and 25 others are in the research stage. A review of TRB’s web page shows that 15 NCHRP synthesis studies were published in 2017.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended
For the FY2018 series, the NCHRP 20-05 project committee requested and AASHTO SCOR approved a budget of $1.83 million to execute 15 topics. The budget recommended by the NCHRP 20-05 project committee for FY 2019 is $1.830 million to support 15 topics. The amount is consistent with last year’s allocation.
3. Funds (in thousands)

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* These transfers were for additional synthesis projects funded by SCOR from among their regular NCHRP problem statement submissions.

4. Interpretation of AASHTO Problem Statement by Panel

Administrators, practicing engineers, and researchers are continually faced with highway problems on which much information already exists, either in documented form or in terms of undocumented experience and practice. Unfortunately, this information is often fragmented, scattered, and unevaluated. Often it is unknown to the persons normally responsible for initiating changes related to the topic (changes in specifications, procedures, etc.). As a consequence, full information on what has been learned about a problem is frequently not brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

Another type of waste occurs if a number of people who have similar problems make independent efforts to assemble the appropriate information, especially if the assemblies are incomplete and not made available to others.

Textbooks, monographs, and state-of-the-art papers represent conventional methods for maximizing the use of existing information and for minimizing the total effort expended in bringing together useful
information. All such documents involve the synthesis of information from various sources and can, therefore, be looked upon as information syntheses.

In this project, particular highway problems, or sets of closely related problems will be designated as topics for information syntheses. For each topic, the project objectives are: (1) To locate and assemble all documented information on the topic; (2) To learn what the practice has been for solving or alleviating problems within the topic; (3) To identify all ongoing research on the topic; (4) To learn what problems remain largely unsolved; (5) To organize, evaluate, synthesize, and document the useful information that is acquired; and (6) To evaluate the effectiveness of the synthesis after it has been in the hands of its users for a period of time.

The document produced by attainment of the foregoing objectives will be called a synthesis of existing information on the topic. The first and third objectives imply full use of the Transportation Research Database (TRID) and other information systems for documented information. It is expected that information obtained for the second and fourth objectives will be largely undocumented and will, therefore, be obtained through interviews in federal, state, and local agencies that have had first-hand experience with problems within the topic.

5. Original AASHTO Problem Statement Number
   Problem Statement is on file.

6. Research Assignment to Date
   NCHRP Project 20-05, "Synthesis of Information Related to Highway Problems" (see NCHRP Research Results Digest 401 for a list of prior synthesis topics).

7. Review Dates
   May 7-8, 2017 (Panel/staff),
Accountability Report for NCHRP Project 20-05
“Synthesis of Information Related to Highway Problems”

Purpose:
To provide summaries of the state of highway practice and knowledge.

Started:
Project 20-05 began in 1968.

Funding:
Allocated for FY 2018: $1,830,000
Requested for FY 2019: $1,830,000

Problem Solicitation:
Once each year, NCHRP specifically solicits topics from state DOTs, AASHTO and TRB committees, and FHWA. TRB staff also encourages submittals by TRB committees during the TRB annual meeting. Topics for FY 2018 are due by February 16, 2018.

Process for Selecting Studies:
Requests are considered at an annual meeting of the 20-05 panel, and a list of 15 topics and 3-5 alternates are selected.

Consultant Selection:
The synthesis program is managed by staff in TRB’s Cooperative Research Program. Each year’s new studies are announced publicly (NCHRP email list and the TRB E-Newsletter) to solicit interest in being a topic panel member or an author. Staff then forms a topic panel for each selected synthesis. The topic panel reviews expressions of interest and selects authors.

Studies Requested Last Year:
152 topics for the FY2017 program.

Studies Funded Last Year:
15 studies, totaling $1,830,000, were funded in 2017 (see attachment A).

Studies Completed Last Year:
15 NCHRP Syntheses were published in Calendar year 2017.

Distribution of Findings:
NCHRP syntheses are distributed widely by TRB to sponsors, subscribers, and affiliates. All NCHRP synthesis reports are posted on the TRB website as well.

Use of Findings:
By all indications, the NCHRP Synthesis Series is one of the most popular of the NCHRP activities. Recent syntheses that have been downloaded most often from TRB’s website include: 364, Estimating Toll Road Demand and Revenues; 365, Preserving and Using Institutional Memory through Knowledge Management Practices; 372, Emerging Technologies for Construction Delivery; 373, Multi-Disciplinary Teams in Context-Sensitive Solutions; 375, Bridge Inspection Practices; 391, Public-Sector Decision Making for Public-Private Partnerships; 393, Adjacent Precast Concrete Box Beam Bridges: Connection Details; and 402, Construction Manager-at-Risk Project Delivery for Highway Programs; and 488, Roundabout Practices.

Next Year’s Studies:
FY2018 studies will be selected in May 2018 from topics submitted to the committee by February 16, 2018. FY 2019 studies will be selected in May 2019.
### ATTACHMENT A

**NCHRP SYNTHESIS TOPICS INITIATED in 2017**

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<td>Summary of Practice for Automated Pavement Condition Surveys</td>
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Continuation Request
Project 20-06, FY 1969 & Continuing
Legal Problems Arising Out of Highway Programs

Present Expiration Date: Continuing
Recommended Allocation: $350,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended
Numerous legal and right of way problems affecting the operations and the services and facilities provided by state transportation agencies have been researched since the beginning of the project. Results are made available to state transportation departments and other public and private agencies through publication of Legal Research Digests and Selected Studies in Transportation Law (SSTL). SSTL is jointly sponsored with TRB’s Transit Cooperative Research Program and is comprised of the following volumes:
- Volume 1 Construction Contract Law (NCHRP)
- Volume 2 Eminent Domain (NCHRP)
- Volume 3 Environmental Law and Transportation (NCHRP)
- Volume 4 Tort Liability (NCHRP)
- Volume 5 Transit Law (TCRP)
- Volume 6 Transit Labor 13(c) Decisions (TCRP)
- Volume 7 Transit Charter Bus Service: Decisions and Documents (TCRP)
- Volume 8 Transportation Law and Governmental Relations (NCHRP)

The Project Committee last met on June 26-27, 2017. The next project panel meeting is scheduled for early June 2018. At the last meeting of the panel, the status of the legal studies program was reviewed and, given the available funds, 4 new topics were chosen for study. No updates of SSTL were recommended in this cycle.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended
The requested $350,000 will provide resources necessary to update another volume of SSTL if necessary, select 3 to 4 new studies to reflect current and important legal problems facing state DOTs, and administer the current topics under study.

The Committee meets annually. The next meeting will be held in June of 2018.
3. Funds (in thousands)

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* $90K was provided by NCHRP Project 20-59

4. Interpretation of AASHTO Problem Statement by Panel
There is a continuing need for State Highway Departments to assemble, analyze, and evaluate legal elements of special problems involving right of way control, tort liability, environmental and other aspects of highway law in general. NCHRP Project 20-06 fills a need for research in these areas which traditionally have not received adequate attention and focus elsewhere.

5. Original AASHTO Problem Statement Number
Problem No. 1969-A-01 on file

6. Research Assignment to Date
NCHRP Project 20-06, "Legal Problems Arising out of Highway Programs" (See the NCHRP website at www.trb.org/nchrp).

7. Review Date
9 December 2017
Accountability Report for NCHRP Project 20-6
“Legal Problems Arising out of Highway Programs”

Purpose: To evaluate legal issues relevant to transportation programs.

Started: Project 20-6 began in 1969.

Funding: Allocated in 2018: $350,000
Requested in 2019: $350,000

Problem Solicitation: The Committee members and TRB’s Counsel for Legal Research maintain contact with the TRB legal committees and the annual TRB Laws Conference for needed studies. Prior to Committee meetings, members are asked to submit topics of interest to them or as gathered from the various TRB legal committees (AASHTO’s Administrative Subcommittee on Legal Affairs does not routinely meet and defers activity to the TRB committees).

Process for Selecting Studies: Requests are considered at an annual meeting of the 20-06 project Committee. The Committee is comprised of members of the transportation legal community.

Consultant Selection: The NCHRP Project Committee provides oversight, selects topics, reviews reports, and approves consultants and their proposals. In consultation with the Committee, depending on the size and topic area, the Program Manager recommends the type of procurement, i.e. sole-source or competitive proposals from a short list of known experts or from a general solicitation.

Current Studies: 8 topics. See Attachment A

Studies Funded Last Cycle: 4 topics. See Attachment A, In Development

Studies Completed Last Year: 3 topics. See Attachment A

Distribution of Findings: Legal studies are published in the NCHRP Legal Research Digest series and/or as contributions to Selected Studies in Transportation Law. Digests are distributed widely by TRB to sponsors, subscribers, and affiliates based on expressed interest areas. Selected Studies, in CD-ROM format, are provided to state DOT legal counsels and FHWA and to others on request.

Use of Findings: Results are used by transportation legal counsels and engineers as a reference and for training/educating new employees.

Next Year’s Studies: The 20-6 Committee remains open to suggested topics; primary sources will be issues discussed at the 2018 TRB Legal Conference and those developed by the NCHRP Committee at its next meeting based on personal experiences and recognition of current problems.
### RECENTLY COMPLETED TOPICS

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### IN DEVELOPMENT

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<td>Guidelines for Drafting Liability Neutral Transportation Engineering Documents</td>
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Continuation Request
Project 20-24, FY 1988 & Continuing
Administration of Highway and Transportation Agencies

Present Expiration Date: Continuing
Recommended Allocation: $1,250,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended
The objectives of NCHRP Project 20-24 are to (1) identify critical problems facing top management officials in state highway and transportation agencies and AASHTO and (2) design and conduct research projects to address those problems. Fiscal year allocations are used to fund projects selected by NCHRP Panel SP20-24 in response to initiatives of interest to state DOT and AASHTO leadership.

The NCHRP Panel currently meets at least twice a year, typically in conjunction with the AASHTO Annual and Spring meetings, with teleconferences as needed to address specific matters. At the two in-person meetings, the panel considers new topics for research, reviews progress on individual studies and the 20-24 project series as a whole, and discusses current issues facing DOTs and top AASHTO leadership. Recent funding has been used to address state DOT strategic management issues, system performance measurement and benchmarking, transportation funding, and effective communication with stakeholders; for fact-finding in support of AASHTO's efforts on federal transportation policy; and for conferences and support for strategic planning. Section 6 contains a comprehensive listing of project topics.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended
Interest in the "20-24 series" concept remains high among top management of state DOTs and the leadership of AASHTO. State DOT leadership generally as well as the AASHTO Board of Directors and staff have a continuing need for research to produce factual evidence and analysis in support of their strategic planning and current decision making to address such critical issues as change and uncertainty in revenues and financing mechanisms, travel demand, balance between federal and states' roles in system management, and workforce development. The project panel requests $1,250,000 to maintain their efforts to address these continuing research needs. As in previous years, the NCHRP 20-24 panel is expected to convene at the AASHTO Spring Meeting and again in conjunction with the Annual Meeting to select new initiatives and review the status of the 20-24 series and current and recently completed projects.

3. Funds (in thousands)

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a  $1M per year for FY 2002-2009, $1.5M for FY 2010; $1.25M per year for FY 2011-2018
b  Obligation of funds based on panel's 9/27/2017 meeting; strategic initiatives pending
4. Interpretation of AASHTO Problem Statement by Panel
At a special session held during the 1986 Annual Meeting of the Transportation Research Board (TRB) a number of Chief Administrative Officers (CAOs) from state departments of transportation identified areas of concern in the management of transportation agencies. Economic considerations and management of financial resources were judged to be the most important areas. Others included the management of people, information systems, public affairs, and technology transfer. In each area discussed, problems were identified that are in need of research. At the same meeting, members of the academic community reported the findings of the NSF seminar on "Transportation Research: The State of the Art and Research Opportunities." Although their recommendations called for more fundamental research, some of the problems identified were very similar to those listed by the CAOs.

As a consequence, a need was recognized for a research program specifically directed to the management, administration, and policy planning needs of senior management of state transportation agencies. Accordingly, the AASHTO Standing Committee on Research directed that a study be undertaken under the NCHRP to develop a plan for research focused on these needs.

5. Original AASHTO Problem Statement Number
Problem No. 1988-A-08

6. Research Assignments to Date
NCHRP Project 20-24 "Research Program Design -- Administration of Highway and Transportation Agencies"
NCHRP Project 20-24(01) "Using Market Research to Improve Management of Transportation Systems"
NCHRP Project 20-24(02) "Executive Management Information Systems for State Departments of Transportation"
NCHRP Project 20-24(03) "Expanding the Civil Engineering Pool"
NCHRP Project 20-24(03)A "Civil Engineering Careers in Transportation -- Outreach Program"
NCHRP Project 20-24(04) "Senior Executive Service Participant's Manual"
NCHRP Project 20-24(05) "Public Outreach in Transportation Management"
NCHRP Project 20-24(06)A "Performance Measures Used by State Highway and Transportation Agencies"
NCHRP Project 20-24(06)B "Business Systems Plan for Highway Engineering Information"
NCHRP Project 20-24(06)C "Information Systems for Transportation Agencies"
NCHRP Project 20-24(07) "Alternatives to Motor Fuel Taxes for Financing Surface Transportation Improvements"
NCHRP Project 20-24(07)A "Alternative Approaches to Taxation of Heavy Vehicles"
NCHRP Project 20-24(08) "Project 20-24 Series -- Revisited" (Completed -- Agency report)
NCHRP Project 20-24(09) "State Departments of Transportation: Strategies for Change"
NCHRP Project 20-24(10) "Customer-Based Quality in Transportation"
NCHRP Project 20-24(11) "AASHTO Guide for Asset Management"
NCHRP Project 20-24(12) "Issues Involving Delays in Completing Federal-aid Highway and Bridge Projects"
NCHRP Project 20-24(13) "Innovative Financing Clearinghouse"
NCHRP Project 20-24(14) "Managing Change in State Departments of Transportation: Topic Scans"
NCHRP Project 20-24(15) "AASHTO Support Activities for Reauthorization"
NCHRP Project 20-24(16) "AASHTO Experience in Transportation Enhancements"
NCHRP Project 20-24(17) "National Conference on Historic Preservation"
NCHRP Project 20-24(18) "Outsourcing of State DOT Delivery of Capitol Programs"
NCHRP Project 20-24(19) "How State DOT's Can Learn to Thrive in an E-Business Environment"
NCHRP Project 20-24(20) "Transportation Outcomes and Other Strategic Performance Impact Measures: A Framework for State Departments of Transportation"
NCHRP Project 20-24(21) "Characteristics of the 21st Century Operations-Oriented State DOT"
NCHRP Project 20-24(22) "Best Practices in Partnering with Public Resource Agencies"
NCHRP Project 20-24(23) "Assessing the Importance of Transportation for Major Industries and Sectors of the U.S. Economy" -- A. Agriculture; B. International Trade; C. Congestion; D. Travel, Tourism, and Recreation
NCHRP Project 20-24(24) "Transportation Mobility, Access, and Safety for an Aging Population"
NCHRP Project 20-24(25) "Improving Project Costing and Incorporation of New Attributes -- Highways and Transit"
NCHRP Project 20-24(26) "Finance Trends in Non-Federal Funding and Debt
NCHRP Project 20-24(27) "Expanded State and National Investment Analysis Capability -- Highway"
NCHRP Project 20-24(28) "Rate of Return from Highway Investment" (Final report overdue)
NCHRP Project 20-24(29) "CEO Peer Exchange Workshop for Strategic Leadership"
NCHRP Project 20-24(30) "Performance Measurement in Context Sensitive Design"
NCHRP Project 20-24(31) "Financial Management for Effective Program Management"
NCHRP Project 20-24(32) "New CEO Briefings"
NCHRP Project 20-24(33)A "21st Century Freight Mobility"
NCHRP Project 20-24(33)C "Transportation Vision 2010" (Active)
NCHRP Project 20-24(34) "Commuting-in-America Reporting Base"
NCHRP Project 20-24(35) "Communicating Urban Congestion Information"
NCHRP Project 20-24(36) "Updating AASHTO's Strategic Plan in CY 2004"
NCHRP Project 20-24(37) "Five Workshop Sessions to Discuss Strategic Measures for State DOTs" (Active)
NCHRP Project 20-24(37)A "Construction Project Cost and Schedule Performance"
NCHRP Project 20-24(37)B "Pavement Smoothness"
NCHRP Project 20-24(37)C "Safety"
NCHRP Project 20-24(37)D "Operations Performance Using Incident Response Time"
NCHRP Project 20-24(37)E "Bridge Conditions"
NCHRP Project 20-24(37)F "Establishment of Comparative Performance Measures program infrastructure to support national system performance data collection and analysis"
NCHRP Project 20-24(37)G "Standards and guidance for national level performance measurements"
NCHRP Project 20-24(37)H "Workshop on transportation-system performance measures suitable for national use"
NCHRP Project 20-24(37)I "Congestion (speed-based measures)"
NCHRP Project 20-24(37)J "Pavement health (composite/structural measures)"
NCHRP Project 20-24(37)K "Safety - Serious Injuries"
NCHRP Project 20-24(38) "CEO Engagement Options for Discussing Strategic Issues and Sharing Best Practices"
NCHRP Project 20-24(39) "Alternative Organizational Designs for State Transportation Departments"
NCHRP Project 20-24(40) "Analysis and Benchmarking of State DOT Human Resource Activities"
NCHRP Project 20-24(41) "Project Summaries for state DOT CEOs"
NCHRP Project 20-24(42) "Comparison of State DOT Quality Management Systems"
NCHRP Project 20-24(43) "Innovative Contracting for Major Transportation Projects"
NCHRP Project 20-24(44) "Highway Safety Leadership Organizational Issues: A Survey of States and Recommendations for Sustaining Progress"
NCHRP Project 20-24(45) "Executive Seminar, Coordinating Transportation and Land Development: Outlook, Challenges, Success"
NCHRP Project 20-24(46) "Freight Transportation: New Roles for State DOTs"
NCHRP Project 20-24(47) "Benchmarking Diversity in the Transportation Industry: A Scoping Study"
NCHRP Project 20-24(48) "Analysis and Benchmarking of State DOT Human Resource Activities (Ph. 2)"
NCHRP Project 20-24(49) "Future Financing to Meet Highway and Transit Needs"
NCHRP Project 20-24(50) "In-Service Training Needs for State DOTs"
NCHRP Project 20-24(51) "State DOT Leadership Forum – 2006"
NCHRP Project 20-24(52) "Future of the National System of Interstate and Defense Highways"
NCHRP Project 20-24(53) "Twenty-first Century Leadership and Management Techniques for State DOTs"
NCHRP Project 20-24(55) "National Summit for Funding and Finance Strategies"
NCHRP Project 20-24(56) "State and Local Officials: To Advance a Vision for the Transportation System Required to Meet Future Needs"
NCHRP Project 20-24(57) "Management and Leadership Information for a Dialogue with New State DOT CEOs"
NCHRP Project 20-24(58) “Toward Developing Performance Based Federal-Aid Highway Programs”
NCHRP Project 20-24(59) “Strategies for Reducing the Impacts of Surface Transportation on Global Climate Change”
NCHRP Project 20-24(60) “Updating AASHTO’s Strategic Plan in CY 2008”
NCHRP Project 20-24(62) “The Identification of Marketing Tools that Resonate with Lawmakers and Key Stakeholders to Support and Increase Funding and Revenue for the Nation’s Transportation System”
NCHRP Project 20-24(63) “Partnership Approaches to Identify, Promote, and Implement Congestion Management Strategies”
NCHRP Project 20-24(64) “Implications for Transportation of a Conformity-Style Approach to Reduce Greenhouse Gases, and Assessment of Alternative Policies to Integrate GHG Objectives into Transportation Decisions”
NCHRP Project 20-24(69) “Implementable Strategies for Shifting to Direct Usage-Based Charges for Transportation Funding”
NCHRP Project 20-24(74) “Risk Management Practices in State Departments of Transportation”
NCHRP Project 20-24(75) “Development of a Performance Management Roadmap”
NCHRP Project 20-24(77) “Support for a TRB-sponsored conference on Strategies for Meeting Critical Data Needs for State and Metropolitan Transportation Agencies”
NCHRP Project 20-24(78) “Integrating Performance Measures into a Performance-Based Planning and Programming Process”
NCHRP Project 20-24(80) “Assessing the Economic Benefit of Transportation Infrastructure Investment in a Mature Surface Transportation System”
NCHRP Project 20-24(81) “Leading in Lean Times: Maximizing Resources in a Constrained Environment”
NCHRP Project 20-24(82) “Increasing Consistency in the Highway Performance Monitoring System for Pavement Reporting”
NCHRP Project 20-24(83) “Alternative State DOT Organizational Models for Delivering Services”
NCHRP Project 20-24(84) “State DOT CEO Leadership Forum- Summer/Fall 2012, a Focus on State DOT Current Organizational and Management Issues”
NCHRP Project 20-24(85) “Scoping support for new NCHRP 20-24 projects”
NCHRP Project 20-24(87) “State DOT Administration of Local Road Safety Aid”
NCHRP Project 20-24(88) “Performance Measure Coordination, Engagement and Reporting”
NCHRP Project 20-24(89) “Role and Value of Transportation for U.S. Industries and Sectors”
NCHRP Project 20-24(90) “Defining and Communicating a National Vision for Transportation”
NCHRP Project 20-24(91) “State DOT CEO Safety Leadership Forum -- May 2013 (Support)”
NCHRP Project 20-24(93) “Improving Public Communication Influence and Effectiveness Through Better Understanding of Transportation Users’ Expectations and Language – Public Outreach”
NCHRP Project 20-24(93)B(02) “Improving Public Communication Influence and Effectiveness Through Better Understanding of Transportation Users’ Expectations and Language – Management Outreach”
NCHRP Project 20-24(95) “Next Generation Workforce Management”
NCHRP Project 20-24(96) “Improving Organizational Traffic Safety Culture in DOTs”
NCHRP Project 20-24(99) “New CEO Orientation and Peer Exchange on Teamwork Between an Agency CEO and a Transportation Board or Commission”
NCHRP Project 20-24(100) “State DOT CEO Leadership Forum – a Focus on Transportation Futures”
NCHRP Project 20-24(101) “An Introduction to Knowledge Management and Workforce Issues for CEOs: A CEO Leadership Workshop”
NCHRP Project 20-24(102) “Executive Strategies to Deliver Practical Design”
NCHRP Project 20-24(103) “Peer Exchange on Issues and Communication to Support Economic Competitiveness through Transportation Investments”
NCHRP Project 20-24(104) “State DOT Implementation of MAP21 Performance Measure Rules”
NCHRP Project 20-24(105) “Launching U.S. Transportation Enterprise Risk Management Programs”
NCHRP Project 20-24(107) “Update to Transportation Governance: A 50-State Review of State Legislatures and Departments of Transportation”
NCHRP Project 20-24(108) “CEO Leadership Peer Exchange”
NCHRP Project 20-24(109) “Research on Enhancing Transportation System Resilience”
NCHRP Project 20-24(110) “Development of Resources to Support State DOT Communications on Safety”
NCHRP Project 20-24(111) “State DOT CEO Leadership Forum on “Connected & Autonomous Vehicles and Transportation Infrastructure Readiness” in conjunction with 2017 ITSWC, Montreal, Canada”
NCHRP Project 20-24(112) “Connected Road Classification System (CRCS) Concept Development”
NCHRP Project 20-24(113) “CEO Peer Exchange 2017”
NCHRP Project 20-24(114) “Supplement to NCHRP 20-07 New project on “flexible” or “urban” design, “green Book” update”
NCHRP Project 20-24(115) “Development of Strategic Plan for Transportation Workforce Planning and Development”
NCHRP Project 20-24(117) “TSMO Workforce Development”
NCHRP Project 20-24(118) “Strategic Planning Support for AASHTO Committees”
NCHRP Project 20-24(119) “Strategic Research in Support of the Connected and Automated Vehicle Executive Leadership Team”
NCHRP Project 20-24(121) “Road Usage Charge: Applying Lessons Learned in New Zealand to the United States”

7. Review Date
27 September 2017
Continuation Request
Project 20-30, FY 1992 & Continuing
*NCHRP-IDEA Program*

Present Expiration Date: Continuing
Recommended Allocation: $1,400,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

IDEA (Innovations Deserving Exploratory Analysis) is a unique concept to traditional transportation research programs. IDEA seeks out proposals from entrepreneurs, inventors, forward thinkers, and problem solvers -- anybody who has a possible solution to a vexing transportation problem. IDEA makes a general solicitation, unlike most transportation research solicitations where competitive proposals are requested on a specific topic and objective.

Two types of IDEA projects, designated Type 1 and 2, are funded. Type 1 projects address technical feasibility of the proposed concepts and Type 2 projects deal with prototyping. The maximum funding for a Type 1 project is $150,000 and for a Type 2 $100,000. Additional funding from other sources as cost sharing is encouraged but not mandatory for Type 1 projects but is required (at least a 50% match) for Type 2 projects.

The NCHRP Project SP 20-30 Panel provides oversight to the NCHRP-IDEA Program. The Panel also evaluates proposals and, based on available funding, selects those with most merit. The selected proposals are then funded, recognizing the high degree of risk but also the potential for scientifically-founded solutions that have high value to transportation practice. The Project Panel meets twice a year to make new IDEA selections and review follow-on requests. The meeting is held in June and December every year. To date, the NCHRP-IDEA Program has awarded 201 contracts, out of which 178 have been completed or closed out, 20 are currently active, and 3 are in the contracting process. Ongoing activity for the NCHRP-IDEA Program can be found on the NCHRP website under the Project SP 20-30.

The NCHRP-IDEA Program's annual report, *New IDEAs for Highway Systems*, is published every January for the preceding fiscal year. The report summarizes research performed on NCHRP-IDEA projects active or completed during a particular fiscal year along with one-page summaries of all previously completed projects. The report for FY 2017 is currently under preparation and will be available in January 2018. The report is now being published electronically.

The product development process encompasses many steps and may also require substantial resources. An IDEA project is only intended to help initiate this process -- give it a jump start. Before a product is implemented, it usually must go through further development and refinement, testing and evaluation, commercialization, and marketing. These phases can be quite involved and resource-intensive. Following is a sample listing of the NCHRP-IDEA projects in three categories. The first category includes products known to be available in the marketplace. The second category includes completed projects that have known follow-on activity, most likely being applied on a trial or experimental basis. The third category includes active projects that are likely to continue beyond the NCHRP-IDEA contract.

**Products in the Marketplace**

- A sacrificial anode system using sprayed zinc for protecting reinforcing steel (acting as the cathode) from corrosion in marine bridge substructures – Project #3
• A composite material layer system called, Interlayer Stress Absorbing Composite (ISAC) that helps eliminate or mitigate reflection cracking in asphalt concrete overlays – Project #6

• An organic compound-based additive that inhibits corrosion of reinforcing steel and waterproofs the concrete – Project #13

• A bridge-mounted automated de-icing system to prevent snow and ice on bridge decks – Project #27.

• A dual phase ferritic martensitic (DFM) steel with improved mechanical properties and corrosion resistance – Project #28

• Lightweight composite bridge made of fiberglass-reinforced polymer honeycomb structural panels – Projects #30 and 46

• A low-cost asphalt pavement density measuring device based on capacitance energy dissipation as a rapid, convenient, and safe alternative to the nuclear gauge – Projects #32 and 47

• A high strength and lightweight hybrid composite beam for bridge structures consisting of an outer fiber-reinforced plastic shell, a compression reinforcement and a tension reinforcement – Project #60

• The application of horizontal wick drains to stabilize slopes and landslides – Projects #57 and 76

• An automated computer controlled image analysis system for measuring aggregate shape characteristics – Projects #77 and 114

• Test methods, based on fracture mechanics, for predicting low temperature performance of asphalt binders – Projects #84 and 104

• A palm-sized video event data recorder (DriveCam) that monitors driving activity by continuously recording video of the roadway, audio, and acceleration/deceleration forces into a digital looping memory – Project ITS #84

• The adaptation of self-compacting concrete (SCC) technology for the U.S. market using domestic concrete-making materials and practice for use in highway structures – Project #89

• A system of vertical composite drains (Earthquake Drains) to dissipate pore pressure to prevent liquefaction during an earthquake – Projects #94 and 103

• A device providing a simple, reliable field-like test for determining thermal cracking temperature of asphalt (Asphalt Binder Thermal Cracking Device) – Project #99

• A hand-held impact echo scanner for non-destructive evaluation of grout/void inside post-tensioned bridge ducts for tendon – Project #102

• A new mobile geophysical method based on electromagnetic induction technology to perform surveys to detect and identify subsurface features and objects for highway-related projects – Project #107

• A real-time hand-held microwave imaging device using smart array antenna for the nondestructive condition evaluation of fiber-reinforced polymer (FRP)-wrapped concrete bridge members (GAP-CAT-110 and 1200) – Project #109
• A portable equipment using a bending plate for rapid measurement of soil modulus for compaction control both in the laboratory and the field – Project #118

• A software system based on 3-D laser scan surveys for the identification, evaluation, and management of unstable highway slopes – Project #119

• A software system consisting of new image pattern recognition algorithms for automatic processing and extraction of information on roadway signs from the roadway video logging images – Project #121

• An accelerometer system based on optical fibers and moiré phenomena to assess structural integrity of highway bridges under traffic, earthquakes, and other dynamic loads – Project #124

• A laser measurement-based technology to improve bridge fabrication quality control by rapid and accurate measurements and reduce overall production costs of steel bridge fabrication – Project #127

• A vehicle-mounted scanner system based on nondestructive evaluation methods such as impact echo, impulse response, spectral analysis of surface waves and acoustic sounding for condition evaluation of concrete bridge decks – Project #132

• Simple test methods to obtain low-temperature creep and strength parameters of asphalt binders and mixtures using small-scale specimens on bending beam rheometer and requiring no additional equipment – Projects #133, 151

• A software package (Bridge Doctor) along with a user’s manual for a baseline-free methodology for real-time structural health monitoring and post-event damage assessment of highway bridges for integrity and safety – Project #137

• A traffic sensor based on computer vision technology (TrafficVision) for use on fixed and pan-tilt-zoom cameras for detecting and tracking vehicles, including motorcycles without the need of having to install additional hardware – Project #140

• A software tool for assessing physico-mechanical properties of subgrade, subbase, and base, and lift layers based on intelligent compaction rollers data during construction – Project #145

• A mobile unit for rapid and reliable measurement of pavement marking retroreflectivity – Project #146

• A low-cost cleaning device using pneumatic power and rotary wire brushes to remove debris and chemicals from cracks and joints prior to sealing treatment – Projects #148, 159

• An advanced laser measurement system (Bridge RLS) to accelerate the bridge retrofit process, reducing the time between identifying repair needs and resuming service on a bridge – Project #153

• Drained timber piling for cost-effective liquefaction mitigation and ground improvement strategy for transportation infrastructure and for improving a structure's seismic resilience – Project #180

Completed Projects with High Implementation/Commercialization Potential

• Basalt fibers and basalt fiber composite rebars made from domestic basalt for use as an alternative to steel fibers and rebars in reinforced concrete – Projects #25, 45, 86

• A lightweight cantilevered fiber-reinforced composite sidewalk for roadway bridges – Project #67
• A geocomposite layer system placed between a base and subgrade to prevent pavement damage by controlling moisture movement in pavement subgrade and base course – Projects #68, 113.

• A mechanical system based on anvil and hammer concept for crushing and recycling concrete pavement. Kansas and Iowa DOTs assisted in testing the prototype – Projects #79, 95

• A robotic safety marker system consisting of mobile signs, cones, lighting and other safety devices to provide safety to workers in the highway work zone – Project #90

• A second generation improved detection control system (D-CS) for enhanced traffic safety at high speed signalized intersections – Project #115

• A field instrument for automated rapid measurement of air permeability of pavement base or subbase – Project #130

• A sensor system for the autonomous monitoring and reporting of highway traffic noise data – Project #131

• An “active confinement” bridge rehabilitation techniques using shape memory alloy (SMA) reinforcement to retrofit concrete columns – Project #135

• A methodology based on vision-based object recognition algorithms and integrated GPS and vision technologies to recognize and warn against intruding vehicles – Project #139

• A vibration absorbing system based on magnetic dampers to reduce fatigue in traffic signal support structures exposed to excessive wind-induced vibrations – Project #141

• A shape memory polymer-based sealant for use in expansion joints in pavements and bridges capable of preventing adhesive and cohesive failures through a self-healing mechanism, eliminating the need for replacing the sealant – Project #142

• An acoustic emission-based system for rapid and reliable characterization of asphalt binder embrittlement temperatures – Projects #144, 170

• A new class of bridge expansion joints based on shape memory alloys to provide superior resistance to fatigue, dynamic loads, and corrosion – Project #147

• Breakaway posts with new design and energy absorbing capability to enhance the safety performance of W-beam guardrail in frozen soil conditions – Project #149

• An automated real-time quality control aggregate monitoring system based on laser-induced breakdown spectroscopy to characterize aggregate properties – Projects #150, 168

• A rapid and reliable non-destructive method based on long-range ultrasound for inspecting bridge cables – Project #152

• A methodology using high-velocity thermal spray coating for the corrosion protection and in-situ reclamation of corroded components in bridges and other load bearing infrastructures – Project #155

• A conductive low-cost, heavy-duty, and environmentally-friendly polymer-based coating system for corrosion protection of structural steel in highway facilities – Project #157
• An ultrasonic hand-held device for measuring cumulative stress at critical highway bridge components – Project #158

• A new “super” weathering, corrosion-resistant, and cost-competitive steel for the transportation infrastructure, including highways, bridges, and buildings – Project #160

• A hand-held device for nondestructively measuring in-situ yield strength of in-service steel gusset plates for use in bridge evaluation and rating – Project #161

• Scour-preventing products (scAUR and VorGAUR) for use on scour-critical bridges – Project #162

• An asphalt pavement raveling detection system based on an algorithm developed using 3-D line laser imaging technology – Project #163

• A technique based on laser induced breakdown spectroscopy to rapidly identify and profile the presence and severity of corrosion under layers of coatings on steel structures and the presence of heavy metals imbedded in the coatings – Project #164

• Guidelines for using waste concrete fines (and the associated wastewater) in concrete by developing methods to rapidly characterize fines samples and evaluating the performance of concrete using these recycled materials – Project #166

• A prototype system for georeferenced augmented reality visualization of buried utility geospatial data and real-time monitoring of an excavator's proximity to buried utilities in its vicinity – Project #167

• An imaging system based on inexpensive off-the-shelf sensors for automated detection and quantification of pavement defects, including cracks and potholes – Project #169

• Bidirectional-ductile end diaphragm in straight and skewed bridge superstructures to provide resistance to bidirectional earthquake excitations – Project #172

• Asphalt binders and mixtures reinforced with grapheme nano-platelets as a multifunctional pavement material providing enhanced durability, the creep stiffness, and low-temperature flexural strength of asphalt binders and mixtures – Project #173

• A thermal zinc diffusion coating with improved corrosion resistance for concrete reinforcing bar with better ductility and durability than commercial coatings currently in use – Project #174

• A nondestructive test procedure based on the impulse response method for rapid detection of fatigue cracking in auxiliary highway structure anchor rods for timely repair and increased service life of highway structures – Project #175

• A Kelvin Probe (KP) electrode device for a rapid and stable electrode potential mapping for early corrosion detection in concrete steel reinforcement in highway structures – Project #176

• A portable field instrument, based on ultrasonic technology, for in-situ measurement of total stress (both dead and live loads) in steel bridge members – Project #179

• A small specimen geometry for uniaxial dynamic modulus and fatigue testing in asphalt mixture performance tester (AMPT) – Project #181

• Application of biochar to highway soils to increase stormwater infiltration and reduce the quantity and improve the quality (reduced nutrients) of stormwater runoff – Project #182
• An event simulation and data fusion system for synthesizing individual travel diaries from multiple passive data sources, including consumer and anonymous location data – Project #184

**Active Projects Showing Promise**

• A bio-asphalt based on swine manure and crumb rubber as an alternative to petroleum-based asphalt for highway construction – Projects #171, 194

• Prototype for obtaining automated turning movement counts at signalized intersections both for exclusive and shared lanes using vehicle trajectory data (obtained from an existing vehicle detection system) for improved traffic safety and operation – Projects #177, 198

• A class of renewable biopolymers for use in asphalt pavements. The developed polymers are expected to be used turnkey in asphalt production and construction facilities – Project #178

• An integrated remote-sensing system based on radio frequency identification (RFID) technology for monitoring, inspection, and life estimation of hydraulic structures for developing an effective scour countermeasure strategy – Project #183

• A prototype of CurvePortal, a web interface for extracting horizontal curve location and geometric information automatically from GIS roadway maps with improved curve data extraction algorithm – Project #185

• An electrical probe that measures the geometry and integrity of ground improvement columns (jet grout, soil mixed, auger cast) during construction or immediately after construction (within 30-60 minutes) – Project #186

• A wireless worker proximity detection and alert sensing system for proactive safety warning at dynamic roadway work zones – Project #187

• V-connectors for bridge deck-piers and pier-footing joints to provide seismic isolation while facilitating accelerated bridge construction and retrofit – Project #188

• A camera-based vision sensor for highly accurate remote, multi-point measurement of bridge displacements enabled by a robust target tracking algorithm, an advanced image distortion filter, and a vibration cancellation technique – Project #189

• A new type of self-de-icing LED signals for highway and railroad intersections as replacement for existing LED signal lights that are too cool to deice or melt snow and may cause accidents in snowy conditions – Project #190

• Development of equipment and software for advanced automation of ultrasonic testing of bridge members – Project #191

• Microbial-facilitated soil stabilization to mitigate volume changes in expansive pavement subgrades – Project #192

• A self-contained, portable asphalt rheology tester to monitor the consistency and uniformity of asphalt binders in real-world product environment – Project #193

• A simple performance-based indirect tensile asphalt cracking test for asphalt mix design, quality control, and quality assurance – Project #195
• A sensor-based inexpensive system for monitoring tension in anchor bolts in support structures for highway signs, luminaires, and traffic signals – Project #196

• Development and evaluation of hexagonal boron nitride reinforced multifunctional concrete for transportation infrastructure applications – Project #197

• An imaging method using medical x-ray machine to measure the ion penetration of concrete material to predict the service life of a pavement or a bridge – Project #199

• Use of native grass and weed seeded microbial induced calcite precipitation to mitigate wind and water erosion of highway slopes – Project #200

• An aerodynamic damping method to mitigate large vibrations in traffic signal structures – Project #201

• A multi-channel vertical impedance scanner with large area electrode to detect corrosion in concrete bridge decks assessment without direct rebar connection – Project #202

Proposals Received and Selected for Funding during FY 2017

During FY 2017, a total of 98 proposals were received by the NCHRP IDEA Program for its 45th and 46th review cycles. The NCHRP Project SP 20-30 Panel, after reviewing these proposals, selected 7 projects for funding.

45th Review Cycle (December 2016)

Number of Proposals Received: 49

Number of Proposals Selected for Funding: 4 (see below)

Proposal N-2002: Using Medical X-Ray Machines to Determine the Service Life of Concrete (Oklahoma State University)

Proposal N-2009: Rapid Rehabilitation of Highway Slopes using Seeded Microbial Bio-Cement (South Dakota School of Mines and Technology)

Proposal N-2025: Development of a Novel Aerodynamic Solution to Mitigate Large Vibrations in Traffic Signal Structures (Iowa State University)

Proposal N-2032: Vertical Impedance Scanner for Concrete Bridge Deck Assessment without Direct Rebar Attachment (Brigham Young University)

46th Review Cycle (June 2017)

Number of Proposals Received: 49

Number of Proposals Selected for Funding: 3 (see below)

Proposal N-2073: Biomimetic Antifreeze Polymers: A Novel Biodegradable Deicing Salt Alternative (University of Colorado - Boulder)

Proposal N-2075: Safer Cushions (University of Alabama - Birmingham)
Proposal N-2094: *MRI Bridge Analysis and Multimodal Imaging using Optimal Multi-Coil Resonant Coupling* (University of Alabama - Birmingham)

Projects Completed during FY 2017

The following NCHRP-IDEA projects were completed during FY 2017:

NCHRP-IDEA 175: *Rapid Detection of Fatigue Cracking in Steel Anchor Rods using the Impulse Response Method*

NCHRP-IDEA 176: *Contactless Electrode for Fast Survey of Concrete Reinforcement Corrosion*

NCHRP-IDEA 179: *Development of a Portable Total-Stress Measurement Instrument for Steel Bridges*

NCHRP-IDEA 181: *Development of a Small Specimen Geometry for Asphalt Mixture Performance Testing*

NCHRP-IDEA 182: *Reducing Storm water Runoff and Pollutant Loading with Biochar Addition to Highway Greenways*

NCHRP-IDEA 184: *Synthetic Household Travel Data Using Consumer and Mobile Phone Data*

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

The NCHRP-IDEA Program continues to receive a high level of interest as evidenced by the number of proposals it receives, averaging 50-60 proposals for each of its half-yearly review, and the number of products entering or being evaluated for actual practice. The NCHRP Project SP 20-30 Panel continues to believe that the NCHRP-IDEA Program, although a modest investment, provides a unique opportunity to innovators and entrepreneurs to pursue their innovative concepts in a variety of technological areas for highway infrastructure applications. At the request of the Project Panel, funding level of the NCHRP IDEA Program was increased from $1.25 million to $1.40 million for FY 2018. The Panel believes that this increase would help maintain a viable IDEA program and permit a reasonable number of awards to meritorious proposals. The requested funds would allow the selection of 7-10 proposals for award in the next two 6-month cycles and help improve the visibility of the program, particularly in the innovation centers of the private sector that are most effective in bringing IDEA-type research to the commercial marketplace.

3. Funds (in thousands)

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4. Interpretation of AASHTO Problem Statement by Project Panel

This project represents a new approach under the National Cooperative Highway Research Program (NCHRP), called the NCHRP-IDEA (Innovations Deserving Exploratory Analysis), for short-term, focused research on new and innovative concepts which have the potential to provide leapfrog technological
advances. The NCHRP-IDEA Program is a continuation of the SHRP-IDEA Program which funded exploration of innovative concepts from the public and private sectors in areas in which SHRP research was concentrated. The NCHRP-IDEA projects will concentrate on innovative approaches aimed at solving problems in the highway infrastructure area. Unsolicited proposals related to any aspect of the highways or intermodal facilities will be accepted; however, the Project Panel will designate specific technological areas for emphasis.

The NCHRP-IDEA Program is being administered as a special project ((NCHRP Project SP 20-30) under the NCHRP each Fiscal Year, similar to the NCHRP Synthesis Program (Project 20-05). Until June 2017, the NCHRP contracted with TRB's Studies and Special Programs Division for administering the NCHRP IDEA Program. Since June 2017, as a result of reorganization, the staff administering the NCHRP-IDEA Program and contracting specific research investigations has been integrated into the NCHRP. Research investigations are to be selected by the NRC-appointed NCHRP Project SP20-30 Panel.

5. Original AASHTO Problem Statement Number

Problem No. 1993-SP-23

6. Research Assignment To-Date

NCHRP Project SP 20-30, "NCHRP-IDEA"

7. Last Review Date

October 15, 2017
### Accountability Report for NCHRP Project SP 20-30, NCHRP-IDEA

**Purpose:** To support deserving proposals from entrepreneurs, inventors, forward thinkers, and problem solvers – anybody who has a possible solution to a vexing transportation problem. The NCHRP-IDEA includes projects that address technical feasibility or prototyping.

**Started:** Project SP 20-30 began in 1992; it was co-funded by FHWA through FY 1999. The NCHRP is now the sole sponsor of the NCHRP-IDEA.

**Funding:**
- Allocated in FY2018: $1,400,000
- Requested for FY2019: $1,400,000

**Problem Solicitation:** An announcement is distributed to solicit submittals throughout the year. Proposals are collected twice each year (deadlines: March 1 and September 1) and reviewed. The announcement is posted on the TRB website and highlighted in the TRB E-Newsletter.

**Process for Selecting Studies:** The NCHRP Project SP 20-30 Panel meets semi-annually to select proposals for award. Proposals are evaluated using the following four criteria for a total of 100 points: (i) Quality of Innovation (50 points); (ii) Research Approach (15 points); (iii) Potential Benefits (20 points); and (iv) Implementation/Commercialization Plan (15 points). Requested funds must not exceed $150,000 for a Type 1 project and 100,000 for a Type 2. Cost sharing is encouraged but not mandatory for a Type 1 project but is required (at least a 50% match) for a Type 2 project. A high degree of risk will be assumed for scientifically-founded proposals with potentially high value to transportation practice.

**Consultant Selection:** The project is managed by the NCHRP staff in the TRB’s Cooperative Research Programs Division under the oversight of the NCHRP Project SP 20-30 Panel that selects the specific research projects and their investigators. No contract may exceed $150,000, and many are for much less.

**Studies Requested Last Year:**
- 98 proposals were submitted in 2 cycles in FY 2017.

**Studies Funded Last Year:**
- See Section 1, above.

**Studies Completed Last Year:**
- 7 studies were completed between October 1, 2016 and September 30, 2017.

**Distribution of Findings:** A summary of all completed and active NCHRP-IDEA projects is published each year and made available to sponsors, subscribers, and affiliates. Individual project reports are posted on the TRB website and also sent to the National Technical Information Service (NTIS).

**Use of Findings:** IDEA projects are intended to help jump-start the product-development process and eventual commercialization. Some products have been commercialized, others are in the process, and some have been identified as having promise. Projects/products in these categories are identified each year in the continuation request to the AASHTO Standing Committee on Research (now the Committee on Research and Innovation).

**Next Year’s Studies:** Funding is requested to support approximately 7-10 new or continuing studies each year.
Present Expiration Date: Continuing  
Recommended Allocation: $2,000,000

1. Anticipated Accomplishments When Funds Allocated Have Been Expended
Since 1996, NCHRP panels, researchers, and staff have addressed all the suggested activities listed under section 4 of this form using 20-44 funds. A much larger program was funded in FY2016, and we anticipate providing assistance to a wide range of activities split between implementation (85%) and information dissemination (15%). Candidate activities are suggested by individual panels, DOTs, and AASHTO committees. Funding requests are subject to the approval of the 20-44 Panel.

Implementation Activities in FY2016

<table>
<thead>
<tr>
<th>Activity Code</th>
<th>Description</th>
<th>Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-86a</td>
<td>An alpha-testing workshop with select state DOT engineers and panel members in the 4th quarter of 2015.</td>
<td>24,000</td>
</tr>
<tr>
<td>15-47</td>
<td>Presentation by two members of the research team at an AASHTO subcommittee on design meeting.</td>
<td>8,597</td>
</tr>
<tr>
<td>20-59(47)</td>
<td>Development of a brochure to promote project results.</td>
<td>$6,714</td>
</tr>
<tr>
<td>14-29</td>
<td>A 2-day workshop be held to familiarize state DOTs with the recommended methodology and facilitate its adoption and implementation.</td>
<td>$75,000</td>
</tr>
</tbody>
</table>
| 10-86A        | 1. A 1-day beta-testing workshop with participants invited from all state DOTs in the 1st quarter of 2016.  
               | 2. Modifications and additions to the software functionality to increase its usefulness and ease of use by the states. | 66,580     |
| 20-83         | Peer exchange based on NCHRP Report 750 Vol. 2 to address climate change adaptation in long-range planning and development of Statewide Transportation Plan. | 20,000     |
| 07-22         | The requested funds will be used to develop three presentations on the guide Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual (i.e., one-hour overview, two-hour workshop for managers, four-hour continuing education workshop for practitioners) and carry out four | 150,000    |
workshops in two locations.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-52</td>
<td>Developing a Context-Sensitive Functional Classification System for More Flexibility in Geometric Design</td>
<td>50,000</td>
</tr>
<tr>
<td>08-93</td>
<td>Managing Risk Across the Enterprise: A Guidebook for State Departments of Transportation</td>
<td>300,000</td>
</tr>
<tr>
<td>Multiple</td>
<td>Warm mix asphalt implementation activities</td>
<td>150,000</td>
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</table>

**Implementation Activities in FY2017**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Cost</th>
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<tbody>
<tr>
<td>20-44(01)</td>
<td>Workshop on Increasing WMA Implementation by Leveraging the State-Of-The-Knowledge</td>
<td>$101,000.00</td>
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<tr>
<td>20-44(02)</td>
<td>Implementation of the AASHTO Guide for Enterprise Risk Management</td>
<td>$300,000.00</td>
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<tr>
<td>20-44(03)</td>
<td>Intellectual Property Management Guide Workshops and Assessments</td>
<td>$115,500.00</td>
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<tr>
<td>20-44(04)</td>
<td>Implementation of NCHRP Reports 639 and 757: Adhesive Anchors</td>
<td>$100,000.00</td>
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<tr>
<td>20-44(05)</td>
<td>Dissemination of &quot;NCHRP Domestic Scan 14-01: Leading Management Practices in Determining Funding Levels for Maintenance and Preservation&quot;</td>
<td>$120,000.00</td>
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<tr>
<td>15-52</td>
<td>Facilitating Implementation of the Context-Sensitive Functional Classification System for More Flexibility in Geometric Design</td>
<td>$50,000</td>
</tr>
<tr>
<td>20-59(30)</td>
<td>NCHRP 20-59(30): Train-the-Trainer Regional Workshops for Incident Command System (ICS) Training for Field Level Transportation Supervisors and Staff</td>
<td>$150,000</td>
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</table>

**Information Dissemination Activities**

- Research Makes the Difference - Annual eight-page brochure, drawing from the 2015, 2016 and 2017 AASHTO RAC High Value Research compilation and from NCHRP suggestions.
- Impacts on Practice - Readable narrative the impact of the selected NCHRP research projects on state DOT practice.
- NCHRP Summary of Progress – The NCHRP annual report
- Webinar Organization and Communication Services - Prepare the TRB Webinar Submission Forms detailing NCHRP’s proposed research projects for the two cycles of the TRB webinar series; prepare moderator PowerPoint template and talking points, and speaker tips (first cycle
only); coordinate with NCHRP manager and TRB webinar staff throughout the process; and follow up with presenters and moderators after TRB has made the webinar selections.

- Paths to Practice - Capture in an interesting, readable narrative successful approaches used for putting NCHRP research to use.
- CEO Briefing / Program Folio - Gather and develop content aimed at highlighting recent NCHRP program and project activities and accomplishments for DOT CEOs.
- Research Briefs - Two-page briefs to disseminate information about key new NCHRP projects. Finalize and deliver 15 briefs in electronic format each year.
- Field Folios / Subject Compilations - Summaries of NCHRP research in key topical areas (e.g. safety, traffic engineering, pavements, structures, etc). Finalize and deliver up to 10 Field Folios in electronic format each year.
- Report Distribution Assistance - Expand and customize alerts for new NCHRP reports by subject area to better promote use of the results. Develop distribution channels and lists that could be used to more effectively target research findings and communication approaches for pushing research results out to these target audiences.
- Tracking Implementation - Develop an online survey for use in gathering information about the use of NCHRP research results from panel members, principal investigators and other research stakeholders (such as DOT managers or field personnel). Create the survey recipient list, distribute the survey and analyze the results.

Subtotal dissemination: $644,000

Contractor Selection
For support of individual research projects, decisions regarding contractor selections rest with the affected project panels. Panels have the option of continuing with the existing contractor, sole-sourcing small efforts to uniquely qualified agencies, or an open solicitation. Funds spent on activities will range from a few thousand dollars to support travel and presentations to approximately $100K to $200K for activities such as further testing or workshops. And for program related support, the projects are relatively small ($25K to $50K) and are typically sole-sourced to qualified agencies or individuals.

2. Anticipated Accomplishments When Funds Requested Have Been Expended
$2,000,000 is being requested to continue efforts to further the implementation and application of NCHRP research results. The principal recommendation for Project 20-44 is unchanged: to maintain the program-level activity and to address unanticipated opportunities that arise during or on completion of individual project-level activity. In 2014, SCOR formed an NCHRP Process Improvement Task Force. One of the key recommendations of this task force was to review the results of CTC and Associates report Evaluating Implementation of NCHRP Products: Building on Successful Practices and implement an NCHRP plan: program of practices to facilitate implementation of NCHRP research results. In FY2016 and beyond, TRB/NCHRP will make use of 20-44 funding to implement projects approved by the NCHRP 20-44 Panel.

3. Funds (in thousands)

<table>
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<tr>
<th></th>
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<tbody>
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<tr>
<td>Recommended Addition</td>
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<td></td>
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</table>

4. Interpretation of AASHTO Problem Statement by Panel
In an applied research program like the National Cooperative Highway Research Program, application of results is the most important measure of success. The NCHRP has been successful by this measure; results of NCHRP research are used by AASHTO committees and member departments, but there is a need to continually look for ways to do better.

The following activities are examples of areas that benefit from greater attention: a) validating research products (e.g., testing NCHRP-developed computer software before widespread distribution); b) using innovative dissemination media to supplement or replace the written report; c) working with AASHTO committees and other code-writing groups to facilitate adoption of NCHRP recommendations; d) providing financial support for NCHRP researchers to assist potential users of NCHRP products; e) offering peer exchanges or demonstrations focused on new NCHRP research results, and f) tracking and documenting applications of NCHRP research.

5. Original AASHTO Problem Statement Number
Problem No. 1996-SP-32

6. Research Assignment to Date
NCHRP Project 20-44, “Accelerating the Application of NCHRP Research Results”

7. Review Dates
November 25, 2015, October 7, 2015, October 14, 2016, and October 16, 2017
Continuation Request  
Project 20-68A/B/C, FY 2007 & Continuing 
U.S. Domestic Scan Program

Present Expiration Date: Continuing
Recommended Allocation: $600,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

The objective of this project is to plan and manage the execution of domestic technology scans, each addressing a single technical topic. The purpose of each scan and of the program as a whole is to facilitate information sharing and technology exchange among the states and other transportation agencies and identify actionable items of common interest, thereby accelerating the rate of beneficial innovation.

A business plan and pilot demonstration with two scans were funded by FY 2005 and FY 2006 allocations. Subsequent SCOR allocations of $500,000 each, from FY 2007 through FY 2012, enabled the program’s initiation and engagement of a contractor to manage scan logistics and provide a yearly assessment of program performance. The primary contractor was engaged for an initial 3-year term with provision for a second 3-year term subject to availability of funds. That contract became effective 12/27/2007. A second competitive procurement was awarded with similar terms: an initial 3-year term, extendable for a second 3 years, subject to funding. In approving commencement of this second 6-year phase, SCOR increased the annual allocation to $600,000 to account for increased costs and increased levels of effort on post-scan information dissemination activities.

SCOR allocated an additional $200,000 of FY 2009 funds to be used particularly for monitoring scan impact and exploring ways to enhance scan effectiveness. The NCHRP project panel used these funds to assess scan impact and explore the mechanisms underlying effective dissemination within and among state transportation agencies. Scan planning and dissemination activities have subsequently been modified to apply lessons learned from these activities.

The domestic-scan project’s plan envisioned that NCHRP funds might be supplemented by additional amounts provided by FHWA or other sponsors. From the project’s pilot phase through September 2017, such supplemental sponsorship has totaled approximately $588,000.

The NCHRP project panel selects scan topics from among numerous proposals received each year in response to AASHTO’s solicitation, sometimes combining multiple proposals into a single scan. Individuals who submitted selected proposals are included when possible in the scan teams. Each scan team produces a report and a slide presentation of the team’s findings and a specific plan of actions to encourage dissemination of useful ideas and lessons learned by the developers and early adopters of these ideas. Scan-team reports are made available from NCHRP’s project web page. Scan-team members may receive limited support for expenses related to presenting these ideas and lessons to colleagues in other agencies; some scan teams organize post-scan symposia or other activities to encourage broad dissemination of the team’s findings. The project panel monitors and documents the impact of domestic scans and explores new ways to accelerate innovation among state DOTs and other transportation agencies.

Through September 2017, scans on 37 diverse topics have been scheduled; 30 scan-team reports have been released. Funding set aside for each scan-team’s members to present scan findings and otherwise encourage information dissemination has exposed the scan results and the program as a whole to a
broader professional audience. Analysis of dissemination experience indicates that scan information reaches well beyond the scan team.

The panel’s request for FY 2019, for $600 thousand, conforms to recent past practice and the panel’s anticipation that the 2nd-stage program should be funded by SCOR at $3.6 million.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended
The requested funding will enable scheduling and execution of two to four new scan topics and development of new efforts to accelerate the rate of innovation within and among transportation agencies. The panel anticipates requesting this funding amount annually throughout the proposed 2nd 6-year program extension.

3. Funds (in thousands)

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<td>600</td>
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</table>

Assignment to specific projects: NCHRP 20-68, $50K; NCHRP 20-68(01), $200K; NCHRP 20-68A, $3.0M; NCHRP 20-68B/C, $200K; NCHRP 20-68A(02), $3.6M.

4. Interpretation of AASHTO Problem Statement by Panel
Continuing innovation in the practices of U.S. transportation agencies has brought substantial benefits to the nation. Examples of beneficial innovation range from new materials used in pavements and structures, to new ways of collecting and analyzing information about transportation system users and the environment in which the system operates, to new ways of funding the investments needed to improve public safety and efficiency of travel.

Beneficial innovation occurs in any field when new ideas are disseminated and widely adopted by practitioners. Experience in many fields illustrates that expanding the extent of information exchange among practitioners and accelerating the rate of the exchange facilitate innovation.

Experience also shows that personal contact with new ideas and their application is a particularly valuable means for information exchange. U.S. engineering professionals have visited their colleagues in other countries and returned with information that they have subsequently communicated to their domestic colleagues and seen applied to improving domestic practice. The American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), and others have been active in technology transfers at the international level with their involvement in such activities as NCHRP Project 20-36 on "Highway Research and Technology---International Information Sharing."

These experiences have shown that the “scan” approach is a productive means for encouraging the spread of information and innovation. Many international program participants and observers have noted that new ideas are emerging in state and local transportation agencies around the United States, and that faster dissemination of many of these ideas could yield benefits similar to those associated with international information exchange. Domestic scans conducted by various FHWA offices as well as through the NCHRP illustrate the potential value of a domestic scan program.

A scan program entails four key steps. First, knowledgeable people identify novel practices in their field of interest. Second, these people assess the likelihood that these new ideas might beneficially be applied in other settings. Third, new practices that offer the most promise are selected and field visits are made to
observe the practices, identify pertinent development and application issues, and assess appropriate technology transfer opportunities and methods. Finally, the results of the initial steps are documented for use by those who participated and for others to apply.

Effective scan programs both supplement and make use of other mechanisms for information exchange such as publications in trade and professional journals, conferences, and peer-to-peer forums. A scan program focuses on face-to-face discussion of current experience, providing opportunities for a uniquely rich exchange of information that is difficult or impossible to replicate through written materials, telephone conversations, and e-mail correspondence. The informal discussions among the scan participants contribute to the extraction of useful information from the individual participant’s observations. Executing an effective scan program requires sound understanding of the topic areas to be considered, insightful selection of topics and new ideas to be observed, careful selection of participants who can provide useful insights from their observations, and thoughtful documentation and dissemination of each scan’s results. Managing the domestic scan program additionally requires that resources be conserved by not duplicating the information exchange activities of others.

5. Original AASHTO Problem Statement Number
Problem No. 2005-SP-05, 2008-SP-08

6. Research Assignments to Date
NCHRP Project 20-68, “US Domestic Scan Program (Business Plan)” (completed)
NCHRP Project 20-68(01), “US Domestic Scan Program Pilot” (completed, 2 scans)
NCHRP Project 20-68A, “US Domestic Scan Program” (contractor engaged for 3-year term, renewed for second 3-year term)
NCHRP Project 20-68A(02), “US Domestic Scan Program” (contractor engaged for 3-year term, renewed for second 3-year term)
NCHRP Project 20-68B(01), “Accelerating the Rate of Innovation Among State DOTs—Tracing Domestic Scan Impacts”
NCHRP Project 20-68B(02), “Accelerating the Rate of Innovation Among State DOTs—Tracing Domestic Scan Impacts”
NCHRP Project 20-68C, “Research on Innovation Networks—Domestic Scans”

7. Review Date
12/5/2017
Part 1.2

AASHTO COMMITTEE SUPPORT PROJECTS
Continuation Request
NCHRP 08-36, FY 1999 & Continuing
Research for the AASHTO Standing Committee on Planning: Support for Improved Transportation Planning and Project Development

Present Expiration Date: Continuing
Recommended Allocation: $600,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended
The objective of this project is to establish a flexible, ongoing program of quick-response research designed to develop improvements to the analytical methods, decision-support tools, procedures, and techniques employed by practitioners in statewide and metropolitan transportation planning, programming, and development. Since this project was initiated in 1999, the Standing Committee on Planning has approved 143 projects that were selected by the project panel — see Item 6. NCHRP 8-36 has been widely recognized as an important source of quick-response research of interest to the transportation planning community.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended
The AASHTO Standing Committee on Planning (SCOP) has a continuing need for an immediately available research mechanism to conduct studies (task research) geared to the needs of the Committee in the development of planning methods, tools, procedures, and techniques to support statewide and metropolitan transportation planning, programming, and development. As such, NCHRP 8-36 is an important element in the strategic plan of the SCOP. The objective of this project is to respond as necessary to the needs of the SCOP and other AASHTO committees related to these issues. SCOP members anticipate a continuing need for NCHRP 8-36, especially in responding to the new and expanded federal planning requirements included originally in MAP 21 and subsequently in the "FAST Act."

For FY 2016, SCOP received requests for 14 tasks under this project at an estimated cost of about $2.0 million, and selected 6 (2 continuations and 4 new projects) for a total of $600,000. The project panel reviews those solicitations, and allocations are based on need and funds available. The SCOP has directed the project panel to the greatest extent possible to work through three task order contracts to carry out selected tasks in an accelerated manner.

For FY 2017, SCOP received requests for 8 new projects requesting $825,000 in assigned funding.

For FY 2018, SCOP received requests for 7 topics, totaling $700,000.
3. Funds (in thousands)

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* $600,000 per year

4. Interpretation of AASHTO Problem Statement by Panel

The AASHTO Standing Committee on Planning is called upon continuously to provide information for the establishment of policies and positions of the state highway and transportation departments on issues associated with the nation’s transportation system. The committee needs information, on a reasonably prompt schedule, through a continuing research project geared to its responsibilities. Implementing federal transportation planning and environmental regulations requires research into the development of new methods, processes, and procedures to ensure their effective and timely implementation on by the states and MPOs. Further, as AASHTO prepares for future reauthorization activities, the SCOP will require support to carry out its responsibilities in a timely and effective manner. In addition, the member departments require timely information regarding new planning methods and procedures in order to most effectively respond to planning, programming, development, economic, and environmental challenges and issues. The project comprises an annual Program of Research Tasks by the committee as the need arises for information required for fulfillment of committee and AASHTO responsibilities. The committee has stipulated that accomplishment of research can be through any agency deemed by the NCHRP to possess the necessary expertise, provided research can be initiated quickly. Accordingly, NCHRP has established three task order contracts through which most of the selected research can be carried out. The objective of this project under the continuation authorization would be to respond, as necessary, to the needs of the Standing Committee on Planning and other AASHTO Committees on urgent issues, especially related to reauthorization and the states’ response to transportation and environmental planning regulatory development.

5. Original AASHTO Problem Statement Number

Problem No. 1999-SP-09

6. Research Assignments to Date

The FY 1999 through FY 2018 Programs of Research Tasks include the following:

**FY 1999**
- Task 1, “Parking Modeling Procedures” $25,000 (Completed)
- Task 2, “Incorporating System Operations and Management Practices in Transportation Planning Processes and Programs” $125,000 (Completed)
- Task 3, “Management of Institutional Changes on State Transportation Planning Processes and Programs” $25,000 (Completed)
- Task 4, “The Use of Expert Panels in Analyzing Transportation and Land Use Alternatives” $100,000 (Completed)
- Task 5, “Incorporating Market Research Techniques into the Transportation Planning Process” $75,000 (Completed)
- Task 6, “Product Delivery of New and Improved Travel Forecasting Procedures” $150,000 (Completed)

**FY 2000**
- Task 7, “Development of a Multimodal Tradeoffs Methodology for Use in Statewide Transportation Planning” $100,000 (Completed)
- Task 8, “Workshop on Transportation Performance Measures” $20,000 (Completed)
- Task 9, “Defining and Identifying Probable Non-Attainment Areas for PM 2.5” $40,000 (Completed)
- Task 10, “Global Climate Change and Transportation: Coming to Terms” $40,000 (Completed)
- Task 11, “Technical Methods to Support Analysis of Environmental-Justice Issues” $100,000 (Completed)
Task 12, “Analysis of the Factors Affecting Future Transportation and Economic Development” $100,000 (Completed)
Task 13, “Year 2000 National Conference on Transportation and Economic Development” $50,000 (Completed)
Task 14, “Consultation Between State DOTs and Local Officials in Non-Metropolitan Areas” $30,000 (Completed)
Task 15, “Conference on Transportation and the Environment for the 21st Century” $20,000 (Completed)

**FY 2001**

Task 16, “Assessment of Proposed Transportation Planning and National Environmental Policy Act Regulations” $80,000 (Completed)
Task 17, “Two-Way Education Process with a New CEO on Transportation Planning” $20,000 (Canceled)
Task 18, “Incorporating Safety into the Transportation Planning Process” $100,000 (Completed)
Task 19, “Transportation Environmental Research Needs Conference” $50,000 (Completed)
Task 20, “Conformity Problems Caused by the Mismatch in SIP/Transportation Plan Timeframes” $25,000 (Completed)
Task 21, “Adapting the Transportation Planning Process to Meet Fast-Paced Customer Requirements” $50,000 (Completed)
Task 22, “Demonstrating the Positive Impacts of Transportation Investments on Economic, Social, and Environmental Issues” $125,000 (Completed)
Task 23, “Review of the Potential Feasibility of Using Alternative Revenue Sources to Fund Future State Transportation Needs” $50,000 (Completed)

**FY 2002**

Task 24, “Investment Requirements Scenarios Development” $75,000. (Completed)
Task 25, “Improved Geographic Clarity in Reporting of Road System Extent” $25,000 (Completed)
Task 26, “Surface Transportation Safety and Investment” $25,000 (Completed)
Task 27, “Interstate Interchange Review” $25,000 (Completed)
Task 28, “Rural Conformity: A Survey of Practice” $50,000 (Completed)
Task 29, “Development of a Multimodal Tradeoffs Methodology for Use in Statewide Transportation Planning: Application of the Framework” $50,000 (Completed)
Task 30, “Workshop on Issues in Intermodal Connectors” $40,000 (Completed)
Task 31, “Elderly Issues in the Transportation Planning Process” $40,000 (Completed)
Task 32, “Tools, Techniques, and Methods in Rural Transportation Planning” $100,000 (Completed)
Task 33, “Best Practices in Statewide Freight Planning” $50,000 (Completed)
Task 34, “Security Considerations in Transportation Planning” $50,000 (Completed; published as NCHRP 525 Vol. 3)
Task 35, “Evaluating State DOT’s Planning Practices in Rural Planning” $50,000 (Completed)
Task 36, “Continuation of NCHRP 8-36(6) TMIP Support” $20,000 (Completed)

**FY 2003**

Task 37, “A Retrospective on the Conditions and Performance Report” $50,000 (Completed)
Task 38, “Supplemental Evaluation in Support of NCHRP 25-17” $75,000 (Completed)
Task 39, “Performance Measures of Travel Time Variation, Delay, and Reliability” $50,000 (included into NCHRP 7-15; Completed)
Task 40, “National Site Visits on Transportation and Growth” $100,000 (Completed)
Task 41, “Research on Household Travel Survey Non-response” $70,000 (included in NCHRP 8-37) (Completed)
Task 42, “MPO Redefinition and Evolving Roles” $65,000 (Completed)
Task 43, “Return on Investment on Freight Rail Capacity Improvement” $50,000 (Completed)
Task 44, “Multi-State MPOs: Approaches, Cases, and Institutional Arrangements” $40,000 (Completed)
Task 45, “Multi-State Corridor Planning” $50,000 (Completed)

**FY 2004**

Task 46, “Synthesis of Where Data Groups are Organizationally Located in State DOTs” $50,000 (Completed)
Task 47, “Effective Organization of Performance Measurement” $100,000 (Completed)
Task 48, “Guidance for Better Linking Systems Planning and the NEPA Process” $100,000 (Completed)
Task 49, “Synthesis of Metropolitan-level Transportation Funding Sources” $50,000 (Completed)
Task 50, “What is the Impact of an Aging Population on System Planning and Investment Policies?” $75,000 (Completed)

Task 51, “Information Design for Effective Decision Making and Communication” $75,000 (Completed)

Task 52, “Changes in Travel Behavior/Demand Due to Managed Lanes (HOV, HOT) Facility System Expansion” $100,000 (Completed)

Task 53, “Peer Review Capacity Building Partnership: Best Practices in Non-Traditional Performance Measures, Reliability, and State Funding” $75,000 (Completed)

Task 54, “Resource Papers in Support of the 2005 TRB Conference on the Use of Census Data for Transportation Planning” $50,000 (Completed)

FY2005

Task 55, “Multi-Party Collaboration and Potential for Freight Improvement” $50,000 (Completed)

Task 56, “Highway Construction Project Coordination to Minimize Traffic Impacts” $100,000 (Completed)

Task 57, “Institutional Needs in Safety Planning” $100,000 (Completed)

Task 58, “Best Practices for State and MPO NHS and STP Programming” $100,000 (Completed)

Task 59, “Transportation and Health: Best Practices in Incorporating Health Concerns in State and Metropolitan Transportation Plans” $75,000 (Completed)

Task 60, “State DOT Consideration of Infrastructure Development Potential in Planning” $75,000 (Completed)

Task 61, “Determining the Monetary Value per Dollar of Investment in Different Performance Measure Categories” $100,000 (Completed)

FY2006

Task 62, “Best Practice Methodology for Calculating Return on Investment for Transportation Programs and Projects” $75,000 (Completed)

Task 63, “Making NAICS (North American Industrial Classification System) Work for Transportation” $25,000 (Completed)

Task 64, “Right of Way Methods and Tools to Control Project Cost Escalation” $50,000 (Combined with NCHRP 08-49/02; Completed)

Task 65, “Best Practices for Incorporating Commodity Flow Survey Data into the MPO and Statewide Planning Processes” $75,000 (Completed)

Task 66, “Quality of Life Indicators to Measure Socio-Cultural Effects of Transportation Projects” $75,000 (Completed)

Task 67, “Best Practices in Using Programmatic Investment Strategies in Statewide Transportation Plans” $75,000 (Completed)

Task 68, “Implication of New 8-Hour Control Strategy Development on Transportation Programs, Policies, and Projects” $75,000 (Completed)

Task 69, “Peer Review Sessions on Capacity Building in Evaluating External Positions Located in other Agencies Funded by State DOTs and Information Exchange in Public-Private Project Planning” (to be included into NCHRP 8-36, Task 53) $80,000 (Completed)

Task 70, “Scoping Study for Development Process of a National Travel Model” $70,000 (Completed)

FY2007

Task 71, “Disclosure Avoidance Techniques to Improve ACS Data Availability” $75,000 (Completed)

Task 72, “Implementing Project Cost Estimation and Management Process Improvements” $100,000 (Completed)

Task 73, “Adding Resilience to the Freight System in Statewide and Metropolitan Transportation Plans” $100,000 (Completed)

Task 74, “Customer Research Practices and Applications in Transportation” $100,000 (Completed)

Task 75, “Research Finders” $40,000 (Completed)

Task 76, “Issue Papers for Conference on Planning Issues in SAFETEA-LU” $75,000 (Completed)

Task 77, “Transportation Program Responses to Greenhouse Gas (GHG) Reduction Initiatives and Energy Reduction Programs” $35,000 (Total $70,000, combined with NCHRP 25-25, Task 45) (Completed)

FY2008

Task 78, “Small Community Research and Peer Exchange” $50,000 (Completed)

Task 79, “Scoping Study for a Freight Data Exchange Network” $79,000 (Completed)

Task 80, “Synthesis of State Practices in Developing Linear Referencing Systems” $60,000 (Completed)

Task 81, “Enhancing the American Community Survey Data as a Source for Home-to-Work Flows” $60,000 (Completed)
Task 83, “Transportation Planning Partnerships to Enhance National Parks and Gateway Communities” $80,000 (Completed)
Task 84, “Asset Management of Environmental Mitigation Features” $40,000 (will be combined with NCHRP 25-25, Task 51 for a total of $80,000) (Completed)
Task 85, “Congestion Pricing and Investment Requirements” $65,000 (Completed)
Task 86, “Corridor Approaches to Integrating Land Transportation and Land Use” $100,000 (Completed)
Task 87, “AASHTO Standing Committee on Planning Strategic Plan Update” $25,000 (Completed)

FY2009
Task 88, “Transportation Research Programs to Address Energy and Climate Change” $75,000 (Total $250,000, joint project with TRB Policy Studies Division) Completed as Special Report 299
Task 89, “Evaluating and Communicating Model Results: Guidebook for Planners” $90,000 (Completed)
Task 90, “Best Practices in the Use of Microsimulation Models” $100,000 (Completed)
Task 91, “Validation and Sensitivity Considerations for Statewide Models” $100,000 (Completed)
Task 92, “Counting Motorcycles” $50,000 (Completed)
Task 93, “Road Pricing Communication Practices” $50,000 (Completed)
Task 94, “AASHTO Workshop to Develop Integrated Policy Approaches to Slow VMT Growth and to Increase Transportation System Efficiency” $50,000 (Combined with NCHRP 25-25, Task 57) (Completed)
Task 95, Virtual Conference to Identify Planning Research Needs $100,000 (Completed)
Task 96, “Selecting and Using Advanced Travel Demand Modeling Tools – A Peer Exchange” $70,000 (Completed)

FY2010
Task 97 and 97A, “Towards Quantitative Safety Planning: Implementation of PLANSAFE” $120,000 (Completed)
Task 98, “Improving Home-to-Work and Employment Data for Transportation Planning” $100,000 (Completed)
Task 99, “Strategies for Improved Passenger and Freight Travel Data” $65,000 (Total $671,000, joint project with TRB Policy Studies Division) (Completed as Special Report 304)
Task 100, “Transportation Data Self Assessment Guide” $70,000 (Completed)
Task 101, “Understanding the Connection between Transportation and the Economy” $125,000 (Completed)
Task 102, “Assessing Alternative Methods for Measuring Regional Mobility in Metropolitan Regions” $80,000 (12 months) (Completed)
Task 103, “Using Economic Recovery Act Jobs Data to Improve the Analysis of Economic and Performance Impacts of Transportation Projects” $100,000 (12 months) (Completed)

FY2011
Task 104, “Integrating Performance Measures into a Performance-Based Planning and Programming (PBPP) Process” $120,000 (Total of $220,000; includes $100,000 from NCHRP 20-24) (12 months) (Completed)
Task 105, “Support and Update of the Strategic Plan for the AASHTO SCOP” $30,000 (12 months) (Completed)
Task 106, “Best Practices for Prioritizing Enhancement Projects and Non-Motorized Transportation Projects” $75,000 (9 months) (Completed)
Task 107, “Synthesis of State DOT and MPO Planning and Analyses Strategies to Reduce Greenhouse Gas Emissions” $150,000 (12 months) (Completed)
Task 108, “Improving Travel Behavior Data for Environmental Vehicle Analysis” $50,000 (12 months) (Completed)
Task 109, “Non-Rail Infrastructure Upgrades and/or New Construction Due to Passenger Rail Implementation” $100,000 (Completed)
Task 110, “Feasibility of River Barges and Lakes Vessels used to Transport Freight on the North American Marine Highways in Central United States” $75,000 (cancelled)

FY2012
Task 111, “U.S. Commuting and Travel Patterns: Data Development and Analysis” $125,000 (18 months) (Completed)
Task 112, “Cross Mode Project Prioritization” $100,000 (12 months) (Completed)
Task 113, The Future of Transportation Planning in State DOTs” $250,000 (18 months) (Completed)
Task 114, “Transportation Asset Management for Ancillary Structures” $110,000 (includes $50,000 from NCHRP 20-07) (15 months) (Completed)
Task 115, "Application of Fair Division, Data Envelopment Analysis, and Conjoint Analysis Techniques, to Funding Decisions at the Program and Project/Activity Level" $125,000 (12 months) (Completed)

**FY2013**

Task 116, “Development of Transportation Asset Management Plan Templates” $100,000 (In Progress)
Task 117, "Sketch Planning Tools for Regional Sustainability" $85,000 (Completed)
Task 118, "Performance Measures for State Infrastructure Preservation" $75,000 (9 months) (Completed)
Task 119, "Transportation User's Guide to the Economic Census" $80,000 (12 months) (Completed)
Task 120, "Research Briefs for the Standing Committee on Planning" $100,000 (12 months) (Continuation)
Task 121, "Successful Implementation of Enterprise Risk Management in State Transportation Agencies" $100,000 (Completed)
Task 122, "Continuation of Task 104: Integrating Performance Measures into a Performance-Based Planning and Programming Process” Canceled.

**FY2014**

Task 123, “Survey Sample Size and Weighting” $100,000 (Completed and published as RRD 400))
Task 124, “Continuation of Task 120 Snapshots of Planning Practices” $75,000 (Research in Progress—Added to Task 120)
Task 125, "Transportation Asset Management Portal" $125,000 (Research in Progress—Continuation)
Task 126, "Development of a Risk Register Spreadsheet Tool" $115,000 (Completed)
Task 127, "Employment Data for Planning: A Resource Guide" $100,000 (includes $40,000 from AASHTO’s Census Transportation Planning Products program) (Research in Progress)
Task 128, "Data Visualization Methods for Transportation Agencies" $100,000 (includes $40,000 from AASHTO’s Census Transportation Planning Products program) (Completed)
Task 129, "Scoping Study to Establish Standards and Guidance for Data for Transportation Planning and Traffic Operations Purposes” $80,000 (Completed)
Task 130, "Inventory and Assessment of Methods for Making Collected Transportation Data Anonymous" $75,000 (Completed)

**FY 2015**

Task 131, "Transportation Data Integration to Develop Planning Performance Measures" $100,000 (Completed)
Task 132, "Understanding Changes in Youth Mobility” $125,000 (Completed)
Task 133, 2nd Continuation of Task 120 (Added to Task 120) $15,000 (Added to Task 120)
Task 134, "Transportation Asset Management Research Roadmap" $100,000 (Completed)
Task 135, "Addressing Margins of Error in Small Areas of Data Delivered through the American Fact Finder or the Census Transportation Planning Products Program” $75,000 (Completed)
Task 136, “License Plate Reader Technology: Privacy Risk Analysis and Case Studies” $125,000 (Completed)
Task 137, Continuation of Task 116 (Research in Progress) $60,000

**FY 2016**

Task 116, Development of Transportation Asset Management Plan Builder—Phase 2 (Continuation) $75,000
Task 120, Snapshots of Planning Practices (Continuation) $70,000
Task 137, Assessing the Utility and Costs of Statewide Travel Demand Models $125,000 (Research in Progress)
Task 138, Support and Update of the Strategic Plan for SCOP/Subcommittees on TAM $80,000 (Completed)
Task 139, Planning Research Digest $125,000 (Research in Progress)
Task 140, Assessing Actual Transportation Impacts of the 2005 BRAC Decisions $125,000 (Research in Progress)

**FY 2017**

Task 120: Planning Snapshots—Continuation (Research in Progress) $ 80,000
Task 125A: TAM Portal—Continuation (Research in Progress) $ 70,000
Task 141: Evaluation of Walk and Bicycle Demand Modeling Practice (Research in Progress) $100,000
Task 142: Advancing Sustainability through Multi-Agency Collaborations (Research in Progress) $100,000
Task 143: Evolving Transportation Planning Research Needs for the 21st Century (Research in Progress) $125,000
Task 144: Transportation Asset Management and Effective Organizational Models for Program Implementation (Research in Progress) $125,000

Total: $600,000

FY 2018
The Following RFPs have been released

Task 145: Scenario Planning “Lite.” ($75,000)
Task 146: Economic Resilience and Long-Term Highway/Transportation Infrastructure Investment ($150,000)
Task 147: Strategic Mobility Research: Enhancing Mobility, Stimulating Economic Activity, Saving Lives. ($150,000)
Task 148: Forecasting Reliability and Safety to Support Performance-Based Long-Range Plans* ($150,000)

Task 135A: Continuation: Addressing Margins of Error in Small Areas of Data Delivered through the American Fact Finder or the Census Transportation Planning Products Program** ($30,000)

Contingency: ($45,000)

Total: $600,000

[* Given the demands of the preliminary scope of work for Task 148, this problem statement will be resubmitted for consideration as a full research study rather than as a task order under NCHRP 08-36. This expanded approach, with an increased budget, would facilitate a more robust effort at building a model with greater potential for realization of a successful product. The increased budget and study period would be more in line with the scope of work as originally drafted, but taking it well-beyond the prototype approach to develop a working performance-based investment tool. As a full study, this proposal will be submitted to the Standing Committee on Research and Innovation (R&I) at its next meeting, with a more realistic budget of $500,000. To fund the study, we will allocate the original $150,000 approved by the 08-36 panel as a contribution to the overall cost, leaving a budget of $350,000 to be provided out of available NCHRP funds.*]

[**Task 135A has been authorized as a sole-source extension to the original contractor for Task 135.**]
Accountability Report for NCHRP Project 08-36
“Research for the Standing Committee on Planning”

Purpose: The AASHTO Standing Committee on Planning (SCOP) has a continuing need for an immediately available research mechanism to develop planning methods, tools, procedures, and techniques to support statewide and metropolitan transportation planning, programming, and development. NCHRP 8-36 is an important element in the strategic plan of the SCOP.

Started: Project 8-36 began in 1999

Funding: Allocated for FY 2018: $555,000 with $45,000 Contingency
Requested for FY 2019: $600,000

Problem Solicitation: Solicitation is ongoing though the AASHTO SCOP website; the annual due date is April 1st. AASHTO staff sends reminders to SCOP. TRB staff sends reminders to AMPO and TRB Technical Committees.

Process for Selecting Studies: Requests are considered and tasks programmed at an annual meeting of the panel, approved by the TRB Executive Director and then approved by SCOP. The selection process and criteria are listed in Attachment A.

Consultant Selection: The panel has selected three task order contractors who are assigned tasks on a competitive basis. In rare occasions and when necessary, sole source awards may also be made.

Studies Requested in the Last Year: 7 topics, totaling $700,000 were submitted for FY 2018

Studies Funded in the Last Year: 5 tasks were selected (1 continuation, 1 expanded into a full project to be submitted, and 4 new), totaling $555,000, $45,000 has been retained as a contingency.

Completed Tasks: Eleven additional tasks have been completed and released: 123, 126, 128, 129, 130, 131, 132, 134, 135, 136, and 138

Distribution of Findings: Reports are always provided to SCOP and to other AASHTO committees requesting the study. Publication decisions are made on a case-by-case basis. Most reports are available on the NCHRP website.

An effort is currently underway to submit several final reports for TRB/SNO oversight review and publication as official TRB documents

Report Usage: The reports are typically used directly by the requesting committee for development of guides or policies, to improve the state of practice or in support of other AASHTO activities.

Next Year’s Studies: The studies approved by SCOP in 2017 are listed in the FY2018 section of the NCHRP 08-36 Continuation Request.
April 1st—
- Task proposals due; open solicitation is on-going through the AASHTO SCOP website

May
- NCHRP 08-36 Panel meeting.
  - select 4-6 tasks that are
    - expected to directly support AASHTO Committee (such as reauthorization, regulatory review, and other AASHTO priorities)
    - expected to benefit the planning community
    - small or moderate scale (not appropriate as full NCHRP projects, usually ≤ $100,000)
    - of short duration (usually ≤12 months)
    - timely
  - assign chairs for tasks from panel members.
  - review process and administration.
  - TRB Executive Director approval of new 08-36 Tasks

June/July
- 08-36 Panel refines problem statements
- SCOP Mid-Year Meeting
  - Report program selection to SCOP Leadership Committee for approval
  - Discussion of research needs and priorities.
  - Discussion of SCOP priorities for NCHRP submission or support.
  - Discussion of NCHRP 8-36 priorities and issues.
  - Discussion of research needed to support SCOP Strategic Plan priorities
  - Solicit panel members for new task panels

July
- TRB Planning Committees at TRB Mid-Year Meeting discuss and coordinate identification of research priorities
  - Solicit panel members for new task panels

July/August/September –
- Task panels assembled and approved by TRB Executive Director
- Task Panels create Requests for proposals and determine procurement method: task-order or sole source contracting.
- Problem statements sent to three task-order contractors

October/November
- Proposals submitted by task-order contractors.
- SCOP Meets at AASHTO Annual Meeting.
  - Status of NCHRP 8-36 tasks is reported.

November/December/January
- Task panels meet by conference call to select contractors.
  - Contract negotiations begin (approximately 2.5 months to contract)

March/April –
- Contracts signed and work initiated.

Year Round –
- As projects are completed, the reports are sent to AASHTO, and made available on the NCHRP project webpage. AASHTO distributes the reports electronically to the SCOP membership.
Continuation Request
Project 20-07, FY 1969 & Continuing
Research for the AASHTO Standing Committee on Highways

Present Expiration Date: Continuing
Recommended Allocation: $1,200,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended
The AASHTO Standing Committee on Highways is continually called on to rule on planning and design policies and standards as a guide for state highway and transportation departments to follow. Funding under NCHRP Project 20-07 produces information useful in the establishment of those policies and standards. Three hundred and forty seven tasks have either been completed or are currently underway. The products of this project continue to be used by NCHRP’s sponsors.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended
The AASHTO Standing Committee on Highways has a continuing need for an immediately available research arm to conduct studies (task research) geared to the needs of the Committee in the development of planning and design studies, standards, policies, and other AASHTO activities. The objective of this project under FY 2019 continuation authorization would be to respond as necessary to the needs of the Committee.

The AASHTO Standing Committee on Highways steadily receives requests for funding of tasks under this project. Those solicitations are reviewed at the semiannual meetings of the Committee and allocations are based on need and funds available. SCOR approved an allocation level for FY 2018 of $1,200,000. The recommended allocation for FY 2019 is also $1,200,000.
3. Funds (per year)

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**Note:** Prior to FY 1998, $6,616,000 was allocated and spent.

4. Interpretation of AASHTO Problem Statement by Panel

The AASHTO Standing Committee on Highways is called upon continuously to rule on engineering and operations policies for guidance of state highway and transportation departments. The committee needs information, on a reasonably prompt schedule, through a continuing research project geared to its responsibilities in the development of guides, standards, policies, and other AASHTO activities. The project comprises a series of individual tasks specified by the committee as the need arises for data required to fulfill committee and AASHTO responsibilities. The committee stipulated that accomplishment of research can be through any agency deemed by the NCHRP to possess the necessary expertise, provided research can be initiated quickly. Accordingly, the objective of this project under the continuation authorization would be to respond, as necessary, to the needs of the Standing Committee on Highways.

5. Original AASHTO Problem Statement Number

Original problem is the same as stated above under Item 4.

6. Research Assignment to Date

NCHRP Project 20-07, “Research for the AASHTO Standing Committee on Highways”

Currently active tasks are as follows:

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</thead>
<tbody>
<tr>
<td>334</td>
<td>Primer on the Joint Use of the HSM and HFG</td>
</tr>
<tr>
<td>341</td>
<td>Guidelines for Development HSM Part C Predictive Method Chapters</td>
</tr>
<tr>
<td>354</td>
<td>Work Zone Speed Limits and Crash Data Practices</td>
</tr>
<tr>
<td>356</td>
<td>Strategic Plan for Prioritization and Selection of Research Proposals for Hydrology and Hydraulics</td>
</tr>
<tr>
<td>358</td>
<td>Reducing Risks to Worker Safety in Work Zones Due to Distracted Drivers</td>
</tr>
<tr>
<td>367</td>
<td>Analysis of Crash Contributing Factors to Determine Appropriate Countermeasures</td>
</tr>
<tr>
<td>368</td>
<td>Development of a Roadmap for Use of SHRP 2 Safety Data to Enhance Existing Publications</td>
</tr>
<tr>
<td>369</td>
<td>Update of SCOH Strategic Plan</td>
</tr>
<tr>
<td>370</td>
<td>Development of a Strategic Plan for the Subcommittee on Traffic Engineering (SCOTE)</td>
</tr>
<tr>
<td>371</td>
<td>DOT Technical Assistance in Using the HFG</td>
</tr>
<tr>
<td>372</td>
<td>Evaluation of MASH Test Vehicles</td>
</tr>
<tr>
<td>373</td>
<td>Utility Coordination Best Practices for Design-Build and Alternative Contracting Projects</td>
</tr>
<tr>
<td>375</td>
<td>Improvements to AASHTO T209</td>
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<tr>
<td>376</td>
<td>Framework to Support Transportation Agency ITS Infrastructure and ITS Legacy Decisions with Consideration of Connected Vehicle Deployment and Autonomous Vehicle and Automated Vehicle Initiatives</td>
</tr>
<tr>
<td>377</td>
<td>Standardized Format for Bridge and Structure Information Models for Life Cycle Management</td>
</tr>
<tr>
<td>380</td>
<td>Review and Update of the AASHTO Maintenance Manual for Roadways and Bridges</td>
</tr>
<tr>
<td>381</td>
<td>Using Resistivity Measurements to Develop a Formation Factor Specification</td>
</tr>
<tr>
<td>383</td>
<td>Review and update of the AASHTO Roadside Design Guide</td>
</tr>
<tr>
<td>384</td>
<td>Core Competencies for Key Safety Analyses</td>
</tr>
<tr>
<td>385</td>
<td>AASHTO Traffic Incident Management Working Group and Technical Advisory Group Business Plan</td>
</tr>
<tr>
<td>386</td>
<td>Update of the 2008 Guide Specifications for Highway Construction</td>
</tr>
<tr>
<td>388</td>
<td>Guidelines for Design and Construction of Temporary Bridge</td>
</tr>
<tr>
<td>389</td>
<td>Dig Law Revisions and an Assessment of Potential Impacts to State Transportation Departments</td>
</tr>
<tr>
<td>390</td>
<td>Parametric Study &amp; Cost Effects for the USDOT Truck Size &amp; Weight Study Vehicles</td>
</tr>
<tr>
<td>391</td>
<td>Develop criteria that establish the amount of energy required to maintain fully-animated particles of loose asphalt within the test procedure AASHTO T 209</td>
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<tr>
<td>392</td>
<td>Transportation System Management and Operations Standards for Highway Infrastructure</td>
</tr>
<tr>
<td>393</td>
<td>Impacts of Motor Vehicle Safety Countermeasures on Pedestrian and Bicyclist Safety</td>
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<tr>
<td>394</td>
<td>Development of Performance-Based Geometric Design Content for the Next Edition of the AASHTO Green Book</td>
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<tr>
<td>395</td>
<td>MASH Equivalency of NCHRP 350-Approved Bridge Railing</td>
</tr>
<tr>
<td>396</td>
<td>Updating the AASHTO Seismic Hazard Maps and Site Coefficients</td>
</tr>
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<td>397</td>
<td>Characteristics of Decommissioned Bridges</td>
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<tr>
<td>398</td>
<td>Flexibility in Design Guidance in Preparation for AASHTO Policy on Geometric Design of Highways and Streets (Green Book)</td>
</tr>
<tr>
<td>399</td>
<td>Identifying Bridge Maintenance and Preservation Activities which Minimize Environmental Impact</td>
</tr>
<tr>
<td>400</td>
<td>Effect of Elevation on Rolling Thin Film Oven Aging of Asphalt Binders</td>
</tr>
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<td>401</td>
<td>Addressing Roadside Safety: A Systemic Approach to Hardware Replacement Analysis to Support MASH Implementation</td>
</tr>
<tr>
<td>402</td>
<td>Improved Reinforced Concrete Interface Shear Design and Detailing for LRFD Specifications</td>
</tr>
<tr>
<td>403</td>
<td>Develop Detailed Elements for Movable Bridge Inspection and Management.</td>
</tr>
<tr>
<td>406</td>
<td>Development of a Framework for Balanced Asphalt Mixture Design and Gap Analysis</td>
</tr>
<tr>
<td>407</td>
<td>Utility Coordination Efficiency, Safety, Cost, and Schedule Impacts using various Contracting Methods</td>
</tr>
<tr>
<td>408</td>
<td>Transportation System Management and Operations Workforce Development-Position Descriptions and KSA’s</td>
</tr>
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<td>409</td>
<td>ITS Communications Integration Needs for Legacy and Emerging Programs Including CV and AV</td>
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<tr>
<td>410</td>
<td>Calibration of Load Factors for the FAST Act Emergency Vehicles EV-2 and EV-3 for Load Rating</td>
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<tr>
<td>411</td>
<td>Pavement Rutting Condition Measurement and Analysis Methodologies</td>
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<tr>
<td>412</td>
<td>Adjustments to the Superpave Volumetric Mixture Design Procedure for Selecting Optimum Asphalt Content</td>
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<tr>
<td>413</td>
<td>Time/cost analysis and comparative study associated with the relocation and acquisition of outdoor advertising signs impacted by state highway improvement projects</td>
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</tbody>
</table>

7. Review Dates
September 25, 2017 (staff/panel)
Accountability Report for NCHRP Project 20-7  
“Research for the Standing Committee on Highways”

Purpose: To support the short-term, rapid-response research needs of the Standing Committee on Highways in developing guides, standards, policies, and other AASHTO activities.

Started: Project 20-7 began in 1969.

Funding: Allocated in 2018: $1,200,000 (all funds will be committed) Requested in 2019: $1,200,000

Problem Solicitation: Twice each year, AASHTO staff solicit requests from SCOH subcommittees and technical committees.

Process for Selecting Studies: Requests are considered at semiannual meetings of the 20-7 panel. The panel includes 8 SCOH members and recommends 20-7 studies for approval by SCOH. Selection criteria are listed in Attachment A. After new studies are selected, SCOR and RAC are notified, titles are posted on the NCHRP website, and the studies are entered into TRIS.

Consultant Selection: Each topic panel is responsible for selecting its contractor. Usually this is a sole-source award, but competitive proposals may also be used.

Studies Requested Last Year: 27 topics, totaling about $2,400,000 were proposed.

Studies Funded Last Year: 15 studies, totaling $1,270,000 were funded in FY 2018. See Attachment B.

Studies Completed Last Year: 10 studies were completed in 2017.

Distribution of Findings: Reports are always provided to the AASHTO committee requesting the study. Publication decisions are made on a case-by-case basis. Options include publication by AASHTO and the full range of NCHRP publication types. Most reports are produced as web documents and entered in TRIS with an announcement in TRB’s e-newsletter. SCOR, RAC, and other appropriate AASHTO committees are notified of the report’s availability.

Use of Findings: The reports, most often, are used directly by the requesting committee for development of guides, standards, or policies or in support of other AASHTO activities. For examples, see Attachment C.

Next Year’s Studies: The FY 2019 studies will be selected from topics submitted to the panel in 2018.
Tasks conducted under NCHRP Project 20-7 must be:

1. requested by an AASHTO committee or task force;

6. directed at a research need
   - usually involving technical issues
   - not purely editorial
   - usually developing a new product or substantially upgrading an existing item;
   - not to support travel to attend conferences
   - to develop technical or other intellectual content – not to support publication, production, or distribution

3. expected to produce results for use directly by an AASHTO committee or task force with widespread benefit throughout the highway community;

4. able to be supported using available Project 20-7 funds;

5. beyond the capabilities or resources of the AASHTO committee or task force;

7. small or moderate in scale
   - less than $100,000
   - usually $25,000 to $50,000;

8. short in duration
   - usually able to be completed in less than 12 months
   - not a continuing operational activity

9. urgent
   - ready to begin now
   - not able to wait for regular NCHRP research

9. not inappropriate for NCHRP (administered by the National Research Council’s Transportation Research Board);

10. approved by NCHRP Project Panel SP20-7; and

11. approved by the AASHTO Standing Committee on Highways.
Note: Funds allocated for tasks under NCHRP Project 20-7 may be used to support panel members' travel expenses to meetings of the panel responsible for each task and to support travel by selected individuals participating at working sessions that are convened by the task panel. Funds from Project 20-7 are not used to pay travel expenses for individuals attending meetings organized by AASHTO, TRB, or others.
<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Funding</th>
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</thead>
<tbody>
<tr>
<td>403</td>
<td>Additional Funding to NCHRP 20-07/ Task 403: Develop Detailed Elements for Movable Bridge Inspection and Management.</td>
<td>$40,000</td>
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<td>410</td>
<td>Calibration of Load Factors for the FAST Act Emergency Vehicles EV-2 and EV-3 for Load Rating</td>
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<td>411</td>
<td>Pavement Rutting Condition Measurement and Analysis Methodologies</td>
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<tr>
<td>412</td>
<td>Adjustments to the Superpave Volumetric Mixture Design Procedure for Selecting Optimum Asphalt Content</td>
<td>$100,000</td>
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<tr>
<td>413</td>
<td>Time/cost analysis and comparative study associated with the relocation and acquisition of outdoor advertising signs impacted by state highway improvement projects</td>
<td>$100,000</td>
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<tr>
<td>414</td>
<td>Benefits of Adaptive Traffic Control Deployments – A Review of Evaluation Studies</td>
<td>$100,000</td>
</tr>
<tr>
<td>415</td>
<td>Guidelines for Bottom Flange Limits of Steel Box Girders</td>
<td>$80,000</td>
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<tr>
<td>416</td>
<td>Alternative Technologies for Mitigating the Risk of Injuries and Deaths in the Work Zone</td>
<td>$75,000</td>
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<tr>
<td>417</td>
<td>Reorganization and Strategy to Update the AASHTO Drainage Manual</td>
<td>$75,000</td>
</tr>
<tr>
<td>418</td>
<td>An Impact and Value Analysis of Requiring Geo-spatial Locations for Utility Installation As-builds</td>
<td>$100,000</td>
</tr>
<tr>
<td>419</td>
<td>Accommodation of Small Cell Sites within Public Rights-of-Way (ROW)</td>
<td>$75,000</td>
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<tr>
<td>420</td>
<td>Road User Understanding of Bicycle Signal Symbol Indications</td>
<td>$100,000</td>
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<tr>
<td>421</td>
<td>Evaluating the Effectiveness of Mechanical Sieve and Screen Shakers</td>
<td>$100,000</td>
</tr>
<tr>
<td>422</td>
<td>User Review of the 'Guide for the Local Calibration of the Mechanistic-Empirical Pavement Design Guide</td>
<td>$25,000</td>
</tr>
<tr>
<td>423</td>
<td>Planning for a Comprehensive Update and Restructuring of AASHTO’s A Policy on Geometric Design of Highways and Streets (8th Edition)</td>
<td>$100,000</td>
</tr>
</tbody>
</table>
Most studies, under Project 20-7, are conducted at the request of SCOH subcommittees or technical committees, and the products usually are used in AASHTO publications or as guidance for committee business. Examples of the use of Project 20-7 products are listed below.

A. Examples of AASHTO publications that are based on results from NCHRP Project 20-7:
- Update to the AASHTO “Pavement Management Guide” (Task 277, 2011)
- Update of the AASHTO Policy on Geometric Design of Highways and Streets (Green Book) (Task 273, 2011)
- Update of AASHTO Roadside Design Guide (Task 228, FY 2007)
- AASHTO Guide for LRFD Seismic Bridge Design (Task 193, 2007)
- Consistency of Titles for AASHTO Publications (Task 194, 2006)
- Maintenance Manual Supplement (Task 200, 2005)
- Bridge Rail Height for Bicycles (Task 168, 2005)
- Guidance on Clear Zones (Task 171, 2005)
- Guide for HOV facilities (Task 154, 2004)
- Guide on context-sensitive design (Task 169, 2004)
- New composite pay factors (Task 164, 2004)
- Pedestrian Guide (Task 161, 2004)
- Standard sampling plans (Task 164, 2004)
- Transportation Glossary (Task 153, 2004)
- Guidelines for Selection of Cable Barrier Systems (Task 210, 2005)
- Design examples for curved bridge specifications (Task 156, 2003)
- Guide for emergency response plans (Task 151, 2003)
- Guide to highway vulnerability assessment (Task 151, 2003)
- Asset management brochure (Task 134, 2002)
- LRFD specifications for retaining walls (Task 132, 2001)
- Guide on acquiring ITS software (Task 96, 2000)
- Guide for snow and ice control (Task 83, 1999)
- LRFD specifications for plastic pipe (Task 89, 1999)
- Maintenance manuals (Task 64, 1999)
- Specifications for polyethylene pipe (Task 68, 1997)
- Standards for testing pavement materials (Task 65, 1996)
- LRFD bridge construction specifications (Task 69, 1995)
- Seismic design bridge specifications (Task 45, 1994)
- Guidelines for bridge management systems (Task 46, 1992)

B. Examples of AASHTO committee activities that were guided by results from NCHRP Project 20-7:
- NCHRP’s Role in Maintaining AASHTO Guidelines and Specifications (Task 324, FY 2012)
- Strategic Plan for Development and Maintenance of AASHTO Standards (Task 281, 2010)
AASHTO SSOM Strategic Plan (Task 253, 2009)
AASHTO SCOH Strategic Plan (Task 275, 2009)
AASHTO SCOM Strategic Plan (Task 268, 2009)
Bridge Construction Practices Using Incremental Launching (Task 229, 2007)
Development of a Toolkit to Assist State DOTs and Contractors in Uniformly Handling DBE requirements (Task 233, 2007)
Utility Encasement Policy for Highway Crossings (Task 248, 2007)
Statewide Incident Reporting Systems (Task 215, 2006)
Operating Procedures for SCOH (Task 179, 2005)
Safety Leadership Forum (Task 189, 2005)
Strategic Plan for Bridge Engineering (Task 199, 2005)
Analysis and recommendations on NTPEP (Task 165, 2004)
Bridge railing heights for bicyclists (Task 168, 2004)
Tolerances in the ADA guidelines (Task 167, 2004)
NTPEP website development (Task 150, 2003)
Website for Subcommittee on Materials (Task 131, 2002)
Development of AASHTO web portal (Task 131, 2001)
Business plan for bridge engineering (Task 121, 2000)
Development of AASHTO’s Products Evaluation List (Task 82, 1999)
Development of TRAC PAC (Task 90, 1999)
Guidelines for AASHTO committee websites (Task 103, 1999)
Quality clearinghouse website (Task 80, 1999)
Website for lead-state activities (Task 101, 1999)
New report review and publication process (Task 93, 1998)
Guidance on telecommunications facilities (Task 76, 1997)
MUTCD Strategic Plan (Task 323, 2012)
1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended
The objective of NCHRP Project 20-65 is to provide flexible, ongoing, quick-response research on public transportation issues in support of AASHTO Standing Committee on Public Transportation (SCOPT) activities. This research is designed to develop improvements to analytical methods, decision-support tools, procedures, and techniques employed by practitioners addressing public transportation issues.

The project received its first allocation of funding ($300,000) from the Standing Committee on Research (SCOR) in March 2003. Shortly thereafter, an NCHRP Project 20-65 project panel was formed consisting primarily of a subset of the SCOPT. In July 2003, a solicitation for potential research topics was distributed to all members of SCOPT. As a result of that solicitation, 13 potential research topics were identified for consideration by the project panel. In October 2003, the project panel met and allocated these funds to 5 tasks (Tasks (1) through (5) as summarized in Item 6 below). These initial 5 tasks have been completed.

In March 2004, SCOR allocated an additional $300,000 for the project. A SCOPT solicitation for potential research topics was completed in October 2004. Seven potential research topics were received. The Project 20-65 panel met on November 30, 2004 to program additional research tasks. These additional tasks are listed as Tasks (6) through (8) in Item 6 below.

Three hundred thousand dollars was allocated by SCOR in March 2005. A research topic solicitation was completed in July 2005, with topics solicited from SCOPT, the 20-65 project panel, members of AASHTO’s MTAP, members of APTA’s State Affairs Committee, and the staffs of AASHTO, FTA, CTAA, and APTA. Eight potential research topics were received as a result of this solicitation. The Project 20-65 panel met on July 25, 2005 to program additional research tasks. These additional tasks are listed as Tasks (9) through (12) in Item 6 below.

In March 2006, SCOR allocated $250,000 for this project. Research topics were solicited from SCOPT, the 20-65 project panel, members of AASHTO’s MTAP, members of APTA’s State Affairs Committee, and the staffs of AASHTO, FTA, CTAA, and APTA. The solicitation, completed in July 2006, yielded 3 study topics, and a task (Task 16) to develop potential research topics for SCOPT consideration. These additional tasks are listed as Tasks (13) through (16) in Item 6 below.

Two hundred and fifty thousand dollars was allocated by SCOR in March 2007. A research topic solicitation was completed in July 2007, with topics solicited from SCOPT, the 20-65 project panel, members of AASHTO’s MTAP, members of APTA’s State Affairs Committee, and the staffs of AASHTO, FTA, CTAA, and APTA. Sixteen potential research topics were received as a result of this solicitation. The Project 20-65 panel met on August 7, 2007 to program additional research tasks. These additional tasks are listed as Tasks (17) through (21) in Item 6 below.
In March 2008, SCOR allocated an additional $300,000 for the project. A SCOPT solicitation for potential research topics was completed in July 2008. Sixteen potential research topics were received. The Project 20-65 panel met on August 5, 2008 to program additional research tasks. These additional tasks are listed as Tasks (22) through (27) in Item 6 below.

In March 2009, SCOR allocated $350,000. Thirty-five topics were received as a result of the solicitation completed in August 2009. The NCHRP 20-65 Panel ranked about half of the proposed topics very high. The FY 2010 allocation allowed for the funding of 8 topics. The Project 20-65 panel met on August 10, 2009 to program additional research tasks. These additional tasks are listed as Tasks (28) through (35) in Item 6 below.

In March 2010, SCOR allocated $400,000. Twenty-two topics were received as a result of the solicitation completed in August 2010. The NCHRP 20-65 Panel ranked about half of the proposed topics very high. The FY 2011 allocation allowed for the funding of 8 topics. The Project 20-65 panel met on August 3, 2010 to program additional research tasks. These additional tasks are listed as Tasks (36) through (43) in Item 6 below.

In March 2011, SCOR allocated $450,000. Fifteen topics were received as a result of the solicitation completed in August 2011. The NCHRP 20-65 Panel ranked about one-half of the proposed topics very high. The FY 2012 allocation allowed for the funding of 6 topics. The Project 20-65 panel met on August 9, 2011 to program additional research tasks. These additional tasks are listed as Tasks (44) through (49) in Item 6 below.

In March 2012, SCOR allocated $450,000. Fifteen topics were received as a result of the solicitation completed in August 2012. The NCHRP 20-65 Panel ranked about one-half of the proposed topics very high. The FY 2013 allocation allowed for the funding of 6 topics. The Project 20-65 panel met on August 14, 2012 to program additional research tasks. Five of the six additional tasks are listed as Tasks (50) through (55) in Item 6 below.

In March 2013, SCOR allocated $450,000. Ten topics were received as a result of the solicitation completed in August 2013. The NCHRP 20-65 Panel ranked about two-thirds of the proposed topics very high. The FY 2014 allocation allowed for the funding of 5 topics. The Project 20-65 panel met on November 17, 2013 to program additional research tasks. Additional tasks are listed as Tasks (56) through (60) in Item 6 below.

In March 2014, SCOR allocated $450,000. Eleven topics were received as a result of the solicitation completed in August 2014. The NCHRP 20-65 Panel ranked over one-half of the proposed topics very high. The FY 2015 allocation allowed for the funding of 6 topics. The Project 20-65 panel met on August 13, 2014 to program additional research tasks. Additional tasks are listed as Tasks (61) through (66) in Item 6 below.

In March 2015, SCOR allocated $450,000. Thirteen topics were received as a result of the solicitation completed in August 2015. The NCHRP 20-65 Panel ranked over one-half of the proposed topics very high. The FY 2016 allocation allowed for the funding of 6 topics. The Project 20-65 panel met on August 11, 2015 to program additional research tasks. Additional tasks are listed as Tasks (67) through (72) in Item 6 below.

In March 2016, SCOR allocated $450,000. The annual solicitation will be completed in November 2016. The FY 2017 allocation will allow for the funding of 6 topics. The Project 20-65 will meet on November 29, 2016 to program additional research tasks.

In March 2017 SCOR allocated $450,000. Nine topics were received as a result of the solicitation completed in October 2017. The FY 2018 allocation will allow for the funding of 4 topics. The Project 20-65 panel met on August 15, 2017 to program additional research tasks. Additional tasks are listed as Tasks (73) through (77) in Item 6 below. The Project 20-65 committee will meet on November 15, 2017 to program additional research tasks.

1a. Additional Funds Requested
The NCHRP 20-65 panel requests $450,000 for FY 2019 to fund an additional four to six topics. If funding is approved, topics will be solicited in May of 2018, and the project panel will meet in August 2018 to identify the topics for the FY 2019 Program.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

There have been 14 solicitations for potential research topics over the past 14 years. These solicitations yielded over 209 potential research topics. In addition, Task (1), "Research Agenda/Potential Roles of SCOPT", developed additional potential research topics for SCOPT consideration. To date, funding has been allocated to 72 tasks.

If approved, a solicitation of research topics will be conducted. This solicitation will include members of SCOPT, MTAP, APTA State Affairs Committee, and staff of AASHTO, APTA, FTA, and CTAA. Also, additional topics identified in Task (15) may be considered. The NCHRP funds requested for FY 2018 will be used to address a number of research topics from these efforts.

3. Funds (in thousands)

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4. Interpretation of AASHTO Problem Statement by Panel

The AASHTO Standing Committee on Public Transportation (SCOPT) is called upon to provide information for the establishment of policies and positions of the state transportation departments on issues associated with the nation's transportation system. The Committee needs information on a reasonably prompt basis, through a continuing research project geared to its responsibilities. AASHTO member departments require timely information regarding transit planning, operations, transit delivery, and related matters as state involvement in public transportation continues to grow. This project comprises a program of quick-response research tasks to assist in the fulfillment of SCOPT and AASHTO responsibilities. Research conducted responds to urgent issues relating to public transportation. For example, when any new or revised federal transportation regulations related to transit are proposed or finalized, research is typically needed to develop new methods, processes, and procedures to ensure their effective and timely implementation. In addition, as AASHTO prepares for final reauthorization and the subsequent implementation of reauthorization legislation, the SCOPT will require increased support to carry out its responsibilities in a timely and effective manner.

5. Original AASHTO Problem Statement Number

Problem No. 2004-SP-12

6. Research Assignments to Date

<table>
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<tr>
<th>Task</th>
<th>Completed Projects</th>
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<tbody>
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<td>1</td>
<td>Research Agenda/Potential Roles of SCOPT</td>
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<td>2</td>
<td>Toolbox for Promoting the Transit Bus Safety and Security Program in Your State</td>
</tr>
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<tr>
<td>3</td>
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<td>Catastrophic Insurance Availability/Accessibility</td>
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<td>Impacts of the U.S.'s Aging Population and Changed Demographics on</td>
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<td>Public Transportation, Including ADA Paratransit, Over the Next Ten</td>
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<td>Transit Oriented Development: Developing a Strategy to Measure</td>
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<td>Evaluation of State’s Ability to Have Adequate Staff Resources to</td>
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<td>Implement Federal Public Transportation Programs, $100,000</td>
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<td>Buy America Issues Associated with the State DOT Procurement of</td>
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<td>Paratransit Vehicles Using FTA Funds</td>
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<td>FMCSA Regulations as They Apply to FTA Section 5310/5311 Providers:</td>
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<td>Management Programs, (published Results Digest 348)</td>
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<td>Evaluate Requirements for the Utilization of Section 5311(f) Funds</td>
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<td>28</td>
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<td>Public Transportation Performance Measures: State of the Practice and Future Needs</td>
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<td>34</td>
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<td>Development of Appropriate Tools to Evaluate the Efficiency and Effectiveness of Selected Specialized Public Transportation Programs</td>
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<td>Data Needs for Assessing Rural Transit Needs, Benefits, and Levels of Service</td>
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<td>Survey of State Funding for Public Transportation—Ways to Improve it.</td>
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<td>MTAP Survey Tool Used to Assess FTA Contractor Performance of State DOT Triennial and other FTA Reviews - An Update</td>
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<td>Condition of State and Federally Funded Transit Assets</td>
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<td>Approaches to Improving the Grant Approval processes for Transit Projects</td>
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<td>Selected Indirect Benefits of State Investment in Public Transportation</td>
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<td>Determine the Benefits and Costs of Alternative Methods Used by States to Administer FTA’s Rail Safety Oversight Program</td>
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<td>Estimating the Long Term Impacts of MAP-21 on the Nation’s Local Rural Transit Bus Infrastructure</td>
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<td>57</td>
<td>Assessment of State DOT Transit Vehicle Procurement Models</td>
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<td>66</td>
<td>States’ Utilization of Administrative Resources Provided by the Federal Transit Administration</td>
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**Active Projects:** These research tasks are currently underway.

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<tr>
<th>Task</th>
<th>Title</th>
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<td>Determine How Federal JARC and New freedom Funds Were Provided under MAP-21.</td>
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<td>DOT Oversight of Facility Projects</td>
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<td>67</td>
<td>Multi Modal Project Planning</td>
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<td>68</td>
<td>Successful Mobility Management Practices for Improving Transportation Services in Small Urban and Rural Areas</td>
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<td>69</td>
<td>Consolidation of Rural Transit Systems</td>
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<td>70</td>
<td>Cross Modal Investment</td>
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<td>Transit Network Balance; Efficiency and Equity</td>
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<td>72</td>
<td>Small System Alternative Fuel Strategies</td>
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<td>73</td>
<td>Best Practices and Marketing to Increase Rural Transit Ridership and Investment</td>
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<td>74</td>
<td>Cancelled</td>
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<td>75</td>
<td>Baseline Research on Allowable In-Kind and Local Match Sources</td>
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<td>76</td>
<td>Opportunities for State DOTs (and Others) to Encourage Shared Use Mobility Practices in Rural Areas</td>
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<tr>
<td>77</td>
<td>Lessons Evaluation of an Automatic, Individual Computer-Based Operator Education and Training Program</td>
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7. **Review Dates**

October 2017
Accountability Report for NCHRP Project 20-65
“Research for the Standing Committee on Public Transportation”

Purpose: To support the short-term, rapid-response research needs of the Standing Committee on Public Transportation (SCOPT) on subjects of importance to the SCOPT and transit sections of state DOTs.


Funding: Allocated in FY 2017: $450,000 (all funds are committed)
Allocated in FY 2018: $375,000

Problem Solicitation: Annually, research topics are solicited from SCOPT; NCHRP Project Panel 20-65; MTAP; APTA State Affairs Committee; and the staffs of AASHTO, APTA, and CTAA.

Process for Selecting Studies: Requests are considered at an annual meeting of the 20-65 project panel. The panel includes 5 SCOPT members and recommends 20-65 studies for approval by SCOPT. Selection criteria are listed in Attachment A. After new studies are selected, SCOR and RAC are notified, titles are posted on the NCHRP website, and the studies are entered into TRIS.

Consultant Selection: Currently, a solicitation is prepared for each topic and sent to the task-order contractors selected competitively for NCHRP Projects 20-65. These task order contractors submit proposals, as interested. The 20-65 project panel reviews the proposals and selects the contractor for each topic.

Studies Funded To Date: 72 studies, totaling $5,560,000 have been funded to date.

Studies Funded Last Year: It is anticipated that 4 topics, totaling $375,000 will be funded in 2017 (FY 2018).

Studies Completed To Date/Last Year: 75 studies have been completed to date, including 4 studies completed in 2017.

Distribution of Findings: Reports are always provided to SCOPT. Publication decisions are made on a case-by-case basis. Options include publication by AASHTO and the full range of NCHRP publication types. Published reports are entered in TRIS with an announcement in TRB’s e-newsletter. SCOR, RAC, and other appropriate organizations are notified of the publication’s availability.

Use of Findings: The reports, most often, are used directly by SCOPT and state DOTs. Some topics may have broader applicability.

Next Year's Studies: The FY 2019 studies will be selected from topics submitted to the panel in 2018.
NCHRP Project 20-65
Research for the AASHTO Standing Committee on Public Transportation (SCOPT)

Guidelines for Allocating Research Funds

Tasks conducted under NCHRP Project 20-65 must be:

1. approved by the Project 20-65 panel;
2. directed at a research need
   - usually involving policy-related and technical issues
   - not purely editorial
   - usually developing a new product or substantially upgrading an existing item;
3. expected to produce results predominantly for use by SCOPT, AASHTO, and/or state DOTs (Research topics oriented more towards transit operators should be directed to the TCRP rather than to NCHRP Project 20-65);
4. able to be supported within available Project 20-65 funds;
5. beyond the capabilities or resources of the requesting committee;
6. small or moderate in scale
   - less than $250,000\(^1\)
   - usually $10,000 to $50,000;
7. short in duration
   - usually able to be completed in less than 12 months
   - not a continuing operational activity;
8. urgent
   - ready to begin now
   - not able to wait for regular NCHRP or TCRP research; and
9. not inappropriate for the NCHRP (administered by the National Academy of Sciences, Engineering, and Medicine’s Transportation Research Board).

\(^1\) Increased to $250,000.00 for Fall 2017 solicitation. Standard is less than $100,000.00
Continuation Request
Project 25-25, FY 2003 & Continuing
Research for the AASHTO Standing Committee on the Environment

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended
The AASHTO Committee on the Environment and Sustainability (SCOE) is called on continuously to provide information for establishing policies and positions of the state highway and transportation departments on environmental issues associated with the nation's transportation system. The Committee needs information, on a reasonably prompt schedule, provided through a continuing research project designed to support the development of technical information, guidance, and policy consistent with the Committee's needs and responsibilities. Member departments require timely information on new environmental analysis, regulatory streamlining, environmental stewardship, and other technical methods and procedures in order to respond effectively and proactively to transportation planning, program-delivery, project-development, and maintenance and operations issues.

The objective of Project 25-25 is to provide flexible, ongoing, quick-response research on environmental issues in transportation. This research will be used to develop improvements in analytical methods, decision support tools, procedures, and monitoring techniques, employed by state DOT environmental practitioners, and to support continuous improvement in state DOT environmental performance. Most of the research in the 25-25 program is conducted by a short list of contractors under task order contracts. The task order contract was last re-competitive in 2014.

A complete listing of all research conducted under NCHRP Project 25-25 is in Appendix A. Since the project's inception in 2003, 113 projects have been selected: 93 projects have been completed, 14 are active, and 5 were cancelled and the funds were reprogramed.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended
This continuation request will support, for another year, research that will provide information and guidance on improving analytical methods, decision support tools, and technical procedures and techniques employed by state DOT environmental practitioners. In particular, the research to be conducted with this funding will be responsive to environmental issues arising out of federal legislation.

3. Funds (in thousands)

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* $4.8 million was spent prior to 2011.
**Unspent contract balances from earlier years.

4. Interpretation of AASHTO Problem Statement by Panel
A program is needed that can respond to the needs of SCOE on urgent issues, especially related to the states’ response to changes in federal regulations related to environmental analysis, transportation planning, and program delivery. This quick-response research program will be designed to develop timely
improvements to the analytical methods, decision-support tools, procedures, and techniques employed by
state DOT environmental practitioners in environmental streamlining, environmental stewardship,
transportation planning, program delivery, project development, and maintenance and operations.

5. Original AASHTO Problem Statement Number
Problem number 2003-SP-14 on file

6. Research Assignment to Date
NCHRP Project 25-25, Research for the AASHTO Standing Committee on the Environment

7. Review Date
Accountability Report for NCHRP Project 25-25
“Research for the Standing Committee on the Environment”

Purpose: NCHRP 25-25 provides SCOE with a flexible, ongoing resource to develop improvements to the analytical methods, decision-support tools, procedures, and techniques employed by state DOT environmental practitioners in environmental analysis, environmental streamlining, environmental stewardship, transportation planning, program delivery, project development, and maintenance and operations.

Started: FY 2003

Funding: Allocated for FY2018: $690,000
Requested for 2019: $600,000

Problem Solicitation: Research problem statements are solicited by AASHTO staff from SCOE subcommittees as a result of a research-needs identification and prioritization process conducted in conjunction with the AASHTO Environmental Center of Excellence.

Process for Selecting Studies: Research problem statements are considered and selected at annual meetings of the Project 25-25 panel. The panel includes seven SCOE members drawn from SCOE subcommittees and that represent various environmental disciplines. The panel also includes liaisons from FHWA, and TRB. Selection criteria are listed in Appendix B.

Consultant Selection: Each task panel is responsible for selecting its contractor. This may be a sole source contract, but generally proposals are solicited from pre-qualified task order contractors. The NCHRP 25-25 task order contracts were re-competed in 2014 and 2 contractors were selected.

Studies Requested Last Year: Nine research problem statements, requesting a total of $1,030,000, were submitted for FY 2017.

Studies Funded Last Year: Five problem statements were selected for funding with FY 2017 funds. The panel will meet on November 9, 2017, to select projects for funding with FY 2018 funds.

Studies Completed Last Year: Three projects were completed in 2017.

Distribution of Findings: The final reports are posted on the NCHRP project website and distributed to the members of the task panel. Final reports are also sent to AASHTO. AASHTO distributes final reports to the SCOE membership.

Use of Findings: The reports are of direct use to members of SCOE and environmental staff at state DOTs and FHWA, as well as federal and state environmental regulatory agencies.

Next Year's Studies: The FY 2018 research projects will be selected from problem statements submitted to the NCHRP 25-25 panel in late October 2017.
# Completed and Active Research Projects

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<td><strong>FY 2003</strong></td>
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<td>Task 1</td>
<td>Synthesis on Data Needs for EA and EIS Documentation</td>
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<td>Transportation Impacts and &quot;Smart Growth&quot; Initiatives</td>
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<tr>
<td>Task 3</td>
<td>Assessment and Mitigation Strategies for Land Development Impacts of Transportation Improvements</td>
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<td>Environmental Stewardship Best Practices for Road Maintenance and Construction</td>
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<td>Assessing the Current State of the NEPA Environmental Review Process</td>
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<td>Preparing State DOTs for Implementation of the 8-hour ozone and PM 2.5 standards</td>
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<td>Evaluation of Mobile Models: MOBILE 6.1, MOBILE 6.2 and MOBILE6/CNG</td>
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<td><strong>FY 2004</strong></td>
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<td>Developing performance data collection protocol for stream restoration</td>
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<td>Use of Existing Data in Decision making</td>
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<td>Alternative Mitigation Strategies/Early Mitigation: Streamlining and Achieving Net Benefits for the Natural Environment</td>
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<td>Agency use and approach to FHWA approved Programmatic Agreements.</td>
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<td>A Summary of Existing Research on Dam Removal Projects</td>
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<td>Historic Bridges</td>
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<td><strong>FY 2005</strong></td>
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<td>Task 16</td>
<td>State Transportation Agency Strategies to Address NPDES Phase II Requirements.</td>
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<td>Assessment of Greenhouse Gas Analysis Techniques for Transportation Projects</td>
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<td>Recommended Approaches to Communicating Air Toxics Issues and Transportation Project-Related Analyses in NEPA Documents</td>
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<td>Task 19</td>
<td>Historic bridge rehabilitation / replacement decision making</td>
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<td>Task 20</td>
<td>The Role of State DOTs in support of Transit Oriented Development (TOD)</td>
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<td>Task 21</td>
<td>Assessment of Geophysical Remote Sensing Opportunities at State Departments of Transportation for Incorporation into Archaeological Investigations</td>
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<td>Guidelines for Environmental performance measurements</td>
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<td>Climate Change and U.S. Transportation</td>
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<td>Modification and Amendment of Environmental Permits on Design-Build Projects</td>
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<td>Task 26</td>
<td>Integration of Charrette Processes into Project Planning</td>
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<td>Task 27</td>
<td>Project Management and NEPA</td>
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<td>Reevaluations of NEPA documents</td>
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<td>Best Practices Library from the Environmental Stewardship Practices in Construction and Maintenance Compendium</td>
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<td>Section 404 Permitting and Roadside Ditches as Jurisdictional Waters</td>
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<td>Task 31</td>
<td>Cost Effective Tools for Achieving PM 2.5 Transportation Air Quality Conformity</td>
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<td>Task 32</td>
<td>Linking Environmental Resource and Transportation Planning – The Current State of Practice</td>
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<td>Task 33</td>
<td>National Register of Historic Places Eligibility</td>
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<td>Task 34</td>
<td>Streamlined Carbon Monoxide Hot Spot Screening / Modeling Tool</td>
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<td>Water Quality Analyses for NEPA Documents: Selecting Appropriate Methodologies</td>
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<td>Recurring Community Impacts</td>
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<td>37</td>
<td>Effective Organizational Structures and Management Practices for Achieving Environmental Stewardship in Transportation Agencies</td>
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<td>38</td>
<td>Guide to Use of Tier I Environmental Impact Statements for Transportation Projects</td>
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<td>39</td>
<td>Improving Project Environmental Cost Estimates</td>
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<td>New Noise Barrier Products &amp; Noise Barrier Approval Research &amp; Guidelines</td>
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<td>41</td>
<td>Implementation of Community &amp; Cultural Resource Commitments</td>
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<td>42</td>
<td>Determine alternative calculations for fine particulate emission factors other than AP-42 applicable to calculate re-entrained dust on transportation projects.</td>
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<td>43</td>
<td>Guidance on legal sufficiency criteria for adequate cumulative and secondary impacts analysis in EIS documents</td>
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<td>44</td>
<td>Development and Implementation of a Transportation and Climate Change Clearinghouse</td>
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<td>45</td>
<td>Transportation Program Responses to Greenhouse Gas (GHG) Reduction Initiatives and Energy Reduction Programs</td>
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<td>46</td>
<td>Compendium of Best Practices for Environmental Compliance and Stewardship at Transportation Maintenance Facilities</td>
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<td>Compendium of Best Practices for Incorporating Environmental Commitments into Transportation Project Construction Contract Documents</td>
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<td>Compendium of Environmental Fieldwork Technologies</td>
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<td>Effective Practices for Considering Historic Preservation in Transportation Planning and Early Project Development</td>
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<td>Finding the Carrot Instead of the Stick - Incentive-based Approaches for Environmental Compliance</td>
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<td>Informational Requirements for Jurisdictional Determinations to be Issued by the Army Corps of Engineers (Corps) Under the Clean Water Act (CWA)</td>
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<td>Stormwater Treatment with Vegetated Buffer</td>
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<td>Evaluate Colorado's Area-wide Cumulative Effects Assessment (ACEA) Methodology as a Mechanism for Cumulative Impacts Analysis of Regional Transportation Plans</td>
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<td>Design, Organize and Implement a Training Program for Mainstreaming Environmental Stewardship and Enhancement Activities into Planning and Project Development</td>
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<td>Cost and Benefit of Transportation Specific MS4 and Construction Permitting</td>
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<td>57</td>
<td>AASHTO Workshop to Develop Integrated Policy Approaches to Slow VMT Growth and to Increase Transportation System Efficiency</td>
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<td>Methods to Address Greenhouse Gas Emissions from Transportation Construction/Maintenance/Operations Activities</td>
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<td>Evaluate the Interactions between Transportation-Related Particulate Matter, Ozone, Air Toxics, Greenhouse gases, and Other Air Pollutant Control Strategies</td>
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<td>Increased Use of Environmentally Preferable, Non-Toxic Products to Reduce Costs, Liabilities, and Pollution at DOT Offices, Maintenance Facilities and Rest Stops</td>
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<td>61</td>
<td>Best Practices for Establishing and Maintaining Statewide Cultural Resource Databases at State DOTs</td>
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<td>Improving Public Outreach for Transportation Projects by Use of Citizen Coalitions</td>
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<td>Transportation Corridor Environmental Management Framework</td>
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<td>Feasibility Study of Using Solar or Wind Power for Transportation Infrastructure</td>
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<td>Synthesis of Greenhouse Gas Emission Inventory Methodologies for State Transportation Departments</td>
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<td>Task 66</td>
<td>Best Practices and Lessons Learned on the Preservation and Rehabilitation of Historic Bridges</td>
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<td>Task 67</td>
<td>Optimizing Conservation and Improving Mitigation Cost/Benefit</td>
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<td>Implementing Measures to Reduce Highway Impacts on Habitat Fragmentation</td>
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<td>Identification of Tools and Techniques to Define Community Context as Part of the Transportation Project Planning and Development Process</td>
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<td>Assessment of Quantitative Mobile Source Air Toxics in Environmental Documents</td>
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<td>Templates for Project-Level Analyses Using MOVES and AERMOD</td>
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<td>A Synthesis of Construction Vibration and Potential Effects to Historic Buildings Adjacent to Transportation Projects</td>
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<td>Task 73</td>
<td>Improved Environmental Performance of Highway Maintenance – a Key to Transportation Sustainability?</td>
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<td>Meeting the New EPA Effluent Limitations Guideline for Construction Site Discharge Turbidity: Effectiveness of Different Turbidity Control Systems and Monitoring Methods</td>
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<td>Nationwide Evaluation of Transfer of Compensatory Wetland Creation Sites for Transportation Projects to Private Conservation Organizations or Government Conservation Agencies</td>
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<td>Synthesis of Climate Change and Transportation Research Efforts at the State DOT, State University, and Federal Levels</td>
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<td>Strategic Options of Inventorying and Updating Environmental Guidance and Links</td>
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<td>Task 78</td>
<td>Programmatic Agreements for Project-Level Air Quality Analyses Using MOVES, CAL3QHC/R and AERMOD</td>
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<td>Successful Practices for Effective Tribal Consultation</td>
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<td>Potential Use of Social Media in the NEPA Process</td>
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<td>Federal Compliance for Projects Utilizing Alternative Funding Strategies</td>
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<td>Permeable Shoulders</td>
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<td>Task 83</td>
<td>Current Practice of Post- Construction Structural Stormwater Control Implementation for Highways</td>
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<td>Task 84</td>
<td>Development of Construction Standards for Wildlife Fencing and Associated Escape and Lateral Access Control Measures</td>
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<td>Task 85</td>
<td>Nutrient (Nitrogen/Phosphorous) Management and Source Control</td>
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<td>Toxicological Effects of Chloride Based Deicers in the Natural Environment</td>
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<td>Coordination of Section 106 and Long Range Transportation Planning</td>
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<td>“Giving Away the Bridge”: A National Synthesis of on Transferring Ownership of Historic Bridges</td>
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<td>Establishing Representative Background Concentrations for Quantitative Hot-spot Analyses for Particulate Matter</td>
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<td>Application of Geographic Information Systems (GIS) to Streamline the Identification of Historic Properties of Federally Funded Transportation Projects</td>
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<td>Task 91</td>
<td>Synthesis of Transportation Exclusions to Section 106 Review</td>
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<td>Task 92</td>
<td>Effectiveness Evaluation of Best Management Practices (BMPs) for DOTs Long-Term Construction and Maintenance Cost Comparison for Road Stream</td>
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<td>Task 93</td>
<td>Crossing Hydraulic Design vs. Bankfull Width Design</td>
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<td>Task 94</td>
<td>Integrating Climate Change and Extreme Weather Into Transportation Asset Management Plans</td>
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<td>SCOE Strategic Plan and Research Plan for SCOE Areas of Interest</td>
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<td>96</td>
<td>Quick Reference Guide for Traffic Modelers for Generating Traffic and Activity Data for Project-Level Air Quality Analyses</td>
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<td>97</td>
<td>Historic Roads: A Synthesis of Identification and Evaluation Practices</td>
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<td>98</td>
<td>Practical Guide for Developing Effective Scopes of Work for the Geophysical Investigation of Cemeteries</td>
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<td>Lessons Learned from State DOT NEPA Assignment</td>
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<td>Compilation of Existing Data on Northern Long-Eared and Other Cave-Dwelling Bat Habitat and the Roadside Environment</td>
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<td>101</td>
<td>Stormwater Monitoring Program Goals, Objectives and Protocols for State Departments of Transportation</td>
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<td>Artificial Bat Roost Mitigation Designs and Standardized Monitoring Criteria</td>
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<td>Administration of Categorical Exclusions by State Departments of Transportation (DOTs) under NEPA</td>
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<td>104</td>
<td>A Pilot Program for Streamlining Carbon Monoxide Project-Level Air Quality Analyses with Programmatic Agreements</td>
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<td>105</td>
<td>A Guidebook for Communications between Transportation and Public Health Communities</td>
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<td>106</td>
<td>National Synthesis of Highway Noise Effects on Historic Properties and Effective Mitigation Practices</td>
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<td>107</td>
<td>Synthesis of Best Practices for the Development and Implementation of Section 106 Delegation Programmatic Agreements</td>
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<td>Creating Look-Up Tables to Streamline the Determination of Emission Reductions for CMAQ Projects</td>
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<td>Successful Practices for Environmental Commitments in Public/Private Partnerships (P-3) and Design-Build (D-B) Contracts</td>
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<td>National Synthesis of Successful Strategies for Managing Post/World War II Resources in Historic Property Identification Surveys</td>
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<td>Environmental Management System Perspective for State DOTs</td>
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<td>Enhancing the International Stormwater BMP Database to Serve as a Highway Specific BMP Database; Continuation of 25-25/Task 92</td>
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<td>113</td>
<td>Highway Passages for Small Terrestrial Wildlife – Summary and Repository of Design Examples</td>
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NCHRP Project 25-25

Research for the AASHTO Standing Committee on the Environment

GUIDELINES FOR ALLOCATING RESEARCH FUNDS

NCHRP 25-25 is designed to provide a flexible, ongoing program to develop improvements to the analytical methods, decision-support tools, technical procedures, and techniques, employed by practitioners in environmental analysis, environmental streamlining, environmental stewardship, program delivery, and project development.

Tasks conducted under NCHRP Project 25-25 must:

1. Address an important environmental research need faced by DOTs,
2. Be limited in scale (typically $75,000 - $125,000)
3. Address a time-sensitive need (usually 10-12 months to complete).
4. Be beyond the resources or capabilities of SCOE to address without assistance.
5. Produce results for use directly by SCOE members
6. Have widespread benefit throughout the state DOT environmental community.
Part 1.3

Research Projects
Continuation Request  
Project 03-123, FY 2019

**Proposed Practices for the Application of Dynamic Lane Use Control**

Present Expiration Date: 6/30/2018  
Recommended Allocation: $80,000

### 1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

The objective of this research is to develop recommendations for the application of dynamic lane use control based upon their human factors implications. For this research, dynamic lane use control should be interpreted broadly so as to include applications such as reversible lanes, hard shoulder running, dynamic junction control, and toll plazas.

At the interim meeting, the panel approved the Phase I report and, based upon the research team’s recommendation, decided to use the Phase II funds for computer-based testing. This will allow a large number of subjects to be tested in four cities (Dallas, Columbus, Raleigh, Las Vegas), some of which have dynamic lane use control installed and some of which do not.

### 2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

The requested funds will be used to augment the computer-based testing with driver simulator testing with 30 subjects. This will allow different aspects of the proposed displays to be tested and increase the confidence in the research results.

### 3. Funds (in thousands)

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### 4. Interpretation of AASHTO Problem Statement by Panel

Active Traffic Management (ATM) strategies provide the “ability to dynamically manage recurrent and non-recurrent congestion based on prevailing and predicted traffic conditions” ([FHWA’s Active Traffic Management website](http://www.fhwa.dot.gov/active-traffic-management/)). New traffic control devices and approaches are needed to support these strategies and many of those devices and approaches are not included in the MUTCD. Furthermore, the effectiveness of the devices and approaches in obtaining the desired response from drivers are not well understood. Inefficiencies in traffic control lead to reductions in safety and operational efficiency, precisely what ATM is intended to improve.

One of the commonly used ATM strategies is dynamic lane use control. The FHWA defines dynamic lane use control as dynamically closing or opening individual traffic lanes as warranted and providing advance warning of the closure(s) (typically through dynamic lane control signs), in order to safely merge traffic into adjoining lanes. Drivers are required to identify and understand the intended lane usage and make an appropriate maneuver safely and smoothly.

In many existing dynamic lane use control installations, acceptable travel lanes are identified by text-based or graphical overhead signage such as a green arrow or a dynamic speed limit sign. Closed travel...
lanes are most often identified by an overhead red ‘X’. In some locations, ground-mounted signing is also used to communicate lane use to drivers. For example, Seattle, WA uses shoulder- or barrier-mounted signs that read either SHOULDER OPEN TO TRAFFIC or SHOULDER CLOSED. Other locations use signs to indicate the type of traffic allowed in the controlled lane (frequently buses). Various forms of static pavement marking or colored pavements are used to support the signs. There is little consistency and limited guidance in the methods used for communicating dynamic lane use control to drivers and little research on the most effective approaches. There are a number of other operational strategies that present similar traffic control challenges and the traffic control approaches should be consistent.

5. Original AASHTO Problem Statement Number
   Problem No. 2016-G-09

6. Research Assignment to Date
   NCHRP Project 03-123, Proposed Practices for the Application of Dynamic Lane Use Control.

7. Review Dates
   Oct 2017
1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

The objectives of Project 05-22, “Guidelines for Solid-State Roadway Lighting,” are to develop comprehensive guidelines in AASHTO standard format for the application of solid-state lighting (SSL) to roadways, and to identify gaps in knowledge where possible future research will enhance these guidelines. The research shall complement and supplement the ongoing efforts of the AASHTO Roadway Lighting Committee on the usage of SSL.

The key project deliverable is a “Guidelines for Solid-State Roadway Lighting” document in standard AASHTO format that addresses all aspects of the application of SSL to roadways. The guidelines document is expected to address the following topics, at a minimum:

- Differences between SSL and high-intensity discharge (HID) fixtures, in both new and retrofit installations (e.g., glare and perceived brightness)
- Safety for pedestrians, cyclists, and motorists
- Applications of and obstacles to adaptive roadway lighting for safety and energy savings; impact of weather and climate on lighting effectiveness
- Application to freeways, arterials, intersections, and interchanges, considering both on- and off-roadway lighting
- Differences in effectiveness of design approach for high mast and conventional installations

The project is being conducted by WSP/Parsons Brinkerhoff with a completion date of 2 January 2019.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

Pennsylvania DOT submitted the original problem statement for Project 05-22 to (1) remedy a perceived lack of progress in developing SSL specifications and the lack of general guidance in on the topic and (2) respond to legislative pressures to adopt SSL to reduce energy use and cost. In addition, the current AASHTO Roadway Lighting Guide is interpreted to rule out acceptance of SSL as a one to one retrofit or replacement for High Pressure Sodium (HPS) unless the SSL puts out the same brightness as the HPS. Additionally, SSLs burn out slowly over time with concomitant light depreciation versus HPS lamps that exhibit instantaneous failure.

With the $400,000 allocated for Project 05-22 in FY 2017, the project panel is able to address:

- Pedestrian, bicyclist, and motorist safety
- Design metrics for lighting adjacent to the traveled roadway
- Design metrics for SSL retrofit and replacement
- Standards for high mast and conventional installations, and guide sign, underpass, and decorative lighting
The panel respectfully requests $300,000 in FY 2019 funds to permit the proposed Guidelines for Solid-State Roadway Lighting to incorporate guidance on the following additional SSL topics:

- Design metrics to incorporate the effect of headlights
- Asset management, maintenance, and revenue streams
- Real-time adaptation to connected vehicles, traffic flow, and weather
- Light depreciation and useful life

### 3. Funds (in thousands)

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### 4. Interpretation of AASHTO Problem Statement by Panel

The lighting industry has changed dramatically over the past decade. The optics of legacy high intensity discharge, full-cutoff luminaires were restricted to the lamp and reflector design; these lamps emit light in almost every direction, which must then be reflected to the roadway. Roadway luminaires have moved beyond this design through the vast possibilities presented by solid-state lighting (SSL)—at present, in the form of light emitting diodes (LED)—which also boasts lower energy usage, reduced maintenance, and improved color. AASHTO target light levels are calculated over a grid limited to the traveled roadway. Any light that lands outside of the calculation grid is not quantified in the average and uniformity results, but is still present with roadway luminaires and may provide a safety benefit. With the greater ability to control the distribution and the sharp cutoff at the edges with SSL luminaires, light levels beyond the calculation grid may be dramatically reduced, but a design may still meet the AASHTO criteria. Therefore, research is needed to investigate the application of AASHTO criteria to SSL roadway lighting and, if the results dictate, provide guidance for light level criteria for areas immediately adjacent to the traveled roadway when using SSL luminaires. Additional research is also needed to explore the benefits and challenges of adaptive lighting and provide further guidelines for its use, as well as the environmental and health effects of roadway lighting.

### 5. Original AASHTO Problem Statement Number

Problem No. 2017-G-20

### 6. Research Assignments to Date


### 7. Review Dates

6/30/2017
1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended

The objective of NCHRP Project 9-55 was to develop a design and evaluation procedure that provides acceptable performance of asphalt mixtures incorporating WMA technologies and RAS, with and without RAP, for project-specific service conditions. The research addressed the following key issues:

- Minimizing the risk of designing and producing mixes containing WMA technologies and RAS with poor constructability and durability.
- Minimizing the risk of designing and producing mixes containing WMA technologies and RAS that are susceptible to premature failure.
- Evaluating type, source, quality, and characteristics of RAS, with and without RAP.
- Binder design and selection, including evaluation of the composite binder.
- The current range of asphalt mix production temperatures.

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended

NCHRP Project 9-55 developed a proposed mixture design and evaluation method for WMA mixtures containing significant RAS contents (with or without RAP) through a series of laboratory and field experiments. Key support for the design and evaluation method came from evaluating the performance of five new-construction WMA field projects monitored from construction to times in service of 14 to 29 months; three existing WMA field projects were also monitored at times in service between 36 and 48 months. The RAS content of the eight projects ranged from 3% to 5%, and all incorporated RAP at contents ranging from 13% to 20%. All projects included an HMA control section.

The project concluded that using WMA with mixtures containing RAS does not appear to have a detrimental effect on their real-world performance. Indeed, some laboratory performance tests suggest that WMA/RAS mixtures will provide better long-term cracking resistance than corresponding HMA/RAS mixtures.

The satisfactory early performance of the field projects makes it challenging to validate the performance test criteria developed as mix design tools. To remedy this lack, the research team recommended longer-term monitoring—for five years or more—of the field sections. The objectives of the long-term monitoring will be to (1) confirm that using WMA with mixtures containing RAS is not detrimental to their performance, (2) better distinguish between the performance of HMA and WMA mixtures with RAS, and (3) compare the overall performance of WMA mixtures with RAS to that of WMA field projects without RAS measured in NCHRP Projects 09-47A, “Properties and Performance of Warm Mix Asphalt Technologies,” and 09-49A, “Performance of WMA Technologies: Stage II—Long-Term Field Performance.”
The project panel concurs with this recommendation and respectfully requests FY 2019 continuation funds of $200,000 to extend the monitoring of the in-service performance of the five new-construction projects to five years or more.

3. Funds (in thousands)

<table>
<thead>
<tr>
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<th>FY 2013</th>
<th>FY 2019</th>
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</thead>
<tbody>
<tr>
<td>AASHTO Initial Allocation</td>
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<td>Recommended Addition</td>
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4. Interpretation of AASHTO Problem Statement by Panel

The use of recycled asphalt shingles (RAS) in asphalt mixtures has increased dramatically since 2009 (approximately 0.7 million tons in 2009 and 1.2 million tons in 2010). Many states currently allow the use of RAS in their asphalt paving materials. This increased use of RAS in both manufactured (manufactured shingle scrap byproduct) and post-consumer (tear-off shingles from re-roofing operations) forms is largely a result of paving industry economics and society’s desire to recycle and conserve natural resources. The introduction of warm mix asphalt (WMA) provides additional opportunities to reduce energy consumption and emissions.

The materials supply and contracting industries are largely responsible for advancing the use of RAS. States have accepted the use of RAS in asphalt mixtures with limited engineering and performance data. Typical quantities of RAS used in asphalt mixtures range from 3 to 5 percent by weight of mix. Since RAS has a relatively high asphalt binder content (20 to 30 percent or more by weight of the shingle), the RAS binder replacement ratio ranges from 10 to 30 percent. Asphalt mixtures made with RAS often also contain recycled asphalt pavement (RAP).

Typically, RAS binders are much stiffer than paving grade asphalt binders. The performance of mixtures containing RAS, with and without RAP, has not been studied in detail on a nationwide scale, but there is concern that such mixtures may be subject to premature cracking in some instances and that the use of high RAS-content mixtures may cause placement (workability) and compaction problems during construction.

Since RAS binders have very high softening points, their use in asphalt mixtures incorporating WMA technologies could possibly result in incomplete blending of the RAS and virgin asphalt binders. Volumetric and engineering properties of asphalt mixtures containing both RAS and WMA technologies need to be measured at placement and after some in-service aging has occurred to determine the effect of RAS on mix design and performance. Performance of asphalt mixtures containing such composite binders is dependent on properties of the constitutive components. These properties likely change during time in service, both from aging of the composite binder as well as possible diffusion of the constitutive binders over time. Volumetric and engineering properties and performance data need to be obtained on a nationwide basis to update current AASHTO specifications for the use of RAS with WMA technologies.

5. Original AASHTO Problem Statement Number
Problem No. 2013-D-16

6. Research Assignments to Date
NCHRP Project 09-55, "Recycled Asphalt Shingles in Asphalt Mixtures with Warm Mix Asphalt Technologies"
7. Review Dates
PROBLEM EVALUATION FORM

Program: Fiscal Year 2010 & continuing

Review Date: November 3, 2017

Problem Area: Special Projects

Assigned to: TCRP Project Panel A-36 / NCHRP Project 20-59(49) Command-Level Decision Making for Transportation Emergency Managers

1. Problem Statement as Received from AASHTO

Problem has been jointly funded by TCRP A-36 and NCHRP 20-59 via 20-59(49).

2. Interpretation of AASHTO Problem Statement by Project Panel

Develop and deploy the Transportation Emergency Response Application (TERA) as a transportation-specific version of the Emergency Management Staff Trainer (EMST).

TERA is a transportation-specific version of the Emergency Management Staff Trainer (EMST). EMST is a robust training and exercise system developed with $4.2M in funding from National Guard Bureau and $2.7M from partner organizations, including:

- Federal Emergency Management Agency
- Indiana State Department of Health
- Technology Support Working Group
- U.S. Army Research Institute
- U.S. Centers for Disease Control
- U.S. Department of Homeland Security
- U.S. Naval Air Systems Command
- U.S. State Department

3. Research Assignment to Date

NCHRP Project 20-59(49), “Facilitation and Coaching Support for the 50 States Exercise” TCRP Project A-36, Command-Level Decision Making for Transportation Emergency Managers. The panel met on November 2-3, 2017, to observe use of TERA by the California DOT (Caltrans) and to discuss the path to deployment.

4. Funds

<table>
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<th>TCRP</th>
<th>NCHRP</th>
<th>NCHRP</th>
<th>ACRP</th>
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TCRP Total Funds Obligated: $590,000
ACRP Total Funds Obligated: $25,000
NCHRP Total Funds Obligated: $446,000
Combined Total Obligated: $1,061,000

Total Available: -0-
Recommended Addition: $360,000
5. **Anticipated Position when Funds Allocated have been Expended**

This panel has been active since 2010, working with a competitively-selected contractor, Engineering & Computer Simulations, Inc. (ECS), to develop the Transportation Emergency Response Application (TERA), which:

- Provides training and simulation exercises for command- and management-level of transit and state DOT emergency roles.
- Promotes active learning by using interactive simulations for each transportation domain.
- Allows for immediate use by agencies after half-day webinars or on-site demonstrations.
- Contains, when enhancements now underway are completed in May 2018, ten (10) training and exercise scenarios for transit and state DOT roles during emergencies, including:
  1. Active Shooter
  2. Computer Hack (Power Outage)
  3. Earthquake
  4. Hazardous Material
  5. Hurricane
  6. Flood
  7. Wildfire
  8. Bus used to injure pedestrians (Vehicle Ramming)
  9. Transit-impacted Contagious Disease
  10. Traffic Incident Management (TIM) Capstone

- Includes, when enhancements now underway are completed by December 2017, nine (9) airport training and exercise scenarios developed by the Airport Cooperative Research Program (ACRP), including:
  1. Bomb Threat
  2. Fuel Farm Fire
  3. Hazardous Materials
  4. Mass Casualty Incident
  5. Power Outage
  6. Sabotage
  7. Severe Storm
  8. Terminal Fire
  9. Water rescue

- Leverages findings and recommendations contained within *TCRP Web-Only Document 60 / NCHRP Web-Only Document 200: Command-Level Decision Making for Transit Emergency Managers*

- Includes
  1. TERA Orientation (slides)
  2. TERA Quick Reference Guide
  3. TERA Trainer Guide
  4. TERA User Guide
• **Free registration and use** for state DOT, transit, and airport emergency management personnel by visiting [www.tera.train-emst.com](http://www.tera.train-emst.com).

The initial focus of TERA was to improve training and exercising using transit emergency scenarios. After field testing of the TERA prototype, scenarios and other transportation agency roles were added using funding from the National Cooperative Highway Research Program. Since that time, webinars, half-day demonstrations, train-the-trainer, and scenario building workshops have been used to introduce transit and state DOT agencies to TERA. In FY14, agencies began using TERA for functional exercises. In 2017, TERA was utilized to exercise several airport emergency scenarios, which were developed under the Airport Cooperative Research Program on another platform and redeveloped recently on the TERA platform.

I. **Scope**

The objective for this continuation request is to add user outreach webinars and facilitated agency exercises to expand TERA use; ensure user feedback is factored into TERA maintenance and optimization activity; and to validate and optimize the initial six scenarios developed for transit and state DOT roles.

**TERA Optimization**

ECS will evaluate and prioritize feedback collected from TERA users during webinars and exercises to ensure optimal functionality and reliability for future users. Insofar as TERA represents a novel use of software and subject matter inputs used to enhance what for many agencies are still nascent emergency management programs, some modifications of system features, workflows, and the use of underlying information technologies are still needed to minimize user frustration and maximize the utility afforded TERA users.

**Scenario Validation**

With the help of carefully-selected subject matter experts for each relevant domain, ECS will engage transit agencies and state DOTs in rigorous validation testing of the 6 TERA scenarios initially developed under this project, while using current funding for validation testing of the 4 new TERA scenarios. A sister project has just completed validation of the 8 airport scenarios. Insofar as TERA software requires use of realistic, engaging and comprehensive scenarios to accomplish user training and exercise objectives, careful and extensive validation of scenarios are as important to system success as software optimization. With all 18 scenarios validated and TERA optimized, the program will be ready for deployment via webinars, other outreach presentations, and facilitated exercises.

**Webinars and Outreach**

ECS will expand the TERA user community by facilitating introductory webinars and other outreach opportunities for transit agencies, state DOTs, and airport operators interested in using TERA to accomplish more efficient emergency training and exercising. Webinars will directly
enable new user registration as well as provide participants with access to valuable emergency management training references and TERA tutorials.

**Facilitated Exercises**

ECS will facilitate onsite functional exercises for agencies that want to use TERA. Exercises serve to reinforce transit, state DOT, and airport use of TERA as a program enhancement tool. Facilitation of multi-agency exercises also serves to reinforce effective integration of transportation and other roles during emergency response.

**Panel Meetings & Reports**

ECS will participate in panel meetings, in-person or virtual, to discuss the progress of TERA implementation, including user demand; the results of scenario validation; and review of user feedback. Written reports submitted for panel approval will include updated user and facilitator guides that leverage what is learned through scenario validation activities and facilitated exercises.

**II. Budget**

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<th>Item</th>
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<th>Amount of Sessions</th>
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<td><strong>Webinars and Outreach</strong></td>
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<td>$10,600</td>
<td>Includes preparation of reports and updated user and facilitator guides.</td>
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<td><strong>Total Cost</strong></td>
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**PROBLEM EVALUATION FORM**

Program: Fiscal Year 2014  
Review Date: December 29, 2017

Problem Area: Special Projects

Assigned to: Project Panel SP20-59(53)

1. **Problem Statement as Received from AASHTO**
   
   Problem Statement on file.

2. **Interpretation of AASHTO Problem Statement by Project Panel**
   
   Flooding, and the effects and impacts of flooding along transportation corridors, has caused billions of dollars of damage and countless deaths. Technology currently exists to accurately pinpoint those areas along a transportation corridor that are susceptible to flooding. Many state DOTs have a bridge flood monitoring program for structures that are susceptible to bridge scour. Additionally, most state DOTs have inundation mapping and use inundation modeling in the design of their transportation infrastructure. Although there are weather and climate tools and systems available for predicting changes in the weather and climate conditions, they have not yet been integrated to provide sufficient planning and prediction information required by state DOTs to carry out flood planning, risk management, mitigation, operations, and emergency response activities. Research is needed to translate the available technologies into a suite of tools and methods for use by decision makers at DOTs. Such research is intended to support DOTs in their efforts to develop and deploy emergency management early warning systems that can be applied to flood prediction and warning for enhanced flood event decision making and situational awareness for transportation resilience by harnessing available processes, tools, and hydrometeorology network capabilities.

3. **Research Assignment to Date**
   

4. **Funds**

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<th>FY 2014</th>
<th>FY 2017</th>
<th>FY 2019</th>
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<tr>
<td>Less obligation</td>
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<tr>
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<td></td>
<td>$650,000</td>
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</table>
5. **Anticipated Position when Funds Allocated have been Expended**

The objectives of this research are to develop a strategic framework and a prototype tool for enhanced flood event decision making. The framework and tool should help state DOTs plan, manage risks, mitigate hazards, and respond to flood and flash flood events. The framework and tool should address not only immediate flood impacts, but also cascading, escalating impacts. Given the large amount and diversity of applicable data and tools, the framework design should be flexible and scalable to accommodate the available data sets and allow users to easily share both data and products with other users, thereby fostering collaboration across government organizations and the private sector.

A thorough gap analysis has been conducted on the methods, tools, and data integration needed to operationalize a decision support system that would enable state DOTs to effectively prepare, respond to, and recover from flood conditions. A prototype for a particular location (at the sub-state level) with coastal and riverine exposure has showcased a range of capabilities in the context of features and benefits for a mature FloodCast platform. A detailed requirements analysis for FloodCast, acknowledging the maturity model for state DOT capabilities, has developed specifications, data standards, and formats for the key data components of FloodCast. The panel and research team are coordinating with other entities to identify ways to accomplish the FloodCast vision.

6. **Anticipated Position when Funds Requested have been Expended**

Additional funds are requested in the proposed continuation, **FloodCast for Every DOT: Conversion of the National Water Model Results into Extent and Depth Products for State DOT Flood Forecasting, Response, and Recovery**.

FloodCast, the name coined by CalTrans for such a system, would inform road closures, support rerouting, and communicate timely, system information to both internal assets and the public at large, through standardized data sharing protocols and advances in water resources analytical tools. To support this urgently needed system, this research will convert National Water Model (NWM) results into an extent and depth product that can easily be ingested into state DOTs current decision making frameworks. In addition to a utility to produce usable NWM outputs, this work will include guidance in the form of a manual supplemented by training sessions with interested DOTs on the process for consuming and integrating this data into existing systems.

State DOTs do not need to abandon their existing decision-making systems or processes; this research would produce a utility for downloading NWM outputs and converting them into extent and depth products that could be easily ingested into any type of system. While NWM outputs for extent and depth for flooding can provide for statewide coverage for flooding of roadways, calibration processes benefitting from 2D (two dimensions) and 3D (three dimensions) digital construction plans and sensors network provides for a more robust engineering process. This enables enhancement and integration into the “business as usual” processes executed at transportation agencies. **A detailed problem statement is on the following pages.**
I. PROBLEM NUMBER

20-59(53)A

II. PROBLEM TITLE

FloodCast for Every DOT: Conversion of the National Water Model Results into Extent and Depth Products for State DOT Flood Forecasting, Response, and Recovery

III. RESEARCH PROBLEM STATEMENT

State Departments of Transportation (DOTs) have a critical need to better predict the timing and extent of flooding likely to occur at critical areas in advance of an approaching storm. While many DOTs are currently leveraging available data and technology to support flood event decision-making, a key data gap exists at locations along the stream network without monitoring gauges. The National Water Model (NWM), an experimental product developed by NOAA’s Office of Water Prediction (OWP), is poised to transform hydrologic prediction capabilities for streamflow. Expanding forecast locations from ~3,600 currently in operation to ~2.7 million nationwide, the NWM will provide access to predicted streamflow on a real-time basis. NWM products include hourly now-casts, short-range (15 hours) and medium-range (10 days) forecasts. A daily ensemble long range forecast to 30-days is also being produced.

Despite the NWM’s significant potential, several key challenges currently prohibit its use at the operational level required by a DOT. First and foremost, the NWM’s main output variable of use to DOTs is stream discharge, but this cannot be readily used for decision support in the current format produced by the NWM (e.g. streamflow forecasts). Instead, these variables need to be converted to either water depth and/or inundation extent. There is currently no agreed upon method for doing this conversion, which forms the first question this proposal seeks to address: how should one convert NWM streamflow data to water depth or inundation extent? Such a conversion would make NWM relevant and useful to DOTs for predicting likely flooding. Second, although the NWM results are presented at high resolution when compared to existing forecasts, it is yet to be validated. Also, it has been demonstrated that the NWM’s performance is not consistent across all areas. Thus, the second question we seek to answer is to determine the NWM’s area of applicability: where can NWM output can be used directly? Where does NWM need post-processing to yield actionable information? Where should the output not be used until further improvements are made?

Starting in 2016, the NCHRP FloodCast Research Team performed a requirements analysis to identify, from a State DOT perspective, the essential capabilities a flood forecasting and response platform should have to support State DOT response, recovery and mitigation activities. This analysis improves the likelihood that the FloodCast approach can be merged effectively into existing DOT activities. The Research Team reached out to a number of State DOTs across the country (see Figure 1) to capture a range of geographic regions with varying flood hazards and also
attempted to engage the appropriate DOT staff with job responsibilities related to flood forecasting, response, and recovery.

Figure 1: Participating State DOTs for the FloodCast Requirements Analysis.

With respect to capabilities, participants were asked a series of questions related to the five dimensions of flood forecasting (i.e., Meteorology, Hydrology & Hydraulics, Asset Management, Communication & Information Transfer, and Incident Management). This information helped the research team identify gaps, both within and between DOTs, by comparing critical flood forecasting system components DOTs already have to capabilities DOTs expressed they would like to have as part of a functional flood forecasting system. These gaps formed the basis of the effort to develop broad requirements (summarized in Table 1).

The FloodCast Research Team discovered that most DOTs maintain a flood emergency planning and response system. While these systems exhibit varying levels of sophistication, even the DOTs with the most advanced systems expressed the need for more efficient prediction of expected timing, magnitude, and location of flooding, as well as anticipated impacts on infrastructure, particularly for locations without monitoring gauges. A substantial enhancement to the existing DOT planning and response toolkit can be achieved by incorporating dynamic inundation mapping that allows for the rapid translation of NWM stream flow predictions of anticipated events to flood elevation, inundation extent, and flood depth products along the hydrologic network. These products will address a high-priority requirement expressed by DOTs across the U.S. during the NHCRP FloodCast requirements analysis: to better understand when, where, and how much flooding there will be in anticipation of an event. DOTs with operational flood forecasting systems or emergency response platforms can incorporate the flood extent and depth products to provide a refined flood risk analysis. For DOTs that do not have a flood forecasting system or flood event decision-framework, this work will significantly accelerate initial efforts to participate in operational flood forecasting.
<table>
<thead>
<tr>
<th>Flood Forecasting Dimension</th>
<th>Existing Capability Summary</th>
<th>Gap/Requirement</th>
</tr>
</thead>
</table>
| **Meteorology**             | • The majority of DOTs surveyed for this project actively consult predictive weather forecasts to prepare for flood events, most commonly from resources/alerts produced by NWS, NOAA, USGS, NHC, and FEMA.  
• Most agencies gather precipitation forecast data separately from each source every time they need an update rather than having one central system that stores all weather and hydrologic data in one place. | • A flood forecasting system that could serve as a centralized repository for flood forecasts to save time and improve situational awareness. |
| **Hydrology & Hydraulics**  | • Several DOTs use the National Flood Insurance Program’s (NFIP) National Flood Hazard Layer (NFHL) for 100-year and 500-year flood events or the NWS’s Advanced Hydrologic Prediction Service (AHPS) depth grids and extents for NWS-defined flood stages. However, it appears that most of this information is being used for long-term infrastructure planning decisions rather than predictive flood risk planning.  
• There are a few DOTs that use USGS rating curves (or similar regression equations) or the USGS StreamStats program to estimate inundation extent and depth predictions for ungauged locations. | • Dynamic inundation mapping (i.e. event-based) that allows for rapid translation of stream flow predictions to extent and depth predictions, especially accurate flood modeling at ungauged locations. In particular, multiple survey respondents expressed the need to answer the following key questions in advance of an event: When will it flood?; Where will it flood?; and How deep will flooding be? |
| **Asset Management**        | • Most DOTs have some sort of asset management system, but the majority of these databases are not complete, only show DOT-owned assets, are not in GIS format, do not include information about asset fragility and vulnerability to flood conditions, do not have or only have partial topology enforcement, and are missing asset elevation attributes. | • System should facilitate data asset data collection (i.e. field personnel could gather geo-located asset data), could easily update additions and changes to assets, and could interface with H&H data outputs to anticipate asset failure. |
| **Communications & Information Transfer** | • Many DOTs use dispatch lines or state 511 systems to communicate and deliver alerts about traffic incidents, closures, and detours. However, these alerts are rarely automated and occur during or post-event rather than delivering predictive information about potential flood risk pre-event.  
• The majority of existing communication platforms do not enable two-way communication with response crews.  
• Most DOTs do not follow, or are not aware of the Open Geospatial Consortium (OGS) guidelines for geospatial data dissemination for sharing data. | • One-click automated communication tools that can help streamline efforts for DOTs to get the word out internally, to partner agencies, to infrastructure owners, and the public are desirable.  
• The system should be structured to adhere to data standards and specifications so that DOT-collected data can be seamlessly transferred to external users such as partnering agencies and the public. |
| **Incident Management**     | • Many DOTs expressed that their agency has a good understanding of locations and assets that are prone to flooding; most of this information is among staff, as institutional knowledge (i.e. experts who have experience with multiple historical flood events), subject to loss. | • System should allow for rapid synthesis of flood event analytics to facilitate both active flood event response as well as assist with post-disaster recovery and reimbursement |
Several agencies maintain an incident tracking database in GIS format (extent of flood and location of impacted assets) with associated damage analytics (i.e. high water mark data, how long infrastructure was inundated, damage estimates, repair/cleanup activities, etc.).

IV. LITERATURE SEARCH SUMMARY

Relevant Literature:

- **NCHRP 20-59(53) FloodCast: A Framework for Enhanced Flood Event Decision Making for Transportation Resilience** – This project identified a number of existing and unmet DOT flood forecasting needs, one of which is floodplain depth and extent predictions at ungauged locations.

- **Transportation Infrastructure Flooding: Sensing Water Levels and Clearing and Rerouting Traffic out of Danger (Virginia Tech and the University of Virginia)** - This study adopts a multi-disciplinary approach (hydrology, regional climate and precipitation forecasting, and transportation engineering) to predict roadway flooding and mitigate travelers’ danger from the flood and delays. This project implements the Weather Research and Forecasting (WRF) Model at a local-level (City of Virginia Beach).

- **Real-Time Flood Forecasting and Monitoring System for Highway Overtopping in Iowa, TR-699** – The Iowa Flood Center has created a hydrologic model for the entire state which can incorporate real-time rainfall events and forecast resultant peak flows along any basin in the state of Iowa. This project aims to integrate the predicted flood discharge to a real-time warning system to notify maintenance staff before a highway overtops.

- **National Water Center Innovators Program Summer Institute Report 2016, Chapter 4: The Modified Hand Method** – Students at the National Water Center (NWC) modified the Height Above Nearest Drainage (HAND) method for enhanced flood inundation mapping. This work proposes to explore and test this method for producing flood extent and depth products consuming NWM outputs (see Task 1 below).

- **HAND Flood Mapping and National Water Model access through Tethys Platform** – this MS thesis performed by a student at Brigham Young University developed an online application that is run through the Tethys Platform that uses the HAND method for generating flood inundation maps. While the application is only available to a few case study locations and requires access to the Tethys software environment, this work offers an interesting area for further exploration and collaboration, especially during proposed Tasks 1 & 2 (described below).

V. RESEARCH OBJECTIVE

The objective of this research is to convert NWM results into an extent and depth product that can easily be ingested into state DOTs current decision making frameworks. In addition to a utility to produce usable NWM outputs, this work will include guidance in the form of a manual supplemented by training sessions with interested DOTs on the process for consuming and integrating this data into existing systems.

State DOTs do not need to abandon their existing decision-making systems or processes; this research would produce a utility for downloading NWM outputs and converting them into extent and depth products that could be easily ingested into any type of system. Because the NWM offers other outputs in addition to streamflow forecasts such as snow depth, soil moisture and
temperature, etc., the utility would be modular and allow users to ingest various types of usable outputs. Development of a utility to enable implementation of the NWM by DOTs requires several tasks to address the key challenges that currently prohibit its use at the operational level required by a DOT.

**TASKS**

1. **Depth & Extent Products**: Initial efforts for developing extent and depth products from the NWM have focused on experimental contiguous United States (CONUS)-scale Geographic Information System (GIS) solutions (e.g. the Height Above Nearest Drainage method (HAND/Modified HAND method), which have not been validated at the proposed scale or across varied physiographic environments (e.g. coastal plains, piedmont, valleys, plateaus, etc.). Another approach for developing depth and extent products includes adapting basin-scale models to translate flows to floodplain extents. The proposed research would identify the optimal methodology for translating NWM flow predictions to depth and extent products for transportation agencies and produce a utility that would implement this methodology.

2. **Validation**: The NWM is currently an experimental product and its utility in operations is not fully defined. Thus, there is a critical need for a more coordinated effort to expand and share validation results for locations that represent a variety of geographies across the United States, since the NWM is likely to have varying performance based on local conditions. The main research objectives of the validation component are:
   - Establish a set of encompassing validation statistics with a focus on areas critical for an individual DOT;
   - Look at the business as usual of digital designs for elevation profiles and flooding systems (network of flooding sensors) to establish a ground truth process;
   - Identify areas where the NWM performs well enough to be used operationally by a DOT; this will include an assessment of:
     - Timing accuracy;
     - Peak flow magnitude;
     - Threshold exceedance (e.g. using known flood stage levels);
     - Location;
   - Flag areas where performance is poor, and if possible, identify what is causing the underperformance.

     - Since the NWM is made up of many sub-components such as rainfall, runoff, and routing models, it may be possible to quantify each component’s performance and possibly recommend tangible alternatives;
     - Have field surveys, water systems, and engineering designs checked against NWM parameters.

The outcome of the validation effort will be a “masking” layer that can overlaid on NWM guidance to quickly inform DOTs how guidance has historically performed as a function of location. For example, in regions where issues have been noted during past flooding situations, a “caution” flag will be displayed.
3. **Case Studies:** Due to the episodic nature of flooding, aggregate statistics such as correlation, mean error, or bias, as will be explored through Task 2 Validation, may not provide a fully complete picture of NWM performance. A complementary approach is to perform case studies. It is proposed that several flooding events typologies (isolated flash flooding, large-scale flooding such as with a tropical cyclone, mud flows/debris slides, etc.) be analyzed in close concert with one or more individual state DOTs. Through the NCHRP FloodCast project, state DOTs representing a diversity of geographies and a wide spectrum of flood forecasting capabilities were identified. This research would leverage these existing relationships to perform case studies. A secondary benefit of a case study approach is the ability to learn about which output methods serve most optimally in a DOT’s decision support system. For example, traditionally, a binary (yes/no) type forecast output has been used to answer whether a location will be flooded or not at some point in the future. The NWM allows for a more advanced forecast based on probabilities. One example of how probability-based forecasts are superior to binary forecasts is in a situation where many areas are forecasted to flood. Given a DOT’s finite set of resources, it may be desirable to know where the probability of impact is highest in order to ensure the best use of resources.

4. **Basic Application:** Additionally, guidance on how to easily create a basic flood forecasting and response application will be produced. For example, many DOTs maintain GIS-based asset management database. The depth and extent product could be consumed and analyzed against critical asset data to enable DOTs to identify vulnerable infrastructure in advance of the onset of the event. The guidance manual would also include instruction on how and when to deliver flood warning notifications based on proximity of the asset to the predicted floodplain. The guidance component of this research will not only better enable DOTs to understand how to interact with the utility described earlier, but will also increase the likelihood of integration of useful NWM products into their daily operations to improve flood forecasting, response, and recovery.

VI. **ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD**

**Recommended Funding:** $650,000

**Research Period:** 24 months

VII. **URGENCY AND POTENTIAL BENEFITS**

Transportation agencies play a critical emergency management function in advance, during, and after flood events because of their ability to move emergency relief personnel and commodities, mitigate adverse economic impacts, and sustain transportation services. This research addresses a critical need to better predict the timing and magnitude of flooding to enable transportation agencies to issue advanced early-warnings to reduce transportation-related deaths and expensive damage to critical assets. The NWM offers a promising solution for improved forecasting of flood impacts, but there is a need for guidance to be developed to inform how the outputs of the NWM can be leveraged in a useful way to enhance DOT flood-event decision making. The research team believes that a State DOT can serve as an optimal practitioner to bring support implementation of the NWM into operations. Furthermore, mutual benefits are foreseen: the DOTs feedback can help improve the NWM in an iterative-like fashion, while the
DOTs will receive a state-of-the-art flood forecasting system to increase warning time, better hone in on timing and location, and ultimately reduce flood-related casualties and damage.

An additional benefit includes the potential for this work to be utilized by a wider audience. For example, some states or localities maintain private software systems that monitor threats to particular assets, such as scour potential for bridges and culvert crossings. Other widely used platforms that support flood response include the Federal Emergency Management Agency (FEMA) Integrated Public Alert and Warning System (IPAWS), Road Weather Information Systems (RWIS), state 511 websites, the Waze traffic app, and geospatial applications such as Google Earth or ArcGIS Online. Usable NWM outputs will integrate well with these existing platforms, providing an enhancement to flood forecasting and response capabilities across all systems. The extent and depth products generated by this work can also support emergency management applications outside of the transportation network, such as planning for impacts to critical infrastructure such as hospitals and power substations. Statewide coverage and cost-effective solutions (or less costly solutions than traditional processes) can fill the gaps for high quality, data-driven decision-making.

VIII. IMPLEMENTATION PLANNING

A. The target audience of this research will be DOT leadership and personnel who are responsible for flood response, recovery, and mitigation efforts within their agency.

B. The emergency management community, especially emergency managers who partner/coordinate with DOTs during a flood event, would be the key decision makers who would be able to champion implementation of the research products.

C. Early adopters of this research would be DOTs involved in the case studies in support of this research, as well as other DOTs that are willing to experiment with integrating the research products into their flood event decision-making process.

D. Potential institutional or political barriers would include the following:
   • Intensive data mining effort of archiving NWM outputs
   • Availability of DOT personnel to participate in case studies

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

The problem statement was developed by:
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- Caroline Whitehead, Dewberry, Senior Environmental Program Specialist, 703-849-0131, cwhitehead@Dewberry.com

X. AASHTO MONITOR
Not applicable

XI. SUBMITTED BY

Panel co-chairs:

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Mailing Address: P.O. Box 942873
Sacramento, CA 94273-0001
916/417-6994
Continuation Request
Project 20-102, FY 2019
Impacts of Connected Vehicles and Automated Vehicles on State and Local Transportation Agencies

Present Expiration Date: N/A
Recommended Allocation: $1,500,000

1. Anticipated Accomplishment(s) When Funds Allocated Have Been Expended
NCHRP Project 20-24(98) developed a research roadmap addressing the policy, planning, and implementation issues associated with connected vehicles (CV) and automated vehicles (AV) that state and local transportation agencies will face (available at http://bit.ly/TRBCVAV).

The NCHRP 20-102 Panel is responsible for deciding which tasks will be undertaken using the funds at their disposal based upon the research roadmap and developments in the public and private sectors. Tasks currently underway are listed below in Item #6. These decisions have been influenced by input from, among others:
- U.S. Department of Transportation (including ITS JPO, FHWA, and NHTSA)
- Connected Vehicle Pooled Fund Study
- V2I Deployment Coalition, an AASHTO led group supporting implementation of standards and guidance for vehicle to infrastructure (V2I) technologies, including CV technologies
- Crash Avoidance Metrics Partnership (CAMP), a group of vehicle manufacturer representatives that collaborates on pre-competitive crash avoidance research projects of mutual interest
- Various AASHTO and TRB Standing Committees
- Conference of European Directors of Roads
- Presentations and discussions at the Automated Vehicle Symposia

2. Anticipated Accomplishment(s) When Funds Requested Have Been Expended
The requested funds will be used to carry out additional tasks, likely drawing from the research roadmap. The roadmap will be updated through Task 19 to reflect changing conditions since its development in 2014.

3. Funds (in thousands)

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*$650k programmed directly by SCOR as Task 15
4. Interpretation of AASHTO Problem Statement by Panel

Connected vehicle technologies are being developed to enable safe, interoperable networked wireless communications among vehicles (V2V), the infrastructure (V2I), and travelers’ personal communication devices (V2X). These technologies are intended to reduce highway crashes; provide data for assessing the performance of the transportation system; provide continual access to accurate information on the operation of the system to travelers; and reduce unnecessary stops, delays, and emissions.

Automated vehicle technologies are also under development that will significantly change fundamental planning, design, and operational characteristics for the road network. Some industry leaders expect that Level 4 vehicle automation (under NHTSA and SAE definitions) will be available on the market by 2018. Fully autonomous, driverless vehicles (SAE Level 5 automation) could be on the market by 2025.

For Level 5 automation, “the vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip.” (NHTSA, Preliminary Statement of Policy Concerning Automated Vehicles) Level 4 automation is essentially the same as Level 5, without any driver supervision (e.g., there is no expectation that the driver will be engaged), over a limited driving domain. These vehicles may be safer than current models.

Connected vehicles and automated vehicles are essentially different technologies, though some of the challenges they present to transportation agencies will be similar. These two technologies may converge or diverge from each other based largely on developments in the private sector (e.g., vehicle manufacturers, third-party vendors). While some actors envision a completely autonomous vehicle that does not require communication with other entities, others see serendipities between the two technologies. This project will address both technologies (including the combination) under the umbrella term of CV/AV. The individual tasks that compose the project will clearly identify which technologies are to be addressed.

5. Original AASHTO Problem Statement Number

Problem No. 2015-G-30
6. Research Assignment to Date
NCHRP Project 20-102, Impacts of Connected/Automated Vehicles on State and Local Transportation Agencies.

Publications (Completed Tasks)

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<td>1</td>
<td>Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies</td>
<td>$400k</td>
<td>Report 845</td>
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<td>2</td>
<td>Impacts of Laws and Regulations on CV and AV Technology Introduction in Transit Operations</td>
<td>$150k</td>
<td>Web-Only Doc 239</td>
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<td>3</td>
<td>Challenges to CV and AV Applications in Truck Freight Operations</td>
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Active Tasks

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<td>4</td>
<td>Evaluation Guidance for AV Pilot and Demonstration Projects (incorporated into NCHRP 08-116)</td>
<td>$75k</td>
<td>2019 Q2</td>
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<td>5</td>
<td>Strategic Communications Plan for NCHRP 20-102</td>
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<td>2018 Q4</td>
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<td>6</td>
<td>Road Markings for Automated Vehicles (Phase I results available in 2018 Q1)</td>
<td>$400k</td>
<td>2018 Q4</td>
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<td>7</td>
<td>Implications of Automation for Motor Vehicle Codes</td>
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<td>8</td>
<td>Providing Support to the Introduction of CV/AV Impacts into Regional Transportation Planning and Modeling Tools</td>
<td>$300k</td>
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<td>9</td>
<td>Cybersecurity Implications of CV/AV Technologies on State and Local Transportation Agencies (incorporated into NCHRP 03-127)</td>
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<td>Summary of Existing Studies on the Effects of CV/AV on Travel Demand</td>
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<td>11</td>
<td>Business Models to Facilitate Deployment of CV Infrastructure to Support AV Operations</td>
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<td>Planning Data Needs and Collection Techniques for CV/AV Applications</td>
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<td>13</td>
<td>Data Management Strategies for CV/AV Applications for Operations</td>
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<td>Understanding the Impacts of the Physical Highway Infrastructure Caused by the Increased Prevalence of Advanced Vehicle Technologies</td>
<td>$650k</td>
<td>2020 Q2</td>
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<td>15</td>
<td>Preparing TIM Responders for Connected Vehicles and Automated Vehicles</td>
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<td>16</td>
<td>Deployment Guidance for CV Applications in the Open Source Application Development Portal</td>
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<td>17</td>
<td>Minimum Safety Data Needed for Automated Vehicle Operations and Crash Analysis</td>
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<td>18</td>
<td>Update AASHTO’s Connected Vehicle/ Automated Vehicle Research Roadmap</td>
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* An additional $200,000 has been added to Task 11 to address other transformational technologies.

7. Review Dates
Part II

NEW PROBLEMS
## FY 2019 CANDIDATES FOR FUNDING AS NEW PROBLEMS
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<td>Workforce 2030: Recruiting and Training the Next Generation Transportation Construction Workforce ($500,000 - $600,000 – 36 months)</td>
<td>AASHTO Committee on Construction</td>
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<td>2019-A-02</td>
<td>Managing the Effects of Uncertain Federal Funding ($ 400,000 – 18 months)</td>
<td>AASHTO Committee on Funding and Finance/South Dakota DOT</td>
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<td>2019-A-03</td>
<td>Assessing Practices for Right of Way Acquisition and Reimbursement in Utility Relocations ($ 300,000 – 18 months)</td>
<td>AASHTO Committee on Right of Way, Utilities and Outdoor Advertising Control</td>
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<td>2019-A-04</td>
<td>Managing Utility Facilities Taken Out of Service (OOS) within Public Right of Way ($ 300,000 – 18 months)</td>
<td>Wyoming DOT</td>
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<td>2019-A-05</td>
<td>Flash Tracking for Accelerated Project Delivery ($ 560,000 – 30 months)</td>
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<td>2019-A-06</td>
<td>Implementation of Programmatic Life Cycle Cost Analysis in a Transportation Asset Management Framework ($ 350,000 – 24 months)</td>
<td>AASHTO Committee on Performance-Based Management</td>
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<td>2019-A-07</td>
<td>Organizational and Cultural Factors for Successful Transportation Asset Management Integration ($ 270,000 – 15 months)</td>
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<td>2019-A-08</td>
<td>Risk Assessment Techniques for Transportation Asset Management ($ 600,000 – 18 months)</td>
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<td>2019-A-09</td>
<td>Making Targets Matter: Effective Practices by Transportation Agencies to Establish, Monitor and Adjust Performance Targets ($ 650,000 – 24 months)</td>
<td>AASHTO Committee on Performance-Based Management</td>
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<td>2019-A-10</td>
<td>A New Tool Assessing the Value of Resiliency Alternatives by State DOTs ($ 500,000 – 24 months)</td>
<td>AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM)</td>
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<td>2019-A-11</td>
<td>Building a Resilient Work Force in State DOTs ($ 350,000 – 24 months)</td>
<td>AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM)</td>
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<td>2019-A-12</td>
<td>Deploying Transportation Security Practices in State DOTs ($ 750,000 – 24 months)</td>
<td>AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM)</td>
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<td>Improving Data and Information Sharing for Collaborative Regional Operations and Traveler Information ($ 600,000 – 18 months)</td>
<td>AASHTO Committee on Transportation Systems Operations</td>
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<td>2019-A-14</td>
<td>Strategies for Incorporating Resilience into Transportation Networks ($ 600,000 – 24 months)</td>
<td>AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM)</td>
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<td>2019-B-01</td>
<td>Tool and Guidebook to Identify Commercial Delivery Parking Needs for Loading and Unloading in Metropolitan Areas ($ 450,000 – 24 months)</td>
<td>Texas/Kansas</td>
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**B – Transportation Planning**
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<td>2019-B-04</td>
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<td>2019-B-06</td>
<td>Measuring Economic Benefits and Costs for the Inclusion of Sustainable Elements on Aging Transportation Systems ($450,000 – 24 months)</td>
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<td>2019-B-07</td>
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<td>Quantifying and Estimating VMT Reduction from Transportation Demand Management Mesures in Rural Communities ($300,000 – 18 months)</td>
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<td>2019-B-09</td>
<td>Sources of Zinc in Highway Runoff ($750,000 – 48 months)</td>
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<td>2019-B-10</td>
<td>Innovative Mitigation Strategies for Highway Noise ($250,000 – 24 months)</td>
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<td>Census Transportation Data Use and Application Field Guide ($375,000 – 18 months)</td>
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<td>Developing Data Standards and Guidance for Transportation Planning and Traffic Operations - Phase 1 ($ 500,000 – 24 months)</td>
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<td>2019-B-14</td>
<td>Best Practices Guide for State Department of Transportation and Economic Development Collaboration on Site Selection ($ 280,000 – 16 months)</td>
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<td>Development of Programmatic Agreements for Project-level Particulate Matter &quot;Hot-Spot&quot; Air Quality Analyses ($ 300,000 – 24 months)</td>
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<td>Methodology for Analyzing Noise and Vibration Impacts on Different Terrestrial Species ($ 249,000 – 24 months)</td>
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<td>Post-World War II Commercial Properties and Transportation Project Development: Historic Context and National Guidance on Evaluation of National Register of Historic Places Eligibility ($ 295,000 – 35 months)</td>
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<tr>
<td>2019-B-20</td>
<td>Watershed Approach to Mitigating Hydrologic Impacts of Highway Projects ($ 500,000 – 36 months)</td>
<td>AASHTO Committee on Environment and Sustainability (formerly SCOE)</td>
<td>B-20/1</td>
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<tr>
<td>2019-C-01</td>
<td>Managing Speed: Self-Enforcing Roadways for Two Lane Rural Highway ($ 900,000 – 36 months)</td>
<td>Federal Highway Administration C-01/1</td>
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<td>2019-C-02</td>
<td>Access Control Techniques to Reduce Wrong-Way Entries from Freeway Exit Ramps ($ 450,000 – 24 months)</td>
<td>New Jersey/Virginia DOTs C-02/1</td>
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<tr>
<td>2019-C-03</td>
<td>Design Specifications for the Static and Seismic Design of Piles for Downdrag ($ 500,000 – 36 months)</td>
<td>AASHTO Committee on Bridges and Structures C-03/1</td>
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<td>2019-C-04</td>
<td>Deceleration Rates for Design and Arterial Access Management ($ 750,000 – 30 months)</td>
<td>Virginia/New Jersey DOTs C-04/1</td>
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<td>2019-C-05</td>
<td>Highway Capacity Manual Methodologies for Analyzing Freeway Merging and Diverging Bottlenecks Considering Different Geometrics Characteristics and Mitigation Strategies ($ 500,000 – 30 months)</td>
<td>California/Texas DOTs C-05/1</td>
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<td>2019-C-06</td>
<td>Strategic Plan Development for Improvement of Roadside Safety Computer Simulation ($ 200,000 – 24 months)</td>
<td>Wisconsin DOT C-06/1</td>
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<tr>
<td>2019-C-07</td>
<td>Developing Endurance Characterization Curves for GFRP Reinforcing Bars ($ 400,000 – 36 months)</td>
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<tr>
<td>2019-C-08</td>
<td>Defining Geotechnical Test and Performance Data for Asset Management and Accelerated Design Benefits ($ 200,000 - $300,000 – 24 months)</td>
<td>AASHTO Committee on Materials C-08/1</td>
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<tr>
<td>2019-C-09</td>
<td>An Update of the Green Book Design Vehicles and Minimum Turning Paths ($ 400,000 – 30 months)</td>
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<tr>
<td>2019-C-10</td>
<td>Determination of Encroachment Conditions in Work Zones</td>
<td>AASHTO Committee on Design - Technical Committee on Roadside Safety</td>
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<td>($ 500,000 – 36 months)</td>
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<td>2019-C-11</td>
<td>Development of a Barrier Design to Accommodate Vehicles, Pedestrians, and Cyclists</td>
<td>AASHTO Committee on Design - Technical Committee on Roadside Safety</td>
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<td>($ 500,000- 24 months)</td>
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<td>2019-C-12</td>
<td>Development of MASH TL-3 Deflection Reduction Guidance for 31-inch Guardrail</td>
<td>AASHTO Committee on Design - Technical Committee on Roadside Safety</td>
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<td>2019-C-13</td>
<td>Guardrail Performance at Various Offsets from Curb for MASH TL-3 Applications</td>
<td>AASHTO Committee on Design - Technical Committee on Roadside Safety</td>
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<td>($ 600,000 – 36 months)</td>
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<td>2019-C-14</td>
<td>Validation of Roadside Crash Injury Metrics in Real World Crashes (Correlation of Actual Injury Outcomes to Those Predicted During Crash Testing)</td>
<td>AASHTO Committee on Design - Technical Committee on Roadside Safety</td>
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<td>Highway Network Alternatives to Determining High Stress Pavement Safety Hotspots</td>
<td>Texas DOT</td>
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<td>($ 350,000 – 24-26 months)</td>
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<tr>
<td>2019-C-16</td>
<td>Surface Property Data Requirements for AASHTO's Highway Safety Manual</td>
<td>Texas DOT</td>
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<td>($ 250,000 – 12-18 months)</td>
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<td>2019-C-17</td>
<td>Wrong-Way Driving (WWD) Solutions, Policy and Guidance</td>
<td>Idaho Transportation Department</td>
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<td>($ 600,000 – 36 months)</td>
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<td>2019-C-18</td>
<td>Submittal and Review Process of Roadside Safety Products for Inclusion on State DOT Qualified Products Lists (QPL)</td>
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<td>($ 150,000 – 24 months)</td>
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<tr>
<td>2019-C-19</td>
<td>Assessing the Impacts of Connected, Automated and Autonomous Vehicles on the Future of Transportation Safety ($ 450,000 – 18 months)</td>
<td>AASHTO Committee on Safety</td>
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<tr>
<td>2019-C-20</td>
<td>Assessing the Impacts of Turn Lanes in Different Contexts and Modal Considerations to Increase Safety Performance ($ 650,000 – 24 months)</td>
<td>AASHTO Committee on Safety</td>
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<tr>
<td>2019-C-21</td>
<td>Developing Safety Performance Functions for Rural Two-Lane Highways that Incorporate Speed Measures ($ 500,000 – 36 months)</td>
<td>AASHTO Committee on Safety /Washington DOT</td>
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<tr>
<td>2019-C-22</td>
<td>Updating Safety Performance Functions for Data-Driven Safety Analysis ($ 500,000 – 24 months)</td>
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**D – Materials and Construction**

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<td>Corrosion Rates for Uncoated Weathering Steel Bridges ($ 1,000,000 – 36 months)</td>
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<td>2019-D-02</td>
<td>Developing High Strength Corrosion Resistant Steel Strnds for Prestressing ($ 600,000 – 36 months)</td>
<td>AASHTO Committee on Bridges and Structures</td>
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<tr>
<td>2019-D-03</td>
<td>Effective Use of Duplex Coating Systems to improved Steel Bridge Structure Durability ($ 500,000 – 36 months)</td>
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<td>2019-D-04</td>
<td>Updating Load and Resistance Factors for the AASHTO LRFD Bridge Design Specifications ($ 425,000 – 36 months)</td>
<td>AASHTO Committee on Bridges and Structures</td>
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<tr>
<td>2019-D-05</td>
<td>Development of a Pavement Surface Image Library for the Evaluation of Image Processing Algorithms for Automated Pavement Condition Survey ($ 400,000 – 24 months)</td>
<td>California DOT</td>
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<td>2019-D-06</td>
<td>Guidelines for Using Sacrificial Coatings to Protect Equipment Assets From Corrosion ($ 400,000 – 36 months)</td>
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<td>2019-D-07</td>
<td>Rubberized Hot Mix Asphalt vs Hot Mix Asphalt Lifespan Study - A Mechanistic Empirical Study ($ 400,000 – 24 months)</td>
<td>California DOT</td>
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<td>2019-D-08</td>
<td>Update to AASHTO M180 and Associated Material Specifications ($ 300,000 - $ 200,000 – 24 months)</td>
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<tr>
<td>2019-D-09</td>
<td>A Guidebook for Risk-Based Construction Inspection ($ 400,000 - $500,000 – 30 months)</td>
<td>AASHTO Committee on Construction</td>
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<td>2019-D-10</td>
<td>Structural Design and Analysis of Post-Tensioned Concrete Structures with Flexible Fillers ($ 600,000 – 36 months)</td>
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<td>2019-D-11</td>
<td>Benchmarking Accelerated Laboratory Tests for ASR to Field Performance: Consideration of Cement and Alkali Contents and Influence of SCMs ($ 650,000 – 39 months)</td>
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<td>2019-D-13</td>
<td>Evaluating Use of Unconventional Fly Ash Sources in Highway Concrete ($ 400,000 – 30 months)</td>
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<td>2019-D-14</td>
<td>Rating Concrete Permeability Based on Resistivity Measurements ($ 500,000 – 30 months)</td>
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<td>2019-D-15</td>
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<td>2019-D-17</td>
<td>Development of a Practitioners Handbook for Noise Wall Inspection Procedures During and Post Construction ($150,000 – 24 months)</td>
<td>AASHTO Noise Work Group (ADC40)</td>
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<td>2019-D-18</td>
<td>Statistical Inspection Procedures for Transportation Projects ($350,000 – 24 months)</td>
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<td>2019-D-19</td>
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<td>2019-D-20</td>
<td>Use of Fibers in Asphalt Concrete to Enhance Material Performance ($500,000 – 36 months)</td>
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<td>Development of a National Performance-Related Specification for Emulsified Asphalt Binder ($950,000 – 42 months)</td>
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**E - Soils and Geology**

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<td>Develop Guidelines for Estimating the Spatial Variability of Scour around Bridge Foundations ($500,000 – 36 months)</td>
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<td>Mitigation of Pressure Flow Scour by Improving the Hydrodynamic Conditions at the Upstream of the Bridge Superstructure ($500,000 – 36 months)</td>
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<td>Development of High-Quality Databases of Deep Foundations Load Tests ($400,000 – 30 months)</td>
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<td>2019-E-06</td>
<td>Deterioration Rates and Unit Costs for Geotechnical Assets ($300,000 – 24-36 months)</td>
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**F – Maintenance**

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<td>Determining Pavement Preservation Treatment Lives and Related Pavement Life Extension ($350,000 – 30 months)</td>
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<td>2019-F-03</td>
<td>Determining State DOT Maintenance Program Implications of Connected and Automated Vehicles (CAV) ($300,000 – 24 months)</td>
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<td>2019-F-04</td>
<td>Guideline for Decision Making for Repair vs. Replacement of Highway Maintenance Equipment ($350,000 – 24 months)</td>
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<td>2019-F-05</td>
<td>Update the AASHTO Guide for Snow and Ice Control ($225,000 – 36 months)</td>
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**G – Traffic**

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<td>Assessing Pedestrian Crashes on the Freeway System: Analysis and Prevention ($250,000 – 24 months)</td>
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<td>2019-G-03</td>
<td>Evaluating the Performance of Right-Turn-On-Red Operation at Signalized Intersections (With Single and Dual Right-Turn Lanes) ($300,000 – 18 months)</td>
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<td>2019-G-04</td>
<td>Holistic Analysis of Detection and Controller Operations at Signalized Intersections ($600,000 – 24 months)</td>
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<td>2019-G-05</td>
<td>Tactile Walking Surface Indicators to Aid Wayfinding For Visually Impaired Travelers In Multimodal Travel ($ 600,000 – 36 months)</td>
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<td>2019-G-07</td>
<td>Algorithms to Convert Basic Safety Messages into Traffic Measures ($ 400,000 – 24 months)</td>
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Research Field A

ADMINISTRATION
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-A-01

II. PROBLEM TITLE

Workforce 2030: Recruiting and Training the Next Transportation Construction Workforce

III. RESEARCH PROBLEM STATEMENT

The U.S. DOT spends $51 billion annually on construction, repair, and operation of our Nation’s public transportation systems—a significant investment benefitting multiple dimensions of society. Every $1B invested in the transportation infrastructure produces 13,000 jobs across multiple industry sectors (US Dept. of Education, US Dept. of Transportation, and US Dept. of Labor, 2015). Much of this investment is in highways and bridges developed, constructed and maintained through state transportation agencies (STA). An increasing challenge is the availability of the construction and maintenance workforce within the agencies to keep pace with the annual $51 billion expenditures; agencies will need over 550,000 new staff within their construction and maintenance programs. However, due to current and anticipated budgeting challenges, STA will likely be working with a smaller workforce, and many new workers will require significant training to meet present and future demands.

The need for this research aligns with the objectives of the Environmental, Safety, and Workforce Section within the AASHTO Subcommittee on Construction. An in-depth discussion took place on several occasions on the topic of workforce issues and workforce development at the AASHTO Subcommittee on Construction Annual Meeting in August 2017 with the result the development of this much-needed problem statement.

IV. LITERATURE SEARCH SUMMARY

To manage the dynamics of meeting tomorrow’s construction and maintenance demands with a smaller workforce, STAs need robust workforce management programs that can attract and train engineers, technicians, and maintenance workers needed to maintain the U.S. highway infrastructure. The workforce shortage among state transportation agencies has evolved over time. This research recognizes that the challenges can be overcome with a single research effort like this. By starting to address the challenges in recruitment and training, Workforce 2030 is envisioned to be the first step on the pathway for rebuilding the workforce by identifying future research needs.

While the shortage of a transportation construction workforce runs parallel to workforce shortages in other industries, state transportation agencies face unique challenges that must be addressed in the research. In general, transportation agencies are unable to offer employees the same pay scales and benefits as private companies. Also, many public agencies struggle to maintain technical career paths that reward and support the development and retention of staff with valuable specific skill areas. The demand of transportation construction, reconstruction, and maintenance work is increasing, so the demand for quality personnel throughout the industry is critical.

Research should address the following questions:

- What are the best practices employed by transportation agencies and private organizations to recruit qualified employees?
- What are career pathways used by industry to recruit the next workforce generation?
- How are projected advances in associated technologies and career functions changing career pathways in transportation construction fields?
• What policy changes in the nation’s secondary and post-secondary education system are needed to provide a more qualified workforce?
• What types of training frameworks will allow state transportation agencies to develop the future workforce?

V. RESEARCH OBJECTIVE

The research is intended to address two primary research goals:
1) Produce a 'roadmap' of the current workforce development system for STAs and identify critical areas for improvement to attract both the quantity and quality of individuals needed to increase representation of the next generation among the state transportation construction workforce; and
2) Identify the policy and training framework to allow state transportation agency to develop the process for moving the workforce into the 2030 competency level.

The research objective will be achieved through the completion of research tasks to be described by the research team that best addresses the research questions and goals.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:
Recommended funding for the project is $500,000 to $600,000

Research Period:
It is estimated that 36 months will be required to perform the research.

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

The U.S. transportation system was historically the envy of most other countries, from its construction of the transcontinental railroad to the interstate highway system. Somewhere along the way, we have allowed our nation’s transportation system to slip; the quality of our roads is now rated 16th in the world. All future transportation innovations hinge on the assumption that a qualified workforce will be there to build and maintain our infrastructure. Reversing the workforce shortages requires new investment and innovations as well as a new workforce. The research described here develops the medium for growth to occur.

VIII. PERSON(S) DEVELOPING THE PROBLEM

Paul Goodrum, PhD – University of Colorado Boulder
Tim Taylor, PhD, PE – University of Kentucky
Roy Sturgill, PE – Kentucky Transportation Center

IX. PROBLEM MONITOR

The TRB Standing Committee on Construction Management (AFH10) is submitting this problem statement through the sponsorship of the AASHTO Subcommittee on Construction.

X. SUBMITTED BY

AASHTO Subcommittee on Construction:
Rob Wight
State Construction and Materials Director
Utah Department of Transportation
801-965-4111
rwight@utah.gov
NCHRP Review of A-01

Reviewed By: Camille Crichton-Sumners ccrichton-sumners@nas.edu

Comments: State transportation agencies must address this at the local level due to heterogeneity of laws, organizational structures, and governance. It may, however, be helpful to have a global perspective to help develop a framework for addressing the varied challenges and provide guidance to states agencies on addressing the changing workforce needs. This could be accomplished under this effort. An additional research question to consider should be: “What are the implications for P.E. licensure of state transportation employees as the workforce skill set changes?” The suggested duration is suitable given the need to collect data from state transportation agencies; however, the objective can likely be accomplished for 450K.

Review Date: 11/28/17

FHWA Evaluation of A-01

Clark Martin/HIN - Industry data indicates tremendous challenge to develop a skilled highway construction industry. A better understanding of efforts to recruit and train the next generation of the highway construction workforce will help with investment of funding, training, and workforce development resources. John McAvoy/HIPA-20; Francine Shaw Whitson/HIF-1 - It's possible that the problem statement is UNDERSTATING the problem. We recommend looking at Synthesis Topic 49-10, Transportation Workforce Planning and Development Strategies Final Scope, which has a similar focus to this proposed research. Good topic, yet the maintenance industry is mentioned, it is not clear if this would be included as part of the study's focus. Encourage project team to include the maintenance industry as well. Katherine Petros/HRDI-20 - Construction workforce shortages have been a continuing hot topic at the AASHTO Subcommittee on Construction. While this problem statement is focused on State highway agency personnel, the issues of attracting and retaining qualified personnel are also experienced by highway contractors. There is an opportunity to showcase highway construction is moving into the digital age with 3D models, automated machine guidance, e-construction, etc as a means of attracting the next generation construction workforce.

AASHTO Committee Evaluation for A-01

Workforce 2030: Recruiting and Training the Next Generation Transportation Construction Workforce
Submitted By:
Evan Rothblatt
Liaison
COC

Comments:
AASHTO Construction Committee number 3 ranked RPS

Submitted By:
Evan Rothblatt
Liaison
CRUO

Comments:
Ranked 3rd choice for Committee on Right of Way, Utilities, and Outdoor Advertising Control. Comments: Recruiting, Retaining, and Training is State DOTs’ #1 Challenge. Institutional knowledge is leaving, and will leave, DOTs’ have to replace this knowledge. Sometimes DOTs can be our own worst enemy. Appraisal is one of these areas, as they have to be "sponsored." Why would DOT appraisers sponsor their competition. Expending resources to train, then the talent leaves to get paid more in the private sector. Do we need to change our work models? Managing the 40 hour work week, or managing product delivery.

Submitted By:
Clarisse Coble
Liaison
Human Resources

Comments:
• Overall comment – The problem described here spans the entire transportation industry. I commend Construction on putting this problem statement together and hope this research can expand to other STA disciplines that are facing similar challenges. Perhaps this is the first of a series of research projects? OR – should we have one mega research project? OR – should we have multiple concurrent research projects happening?
  • Overall comment – the AASHTO HR subcommittee should be a co-sponsor of this research effort.
  • Section IV. Literature search summary
    o Paragraph 1, sentence 3: change "can be overcome" to "cannot be overcome"
  • Section V. Research objective
    o Additional goal = connect to other NCHRP studies that have touched on this topic of workforce development and preparing for the future workforce

OVERALL COMMENTS FOR BOTH A-01 and A-11:
I think this is a good opportunity for us to offer the interconnectedness of our committee with other committees and indicate our interest in being part of the team. Although the problem statements start out operations based, they quickly become a study in HR patterns, practices and solutions. Our committee should offer to be part of the study team to collaborate with the operations folks on what is being done and take a realistic review of what can be done.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-A-02

II. PROBLEM TITLE

Managing the Effects of Uncertain Federal Funding

III. RESEARCH PROBLEM STATEMENT

Uncertain federal funding adversely affects performance management, asset management, statewide and metropolitan Transportation Improvement Plans, and other planning efforts required by federal laws and rules. All of these management approaches rely on the fundamental assumption that funding is predictable during the planning analysis period. Transportation agencies are compelled to invest in increasingly costly and sophisticated management systems, but their effectiveness is ultimately limited by funding uncertainty. When funding levels are predictable, these systems can accurately forecast future asset conditions, set realistic performance targets, and devise optimal long-term capital investment plans, but uncertain federal funding undermines their effectiveness and their ability to support critical management decisions.

As the need for federal funding has increased in recent years, so has its uncertainty. Federal rescissions, obligation limits less than apportionments, and funding extensions instead of long-term appropriations bills combine to cause these effects. Federal Highway Trust Fund outlays exceeding revenue is an underlying contributor.

Some transportation agencies attempt to mitigate the effects of federal funding uncertainty by adopting conservative investment strategies, which can slow program and project delivery, leading to declining pavement and bridge conditions, reduced operational efficiency, and worsening transportation service. Many agencies are forced to adopt short-term planning horizons, while others have attempted to use probabilistic methods to incorporate uncertainty into their financial analyses. Some agencies have successfully increased the non-federal proportion of transportation funding by increasing state revenues or bonding, but all state transportation agencies remain heavily dependent on federal funding.

Agencies could benefit from understanding how federal transportation funding uncertainty affects their planning and investment processes, long-term economic growth, and how their colleagues are managing this increasingly common issue to improve their analysis and decision-making.

IV. LITERATURE SEARCH SUMMARY

Although uncertain federal funding is the norm, little substantive research describes its impact on decisions regarding project delivery, performance management, planning, programming, asset management, and fiscal constraint in state and local highway and transit agencies. Some research addresses disinvestment and right-sizing of transportation services. FHWA's Condition and Performance report to Congress, AASHTO's Bottom Line report, and ASCE's Infrastructure Report Card provide detailed documentation of system condition and service levels, but the influence of funding uncertainty on these conditions is not described.
V. RESEARCH OBJECTIVE

The proposed research would generate a summary report that describes:

- the recent history of federal transportation funding uncertainty
- the nature and severity of impacts of federal funding uncertainty on the performance of state and local transportation agencies, the validity of the public involvement process, the resulting condition of assets and services, and effects on long-term economic growth
- the nature and effectiveness of approaches state and local transportation agencies are using to manage or mitigate federal funding uncertainty
- opportunities for further application and development of successful management approaches

An executive presentation summarizing the effects and successful approaches should be developed to communicate the findings to transportation officials and policy makers.

The summary report and presentation should associate readily available information on transportation condition and service levels to uncertain federal funding. A holistic presentation would illustrate the total impact of uncertain federal funding on critical processes, management systems, system condition, and agency services to appropriate audiences.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

Recommended funding for the research is $400,000.

**Research Period:**

The research effort is expected to take approximately 18 months.

VII. URGENCY AND POTENTIAL BENEFITS

Uncertain federal funding has been virtually continuous for decades. A document describing the effects on transportation agencies and successful approaches to address and mitigate the impacts would educate and influence policy makers and administrators regarding the complexity, difficulty, and decreasing value to decision-making under these circumstances. A fundamental understanding of the negative impact of delivering transportation projects and services using a required performance management approach with uncertain federal funding is overdue.

Consideration should be given to combining the information from this research with existing information regarding transportation system conditions and performance in a presentation to more fully document the total effects of uncertain and inadequate federal funding because of the value, ready availability and low cost.

VIII. IMPLEMENTATION PLANNING

Documentation of the effects of uncertain federal funding and successful approaches to address and mitigate its impacts would be of interest to DOT executives, transportation policy makers, administrators, and practitioners trying to implement transportation programs, plans, projects, services under current federal requirements. The AASHTO Board of Directors, the Committee on Funding and Finance, the Committee on Planning, and the Committee on Performance-Based Management would be particularly interested.
IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Ben Orsbon, Special Assistant to the Secretary for Policy and Legislative Affairs
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X. AASHTO MONITOR

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XI. SUBMITTED BY

David Huft, Research Program Manager
South Dakota Department of Transportation
605.773.3358
Dave.Huft@state.sd.us
November 29, 2017

Mr. Christopher W. Jenks
Director, Cooperative Research Programs
Transportation Research Board
500 Fifth St. NW
Washington, DC 2000

Subject: Managing the Effects of Uncertain Federal Funding

Dear Mr. Jenks:

The research proposed in the attached statement would document the effects of uncertain federal funding and how states and other transportation agencies are coping while attempting to implement increasingly costly and sophisticated transportation management systems. A fundamental assumption used to accurately forecast future asset conditions, set realistic performance targets, devise optimal long-term capital investment plans, validate public input and involvement, and achieve other planning objectives is that funding is predictable. Currently, important management decisions are linked to unreliable and volatile federal transportation funding, creating substantial risk and a shaky foundation for forecasting outcomes.

Because of their value, many states used similar management systems before they were required but their effectiveness is constrained by federal funding uncertainty. Federal rescissions, obligation limits less than apportionments, and funding extensions instead of long-term appropriations bills combine to cause federal funding uncertainty. Federal Highway Trust Fund outlays exceeding revenue is an underlying contributor. These effects need to be acknowledged and documented.

The proposed research would generate a summary report and presentation detailing the negative impacts of delivering transportation projects and services with uncertain federal funding. Understanding these effects and successful approaches to mitigate the impacts would be of interest to Congress, the AASHTO Board of Directors, the Committee on Funding and Finance, the Committee on Planning, the Committee on Performance Based Management, and other transportation policy makers.

Please consider funding this important topic as you make your deliberations.

Sincerely,
Pete K. Rahn, Secretary
Maryland Department of Transportation
Chair of the AASHTO Committee on Funding and Finance

NCHRP Review of A-02

Reviewed By:
Andrew C. Lemer
alemer@nas.edu

Comments: The funding streams on which DOTs depend are inherently uncertain, regardless of their origin in federal or state legislation and appropriations or other sources. The principles, tools, and analytical methods of risk analysis are well suited to dealing with such funding uncertainty and supporting management decision making; risk analysis methods have been addressed in several recent NCHRP and FHWA projects. The problem statement does not present compelling arguments that the research will add to the body of practical decision-support tools and methods. A synthesis of how agencies have chosen to manage the risk associated with uncertain funding—for example project deferral, campaigning for state and local tax referenda, and tapping private-sector capital markets—might be interesting, but seems unlikely to contribute new information on actionable ideas for DOTs. The proposed budget and time are out of scale for a synthesis.

Review Date:
11/22/2017

FHWA Evaluation of A-02

Ben Hawkinson/HPTS-10 - Under section V. 3rd bullet, recommend adding "governments" after "state and local" - this would highlight what lawmakers are doing, such as raising gas taxes, tolls, state infrastructure banks, etc. FYI, under Section IV, there have been some reports on the influence of funding uncertainty, such as http://bipartisanpolicy.org/wp-content/uploads/sites/default/files/BPC-Eno%20Transportation%20Report.pdf http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-24(81)_Workshop-Draft-Final-Report-BL.pdf.

AASHTO Committee Evaluation for A-02

Managing the Effects of Uncertain Federal Funding
Submitted By:
Pete Rahn
Chair
Committee on Funding and Finance

Comments:
The Committee on Funding and Finance strongly endorses this problem statement (A-02: Managing the Effects of Uncertain Federal Funding), as indicated by the Committee on Funding and Finance letter of support. Uncertain federal funding has been virtually continuous for decades. Statewide plans (such as performance management, asset management, and STIPs) all rely on predictable federal funding. Uncertain federal funding undermines transportation agencies' effectiveness and ability to support critical management decisions. State DOTs will greatly benefit from this research which will provide an understanding of how federal funding uncertainty affects transportation agency planning and investment processes and how peers are managing this increasingly common issue to improve their analysis and decision-making. This research will apply to all State DOTs and is especially timely given that the FAST Act is expiring in 2020 and that rescissions of unobligated contract authority are increasingly becoming a threat.

Submitted By:
Sharon Edgar
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel
Council on Public Transportation

Comments:
Consider all modes. For transit agencies that are subrecipients of the state, federal funds are used to maintain service levels. Uncertainty can impact essential mobility services

Submitter Response for 2019-A-02
Managing the Effects of Uncertain Federal Funding

From: Orsbon, Ben <Ben.Orsbon@state.sd.us>

Ben Orsbon, FAICP
Office of the Secretary
South Dakota Department of Transportation
700 East Broadway
Pierre, SD 57501
Phone: 605 773-5105

PROBLEM NUMBER: 2019-A-02

PROBLEM TITLE: Managing the Effects of Uncertain Federal Funding

Comments
The Committee on Funding and Finance strongly endorses this problem statement (A-02: Managing the Effects of Uncertain Federal Funding), as indicated by the Committee on Funding and Finance letter of support. Uncertain federal funding has been virtually continuous for decades. Statewide plans (such as performance management, asset management, and STIPs) all rely on predictable federal funding. Uncertain federal funding undermines transportation agencies' effectiveness and ability to support critical management decisions. State DOTs will greatly benefit from this research which will provide an
understanding of how federal funding uncertainty affects transportation agency planning and investment processes and how peers are managing this increasingly common issue to improve their analysis and decision-making. This research will apply to all State DOTs and is especially timely given that the FAST Act is expiring in 2020 and that rescissions of unobligated contract authority are increasingly becoming a threat.

Submitted By:

Pete Rahn, Chair
Committee on Funding and Finance

Response

The submitters appreciate the supporting comments. These comments capture the importance of this research and the effects of federal funding uncertainty on management decisions, particularly decisions required by the provisions of MAP-21 and FAST.

Comments

Consider all modes. For transit agencies that are subrecipients of the state, federal funds are used to maintain service levels. Uncertainty can impact essential mobility services.

Submitted By:

Sharon Edgar
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel
Council on Public Transportation

Response

Ms. Edgar makes the point that this uncertainty applies to all modes. The authors agree and all modes should be considered.

FHWA Evaluation for 2019-A-02
Managing the Effects of Uncertain Federal Funding

Comments

Ben Hawkinson/HPTS-10 - Under section V. 3rd bullet, recommend adding "governments" after "state and local" - this would highlight what lawmakers are doing, such as raising gas taxes, tolls, state infrastructure banks, etc. FYI, under Section IV, there have been some reports on the influence of funding uncertainty, such as http://bipartisanpolicy.org/wp-content/uploads/sites/default/files/BPC-Eno%20Transportation%20Report.pdf http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-24(81)_Workshop-Draft-Final-Report-BL.pdf.

Response

The submitters thank the reviewer for these comments. The suggested language would be a good addition. Beyond briefly citing revenue efforts of other governments to cope with federal funding uncertainty, this research should not emphasize non-federal revenue generation. Those practices are well known. Its focus is on and the effects of federal funding uncertainty and the "timing of when federal funding becomes known" on sophisticated management decision-making methods like performance
management, asset management, and pavement and bridge management optimization. These systems are premised on reasonably predictable funding, but the federal portion remains unpredictable. In regard to the other comments of this reviewer, the studies by the Bipartisan Policy Group, National Surface Transportation Policy and Revenue Study Commission, and the National Surface Transportation Infrastructure Financing Commission and other entities highlight the effects on inadequate funding as do other references and they are useful in documenting macro-effects. But, these studies do not investigate planning and management system effects. Also, those efforts did not describe state and local efforts to address the detailed legislative and regulatory requirements of MAP-21 and FAST under such uncertainty.

The intent of this research is to investigate how uncertain federal funding undermines the effectiveness and the ability of state and local agencies and governments to support critical management decisions like forecasting future asset conditions, setting realistic performance targets, and devising optimal long-term capital investment plans. To improve analyses and decision-making, the research is also expected to describe how transportation professionals are attempting to manage this issue.

NCHRP Review of 2019-A-02
Managing the Effects of Uncertain Federal Funding

Comments
The funding streams on which DOTs depend are inherently uncertain, regardless of their origin in federal or state legislation and appropriations or other sources. The principles, tools, and analytical methods of risk analysis are well suited to dealing with such funding uncertainty and supporting management decision making; risk analysis methods have been addressed in several recent NCHRP and FHWA projects. The problem statement does not present compelling arguments that the research will add to the body of practical decision-support tools and methods. A synthesis of how agencies have chosen to manage the risk associated with uncertain funding, for example project deferral, campaigning for state and local tax referenda, and tapping private-sector capital markets, might be interesting but seems unlikely to contribute new information on actionable ideas for DOTs. The proposed budget and time are out of scale for a synthesis.

Reviewed By:
Andrew C. Lemer
alemer@nas.edu
Review Date: 11/22/2017

Response
The submitters thank the reviewer for his comments. The reviewer appears to accept that the current level of federal funding uncertainty is normal and tolerable. Historically, federal funding with known six-year authorizations were normal and quarterly or semi-annual continuing resolutions and extensions were not normal. Funding was more predictable and planning, programming, and long-range management decisions linked to this funding were made with far less risk. The submitters think that documenting and understanding the effects of uncertainty would be beneficial.

Federal performance management, planning, programming, and asset condition decisions would be far less risky if they were based on long-term federal funding at known funding levels. Would describing the risk and value of ten-year asset management decisions and financial plans based on federal funding that is only known over a quarterly or six month period be helpful? Understanding and describing this problem and its effects will create a base of knowledge that might improve how we respond to it.

This research is not intended to create decision-support tools and methods or to be a synthesis of existing studies and research. It is also not intended to be a discussion of the application of risk analysis methods or to create decision-support tools and methods. The submitters agree with the reviewer that they already exist. Also, the subject is too extensive to be a synthesis.

The intent of this research is to improve understanding of how federal funding uncertainty affects state and local planning, management, and investment decisions processes and to document how state and local agencies are managing this increasingly complex issue. As the need for federal funding has increased, so has its uncertainty. Transportation agencies are compelled by law and regulation to invest in costly and sophisticated management systems that are premised on a reasonable level of funding
certainty. Analyses are needed of how state and local agency management decision processes are compromised by the absence of federal funding certainty, the risk that results from decisions based on that uncertainty, and the value of those decisions and management systems under those circumstances. There have been little research and investigation into the effectiveness, and the ability of state and local agencies and governments to support critical management decisions like forecasting future asset conditions, setting realistic performance targets, and devising optimal long-term capital investment plans under increasingly uncertain federal funding. Billions of dollars of transportation investment decisions are made each year under volatile funding circumstances. Continually studying how to cope hasn’t changed anything. We need to understand and document how the decisions are being compromised.

Submitter Response for NCHRP Problem 2019-A-02
Managing the Effects of Uncertain Federal Funding

To Whom It May Concern:
The Committee on Funding and Finance would like to add to the comments submitted by the South Dakota DOT. The Committee emphasizes that while federal funding uncertainty has always existed, the uncertainty has increased in recent years as shorter term continuing resolutions have replaced longer term authorizations, and rescissions have increasingly compromised States’ abilities to accurately forecast federal funding. Additionally, the magnitude of this uncertainty compared to historic federal funding volatility presents greater challenges than States have traditionally dealt with.

In our original comment, we noted that statewide plans – such as STIPs, asset management, and performance management – that rely on accurate assessments of federal funding can only be as dependable as the projections used to create them. As the predictability of federal funding goes down, the cost to create these plans, and their complexity, will increase while the usefulness of the plans decreases. To improve the reliability of these plans going forward, it is imperative that States better understand the effects of increased federal funding uncertainty so long as this increased uncertainty exists.

This research will provide States with information to go before stakeholders and convincingly illustrate how this uncertainty is negatively impacting the DOTs. The methods that are being used to cope with this uncertainty have been documented; however, the goal of the research described in this problem statement is to describe and document the effects rather than devise additional methods to cope with the symptoms.

Sincerely,

Pete K. Rahn, Secretary
Maryland Department of Transportation
Chair of the AASHTO Committee on Funding and Finance
NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-A-03

II. PROBLEM TITLE

Assessing Practices for Right of Way Acquisition and Reimbursement in Utility Relocations

III. RESEARCH PROBLEM STATEMENT

Assessing the practices for right of way acquisition and reimbursement in utility relocations is an effort in sync with the Committee on Right of Way (ROW), Utilities and Outdoor Advertising Control’s vision statement, which calls for “maximizing the quality…and efficiency of national transportation programs.” The proposed research focuses on an aspect of utility coordination that has gone uninvestigated in recent history. Outcomes of the research will provide practices that result in timely, efficient, and quality ROW easement acquisitions involving utility relocations.

When a transportation construction project involves the relocation of utility facilities, the reimbursement, accommodation, and ROW or easement acquisition for that relocation can be a complex negotiation of state and federal statutes. Further, the flexibility garnered by federal statutes regarding utility relocation reimbursement allows states to develop individualized policies regarding this process. The process for ROW acquisition is controlled by the Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act). While both flexibility and legislative protections are important, the lack of uniformity across state legislation breeds confusion within these processes and in the determination of who is responsible for the associated costs. Ultimately, the public will be responsible for these costs either in payment of taxes or rates to the utility company. An assessment to determine the most efficient approach to this process may present an opportunity to improve uniformity and efficiency. There are several issues to scrutinize when assessing the utility relocation policies regarding reimbursement and ROW acquisition. First, reimbursement policies often depend upon the designation of a utility as a public or private entity and whether the facility requiring relocation has a property interest to that location. The effort in making these determinations can at times be complex and costly. Due to these policies being state specific, there is considerable variance in practices state-to-state.

Though controlled by the Uniform Act, ROW acquisition is another area to scrutinize for efficiencies. For example, some states legislatively cannot acquire property rights (typically easements) for utility companies, which then requires parallel ROW acquisition processes (one by the transportation agency and one by the utility company). Conversely, there are some states where the reimbursement for utility property access needs is available. Where ROW acquisition by the State Transportation Agency (STA) would involve stringent policy driven negotiations, that same acquisition in the hands of the utility company may entail less effort in negotiating conservative cost since the work is reimbursable. Along similar concerns, when the transportation agencies must employ condemnation, or use eminent domain, to acquire ROW, the utility companies may not have the means to garner access. STAs must be aware of their authorities when acquiring by condemnation, using the power of imminent domain, particularly when that acquisition includes a replacement utility easement.

These concerns present opportunities for efficiencies by combining or synergizing ROW acquisitions for the transportation project with utility relocation access needs. An additional benefit lies in the timing of the acquisition. The timeliness of all property acquisition (including ROW and replacement utility easements) early in the process can be advantageous, facilitating timely completion of the utility relocation and subsequently the road project. STA based ROW negotiations begin early in the plan production process as highway projects do not go to letting
until the ROW is acquired. If the replacement easement/private utility ROW process occurs simultaneously, the utility maximizes the opportunity to relocate before the road project commences.

If the easement acquisition cannot take place until a utility agreement is approved, the process may be delayed months or years after the ROW for the project is underway. As it typically occurs, the acquisition for utility access is delayed, potentially negatively influencing access for highway construction.

Another means to expedite the property acquisition in total is for the STA to acquire enough ROW to build the highway and accommodate the pre-existing utilities in their relocated positions. This method must be carefully employed considering many factors including cost, design, regulatory and statutory requirements. In cases of a utility company that is due a replacement utility easement, one must consider if an easement or prior rights may be granted if that facility is relocated into the STA ROW.

Expedited utility relocations inherently reduces road project delay potential, allowing the roadwork to be completed sooner. Since road projects are often implemented to improve safety, any of the above efforts to expedite the needed utility property needs early in the ROW process will facilitate faster road improvements and safer roads for the community.

IV. LITERATURE SEARCH SUMMARY

A search of the Transportation Research Board (TRB) TRID (Transportation Research Integrated Database) indicates that there has been no recent research into this subject matter. One record in the database is TRB Annual Conference paper number 12-0429 entitled "Using the Easement Assignment Process for Efficient Utility Relocation of a Locally Administered Project."

Other related research is included in the table below.

<table>
<thead>
<tr>
<th>Project No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>FHWA-PL-09-011</td>
<td>Streamlining and Integrating Right-of-Way and Utility Processes with Planning, Environmental, and Design Processes in Australia and Canada</td>
</tr>
<tr>
<td>FHWA-HEP-07-022</td>
<td>Domestic Scan Program: Best Practices in Right-of-Way Acquisition and Utility Relocation</td>
</tr>
<tr>
<td>FHWA-PL-02-013</td>
<td>European Right-of-Way and Utilities Best Practices</td>
</tr>
<tr>
<td>NCHRP 20-84</td>
<td>Improved Right-of-Way Procedures and Business Practices</td>
</tr>
</tbody>
</table>

This proposal shares the topical area of the previous mentioned research however there is a need for a more recent and detailed study covering the broad aspects of practices for right of way acquisition and reimbursement in utility relocations.

V. RESEARCH OBJECTIVE

The objective of this study is to review the policies, procedural steps and legislative means to effectively secure the needed replacement easements or ROW to enact utility relocations. Given the impact to transportation projects when utility relocations are delayed, maximizing the efficiency of utility ROW access to facilitate relocations is a subject in great need of investigation.

Since most STAs are already aware of the impacts, this research will focus on defining efficient procedures, policies and activities to acquire utility relocation related property access. Identified efficiencies may include proven means to acquire ROW needs for a utility company, replacement easements, joint easements, and any changes to policies or law that can bring about using these efficiencies. A primary aspect of this proposal is to determine how STAs can successfully acquire the replacement easements or ROW. This is especially important where condemnation is required for acquiring parcels. Proposed objectives are outlined here:

Proposal Objectives:
• Effective STA acquisition of replacement utility easements or ROW
• Effective utility company acquisition of replacement utility easements or ROW
• Effective use of Joint (Shared) Utility Easements
• Policies addressing utility property needs in a timely manner
• Procedures addressing utility property needs in a timely manner
• Law that encourages efficient replacement utility easements or ROW acquisition
• Legal impacts of condemnation to viability of making process changes
• How eminent domain can be employed to acquire replacement utility easements
• Implementable cost efficiencies, identify cost effective means to acquire the ROW and replacement utility easements
• How the ROW footprint can consider the accommodation of pre-existing utilities
• How private easements or prior rights may be granted for utility relocations in the STA ROW

The above objectives will require minimally the following tasks. These tasks are not comprehensive. They are only minimal needs for the research:

• Review current accommodation and reimbursement policies at the federal level
• Survey STAs regarding their history of acquiring ROW or replacement easement for utility companies
  ▪ Legislative controls
  ▪ Policies
  ▪ Practices
  ▪ Controlling factors
  ▪ Innovative tactics
• Conduct follow-up interviews or case studies to enhance previous findings
• Review accommodation and reimbursement policies at the case study levels
• Identify and conduct utility company interviews to consider viability of findings
• Provide legal reviews of federal and state findings, defining opportunities and challenges
• Develop a report summarizing findings inclusive of recommendations for policy change, process change, example legislative needs, risks, and benefits
  ▪ The report shall analyze both acquisition by the STA and by the impacted utility company
  ▪ The report shall consider innovative means to achieve the goal of efficient utility property access, a potential example being joint utility easement
• Perform supplementary activities to facilitate implementation of the research products:
  ▪ Summary guide
  ▪ AASHTO committee conference presentation
  ▪ Web based workshops
  ▪ Limited outreach to an audience with utility company representation

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

It is estimated that this research will require $300,000 in funding

Research Period:

It is estimated that this research will take 18 months to complete

VII. URGENCY AND POTENTIAL BENEFITS

This study will present STA with several opportunities to learn about efficiencies available, beneficial legislation, policies and innovative tactics that promote expedited and efficient utility property access, which in turn maximizes opportunity for successful utility relocation and road
project execution. This work includes documenting potential benefits and risks of acquiring ROW on behalf of a utility company. In recent history, these elements have not been documented, assessed, and shared with STAs. Since utility relocation is essential and frequently impactful to road project construction, this subject is of particular importance and relevance. For example, STA acquired replacement easements that are both cost and time effective inevitably will prevent utility related delays and subsequent claims from the roadway contractor. Given the nationwide emphasis on infrastructure investment, this study will assist STAs in building efficiencies into the project development process.

VIII. IMPLEMENTATION PLANNING

a) The appropriate target audience for this research would be STAs and the Federal Highway Administration (FHWA)

b) STAs and the FHWA will be the key decision-makers on the implementation of these products

c) The AASHTO Committee on Right of Way, Utilities and Outdoor Advertising Control will be responsible for adopting this research

d) Most STAs will have interest in the findings. Alabama DOT and the Kentucky Transportation Cabinet hope to be early adopters. Some STAs may have problems implementing all of the suggestions due to STA policy, procedure and state law. The guide should help these STAs change their current policies, procedures and state laws.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

Recommended AASHTO Monitor:

Robert G. Lee, P.E.
State Utilities Engineer
Alabama DOT
1409 Coliseum Blvd.
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334.242.6155
leer@dot.state.al.us
XI. SUBMITTED BY

AASHTO Committee of Right of Way, Utilities and Outdoor Advertising
Utilities Project Scoping and Coordination Technical Council

TC Member:
Jennifer McCleve, P.E.
Utilities and Rails Branch Manager
Kentucky Transportation Cabinet
200 Mero Street, 5th Floor East
Frankfort, KY 40622
502.564.3210
Jennifer.McCleve@ky.gov

NCHRP Review of A-03
Reviewed By: Camille Crichton-Sumners ccrichton-sumners@nas.edu
Comments: States transportation agencies typically are interested in gleaning new methods for streamlining utility relocation and right-of-way acquisitions in order to expedite project delivery, but due to varying laws, policies, and procedures within each state it will be difficult to develop guidance that will be useful to a broad audience. Since this problem statement includes an assessment of practices, it is achievable. The 18 month time frame and the 300K budget will be insufficient given the anticipated coordination and input from the legal and utility/representatives delegates from various states and the federal government. 450K and 36 months may be feasible.
Review Date: 11/28/17

FHWA Evaluation of A-03

Arnold Feldman/HEPR-10; Julie Johnston/HIPA-20 - Emphasis should focus on the difference among states’ definitions of utilities. However, it shouldn’t be the sole objective.

AASHTO Committee Evaluation for A-03

Assessing Practices for Right of Way Acquisition and Reimbursement in Utility Relocations

Submitted By:
Evan Rothblatt
Liaison
CRUO

Comments:
Ranked 2nd choice for Committee on Right of Way, Utilities, and Outdoor Advertising Control. Comments: Many states do not have the authority to condemn for a utility easement, because it is not for a highway system. Utilities may not have condemning authority, or may not be able to utilize it in a particular situation, or won't condemn. What is the standard of practice, and how do we develop consistent approaches across the country.

Submitter Response for 2019-A-03
Assessing Practices for Right of Way Acquisition and Reimbursement in Utility Relocations
From: [email: jennifer.mccleve@ky.gov]

Comments:

Response to FHWA Comment:
'Emphasis should focus on the difference among states' definitions of utilities. However, it shouldn't be the sole objective.'

I agree that the definition of a utility may well possibly factor into the mechanisms by which easement and right of way are most effectively secured in various states. I recommend this as a factor in any survey of DOTs for best practices and must come into play in the analysis or that data.

Response to NCHRP Comment:
'States transportation agencies typically are interested in gleaning new methods for streamlining utility relocation and right-of-way acquisitions in order to expedite project delivery, but due to varying laws, policies, and procedures within each state it will be difficult to develop guidance that will be useful to a broad audience. Since this problem statement includes an assessment of practices, it is achievable. The 18 month time frame and the 300K budget will be insufficient given the anticipated coordination and input from the legal and utility/representatives delegates from various states and the federal government. 450K and 36 months may be feasible. Review Date: 11/28/17'

If we are going to assess many state practices, I agree with the need for larger budget and duration. However, the subcommittee that originated the request intend to identify a smaller sampling of states with successful right of way and utility easement programs. This method will result in a reduced cost but in turn will narrow the practices found and may hinder the capturing of good practices from the wide array of laws, policies and procedures that are found across the country. In light of these hindrances, I am fully supportive of the larger budget and schedule. It should be noted that results of this study will provide definitive means to expedite road project execution and therefore is intrinsically valuable to both DOTs and FHWA. This subject is long overdue exploration and study, I recommend it move forward with the smaller budget if cost prohibits the expanded scope proposed by NCHRP.

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Review Date:
12/15/17
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER
2019-A-04

II. PROBLEM TITLE
Managing Utility Facilities Taken Out Of Service (OOS) within Public Right of Way

III. RESEARCH PROBLEM STATEMENT
When building their infrastructure, utility companies frequently need to encroach within primary highway Right Of Way (ROW) or cross roads and highways with their facilities. State law typically provides utility companies the authority to place their facilities inside highway public ROW. Permits may be required when these facilities are initially installed. Utility companies that place their facilities in public ROW may later abandon their infrastructure, go out of business, or sell their facilities to other companies. When this happens, the State Transportation Authority (STA) that issued the permit may not be notified of the changes. The term abandoned is often used for out of service (OOS) utilities but it is not used here because it implies that utility has relinquished responsibility for the facility/infrastructure.

Since increasing numbers of utility facilities occupy public right of way, it is to be expected that OOS facilities are becoming a very significant issue with STAs. OOS facilities often negatively impact STA construction projects and it is expected that this will happen more frequently as the numbers of OOS facilities increase. Since these facilities are not in service, they are typically not marked by utility locators and may not be identified until construction when a contractor exposes the facility. When this happens, work is typically stopped at the location to identify the facility type, owner, active or inactive status, how to address the facility during construction, and what the potential consequences are. These delays affect the contractor, which is then passed onto the STAs and subsequently taxpayers.

As an element of transportation project development, the utility coordination process is the ideal place for STAs to manage OOS facilities. Defining typical effective and required processes for identifying these facilities and addressing their existence in the project footprint during the utility coordination will help STAs optimize their efficiency in project execution.

IV. LITERATURE SEARCH SUMMARY
When researching OOS facilities, there are numerous publications on the market that discuss "abandoned" facilities and the problems they cause to designers and contractors on projects. Very few of these publications discuss practices for STAs to reduce or eliminate these project delays and costs caused by OOS facilities. A search of the Transportation Research Board database indicates that there has been no recent research endeavors into this subject matter. Given the impact an unexpected OOS facility can have on a road construction project, it is a subject in great need of investigation.

Since most STAs are already aware of the problems posed by OOS facilities, this research will focus on defining effective policies and actions to reduce or eliminate these construction delays and costs. Effective policies and actions may involve the early identification, location, and management of OOS facilities, thereby avoiding construction related delays and costs. Identified efficiencies may also include the identification, management and mitigation of OOS facilities during a construction project, with the goal being then to minimize impact in terms of delay and cost.

V. RESEARCH OBJECTIVE
This research is to document how STAs handle OOS facilities prior to and during road project construction. The research will gather information identifying and assessing various ways that STAs currently deal with OOS utility facilities. The study will focus on three areas of STA operations that are commonly impacted by OOS facilities: Permitting, Project Development, and Project Construction. The study will use the assessment process to identify particularly successful practices that ensure STAs are aware of changes to existing permitted facilities that are taken OOS. The study will identify means to increase utility coordination efficiency on transportation projects during project development, identifying OOS facilities and addressing their proximity to avoid negative impacts to STA projects. Finally, the study will identify effective steps to take if a potential OOS facility is discovered onsite during STA project construction. The product of the research will be a “Scoping Guide”, defining effective practices, policies and actions for a STA to use in similar situations.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

$300,000

**Research Period:**

This project should be completed within 18 months.

VII. URGENCY AND POTENTIAL BENEFITS

STAs are seeking out ways to eliminate construction delays and costs associated with OOS facilities. The efficiency of utility coordination can be improved if these facilities are found prior to construction. This document will give STAs guidance on how to track, control, eliminate, and minimize impacts of OOS facilities inside public ROW. This research is essential to keeping future construction project costs and delays low.

Without this guide, STAs will continue to handle OOS facilities in the same manner as they have in the past. There will be no improvement in reducing the number of conflicts and delays on construction projects.

VIII. IMPLEMENTATION PLANNING

a) The appropriate target audience for this research would be STAs.

b) STAs will be the key decision-makers who can approve, influence, or champion implementation of the research products.

c) The AASHTO Committee on Right of Way, Utilities and Outdoor Advertising Control will be responsible for adopting and implementing this research.

d) Most STAs are expected to be willing to use the "Scoping Guide" to implement changes in how they manage OOS facilities, including Wyoming DOT and the Kentucky Transportation Cabinet. Some STAs may have problems implementing all of the suggestions due to STA policy, procedure and State law. The guide should help these STAs change their current policies, procedures and state laws to better work with OOS facilities and reduce the number of conflicts and delays on construction projects.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Keri Bohlmann, P.E.
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Recommended monitor:

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NCHRP Review of A-04
Reviewed By: Camille Crichton-Sumners ccrichton-sumners@nas.edu
Comments: State transportation agencies will find the proposed "scoping guide" helpful if it can help them avoid impacting an out of service (OOS) utility provided they have sufficient right-of-way. Any guidance on streamlining utility coordination and minimizing relocation/removal costs will be valuable. It will likely require 24 months and 450K due to feedback solicitation and coordination with right-of-way attorneys and utility company representatives.
Review Date: 11/28/17

AASHTO Committee Evaluation for A-04

Managing Utility Facilities Taken Out Of Service (OOS) within Public Right of Way

Submitted By:
Evan Rothblatt
Liaison
CRUO

Comments:
Ranked 1st (top choice) for Committee on Right of Way, Utilities, and Outdoor Advertising Control. Comments: How do you hold people accountable for abandoned facilities (wireless telcom?). Most difficult to clear in a utility conflict situation. Times abandoned facilities are not identified. Direct impact and can shut down active construction projects. Cost Implications, Safety Implications, Project Delay Implications.

Submitter Response for 2019-A-04
Managing Utility Facilities Taken Out of Service (OOS) within Public Right of Way

From: [email: keri.bohlmann@wyo.gov]
Comments: I agree with the comments.
Contact Info:
Keri Bohlmann
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Review Date:
12/15/17
(307) 777-4133
keri.bohlmann@wyo.gov
I. PROBLEM NUMBER

2019-A-05

II. PROBLEM TITLE

Flash tracking for Accelerated Project Delivery

III. RESEARCH PROBLEM STATEMENT

Speed and quality of construction have always been a driving factor in the construction industry. In today’s era of technically complex projects, a variety of concepts and delivery methods have been defined all striving to satisfy the ever-increasing demand for faster project delivery. One such approach—fast tracking—has become a staple of the construction industry to the extent that most organizations employ some level of it on all their construction projects. However, the need for even quicker project deliveries is now being driven by a greater demand for emergency rebuilds, by pressing economic need, by a window of opportunity, and/or by stricter regulations. Meeting these increasing demands has led to the pursuit of faster fast tracking or “flash tracking.” Flash track projects are faced with a high degree of chaos given the heightened degree of concurrency between scope definition, engineering, procurement, and construction. Knowing how to manage risks in such a volatile environment is a key to project success.

Through a recent research on “Successfully delivery of flash track projects”, the Construction Industry Institute (CII) has synthesized 47 essential flash track practices; the Virginia Department of Transportation (VDOT) and the Georgia Department of Transportation (GDOT) have recently adopted, adapted, and expanded CII’s research, and in the process have added 19 and 17 flash track practices, respectively, which are DOT unique.

This research seeks to engage the remaining 48 States in expanding the set of flash track practices to develop a comprehensive flash track Framework that can be deployed by any State DOT in the pursuit of an accelerated project delivery.

Special note to AASHTO Committees and Subcommittees: Accelerated project delivery is becoming necessary to meet the demands for new infrastructure as well as the backlog of rehabilitation and maintenance requirements of existing roads and bridges. The development of a comprehensive flash track Framework for project delivery, incorporating the best practices of flash tracking currently in place by organizations, will support in the need to accelerate investment in infrastructure. The strategic goal for flash tracking new construction projects is to expeditiously address critical transportation infrastructure needs and provide benefits more efficiently to taxpayers. For rehabilitation and maintenance projects, flash tracking will decrease the cost of maintaining the infrastructure over time. Overall costs are reduced by accelerating the repair of deficient roads and bridges, which may eliminate maintenance cost and/or lesson the cost of corrective action if performed at a later date.

IV. LITERATURE SEARCH SUMMARY

In the last ten years, several transportation projects have been executed using a fast track approach. Under this strategy, project phases overlap with the purpose of shortening the
completion time. Oftentimes, the construction starts before the design is completed. Lately, fast track has also extended to bridge construction. The need of completing this type of projects without disrupting the traveling public in a safe and short way has led to the use of Accelerated Bridge Construction (ABC). By using innovative construction methods, bridges can be placed in weeks, days and even hours.

Up to date, the majority of transportation research published focuses on showing the application, results, and challenges of this project delivery by using cases studies. Some of these studies are described below. This literature review solely focuses on the Transportation Research Information Services (TRIS) and the International Transport Research Documentation databases.

**Accelerated Construction**

At present, two transportation research projects about flash tracking are in progress. The main objective of these two studies is to evaluate the implementation of the Construction Industry Institute’s flash track best practices for the successful execution of Accelerated Project Delivery. To this end, four projects executed by the Georgia Department of Transportation (GDOT) and two projects executed by the Virginia Department of Transportation (VDOT) are being used as case studies to validate the existing practices and to identify new best practices (de la Garza and Pishdad-Bozorgi, 2018) and (Pishdad-Bozorgi et al., 2018). The four projects in Georgia were: the Bridge Replacement of SR 299 on I-24; the Jimmy Deloach Connector; the Bridge Replacement of SR 47 over the Little River; and the Riverside Drive Roundabouts on I-285. The two projects in Virginia were: the I-95 Expressway Lanes and the US 29 Solutions.

The lessons learned from fast tracked Portland Cement Concrete (PCC) paving projects from the airport pavement industry were presented by Pekin et al., (2006). A report, prepared by the Innovative Pavement Research Foundation, was based on several accelerated projects of the airfield paving industry that were considered as case studies. The planning guide provided by the authors highlights the steps that can be taken during the planning, design, and construction phase to accelerate airfield PCC paving projects. Some of the practices that should be taken into account to accelerate this type of projects are: selection of appropriate materials, a good coordination of the work, an efficient sequence of construction activities, and an appropriate strategy for early opening to traffic. This guide also includes a decision tool that, based on project variables, identifies the most suitable techniques for other fast track projects.

The construction practices executed during the fast track runway pavement rehabilitation of the Sarasota-Bradenton International Airport, FL were described by Vélez-Vega and Bardt, (2008). Since flights could not be delayed, canceled or diverted, the project had to be completed in seven hours. To ensure the successful delivery of the project, the contractor provided enough resources on the site and guaranteed that an equipment breakdown would not delay the reopening of the runway. The decision process was easy thanks to the close coordination between the contractor, owner, and engineer.

A framework was proposed by Buwanpura and Mehamed, (2014) to evaluate and to quantify the impact of the application of fast tracking techniques on project duration and cost. The most common fast tracking techniques and their application areas in the project were selected based on an industry survey and a literature review carried out by the authors. Then, several projects with similar fast track application areas were used as case studies to examine the relationship between the time and cost of the projects. The effect of the fast tracking technique was determined based on the project cost and time before and after fast tracking. By having a benchmark for different fast tracking techniques, project managers can better plan the projects.
The technical aspects and challenges of the successful fast tracked upgrade of the Mthatha Airport in South Africa were described by Horak et al., (2015). The need for a rapid execution led to conducting the preliminary and detailed design phases concurrently with the actual execution of the project. The procurement procedures were adapted to a fast track process. The improvement of the airside infrastructure capacity was achieved in the short term of eight months keeping the existing runway operational during the day and night. The construction process was speeded up by using specific pavement materials, rapid construction methodologies, and working extended hours of two shifts of 10 hours.

**Accelerated Bridge Construction – ABC**

Utah DOT was among the first states to implement ABC and through the years they have developed a sustainable framework to keep developing and improving ABC. Hanson published an article in 2012 about the Utah DOT ABC experience. In his article, the author describes the main technical innovations in ABC and discusses details about the management strategies developers had to use to successfully implement ABC and finally gives recommendations to successfully implement ABC at the state level (Hanson, 2012).

The Federal Highway Administration (FHWA) is developing a recommended guide for ABC under the AASHTO specifications for Design and Construction to agglomerate the abundant and scattered recommendations which have been developed in the past years. This research has been a phased effort since 2014 and was expected to be finished in 2016, but apparently, is not yet published. This guide focusses on the technical means and methods of construction, like prefabrication and placement of bridge elements, foundations, walls, and embankment construction (Culmo, 2014).

The reasons for the selection of ABC over conventional project delivery models include: reduced traffic disruptions, safety, and economic impact to the public. However, these benefits are difficult to measure; for instance, the economic impact during bridge construction can become subjective. Yavuz et al. published a paper where they evaluated this economic impact by measuring the effect on businesses around the area where a bridge construction was in progress. They took in consideration traffic delays and business revenue lost as costs parameters for their comparative analysis between ABC project and conventional project delivery models. In their article, they found that the impact of a conventional bridge project cost can be 16 times higher than the ABC project cost impact. They assert that this proportion can be used to justify the increased cost of ABC construction (Yavuz et al., 2017).

Frangopol et al. has published an article which is focused on the life-cycle considerations for bridge construction. Their approach addresses the criteria to make decisions during all the stages of bridge construction and operation, to inform stakeholders about the best approach to resolve conflicts, and to make the best management of the available resources to achieve optimum performance. The authors used probabilistic methods to evaluate bridges’ life cycle including climate change considerations and other risks. Because this article takes into consideration a complete bridge structure’s life cycle, it has the potential to aid stakeholders to make informed decisions about design and construction and planning the operation and maintenance of the infrastructure (Frangopol et al., 2017).

The ABC knowledge base has been developed by the collections of lessons learned and observations from completed bridge projects in the past. It is the variety of cases in which the circumstances, conditions, and needs which raise awareness of innovations and changes. Khan et al. studied the case study of the "MacKays to Peka Peka Expressway" project which is located in a very seismic area. Their study went into details about the ABC implementations made to bring this project to fruition. They developed a framework about the proceedings during this
bridge project construction which is mainly focused on the technical means and methods of construction like pre-fabrication and standardization of bridge elements. Despite the technical emphasis of the paper, the authors recognize some managerial strategies that support the successful implementation of this project and the application of ABC considerations. For example, the authors highlighted the importance of the early involvement of stakeholders in all the development stages, e.g., contractor involvement in design (Khan et al., 2017). Another case study, the Baudette/Rainy River International Bridge Replacement Project is a binational project which exposes additional considerations needed to be considered in such cases. The report by the FHWA and the Minnesota DOT thoroughly shows considerations and criteria for the development of this project (Federal Highway Administration and Minnesota Department of Transportation, 2017). Finally, the applicability of Accelerated practices in bridges can be very diverse, for example the Gifford Pinchot National Forest Layout Creek Bridge Project is a project related to natural preservation. This project created a structure in a short time, and served to take advantage of the funding available which employ special management practices (Gifford Pinchot National Forest and Federal Highway Administration, 2017).

Because ABC researchers are seeking mechanisms to improve the means and methods to apply in ABC and improve the technical challenges to quicken the delivery of projects, Farzad et al. studied a new structural bridge system that combines steel and concrete materials to create an assembly of structural elements that efficiently can be used to support bridges and its elements (Farzad et al., 2017). Prasad et al., focused on the bridge bearings and discussed how these elements have evolved from simplicity in the past to become more complex nowadays. In their study, they highlight how improvements on these elements may impact infrastructure expenditures and increase the life of the bridge structure (Prasad et al., 2017). Innovation, even on small elements like shear connectors, has been proposed to improve accelerated construction. Suwaed and Karavasilis researched how improvements in shear connectors can support assembly and disassembly of bridge elements during construction and replacement, and even ease maintenance procedures by easy substitution of precast panels, the connectors themselves and beams. These connectors work adequately with precast sections and support accelerated construction practices (Suwaed and Karavasilis, 2017).

Incidents arise during bridge construction that need to be addressed. Demolition, in particular, is a dangerous activity such that injuries and fatalities can happen. According to Gause, statistical information from previous projects support the development of practices to improve safety considerations during bridge projects and is of great interest to organizations like the AASHTO, which is sponsoring the development of a manual of specifications for demolition process during bridge construction. This study which is in development, will be sustained by literature review, review of case studies and interviews with relevant stakeholders (Gause, 2017).

ABC implementation has many advantages. However, the durability of the structure can not be disregarded. According to Andres-Phaedonos, quality assurance and quality control (QA/QC) during bridge construction is important if the infrastructure created is expected to last. His study provides insights about existent practices and practices that need to be addressed to achieve lasting structures in bridge projects and avoid undesirable outcomes because of defective construction processes (Andrews-Phaedonos, 2017).

Infrastructure development is a staged effort; however, construction is usually the one stage which is believed to be the most important during the structure development. Design phases are also having a great relevance because, the project is subjected to selection criteria to adjust meeting the requirements. Tang addressed conceptual design of bridges in a recent study which relates the selection of the alternatives, managing of resources, and the creation of the construction design as a methodical sequence of processes to achieve better outcomes (Tang, 2017). Further innovation can also be applied in design stages through the implementation of innovation in these stages. The Angellala Creek Bridge reconstruction served as a case study for
the application of these innovations to test different alternatives to the final design through the

generation of testing models through BIM technology. It was the report made by Hourigan that
asserted that this technology helped designers to test different alternatives and served as
decision tool to the development of the best scenarios which was fundament to the final design
(Hourigan, 2017).

Zaeri discussed how simulation tools may help stakeholders be better prepared to asses and
proceed before the advent of project construction procedures. In this study, Zaeri employed a
new untested construction procedure in a project in New Zealand as case study to evaluate the
simulation tools in context (Zaeri, 2017). A special involvement approach by the public is the main
topic in a study in development by Alluri and Gan. Their study seeks to attract public though
nowadays media alternatives (Alluri and Gan, 2018).

How does the proposed research relate to the existing body of knowledge?

The proposed research significantly expands the existing ABC and non-ABC body of knowledge
by actively engaging all 50 State DOTs in the distillation of flash track best practices. VDOT and
GDOT are early adopters of the 47 CII-derived flash track practices and each contributed 19 and
17 additional flash track practices, respectively. There is no doubt that the other 48 State DOTs
have a lot to contribute to expand and convert this flash track body of knowledge into a robust
framework that can be broadly utilized.

References

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methods.” Public Works, 143(13).
V. RESEARCH OBJECTIVE

This research seeks to expand and refine the existing set of essential flash track practices by engaging the remaining 48 States so as to develop a comprehensive flash track Framework that can be deployed by any State DOT in the pursuit of an accelerated project delivery. The final product will be a flash track Framework packaged in an Excel-based Toolkit designed to assess the overall and categorical readiness for a given project to be undertaken on a flash track basis. For those practices in which the project stakeholders score weak, the Toolkit will suggest strategies to enhance performance.

The methodology includes the following Tasks within each of the four AASHTO Regions:

1. Charrettes will be held to distill potentially new flash track practices.
2. The outcome from Task #1 will be vetted, via a Delphi process, to identify the truly essential practices needed for flash tracking.
3. For each essential flash track practice from Task #2, the following elements will be elicited: implementation risks, implementation barriers, and risk mitigation strategies.
4. Once Tasks #1, #2, and #3 have been carried out in each of the four AASHTO Regions, the practices from Task #2 will be Categorized.
5. Another round of Charrettes will be conducted to prioritize, via the Analytic Hierarchy Process (AHP), the flash track practices within each Category and the Categories themselves.
6. The outcome from Tasks #1 through #5 will be packaged in an Excel-based Toolkit designed to assess flash track readiness.
7. Technology Transfer Charrettes will be held in each AASHTO Region to help facilitate adoption and implementation of the flash track Framework by each State DOT.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

The estimate of the funds necessary to accomplish the stated objectives is approximately $560,000 over 2.5 years.

Virginia Tech
Jesus M. de la Garza (fully burdened)
Hourly Rate (year 1) = AY (78 hours): $235.23; SMR (173 hours): $234.19
Hourly Rate (year 2) = AY (78 hours): $244.62; SMR (173 hours): $243.56
Hourly Rate (year 3) = AY (39 hours): $250.54; SMR (87 hours): $248.32

PhD Student (fully burdened, including tuition)
Hourly Rate (year 1) = CY (1,040 hours): $59.28
Hourly Rate (year 2) = CY (1,040 hours): $61.65
Hourly Rate (year 3) = CY (520 hours): $63.88

Travel: 2-3 trips to each of the four AASHTO Regions

Georgia Tech
Pardis Pishdad-Bozorgi (fully burdened)
Hourly Rate (year 1) = $106.90
Hourly Rate (year 2) = $110.11
Hourly Rate (year 3) = $113.41

PhD Student (fully burdened, including tuition)
Hourly Rate (year 1) = $43.21
Hourly Rate (year 2) = $46.74
Hourly Rate (year 3) = $48.44

Travel: 2-3 trips to each of the four AASHTO Regions

Research Period:

24 months of research effort and 6 months for review and revisions of interim and final reports.

VII. URGENCY AND POTENTIAL BENEFITS

The research will result into the practical and implementation-ready flash track Tool, which guides users through the actions needed for the successful overlapping of workflow processes required by flash tracking. The flash track Tool helps users proactively mitigate the risks introduced by flash tracking, like volatility, as well as the heightened normal risks, by:

✓ Providing project-level guidance for executing flash track projects.
✓ Enabling project-level users to calculate their readiness and determine the degree to which the key stakeholders are capable of successfully delivering a flash track project. Project stakeholders whose overall readiness is weak will be better off reconsidering the flash track project delivery strategy and switch to a more conventional one where fast track is utilized to avoid the corresponding negative and disappointing consequences (schedule growth, cost growth, poor quality) of attempting flash tracking without the proper preparation.
✓ Offering meaningful measures and implementation recommendations for overcoming the inherent risks of heavily overlapped, accelerated project deliveries.

The tool should be used as a planning tool at the start of a project during Front-End-Planning stages. It is also valuable to use retrospectively at the end of the project, to capture the project’s actual flash track readiness and the lessons learned.

The research will address the prevailing industry calls for innovative approaches to project delivery, for reevaluation of prevailing practices, and for new paradigms for accelerated projects, and will address the blind spots, obstacles, and pitfalls of the flash track process.

The planned Technology Transfer charrettes will ensure that the computerized flash track Framework is ready to use and ready to deploy.

VIII. IMPLEMENTATION PLANNING

The target audience for the research results of “flash-tracking” would be transportation boards, councils or executive committees responsible for the timely execution of infrastructure programs. The Key decisions makers who can champion the implementation of the research products would be the Chief Engineers or Program Directors within these agencies. In order for an agency to adopt the results of the “flash-tracking” research, the necessity, along with the funding, must be apparent to accelerate projects or a program of projects. The additional risk of “flash-tracking” projects may not be justified unless a heightened level of urgency to deliver a project or program exists within the agency.

VDOT and GDOT would be appropriate agencies to implement and evaluate the results of “flash tracking.” Their participation in this study will allow a better understanding of the process when the time comes for implementation. VDOT has a large program with multiple projects in various stages of development for implementation.

NYSDOT would also be an agency to evaluate the results of “flash-tracking”. NYSDOT has produced an ABP, Accelerated Bridge Program. NYSDOT is also in the final stages of an accelerated critical flood prone bridge program, CBOW, Critical Bridges over Water. With an unprecedented 2 tropical storms, Hurricane Irene and Sandy, impacting New York within 15 months, the fast tracked FEMA funded program was initiated to repair and enhance the resiliency of 105 bridges that are flood prone throughout the state. The evaluation of the “flash-tracking” research product should potentially be compared to the fast tracking practices used by NYSDOT to produce their ABP and CBOW programs.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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Pardis Pishdad-Bozorgi, Ph.D.
Assistant Professor
NCHRP Review of A-05
Reviewed By: Camille Crichton-Sumners ccrichton-sumners@nas.edu
Comments: Engaging all fifty states is a logical next step to advancing the Flash Tracking concept from the experiences of two states. The problem statement was prepared by two university representatives and the estimates reflect their available resources. The time-frame should be increased to 36 months including NCHRP reviews since many hours will be spent in states identifying potential flash track projects and convening three charrettes for each AASHTO region will require significant amount of time. The budget seems insufficient to cover the suggested tasks. The research plan should be phased and possibly include an exit strategy in the event that the research team and panel learn (at the first charrette or a survey) that the majority of state agencies are unlikely to assume the risk of implementing fast tracking and question the feasibility of implementation. The development of an implementation-ready, flash track tool that will guide users through the actions needed for the successful overlapping of workflow processes and be compatible with state transportation project management legacy systems will be challenging. If a stand-alone tool is created it may not easily be assimilated into well-established state agency processes. Final products should include a summary of the barriers to implementation and a framework to aid state transportation agencies in the decision making process. The problem statement
could be rephrased so that proposers are asked to provide their methodology rather than including the recommended use of charrettes as a means for data gathering and dissemination.

Review Date: 11/29/17

FHWA Evaluation of A-05

Sam Tyson/HIAP-20 - Would be beneficial to include precast concrete panels for rapid repair and rehabilitation of existing pavements, which is part of SHRP2 project R05 under the rapid renewal focus area. Richard Duval/HRDI-20 - It is important to accelerate project delivery, but the term "Flash Tracking" is a bit concerning based on our understanding of the RNS. This statement, "the need for even quicker project deliveries is now being driven by a greater demand for emergency rebuilds, by pressing economic need, by a window of opportunity, and/or by stricter regulations". Will this research lead to throwing out all proper QA and Oversight and provide a blank check to the contractor? The risk is huge on the States if fully adopted, but it would depend on the exact scope of the work and findings. We do understand in Emergency situation, but in everyday delivery we need to be careful. We would recommend a rewrite to the RNS. It is inappropriate to include pricing information in the RNS and it should be removed.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-A-06

II. PROBLEM TITLE

Implementation of Programmatic Life Cycle Cost Analysis in a Transportation Asset Management Framework

III. RESEARCH PROBLEM STATEMENT

Background

Federal and state policies are increasingly directing the owners of transportation assets to manage the performance of their assets and networks, using this information to minimize the long term cost of providing service. Lifecycle cost analysis considers how the overall cost of an asset, as it is incurred from planning and design through construction, operation, maintenance and decommission phases, can be optimized. It also often includes costs experienced by transportation system users and stakeholders. It evaluates projects, programs, and policies in light of these economic outcomes, often in combination with other non-economic aspects of performance.

Over time, the costs of routine maintenance and programmed repair work tend to increase as condition deteriorates. Agency policies and actions attempt to slow the rate of deterioration, or interrupt it entirely by means of rehabilitation and replacement. If major agency expenditures can be delayed, this may be an attractive option in order to free up resources for higher priority uses. However, delayed maintenance or rehabilitation means further expenditures in future to bring the condition of those assets to an acceptable level of service. This implies that there is a time value of money, and that data-driven decisions should be made about when to intervene in the life of an existing asset. In addition, future costs are subject to considerable uncertainty, which can have a significant effect on the relative attractiveness of various scope and timing alternatives.

AASHTO, FHWA, state governments, and international agencies have begun to develop analysis tools that can assign an economic value to agency actions and to user and non-user stakeholder concerns. These systems require quantitative forecasting models to predict immediate and long-term changes in performance that might occur because of the projects that are generated or described in these systems. NCHRP Project 08-71 produced Report 713, to document methods for assessing the deterioration and life expectancy of a variety of highway assets, including signs, traffic signals, street lighting, sidewalks, culverts, pavements, and bridges.

Life cycle cost analysis tools are widely used for a few of the more expensive types of assets, such as pavements and bridges. However, for the broader range of assets managed by highway agencies existing tools are informal and often lack reliable or consistent research-based inputs, especially regarding non-agency costs and the quantitative effects of preservation activity.

In addition to tools, there is an increasing recognition that whole-life planning should occur as early as possible in the lifecycle of an asset, so that short term efficiencies in the design or construction phase are considered alongside the long-term impacts for operations and maintenance. For transportation asset owners, this requires a new mind-set, as the whole supply chain is required to collaborate and share information, perhaps prompting consideration of new, innovative project delivery mechanisms.
Research is needed to develop guidance and one or more example tools to demonstrate quantitative asset-level, project-level, and network-level models for predicting the life cycle costs associated with preservation, replacement, and risk mitigation activities on the full range of highway assets. It is envisioned that the research will involve at least the following tasks:

1. Gather and synthesize the literature on life cycle cost analysis for highway assets, including methods for estimating agency, user, and non-user costs, for selecting a discount rate, and for quantitatively modeling the uncertainty of costs. Also gather existing literature on deterioration and effectiveness of actions, and information on existing life cycle cost analysis tools in use by transportation agencies for the broad range of highway asset types.

2. Document use-cases for a practical life cycle cost analysis tool usable by highway agencies to support asset management decision making, meeting the objectives listed above. Develop a set of requirements in the form of recommended performance measures and the recommended usage of these measures to inform practical types of decisions, consistent with the requirements of 23 CFR 515 (governing asset management plans and systems).

3. Using the understanding developed in the preceding tasks, develop quantifiable and probabilistic prediction models of deterioration, action effectiveness, cost, and (short-term and long-term) economic impacts on users and non-users, considering the quantified uncertainties in these parameters. Develop suitable functional forms, and show examples using published or representative parameters. No live agency data are to be gathered in this project.

4. Develop an open software tool to implement the methods developed in the preceding tasks, using a suitable generic format for input data, data quality management, data processing, and for reporting of results. Test, validate, and document the tool.

5. Develop guidance for agencies to use in adapting the recommended models and tool to best fit their own maintenance and operating practices, climate, and other local conditions.

6. Suggest practical solutions for increasing awareness of life-cycle cost among public and private sector stakeholders.

7. Prepare a Manual or Guidebook for Life Cycle Cost Analysis of Preservation and Replacement of Highway Assets, as a user-friendly but formal guide to help agencies customize and implement the new methods.

IV. LITERATURE SEARCH SUMMARY

NCHRP Report 713 provides fundamental methods and examples for the forecasting of deterioration and life expectancy, primarily related to asset condition. It does not address user or non-user costs, and touches only lightly on agency life cycle cost analysis and uncertainty. Pavement and bridge management systems go into much more depth on life cycle cost analysis, using relatively simple models suitable for network level analysis. NCHRP Report 483 goes into much more depth on life cycle cost analysis for bridges, with a detailed quantitative treatment of uncertainty and a project-level perspective. NCHRP Report 806 developed methods and tools for cross-asset decision support but did not develop a means of considering long-term cost tradeoffs and infrastructure deterioration. There is currently no easy way to evaluate the impact of delaying a recommended project due to fiscal constraints on the overall system performance.

Research is in its infancy for asset management use of non-agency costs, including costs associated with travel and waiting time, vehicle operations, accident losses, work zone and accident-caused delays, and the risk of extreme events. Some NCHRP, AASHTO, and FHWA resources developed for other purposes (e.g. the Highway Economic Requirements System and the AASHTO Manual on User Benefit Analysis) may be adaptable to asset management. Research by State DOTs on user cost and risk (e.g. in New York, Florida, Texas, and Alaska) may provide relevant concepts and data. Other industries such as electric power and insurance may also provide relevant inputs.

V. RESEARCH OBJECTIVE

The objective of this research project is to develop guidance and one or more example tools to demonstrate quantitative asset-level, project-level, and network-level models for predicting the
life cycle costs associated with preservation, replacement, and risk mitigation activities on the full range of highway assets. These costs may include agency, user, and non-user stakeholder costs. They may be associated with condition, risk, mobility, safety, or any other quantifiable aspect of transportation system performance. The guidance will address major issues such as:

- How to reconcile fiscal limitations with agency and stakeholder performance goals, while minimizing long-term costs;
- Incorporating risk management in its relevant forms, including uncertainty of planning metrics and the potential impacts of unpredictable natural and man-made hazards;
- Considering multiple competing objectives affecting multiple asset classes.
- Recommending a mutually-compatible set of quantitative life cycle planning performance measures for use in various decision-making scenarios including needs identification; comparison of project scope and timing alternatives; prioritization and resource allocation; tracking of the performance of individual assets and groups of assets; comparing investments across asset categories; evaluating projects that affect multiple classes of assets in a corridor; retirement or other disinvestment alternatives; network target-setting and tracking; establishment of level-of-service standards; establishment of treatment selection policies; negotiating funding levels; and public reporting of network performance.
- Documenting commonly-used analysis parameters and the rationale for establishing and using these parameters, including deterioration rates, unit costs, indirect costs, treatment application criteria and effectiveness, discount rate, program planning horizon, long-term cost horizon, fiscal scenarios, and inflation projections.

The model will enable assessment of trade-off decisions to help asset owners understand how investment at one point in the asset’s lifecycle can impact on the whole.

The recommendations developed in response to these objectives will be demonstrated using a generic analysis tool to be developed in this project. This is meant to be an open, transparent working prototype that agencies can use as a model or can elaborate to serve their own needs.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

This research is estimated to cost $350,000 and require 24 months to complete, including the Final Report.

VII. URGENCY AND POTENTIAL BENEFITS

Life cycle cost analysis is an integral part of management systems for major constructed facilities, such as pavements and bridges. It is not yet routine for other types of assets such as signs, traffic signals, and geotechnical assets. Consideration of life cycle cost, especially in combination with the analysis of uncertainty, may identify opportunities to optimize preservation and replacement policies to reduce life cycle costs.

VIII. IMPLEMENTATION PLANNING

The target audience for the research findings and products of this work will be State DOTs, MPOs, transit agencies, and other transportation agencies, as well as researchers and engineering staff involved in transportation. The key decision-makers who can approve, influence, or champion implementation of these research products are the senior staff and CEOs of the transportation agencies. The AASHTO committees that will be involved in the adoption and implementation of the results will be the AASHTO Committee on Planning and its subcommittee on Asset Management.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

This research statements was developed by Transportation Research Board (TRB) Committee on Transportation Asset Management (ABC40) on behalf of the following research sponsors:
NCHRP Review of A-06
This study should be timely and useful, but it must build on work either completed or underway in other related studies. This is a complicated process that requires integration of asset management priorities, performance measures, risk assessment, uncertainty, institutional frameworks, and fiscal considerations. Given the extent of the models and products included in this study, it would be seriously underfunded at $350,000. Increasing to $500,000 at a minimum would be desirable.

FHWA Evaluation of A-06
Nadarajah Sivaneswaran/HRDI - A very timely and important RNS. Recently proposed rules require lifecycle planning (LCP) for pavement and bridge assets and recommend for others. While several agencies conduct LCCA at the project level, few conduct at the asset or network levels and even those few consider only a short analysis horizon not sufficient to capture a sequence of actions over the lifecycle. The proposed deliverables of an "open software tool" that can be adopted or incorporated with agency AMS and manual or guidebook would be very beneficial as agencies address LCP requirements and take advantage of this opportunity to incorporate processes to minimize LCC. The RNS addresses a broad range of topics with different levels of current technical maturity and the final problem statement should carefully consider subset of topics with priority need and potential for successful implementation. The funding appears inadequate for the scope - may require $500,000. If selected, may benefit from coordinating with FHWA's project on next generation and lifecycle performance measures. Getachew Mekonnen/HPTS-10 - One of the most important contribution of this project will be the development of the analytical tool. The objective needs to be more specific regarding the number of tools that will be developed, as opposed to saying one or more example tools. Under background, the research proposal includes a list of tasks that will be accomplished in this project. We think this list should be moved to the "Objectives" part. Item 3 states quantifiable and probabilistic prediction models of deterioration shall be developed. The proposal should not determine, in advance before conducting the research, what approach will be used in the development of the analytical tool. Different alternative approaches can be used in the tool or tools, instead of only probabilistic approach. The costs should include agency, user, and non-user costs, not "may" include. Heather Dylla/HIAP-10 - Not clear on if this is solely focused on LCCA at the asset management level or also the project level. FHWA is currently in the process of updating the LCCA guidance at the project level.
AASHTO Committee Evaluation for A-06

Implementation of Programmatic Life Cycle Cost Analysis in a Transportation Asset Management Framework

Submitted By:
Matthew Hardy
AASHTO Liaison
Committee on Performance-Based Management

Comments:
Ranked #3 by the Committee on Performance-Based Management
I. PROBLEM NUMBER

2019-A-07

II. PROBLEM TITLE

Organizational and Cultural Factors for Successful Transportation Asset Management Integration

III. RESEARCH PROBLEM STATEMENT

Transportation agencies have the responsibility to set strategic goals and objectives, and manage organizational and system performance, to achieve the goals they adopt for their transportation networks. These goals have traditionally involved such objectives as Safety, Mobility and Reliability, and Infrastructure Health. Increasingly, transportation agency goals include such objectives as system resilience and environmental sustainability. Because, in the absence of continuous management by the agency, the metrics for these performance areas decline over time, all decisions for maintaining these metrics need to be made with a long-term view. Similarly, strategies for improving performance in these areas require steady, long-term investments to provide desired results. Short term efforts rarely provide lasting results. Executing long-term strategies requires that an agency “stay the course” through changes in areas such as internal and external leadership, technology, staffing, and the economy. Promoting cost efficient tactical and strategic decisions that foster the achievement of long term goals requires a culture within the organization that affects day-to-day and longer-spaced decision making at all levels.

The recently initiated NCHRP project 08-113, Integrating Effective Transportation Performance, Risk, and Asset Management Practices, focusses on three aspects of organizational effectiveness for implementing long-term change a transportation agency.

1. Integrating performance, risk, and asset management at transportation agencies;
2. Identifying, evaluating, and selecting appropriate management frameworks; and
3. Recruiting, training, and retaining human capital to support asset management and related functions.

While these three areas are critical to successful implementation of performance-based management, they do not directly address the aspects of corporate culture that support an agency’s policies, processes and internal controls. Research is needed to develop guidance on how transportation agencies can create and maintain this culture within their organizations.

This research effort will involve the following activities:

1. Review the available literature, ongoing research, and state-of-the-practice, domestically and internationally, related to the development of performance-based cultures in public-sector organizations.
2. Critically assess domestic and international models for TAM program cultures and organizations to develop a set of cultural factors and organizational models that distinguish the various approaches. The cultural factors should be described with explanations of why they are important, how they work, and recommendations on how to implement them.
3. In cooperation with the project panel, identify and define at least four effective organizational models for TAM programs, and how those organizational models support the agency’s corporate culture.
4. Prepare case studies illustrating application of the most successful organizational cultural models to support performance-based management in public sector agencies.
5. Other issues that should be considered include the following:
   a. How to foster a culture that makes decisions based on a strategic view of goals and metrics and is more concerned with long term trends than short term gains.
b. How to allow for centralized vs decentralized structures.
c. How to balance accountability with collaboration.
d. How to best align more or less autonomous entities such as MPOs with statewide or corridor specific goals.
e. How to understand, accept and target distributions of levels of service in metrics rather than concentrating on single statistics such as the average or percent of assets with a 'poor' metric rating.
f. How to align strategic planning/management with asset management and organizational performance management agency-wide.
g. Understanding staffing requirements.
h. Understanding internal and external communication requirements.

6. Develop tools and procedures that address the barriers to developing an organizational culture that promotes long-term performance-based decision making at all levels.

7. Prepare a guide that assists transportation agencies in developing a cultural improvement plan.

8. Prepare a report detailing the results of the research, including a set of potential actions to further extend the results of the research.

IV. LITERATURE SEARCH SUMMARY

The proposed research is intended to build upon previous research to develop transportation asset management and performance management guidance, including:

- NCHRP Project 8-69: Supplement to the AASHTO Transportation Asset Management Guide: Volume 2--A Focus on Implementation;

V. RESEARCH OBJECTIVE

This research will focus on two areas: 1) identifying successful cultures, and the critical factors that define them, to promote achievement of the strategic goals of the organization; and 2) identifying organizational models that enhance and enable the lines of sight and communication methods and channels that promote this successful culture. Two main products are sought through this research: 1) A catalog of the factors that define a successful transportation asset management (TAM) culture within a transportation agency that promotes asset and performance management at every level, 2) A catalog of organizational models that are conducive to these cultural factors that transportation agencies could consider for improving TAM capabilities.

This problem statement was developed based on research needs identified in the TAM Portal, and through the research roadmap developed for TRB Committee ABC30, Performance Management.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $270,000
VII. URGENCY AND POTENTIAL BENEFITS

All fifty State DOTs, along with Washington D.C. and Puerto Rico, are in the process of implementing performance and asset management to comply with MAP-21 and the FAST Act requirements. Agencies have already begun setting performance targets for the seven national goal areas. In 2018, agencies will submit initial transportation asset management plans, and begin reporting performance for compliance with the federal regulations. Many agencies are complying with these requirements without a fully-developed plan for integrating performance-based management into routine business practices. Agencies that have begun to change their organizations face challenges in finding and retaining staff with the necessary skills, and developing organizational cultures that strive for multidisciplinary approaches to problem solving, and seek continual improvement. This research is needed as soon as possible, to allow agencies to learn from their peers, as well as other industries where organizations have experienced similar transformations. With the initiation of NCHRP 08-113, this research has an opportunity to be delivered at least six months faster than a typical project, saving at least the time to assemble and coordinate a new project panel.

VIII. IMPLEMENTATION PLANNING

Implementation of this research will provide significant benefit to State DOTs looking to implement performance-based management and asset management beyond the minimum requirements of Federal regulations. The research results are targeted at champions of asset and performance-based management at State DOTs, such as those identified in FHWA’s State DOT Asset Management Contact List. Additional outreach will be made through the AASHTO Standing Committee on Performance-Based Management, and its subcommittees on Asset Management and Organizational Management, who can champion the use of the results amongst their peers. No specific “early adopters” have been identified; however, that is likely to be part of the research project. As all State DOTs are currently under requirements to implement asset and performance management, it is anticipated that many states will desire to implement aspects of the research results as soon as they are available.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

This research statements was developed by Transportation Research Board (TRB) Committee on Transportation Asset Management (ABC40) on behalf of the following research sponsors:

- AASHTO Committee on Performance-Based Management
- AASHTO Subcommittee on Asset Management
- Iowa DOT

X. AASHTO MONITOR

n/a

XI. SUBMITTED BY

AASHTO Committee on Performance-Based Management
Chair: Russell McMurry, Georgia DOT
Vice-Chair: Christos Xenophontos, Rhode Island DOT
Research Task Force: Jim Ritzman, PennDOT

1 [https://www.fhwa.dot.gov/infrastructure/asstmgmt/amcontacts.cfm](https://www.fhwa.dot.gov/infrastructure/asstmgmt/amcontacts.cfm)
NCHRP Review of A-07
I am not sure what is meant by “Performance-based cultures in public-sector organizations.” Cultures influence public sector organizations, and organizations influence culture. Policies, economics, technology, leadership are all factors that contribute to corporate culture, and leadership changes with changes in administrations. How all these factors influence the ability to integrate transportation asset management practices into the organization is part of the argument but not necessarily the driving force. It would seem that NCHRP 08-113 should proceed first, and then consider ?cultural factors? after realizing effective practices overall.

FHWA Evaluation of A-07
Steve Gaj/HIAP-30 - This is important as States break down silos and change the way Districts, etc., do business. It's important to document examples of how some States have addressed this. Morgan Kessler/HRDI-20 - Well-developed project statement that builds off existing work. We agree with the author(s) that whole-enterprise culture needs to be researched and somehow captured in case studies. David Luskin/HPTS-30 - The influence of organizational and cultural factors on transportation system asset management is a topic worth investigating, particularly with the current push for the State DOTs and MPOs to manage their performance more effectively. At this stage, however, the investigation of this topic might be best pursued through lower-cost means, such as information exchange through a TRB webinar or an NCHRP synthesis study. The literature search summary does not make clear how the new project would build on previous research. What did the cited studies find and what was missing from their analyses? Discussion is lacking of how the case studies would measure performance for the purpose of identifying the more successful organizational and cultural models. Is success to me measured simply by progress toward meeting an organization's performance targets? Isn't more than that involved, particularly given the possibilities for gaming the targets?

AASHTO Committee Evaluation for A-07
Organizational and Cultural Factors for Successful Transportation Asset Management Integration

Submitted By:
Matthew Hardy
AASHTO Liaison
Committee on Performance-Based Management

Comments:
Ranked #4 by the Committee on Performance-Based Management
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-A-08

II. PROBLEM TITLE

Risk Assessment Techniques for Transportation Asset Management

III. RESEARCH PROBLEM STATEMENT

Transportation agencies must contend with a wide variety of risks as they manage their physical transportation assets. In operating their transportation networks, asset owners frequently must respond to impacts of events outside their control, such as weather events, geo-hazards, and other threats. Planning for the future requires projecting asset performance, construction costs, and future funding, all of which can be highly uncertain. Once an agency has made its investment plans, changes in commodity prices, project timing or other factors may impact delivery of its capital program. Despite improvements in information technology and other areas, deep uncertainty remains with respect to areas such as predicting future weather events, asset condition, system demands, funding and other critical variables. Failure to correctly account for risk can have a variety of consequences, from cost overruns on projects to inaccuracies in estimating future needs, and inefficient allocation of resources. Simply following an extremely risk-averse strategy can have negative consequences, as well; an overly conservative approach to accounting for risk can result in a significant gap between investment planning/budgeting and actual costs. Asset owners thus need better techniques for assessing and managing risk in order to best manage their physical transportation assets.

A number of approaches are commonly used to manage risk, including conducting visual inspections of existing infrastructure, using design standards with conservative safety factors for new infrastructure, and applying best practices for minimizing risks of project cost and schedule overruns. Research is needed to determine how to build on existing practices to better assess the risks to transportation assets, better quantify consequences of different risks, and better prioritize investments explicitly acknowledging uncertainty in future events.

IV. LITERATURE SEARCH SUMMARY

The proposed research is intended to build upon previous research to develop transportation asset management and performance management guidance, including:

- NCHRP Project 08-93, Managing Risk Across the Enterprise: A Guidebook for State Departments of Transportation
- NCHRP Project 8-69: Supplement to the AASHTO Transportation Asset Management Guide: Volume 2--A Focus on Implementation;
- NCHRP Report 806, Guide to Cross-Asset Resource Allocation and the Impact on Transportation System Performance; and

V. RESEARCH OBJECTIVE

The objectives of the proposed research are to:

- Provide tools that will help transportation agencies better identify, quantify and manage risk to their assets.
• Review existing and best practices in risk assessment applicable to managing transportation assets in transportation and other infrastructure-intensive industries. The review should include methods for quantifying risk consequences, such as cost, safety, reliability impacts, as well as any approaches used for addressing compound risks.

• Define improved approaches to incorporating consideration of risk in asset data collection, needs assessment, project alternatives analysis; prioritization and resource allocation; and performance reporting and tracking. The approaches should address how transportation agencies make multi-objective, cross-asset investment decisions under uncertainty to best support the national goals identified in 23 USC 150(b).

• Review techniques that would be applicable in estimating and incorporating levels of uncertainty in the decision making and asset management process. The review should consider approaches used for managing a portfolio of financial risks, as well as other relevant techniques.

• Define measures of asset resilience that can be incorporated into performance management in support of 23 USC 150(a).

• Provide an implementation guide with practical guidance for transportation agencies to use to incorporate improved risk assessment into their existing asset management business processes, adapting strategies for managing financial risk and other approaches identified through the research.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

This research effort is proposed as a two-part effort. The first part of the effort will to synthesize materials on existing practice, perform a critical assessment of existing tools, approaches, performance measures, and frameworks that can be used to improve asset risk assessment. The second part of the research will focus on developing an implementation guide with recommended risk management practices and performance measures.

Potential tasks in Part I of the research include:

1. Review the available literature, ongoing research, and state-of-the-practice approaches for risk assessment. The review should address approaches applicable to managing transportation assets used in transportation and other infrastructure-intensive industries (e.g., water, wastewater, oil & gas, and facilities) in the U.S. and internationally.
2. Perform a critical assessment of existing tools, approaches and frameworks, determining which have the greatest potential for improving risk-based transportation asset management.
3. Identify gaps in the tools, approaches and frameworks.
4. Develop a framework for applying improved risk assessment and dealing with uncertainty to the full set of risks and business processes identified in the project objectives.
5. Identify potential barriers to implementing the risk assessment/management framework.
6. Prepare a report detailing the results of Part I of the research.

Potential tasks Part II of the research include:

1. Detail practical approaches to applying the risk assessment framework and estimating uncertainty to asset management at transportation agencies, integrating recommended new approaches with existing business process.
2. Develop performance measures characterizing level of asset vulnerability and resilience for use in a performance management approach.
3. Prepare an implementation guide.
4. Pilot the implementation guidance and one or more transportation agencies.
5. Conduct a project workshop to review the guidance and pilot results.
6. Prepare a report detailing the results of the research.

Cost: $600,000 ($300,000 each for Part I and Part II)
Duration: 18 months
VII. URGENCY AND POTENTIAL BENEFITS

The passage of the transportation legislation Moving Ahead for Progress in the 21st Century (MAP-21) creates an imperative for improved research. MAP-21 amended 23 USC 150(b) to include national goals for the Federal-aid highway program with a focus on better operating the existing system, such as through improving safety and infrastructure condition. Also, MAP-21 established the requirement for State Departments of Transportation (DOTs) to prepare risk-based asset management plans describing how they will manage their roads and bridges on the National Highway System (NHS) considering risks to the system.

This research will bridge the gap between existing transportation asset management guidance detailed in resources such as the American Association of State Highway and Transportation Officials (AASHTO) Transportation Asset Management Guide and best practices for assessing and managing risks applicable to asset management. The research will help improve the state of the practice in risk-based asset management, and help ensure that the full range of relevant factors is incorporated into transportation agencies’ resource allocation processes.

VIII. IMPLEMENTATION PLANNING

The target audience for the research findings and products of this work will be State DOTs, MPOs, transit agencies, and other transportation agencies, as well as researchers and engineering staff involved in transportation. The key decision-makers who can approve, influence, or champion implementation of these research products are the senior staff and CEOs of the transportation agencies. The AASHTO committees that will be involved in the adoption and implementation of the results will be the AASHTO Committee on Planning and the Committee on Performance-Based Management and its Subcommittee on Asset Management.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

This research statements was developed by Transportation Research Board (TRB) Committee on Transportation Asset Management (ABC40) on behalf of the following research sponsors:

- AASHTO Committee on Performance-Based Management
- AASHTO Subcommittee on Asset Management
- Iowa DOT

X. AASHTO MONITOR

tbd.

XI. SUBMITTED BY

AASHTO Committee on Performance-Based Management
Chair: Russell McMurry, Georgia DOT
Vice-Chair: Christos Xenophontos, Rhode Island DOT
Research Task Force: Jim Ritzman, PennDOT

Contact: Matt Hardy, Program Director for Planning and Performance Management, mhardy@aashto.org

NCHRP Review of A-08
I believe there is significant potential overlap with the newly initiated study, NCHRP 08-113, on Integrating Effective Transportation Performance, Risk, and Asset Management Practices, which is not mentioned in
the Literature Search Summary. The approach envisioned in 08-113 is one of integration. Risk Analysis is not the only driver in a program of successful TAM. The structure of this study would be influenced significantly by the output of NCHRP 08-113.

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**FHWA Evaluation of A-08**

Rob Kafalenos/HEPN-30 - Under Literature Search Summary, suggest including NCHRP 25-25(94) Integrating extreme weather into TAMPs. (2015). Also, this looks like it's an all-hazard approach, which is good, so it would include the full range of risks: budget, economic, as well as extreme weather, seismic, other natural hazards. Steve Gaj/HIPA-30 - Important to advance where we are today as few States are comfortable addressing risks to their network and formalizing and documenting their processes. Kessler/HRDI-20 - This project is similar in many regards to the ongoing HRDI-20 project "Integrating Emergency Response into Transportation Asset Management". It is early enough in the project to possibly tailor the work scope to specifically include some of the goals of this problem statement. Valentin Vulov/HPTS-30 - Need to define and distinguish between uncertainty and risk. Define better the variables with respect to which risk to transportation assets will be considered. Define a desirable framework for risk management. For example, a risk-based asset management where the resources will be prioritized to assets where (asset value x probability of lost of value due to risks) is the highest. Define how incorporating levels of uncertainty in the decision making and asset management process is different from risk management. Can you define better the type of transportation agency where a pilot should be done? "Develop performance measures characterizing level of asset vulnerability and resilience for use in a performance management approach." Is there a relationship between risk and resiliency in this context? How would you define it? Generally, what will be the contribution of this research compared to the numerous existing research in this area (some listed in the problem statement).

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**AASHTO Committee Evaluation for A-08**

Risk Assessment Techniques for Transportation Asset Management

Submitted By:
Matthew Hardy
AASHTO Liaison
Committee on Performance-Based Management

Comments:
Ranked #2 by the Committee on Performance-Based Management
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-A-09

II. PROBLEM TITLE

Making Targets Matter: Effective Practices by Transportation Agencies to Establish, Monitor and Adjust Performance Targets

III. RESEARCH PROBLEM STATEMENT

The AASHTO Committee on Performance-Based Management is seeking to support the implementation of a strategic approach that uses system information to make investment and policy decisions to achieve performance goals. An increasing number of transportation agencies are adopting Transportation Performance Management (TPM) principles to ensure the right investment decisions surrounding transportation projects are made and delivered to produce the performance outcomes desired by the agency, external partners, elected officials, and the public. TPM helps determine what results are to be pursued, using information from past performance levels and forecasted conditions to guide investments, measuring progress toward strategic goals, and making adjustments to improve performance. TPM is grounded in sound data management, usability, and analysis as well as in effective communication and collaboration with internal and external stakeholders. The key to successful implementation of TPM practices lies in the organizational support and agency embrace of data-driven decision making. TPM uses performance information to create a linkage between an agency’s strategic direction, resource allocation decisions, individual employee activities, and external stakeholders’ priorities.

A core piece of TPM is performance targets that connect investment decisions to results in a transparent manner for all stakeholders. Targets are used to assess progress towards achieving strategic goals, guide planning efforts, inform programmatic decisions and adjustments, and communicate with stakeholders. Setting targets has become more common with the requirements outlined in MAP-21 and the FAST-Act, but what remains missing is the establishment of a feedback loop to adjust planning, programming and future target setting decisions. This research will zero in on this challenging yet critical piece of TPM: the relationship between actions taken and performance results and an assessment if targets are practical and reasonable. The value of TPM is not grounded in achieving targets, but in connecting employee actions to results, motivating and focusing staff, increasing accountability, guiding the allocation of resources and tracking the efficacy of various strategies. This research will go beyond how agencies are setting targets by examining closely how agencies are establishing, monitoring, communicating and adjusting performance targets in both the short and long term. In summary, this research will focus on how target setting improves agency decision making.

IV. LITERATURE SEARCH SUMMARY

There are four primary resources available to transportation professionals concerning the establishment of transportation performance targets. They are:

- NCHRP Report 666, Target-Setting Methods and Data Management to Support Performance-Based Resource Allocation by Transportation Agencies—This report, published in 2010, describes methods that managers of state departments of transportation (DOTs) and other agencies can use for setting performance targets to achieve multiple objectives and interact with multiple decision-makers and stakeholder groups, and how data management systems within a DOT can support performance-
based decision-making. The research was conducted prior to the passage of MAP-21 and the FAST Act and provides limited information on how to establish performance targets given the cross-cutting nature of them ranging from national to state to local.

- **FHWA Transportation Performance Management Guidebook**—The FHWA TPM Guidebook introduces a comprehensive TMP Framework that is used to relate the many different elements of performance management to each other. The guidebook includes two chapters that focus on the target setting process (Chapter 2) and monitoring and adjustment (Chapter 5). While an extremely valuable resource to understanding TPM and its interdependencies at a high level, it does not provide the level of detail needed to fully understand the target setting process or how to continually monitor and adjust performance targets to meet agency objectives.

- **NHI Course, Effective Target Setting for Transportation Performance Management**—This course was developed in reaction to the MAP-21 performance management requirements and explains the elements of target setting and focuses on how to set reasonable, attainable targets. The course is designed as an introductory overview of target setting.

- **Transportation Performance Management (TPM) Research Roadmap**—Developed under the NCHRP 20-24 quick response research program, this roadmap includes a multiyear research program that aims to improve the overall implementation of transportation performance management at state, regional, and local transportation agencies. It is available at http://www.tpm-portal.com. The TPM Research Roadmap was developed in cooperation with AASHTO, TRB, USDOT and other industry partners. The purpose of the TPM Research Roadmap is to enable the TPM community to identify, develop and propose TPM research projects that are necessary to improve the understanding of TPM and allow for these projects to be funded through various research programs including NCHRP, quick response research funds, USDOT funding sources, etc. The TPM Research Roadmaps identified target setting as a high priority area with a significant gap in the publication of research, guidance, manuals, and tools on how agencies should approach target setting and ultimately integrate targets into their performance management processes.

**V. RESEARCH OBJECTIVE**

The objectives of this NCHRP Project are the following:

1. Document and highlight successful practices of transportation agencies establishing and communicating performance targets related to both the national regulations and individual state-based targets.
2. Identify and fill the gaps between the needs of transportation professionals and current resources related to target setting.¹
3. Prepare a collection of resources focused on how transportation agencies have and can implement a monitoring and adjustment program in order to track and evaluate actions taken and outcomes achieved related to performance targets.

It is anticipated that this research will be conducted in two parts. The first part will focus on organizing a series of workshops and peer exchanges that will bring together state DOTs, MPOs, and transit agencies that have been involved in the implementation of the national-level performance management regulations in order to share, document and learn from each other how they have established performance targets for the various performance and asset management areas. It is expected that these in-person meetings will focus on agency experience with target setting: a) challenges (e.g., lack of forecasting tools), b) benefits (e.g.,

¹ For example, many transportation agencies identified a concern associated with long term (e.g., aspirational or state-based) versus short term (e.g., the MAP-21) targets and how these two different sets of targets affect investment decisions.
collaborating with stakeholders), c) keys to success (e.g., new data sources identified) and d) how targets are linked to agency decision making. The workshops will also delve into the business processes around target setting: agency staff roles and responsibilities, purpose of the target, information gathered through benchmarking, and external stakeholder roles. In essence, what worked, what didn’t, key lessons learned and keys to success.

The result of part one of this research should be the following:

- Compendium of case studies lessons learned of transportation agencies establishing performance targets related specifically to the national-level performance management regulations. The case studies should highlight both successful and unsuccessful target setting processes to the extent practicable.
- Analysis of the strengths, weaknesses, opportunities and threats transportation agencies face in establishing and implementing performance targets as part of a performance management program.
- Identification of resources needed by transportation agencies to better establish, monitor and adjust performance targets.

The first part of this research would lay the foundation for part two by gathering information on how agencies have used targets beyond merely fulfilling the federal mandates (e.g., assess the efficacy of various strategies). The second part of this research will focus specifically on developing resources related to the monitoring and adjustment of targets as part of a comprehensive performance management program. Monitoring and adjustment is a set of processes used to track and evaluate actions taken and outcomes achieved, thereby establishing a feedback loop to refine planning, programming, and target setting decisions. It involves using performance data to obtain key insights into the effectiveness of decisions and identifying where adjustments need to be made in order to improve performance. To move into the realm of transportation performance management, agencies must actively use information gained from monitoring performance data to obtain key insights into the effectiveness of decisions in making measurable progress towards stated goals and identifying where adjustments need to be made. The combination of monitoring and adjustment processes is the “bread and butter” of TPM, establishing a critical feedback loop between performance results and future planning, programming and target setting decisions.

Currently, there are limited, if any resources, that focus on how a transportation agency can move beyond simply fulfilling the federal mandates (e.g., assess the efficacy of various strategies). The second part of this research will focus specifically on developing resources related to the monitoring and adjustment of targets as part of a comprehensive performance management program. Monitoring and adjustment is a set of processes used to track and evaluate actions taken and outcomes achieved, thereby establishing a feedback loop to refine planning, programming, and target setting decisions. It involves using performance data to obtain key insights into the effectiveness of decisions and identifying where adjustments need to be made in order to improve performance. To move into the realm of transportation performance management, agencies must actively use information gained from monitoring performance data to obtain key insights into the effectiveness of decisions in making measurable progress towards stated goals and identifying where adjustments need to be made. The combination of monitoring and adjustment processes is the “bread and butter” of TPM, establishing a critical feedback loop between performance results and future planning, programming and target setting decisions.

The result of part two of this research will be a collection of resources whereby transportation agencies can truly integrate target setting into agency decision making. The result will be clear steps to linking system level and program/project level targets, the benefits of implementing a monitoring and adjustment program, and how a monitoring and adjustment program can be used to obtain key insights into the effectiveness of decisions and identifying where adjustments need to be made in order to improve performance.
VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

$650,000

**Research Period:**

24 months

VII. URGENCY AND POTENTIAL BENEFITS

The AASHTO Committee on Performance-Based Management serves as the technical and policy resource on TPM issues for AASHTO. As such, the committee frequently identifies needs for research to answer questions or develop methods for AASHTO member departments and individual TPM professionals. This research will assist the committee in fulfilling its commitment, and AASHTO responsibilities, by helping to implement TPM.

This research will specifically benefit many different transportation professionals who are currently implementing a performance management program in their agency. This includes state DOTs, MPOs and transit agencies. This research will make inroads into providing transportation professionals with needed insight and information beyond the federal regulations that so many are focused on right now.

VIII. IMPLEMENTATION PLANNING

The target audience for the research findings and products of this work will be State DOTs, MPOs, transit agencies and other transportation agencies. The key decision-makers who can approve, influence, or champion implementation of these research products are the senior staff and CEOs of the transportation agencies. The AASHTO committees that will be involved in the adoption and implementation of the results will be the AASHTO Committees on Performance-Based Management and its subcommittees and the Committee on Planning.

IX. PERSON(S) DEVELOPING THE PROBLEM

AASHTO Committee on Performance-Based Management
   Chair: Russell McMurry, Georgia DOT
   Vice-Chair: Christos Xenophontos, Rhode Island DOT
   Research Task Force: Jim Ritzman, PennDOT

TRB Performance Management Committee (ABC30)
   Chair: Mara Campbell, CH2M
   Research Co-Chairs:
      Trish Hendren, I-95 Corridor Coalition and
      Matthew Hardy, AASHTO

X. AASHTO MONITOR

n/a

XI. SUBMITTED BY

AASHTO Committee on Performance-Based Management
   Chair: Russell McMurry, Georgia DOT
   Vice-Chair: Christos Xenophontos, Rhode Island DOT
   Research Task Force: Jim Ritzman, PennDOT
NCHRP Review of A-09

Reviewed By:
Andrew C. Lemer
alemer@nas.edu

Comments: Setting performance targets is certainly a major challenge for DOT managers and the subject of ongoing and recently completed research by NCHRP and others. Some of this research is cited in the problem statement, along with reference to the research roadmap developed initially with NCHRP support to guide continuing research activity in this area. It is surprising that the objectives stated in this problem statement are not more clearly linked to either the research roadmap or work to date. Documenting current practices of transportation agencies could create an informative synthesis but it is debatable whether efforts to set performance targets and use them in transportation system development and management have been going on long enough to draw convincing conclusions regarding what practices are most successful and transferable from one agency’s situation to another. Conducting multiple workshops and peer exchanges will add significant travel costs and time to the project, as reflected in the substantial amount of funding recommended. Whether the ultimate intent of the proposed research - developing resources related to the monitoring and adjustment of targets as part of a comprehensive performance management program - is best approached through a single concentrated effort or through a series of smaller efforts designed to make incremental progress warrants discussion that one might expect to see reflected in the TPM research roadmap.

Review Date:
11/22/2017

FHWA Evaluation of A-09

Nadarajah Sivaneswaran/HRDI - This problem statement is based on and addresses Chapter 5 of FHWA’s TPM Toolbox Guidebook. The national PM requirements and state/local initiatives have required agencies to set targets for a number of performance measures but the process to set consequential targets that represents agency’s long term objectives and how they will respond to current decisions are not fully developed. This project is focused on meeting that need. However, the project should closely coordinate with and leverage FHWA efforts on this topic. Pete Stephanos/HIPA-01 - Proposed research is needed for agencies to fully understand the effectiveness of their investments in achieving targets. This proposal is being submitted by the Committee on Performance-based Management as one of their top priorities. FHWA has been involved in a liaison capacity as this proposal was being developed. Although this proposal is not included, as written, in the TPM Research Roadmap, it does support many of the research needs noted in this document. Based on MAP-21 implementation timing, States and MPOs will be in a position by 2020 to assess the effectiveness of their investments so carrying out this work at that time would provide the greatest chance to capture best practices. Wenjing Pu/HPPI-30 - The proposed research is timely and much needed. We have the following suggestions or comments: Elaborate “developing resources,” which is the focus of the second part of this research. What kind of resources are to be developed? Who is the user of the resources? How could the resources be sustained? Recommend
highlighting the example showing as the endnote for Research Objective 2. The example is "many transportation agencies identified a concern associated with long-term (e.g., aspirational or state-based) versus short-term (e.g., the MAP-21) targets and how these two different sets of targets affect investment decisions."

AASHTO Committee Evaluation for A-09

Making Targets Matter: Effective Practices by Transportation Agencies to Establish, Monitor and Adjust Performance Targets

Submitted By:
Matthew Hardy
AASHTO Liaison
Committee on Performance-Based Management

Comments:
Ranked #1 by the Committee on Performance-Based Management

Submitted By:
Elizabeth Robbins
Chair
Committee on Planning

Comments:
COP’s second highest ranking.
PROBLEM NUMBER: 2019-A-10

PROBLEM TITLE

A New Tool Assessing the Value of Resiliency Alternatives by State DOTs

STATEMENT OF THE RESEARCH PROBLEM

Implementing effective government resiliency management programs is in many respects more challenging than in the private sector for several primary reasons.

The nature of the problems addressed by government is exceedingly complex with high levels of uncertainty and multiple constituencies. Decision-making under uncertainty needs to consider the impact distribution over time, and not just negative outcomes. The near-term predisposition can eliminate consideration of decisions that yield much greater long-term value to the public. The absence of a single monetary value measure used in the government setting (as opposed to “for profit” firms) results in decision attributes being measured and evaluated in different ways which makes it extremely difficult to quantify and compare decision options from the perspective of public value. In practice, attributes and their relative importance for government decisions may be based on subjective criteria when no quantitative data is available. These challenges shape how government and political leaders understand risk and what they consider public value.

Most government risk management programs follow the vulnerability-focused, probabilistic federal model. These programs primarily consider only the downside aspects of risk, and lack the ability to explicitly consider potential upside opportunities. They also lack a common measure of value that is necessary to quantify and compare the impact of response alternatives and perform trade-off analyses over different time periods.

Transportation decision-makers need a better method to quantify the impacts of various transportation system resiliency investment and response scenarios that supports consideration of the full distribution of possible of social and economic outcomes and impacts using different time periods.

LITERATURE SEARCH SUMMARY

The research proposed is original, and adapts theoretical concepts developed in an aviation focused case study (Fletcher, K.C., and Abbas, A.E. 2017. "A Value Measure for Public Sector Enterprise Risk Management: A TSA Case Study", Risk Analysis, Under Review), to the surface transportation environment.

Decision analysis has been studied extensively over several decades producing two commonly used evaluation approaches - Multi-Attribute Utility (MAU) and Analytical Hierarchy Process (AHP).

- MAU provides a mathematical model for evaluating and rank ordering decision alternatives related to highly complex problems. This method produces a rank ordering of the decision
alternatives by weighting and scoring individual attributes, and then summing the scores to
determine the total utility (value).

- AHP is a structured analytical approach that breaks down the decision problem into a series of
criteria, sub-criteria (sub-sub-criteria and so on), and evaluates each hierarchy level
independently using pairwise comparison.

Although both MAU and AHP approaches support evaluation of complex problems with a variety of
different attributes (or criteria) measured in different ways, they have several limitations:

- They are subjective with scoring and weighting values too often arbitrarily assigned based on
opinions and without proper justification. In addition, the weights assigned to each AHP hierarchy
level do not account for risk appetite or uncertainty.
- Because of their subjective nature, weighting and evaluation decisions may produce results that
may be more desirable or acceptable.
- The results do not support evaluating and comparing the potential outcome of different decisions
over different time periods that impacts the ability to consider response options that could result in
long-term upside opportunities.

RESEARCH OBJECTIVE

The proposed research will develop a decision analysis support model and tool for use by transportation
officials when assessing resiliency response alternatives that addresses the deficiencies inherent in
current approaches. The envisioned model uses a common measure of public value, incorporates
uncertainty, and allows explicit consideration of the risk tolerance of the decision maker. Using the public
value of social and economic outcomes (both positive and negative), and the associated cost of using
government assets and authorities to achieve those outcomes, the model supports evaluation of both
downside consequences and upside opportunities related to resiliency decision alternatives for
transportation systems and infrastructure. The model will also support evaluating decision outcomes over
different time horizons. The proposed work develops a surface transportation resiliency value model to be
used by transportation officials when assessing and selecting resiliency intervention strategies, and
calibrates the model using case studies.

TASKS

The following draft phases and tasks associated with this research illustrate the scope, scale, and
approach for the proposed work.

PHASE 1: Develop Model and Test on Selected Case Studies

High level tasks associated with this phase are:

- Task 1: Develop PUBLIC VALUE MODEL for surface transportation systems
- Task 2: Conduct case studies
- Task 3: Identify and work with State Transportation Agencies to validate the PUBLIC VALUE
  MODEL

PHASE 2: PUBLIC VALUE MODEL USER GUIDE

Using the validated model from Phase 1, develop a prototype application, and then validate the
application using real world risk/resiliency events related to the two case study transportation systems.
Once the prototype system is validated, develop an implementation user guide. The high-level tasks
associated with this phase include:

- Task 4: Validate the application using resiliency events with transportation officials involved in two
  case studies
Task5: Develop a prototype user guide

ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $500,000

Research Period: 24 months

PERSON(S) DEVELOPING THE PROBLEM

AASHTO SPECIAL COMMITTEE ON TRANSPORTATION SECURITY AND EMERGENCY MANAGEMENT (SCOTSEM)

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fedex zip: 83703

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cell 304-543-1065
home 304-344-1902

PROBLEM MONITORS

DATE AND SUBMITTED BY

Patrick Zelinski

NCHRP Review of A-10

Reviewed By:
Stephan A. Parker
saparker@nas.edu

Comments:
Since 2007, the AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM) has demonstrated a performance-based work planning and engagement approach for the Committee that combined its strategic goals, past accomplishments and planned activities into unified work and engagement plans. Research support projects for SCOTSEM created interactive methodologies to identify research needs and prepare problem statements that led to funded projects.

At its final meeting in July 2017 in Houston, Texas, SCOTSEM applied that methodology to identify four priority projects for NCHRP funding:

**Priority #1 of 4. Deploying Transportation Security Practices in State DOTs**

**Priority #2 of 4. Assessing the Value of Risk and Resiliency Alternatives by State DOTs**

The objective of this research is to develop a surface transportation resiliency value model to be used by transportation officials when assessing and selecting resiliency intervention strategies, and calibrate the model using case studies.

This is a well-written problem statement on an important topic. The budget is appropriate to the scope.

**Priority #3 of 4. Strategies for Incorporating Resilience into Transportation Networks**

**Priority #4 of 4. Building a Resilient Workforce in State DOTs**

Review Date: 12/12/2017

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**FHWA Evaluation of A-10**

Becky Lupes/Rob Kafalenos/HEPN-30 - It would be good to clarify how this builds on, relates (or doesn't relate) to the ongoing NCHRP Study 20-101: Guidelines to Incorporate costs and benefits of adaptation measures in preparation for EWE and CC. Paul Pisano (HOP/HOTO): The tool should consider all aspects of the transportation life cycle, including Operations and Maintenance, not just infrastructure (it's silent on that topic).

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**AASHTO Committee Evaluation for A-10**

A New Tool Assessing the Value of Resiliency Alternatives by State DOTs

Submitted By:
Elizabeth Robbins
Chair
Committee on Planning

Comments:
Not in COP's top 3, but this research would be more robust in terms of the resiliency tool than the 08-36 Task 146 project we funded (with only one response). The 08-36 project would provide $150k but the proposal we received did not seem to address the planning piece in detail. This would provide $500k and produce a tool that may be able to serve the purpose the 08-36 committee was looking for.
Submitted By:
Lorenzo Parra
Vice Chair
Committee on Transportation System Security and Resilience (CTSSR)

Comments:
Committee on Transportation System Security and Resilience (CTSSR) #5 priority
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

Problem Statement Special Note: This problem statement was endorsed by the AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM).

PROBLEM NUMBER 2019-A-11

PROBLEM TITLE

Building a Resilient Work Force in State DOTs

STATEMENT OF THE RESEARCH PROBLEM

Over the past three years, the AASHTO Special Committee on Systems Transportation Security and Emergency Management (SCOTSEM) undertook an exhaustive effort to define and propose a comprehensive research strategy and implementation process for integrating resilience into the nation's transportation systems and programs. In 2016 the AASHTO Board of Directors adopted this definition, framework and forward research program for the period 2016 to 2018. These actions resulted in three funded NCHRP Projects to make the program actionable. These combined objectives of these projects are focused on providing state DOT executive leadership with the necessary information and tools to propagate the principles and effective practices of transportation resilience throughout their agencies.

The AASHTO adopted definition defines resilience as “the ability to prepare and plan for, absorb, recover from, or more successfully adapt to adverse events”. Implicit in AASHTO's definition is an understanding that this capability spans multiple time horizons and affects all aspects of a state DOT. These dimensions are best understood with respect to the NIST Risk Management Framework. This framework outlines five mission critical components to risk and resilience management, including Functions, Assets, Networks, Systems, and People. The People element is defined as including “The necessary personnel needed by a state DOT to ensure that transportation services are provided through any hazard or disruption.”

While other NCHRP and AASHTO initiatives have been concerned with the first four elements of the Framework, little attention has been paid to date to the “People” element. This dimension is a key aspect of the forward action plan and its potential implications for state DOT workforce makeup, employee performance, expectations, and workplace culture. Indeed, without a ready and resilient workforce, sustainable transportation system resilience is impossible to achieve.

A DHS report, A Ready and Resilient Workforce for the Department of Homeland Security: Protecting America's Front Line offered workforce policy guidance for senior executives on institutional and workforce resilience. This policy guidance emerged from a frank assessment of its mission readiness and resilience capacity. The questions DHS asked itself are equally pertinent to state DOTs.

- Is the agency ready to perform the enhanced roles and missions required by a more resilient system?
- Is the agency guided by strong, effective, and trusted leaders?
- Is the workforce trained with the knowledge, skills, and attitudes required to perform the mission?
- Is the workforce properly equipped with the best tools and assets to support the mission?
- Are employees healthy and fit enough to endure the environmental conditions they encounter?
- Can employees withstand and cope with stress?
- Can the agency, management and staff adapt and adjust to challenging conditions?
- Can personnel across the agency rebound and grow from experience?
Recent findings from the 2017 SCOTSEM Annual Meeting suggest that many agencies are not sufficiently mature in the way they are addressing the people side of resilience. This project is intended to provide implementable approaches to building a more resilient workforce.

LITERATURE SEARCH SUMMARY

Despite its increasing importance, a literature search of workforce resilience reveals only a small number of references specifically addressing DOT workforce resilience.

A DHS report, A Ready and Resilient Workforce for the Department of Homeland Security: Protecting America’s Front Line offers policy guidance for senior executives to reshape organizational culture. Many of its findings and recommendations are pertinent to state DOTs and this topic though not specific to transportation.

Several NCHRP Syntheses have been conducted that focused on training, development and certifications of transportation workers, but do not specifically focus on resilience. For example:


Other investigations that have been undertaken deal with knowledge management, however, these studies deal with techniques to retain knowledge rather than adapting and changing the workforce of a DOT.

RESEARCH OBJECTIVE

The objective of this research would be to develop guidance for state DOTs to:

- Develop and promote a unified strategy and common vision of workforce readiness and resilience
- Clarify and expand roles and responsibilities for workforce resilience
- Review and align responsibility and accountability for workforce resilience
- Propose an AASHTO sustainable leadership development program or focus on resilience
- Develop approaches to cultivate and sustain a culture of resilience
- Develop a measurement and evaluation strategy for workforce resilience in a state DOT
- Develop a 5-year workforce resilience work plan for use by AASHTO

Some of the specific Tasks that could be a part of this work include,

Task 1 – literature review and survey of the national and international transportation agency experiences in managing workforce change, adaption, and adjustment. Special emphasis would be placed on successful efforts and long-term sustainability in different types of agency environments.

Task 2 – compile case studies and examples from state DOTs of innovative ways to organize and develop an agile and resilient DOT. For example, Tennessee DOT merged and cross-trained staff - four to five additional persons are cross-trained to perform a particular function that has been designated as an “Essential Function” of the DOT. The DOT also created new job classifications and eliminated older ones. In addition, they are working with a local technical college to provide classes at regional DOT centers so staff has easier access to college credits and degrees. Other potential practices would include how to set up organization to be ready for any future challenges; how to establish professional qualifications,
certifications, and/or performance standards for individuals and teams; how to approach outsourcing and its associated issues; how to handle turnover and retain knowledge gained through experience; and how to transfer quickness and nimbleness of emergency response efforts to every day efforts.

**Task 3** – develop and test maturity models of potential organizational characteristics that would define a resilient DOT workforce.

**Task 4** – develop guidelines and templates for operationalizing readiness and resilience into agency practices.

**ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD**

<table>
<thead>
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<th>Recommended Funding:</th>
<th>$350,000</th>
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</thead>
<tbody>
<tr>
<td>Research Period:</td>
<td>24 months</td>
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</tbody>
</table>

**PERSON(S) DEVELOPING THE PROBLEM**

**AASHTO SPECIAL COMMITTEE ON TRANSPORTATION SECURITY AND EMERGENCY MANAGEMENT**

**Mr. Brian W. Ness (Chair)**  
Director  
Idaho Transportation Department  
3311 W. State Street  
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**VIII. PROBLEM MONITOR**

**IX. DATE AND SUBMITTED BY**

Patrick Zelinski

NCHRP Review of A-11
Since 2007, the AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM) has demonstrated a performance-based work planning and engagement approach for the Committee that combined its strategic goals, past accomplishments and planned activities into unified work and engagement plans. Research support projects for SCOTSEM created interactive methodologies to identify research needs and prepare problem statements that led to funded projects.

At its final meeting in July 2017 in Houston, Texas, SCOTSEM applied that methodology to identify four priority projects for NCHRP funding:

Priority #1 of 4. Deploying Transportation Security Practices in State DOTs
Priority #2 of 4. Assessing the Value of Risk and Resiliency Alternatives by State DOTs
Priority #3 of 4. Strategies for Incorporating Resilience into Transportation Networks
Priority #4 of 4. Building a Resilient Workforce in State DOTs

The “People” dimension is a key aspect of the forward action plan and its potential implications for state DOT workforce makeup, employee performance, expectations, and workplace culture. Indeed, without a ready and resilient workforce, sustainable transportation system resilience is impossible to achieve.

Recent findings from the 2017 SCOTSEM Annual Meeting suggest that many agencies are not sufficiently mature in the way they are addressing the people side of resilience. This project is intended to provide implementable approaches to building a more resilient workforce.

This is a well-written problem statement on an important topic. The budget is appropriate to the scope.

FHWA Evaluation of A-11

Clark Martin/HIN - The State DOTs are a centerpiece for highway program delivery and currently challenged with increasing responsibilities and limited resources. A better understanding of policies and programs to enhance State DOT workforce development will improve efficiency and program delivery.
Submitted By:
Lorenzo Parra
Vice Chair
Committee on Transportation System Security and Resilience (CTSSR)

Comments:
Committee on Transportation System Security and Resilience (CTSSR) #4 priority

Submitted By:
Clarisse Coble
Liaison
Human Resources

Comments:
• Overall comment – This is very timely and much needed. It will impact multiple future DOT activities and related research efforts. I believe A-11 is more urgent/important than A-01 – if we need to prioritize.
• Overall comment – The AASHTO HR subcommittee should sponsor this research effort.
• Overall comment – Requirements for the research contractor should include at least one industrial/organizational psychology expert (does not have to be a psychologist) – perhaps a member of SIOP? – SIOP = Society of Industrial Organizational Professionals.
• Section IV. Literature search summary
  o There are several more NCHRP studies that are related to this topic and should be included
  o The literature search could include information that is focused on another discipline but is transportable to the transportation industry – that is, findings can be directly applied in the transportation industry
• Section VI. Estimate of problem funding and research period
  o $350K is on the light side – I would anticipate this would be $400K-$600K
• Section VIII. Problem Monitor
  o Recommend the AASHTO HR subcommittee be the sponsor or co-sponsor if there is another committee that wants to sponsor the research effort
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

Problem Statement Special Note: This problem statement was previously approved by the AASHTO Special Committee on Research contingent on funding from the Transportation Security Administration. Funding for the project became unavailable so SCOTSEM is resubmitting the problem statement requesting funding from the NCHRP Program.

I. PROBLEM NUMBER
   2019-A-12

II. PROBLEM TITLE
    Deploying Transportation Security Practices in State DOTs

III. STATEMENT OF THE RESEARCH PROBLEM
    In 2012, the AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM) adopted NCHRP Report 525 Vol. 14: Security 101: A Physical Security Primer for Transportation Agencies. Since the publication of Security 101, there have been both significant changes and a substantial increase in knowledge about surface transportation security. In response to this changed landscape, NCHRP Project 20-59(51)A "Update of Security 101: A Physical Security Primer for Transportation Agencies" was initiated in September 2015 to update the Security 101 guidance and resource material. This new edition will include not only the latest state of the practice recommendations on physical security, cybersecurity and infrastructure protection as defined in the Security 101 primer, but will also present the transportation security function in the broader contexts of system resilience and sustainability, systems management and operations (broadly defined). The updated Security 101 Primer is scheduled to be available in the 1st Quarter of 2018.

    As a part of this project, the contractor will prepare a stand-alone technical memorandum titled "Implementation of Research Findings and Products. This required deliverable will (a) provide recommendations on how to best deploy the updated Security 101 approaches into practice; (b) identify possible institutions that might take leadership in applying the research findings/products; (c) identify issues affecting potential implementation of the findings/products and recommend possible actions to address these issues; and (d) recommend methods of identifying and measuring the impacts associated with implementation of the findings/products.

    Additionally, the Contractor’s Final Report will contain an Implementation Plan that describes, at a minimum, (a) the "product" expected from the research, (b) the audience or "market" for this product, (c) a realistic assessment of impediments to successful implementation, (d) the institutions and individuals who might take leadership in applying the research product, (e) the activities necessary for successful implementation, and (f) the criteria for judging the progress and consequences of implementation.

    As noted in the NCHRP Project 20-59(51)A request for proposals, “Implementation of these recommendations is not part of the [update] research project and, if warranted, details of these actions will be developed and implemented in future efforts.” All too often, research products are not fully deployed in State DOTs due, in part, to a lack of tools, training and tutors. This research is intended to more effectively bridge the gap between security research and DOT practice and thereby reduce the risk to the nation’s travelers, economy and infrastructure.

    This proposed project supports and has been informed by Goal 4 of SCOTSEM's 2014-2018 Strategic Plan “Advance the state-of-the-practice and awareness of transportation infrastructure protection and emergency management through training, technical assistance, and technology transfer activities.”

IV. LITERATURE SEARCH SUMMARY

A-12/1
No literature search in TRID was conducted. The research proposed in this project is original and has not been undertaken in any other forum or arena.

The Final Report Summary for NCHRP 20-59(29) All-Hazards Security and Emergency Management Implementation Plan, November 2010 was used to identify potential deployment strategies and funding estimates.

V. RESEARCH OBJECTIVE
The objective of this research is to develop and implement a comprehensive deployment and change management strategy assisting states who wish to more effectively evaluate and implement the revised security guidelines recommended in the updated Security 101 Primer and related material developed in NCHRP 20-59(51)A.

The following draft set of tasks illustrates the scope and scale of the proposed work.

PHASE I

Task 1. Meet with the Project panel to discuss and finalize the working plan.

Task 2. Review the updated Security 101 Primer, the 20-59(51)A Implementation Plan and the technical implementation memorandum.

Task 3. Review the current physical and cybersecurity practices of transportation agencies in meeting their responsibilities and assess the gaps existing between commonly deployed practice and the recommendations contained in the revised Security 101 guidelines.

Task 4. Develop a security guidelines deployment strategy and a revised work plan for Phase II. Based on the material contained in the updated Security 101 Primer, the Project’s Implementation Plan and the Technical Implementation Memorandum, develop security implementation, workforce development and change management plans incorporating both didactic and experiential tools, techniques and workplace learning approaches. The plan should include recommendations of appropriate learning and change management techniques spanning a 12-month deployment schedule.

At a minimum the techniques and approaches that should be estimated, considered and possibly recommended should include:

- Workshops/Training Classes
  - National events
  - Regional events
  - Statewide (i.e., DOT-wide) events
- Peer To Peer Programs
  - Peer Ambassadors
  - Peer-to-Peer Reviews
  - Peer Exchanges
  - Train-the-Trainer Program
- Presentations
  - Conferences
  - Webinars
  - Website Materials
  - Technical Advisories
  - Press Releases
  - Publication-ready Articles
- Technical Training Courses for Use in Educational Institutions (NHI, Centers, Professional Development Programs, etc.)
- Use of the NOCoE knowledge base and forums
Note: the contractor will be expected to meet with the NCHRP oversight Panel approximately 1 month later. The Task 4 recommended research activities will be discussed with the panel at the interim meeting. A PowerPoint presentation provided at the interim meeting should be suitable, after revision, for use by panel members and others in describing the research and for posting on the project website.

PHASE II

Task 6. Develop training and educational courses and supplementary materials.
Based on the strategy, techniques and approaches selected in Task 1, develop and test the lesson plans, training courses and other materials for use in the deployment strategy.

Task 7. Coordinate stakeholder outreach and engagement; implement the deployment strategy
Based on the strategy approved by the NCHRP Panel, Conduct, at a minimum, the following events.
- At least 1 national workshop/training class of at least 6 hours.
- At least 4 regional events – 1 per AASHTO/SCOTSEM Region of at least 2 hours
- At least 2 events to be held at an individual DOT
- At least 1 nationally publicized webinar
- At least 2 conference presentations, one at the TRB Annual Meeting and one at the TSSR Annual Meeting

Contractors are encouraged to be creative in the selection of their proposed venues and events, identifying a diverse audience from field personnel to CEOs. Co-locating and joint scheduling with existing meetings, conferences and other training events is encouraged.

Task 8. Final deliverables should include the following: (1) the updated Security 101 implementation and change management strategy and all supporting lesson plans, scripts, training exercises and all other didactic and experiential material developed in support of the strategy; (2) a final report summarizing the background research; (3) an updated interim meeting PowerPoint presentation suitable, upon revision, for posting on the project website; and (4) a stand-alone 1-page executive summary in a suitable format of text and graphics aimed at senior decision makers.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

<table>
<thead>
<tr>
<th>Recommended Funding: $750,000</th>
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<tbody>
<tr>
<td>Research Period: 24 months</td>
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</table>

VII. PERSON(S) DEVELOPING THE PROBLEM

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NCHRP Review of A-12

Reviewed By: Stephan A. Parker
saparker@nas.edu

Comments:

Since 2007, the AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM) has demonstrated a performance-based work planning and engagement approach for the Committee that combined its strategic goals, past accomplishments and planned activities into unified work and engagement plans. Research support projects for SCOTSEM created interactive methodologies to identify research needs and prepare problem statements that led to funded projects.

At its final meeting in July 2017 in Houston, Texas, SCOTSEM applied that methodology to identify four priority projects for NCHRP funding:

Priority #1 of 4. Deploying Transportation Security Practices in State DOTs

This problem statement was previously approved by the AASHTO Special Committee on Research contingent on funding from the Transportation Security Administration. Funding for the project became unavailable so SCOTSEM is resubmitting the problem statement requesting funding from the NCHRP Program.
The objective of this research is to develop and implement a comprehensive deployment and change management strategy assisting states who wish to more effectively evaluate and implement the revised security guidelines recommended in the updated Security 101 Primer.

This is a well-written problem statement on an important topic. The budget is appropriate to the scope.

Priority #2 of 4. Assessing the Value of Risk and Resiliency Alternatives by State DOTs

Priority #3 of 4. Strategies for Incorporating Resilience into Transportation Networks

Priority #4 of 4. Building a Resilient Workforce in State DOTs

Review Date: 12/12/2017

FHWA Evaluation of A-12

Sheila Duwadi/HRDI-20 - The problem title is 'Deploying Transportation Security Practices in State DOTs' with the objective of developing implementable products from the ongoing project NCHRP 20-59(51) that will produce an updated Security 101 Primer with an implementation plan, geared for completion the 1st quarter of 2018. It may be worthwhile to first review the completed report. Additionally, there are three NCHRP studies underway focused on implementing security, emergency management and resilience products. Under NCHRP 20-117 research is underway to develop and provide implementation support tools, services, and strategies to enable state DOTs to mainstream transportation system resiliency into day-to-day practices. Two major outcomes will be development of Resilience Guide and Toolkit, and a National Summit and Peer Exchange. This Summit and Peer Exchange titled, “Transportation RISE 2018 (Transportation Resilience Innovations Summit and Exchange)” is planned for October 2018 and will be a major event. An approach beyond the Summit from dissemination to deployment will be developed. Two other projects, NCHRP 20-59(54) and NCHRP 20-59(55), are developing tools and practices to further the understanding and assist States in implementation. In light of all these, it may be worthwhile to wait for results of these efforts, and revisit this problem statement at a later stage.

AASHTO Committee Evaluation for A-12

Deploying Transportation Security Practices in State DOTs

Submitted By: Lorenzo Parra
Vice Chair
Committee on Transportation System Security and Resilience (CTSSR)

Comments:
Committee on Transportation System Security and Resilience (CTSSR) #2 priority
I. PROBLEM NUMBER

2019-A-13

II. PROBLEM TITLE

Improving Data and Information Sharing for Collaborative Regional Operations and Traveler Information

III. RESEARCH PROBLEM STATEMENT

Modern data management applications in the transportation industry make static and real-time data available to regional partners or to the public through various standards-based connections. Extensive regional integrated datasets are made available to the various stakeholders through the use of analytics, data warehousing, and business intelligence tools.

Some standards exist for data sharing within regional mobility management, but usually in specific segments of the operation (i.e., Traffic Management Data Dictionary [TMDD], Center to Center [C2C] protocols), which do not include all data elements needed for Integrated Corridor Management (ICM), and regional mobility management. For instance, TMDD works well for data sharing between traffic management centers, but does not include some data or granularity of data needed for decision support systems and modeling systems within ICM and Smart Cities. For instance, lane data (speed, volume, occupancy) is only available in most C2C systems at the macroscopic level (all lanes combined). Transit data within C2C systems is mostly static information and does not include real-time vehicle location and passenger count information.

Lessons learned from the ICM implementations, Smart City programs, and regional mobility programs in the U.S. point to research gaps and ideas that can help data sharing programs. These gaps can be organized along three general areas: a) data warehousing and data sharing standards, b) use of Intelligent Transportation Systems (ITS) standards and regional ITS architectures, and c) institutional coordination. This problem statement further expands on these topics.

The FHWA and several Transportation Research Board (TRB) Committees have identified research in this area as a high priority. This problem statement was identified as the 9th highest research need of over 100 needs identified in Transportation Research Circular E-C218: Advancing Freeway Operations through Strategic Research (TRB, 2016). This problem statement is sponsored by the TRB Freeway Operations Committee (AHB20) and endorsed by the following committees/subcommittees: Regional Transportation Systems Management and Operations (RTSMO) (AHB10) and the Active Traffic Management Joint Subcommittee (AHB20[5]).

IV. LITERATURE SEARCH SUMMARY

U.S. National ITS Architecture

The National ITS Architecture provides a common framework for planning, defining, and integrating intelligent transportation systems. It is a mature product that reflects the contributions of a broad cross-section of the ITS community (transportation practitioners, systems engineers, system developers, technology specialists, consultants, etc.).

The architecture defines:

- The functions (e.g., gather traffic information or request a route) that are required for ITS.
• The physical entities or subsystems where these functions reside (e.g., the field or the vehicle).
• The information flows and data flows that connect these functions and physical subsystems together into an integrated system.

A well maintained Regional ITS architecture will include the data sharing standards and methods needed for regional mobility management and identify the sources and protocols for sharing data between agencies and with the public.

Center to Center (C2C) Standards
C2C communication involves peer-to-peer communications between computers involved in information exchange in real-time transportation management in a many-to-many network. This type of communication is similar to the Internet, in that any center can request information from, or provide information to, any number of other centers.

Transportation Management Data Dictionary (TMDD)
The TMDD Standards were developed to support center-to-center communications as part of the regional deployment of ITS in order for centers to cooperate in the management of a corridor, arterial, traffic incidents, special events, etc. Hence the TMDD provides the dialogs, message sets, data frames, and data elements to manage the shared use of these devices and the regional sharing of data and incident management responsibility.

Transit Communications Interface Profile (TCIP)
TCIP is an American Public Transportation Association Standard that provides a library of information exchange building blocks which allow transit agencies and transit suppliers to create standardized tailored interfaces. APTA TCIP is based on the earlier TCIP work performed by ITE, AASHTO, and NEMA and published as the NTCIP 1400-series standards. APTA TCIP extended the NTCIP Standards to include a Concept of Operations, Model Architecture, Dialog Definitions, and a rigorous, modular approach to conformance. Both the APTA TCIP development and the earlier NTCIP development were sponsored by the US DOT ITS Joint Program Office.

Integrated Corridor Management (ICM)
Many jurisdictions have implemented a variety of strategies for maximizing flow on facilities by using all available pavement and managing their facilities by using new technologies and better techniques. Most recognize the importance of interjurisdictional coordination with emergency responders, maintenance and incident response, and construction management, as well as providing timely notification to the public in managing their systems. Monitoring traffic operations through traffic management centers with reliable detection and surveillance and available deployment strategies (e.g., incident response) is an active engagement in reducing recurring and nonrecurring congestion.

NCHRP Scan 12-02 identified some key aspects of ICM deployments related to data sharing and data warehousing. Sharing data among agencies is a key component of an ICM system. This can be accomplished through manual methods (e.g., phone calls, text messages, and on-line messaging) or through more-automated systems. Most of the sites the team visited have some form of an ITS standards-based C2C system that allows automated exchange of data among agencies. However, many sites do not use the full functionality of the C2C systems, and not all partner agencies are connected to the systems. The report identified data fusion as a key area for ICM, and defined the maturity of data fusion as follows:

The data fusion process area relates to transportation agencies’ ability to accept and disseminate information across multiple modes to enable informed decision-making. This integration extends the security and privacy concerns arising from data collection because it increases the scope and reach of the information generated. Data collection functions provide necessary “raw material” for transport network management; however, decisions cannot be made on data. In fact, many transportation agencies have too much data. To be useful, the data must be integrated and transformed into information.
Specific Goals and Practices:

- **Level 1**: Individual agencies have data on their systems, and some sharing is done either through a data feed or manually.
- **Level 2**: Multiple agencies have near real-time data, which is provided to the travelers in the corridor; however, the data is not centralized.
- **Level 3**: Multiple agencies have near real-time data, which is integrated into a central data system and provided to the travelers in the corridor. Data is only one way; that is, agencies provide data to the central system, but do not receive fused data from the central system.
- **Level 4**: Multiple agencies have near real-time data, which is integrated into a central data system and provided to the travelers in the corridor. Data is provided to the agencies, so that their operational systems are updated with fused data.
- **Level 5**: Multiple agencies and modes have near real-time data, which is integrated into a central data system and provided to the travelers in the corridor. Data is provided from both private and public sources and fused together to provide more coverage of the entire corridor. Data is provided back to the agencies, so that their operational systems are updated with fused data.

State of the Practice on Data Access, Sharing, and Integration Document

In 2012, the Federal Highway Administration (FHWA) initiated a 3-year project entitled “Virtual Data Access (VDA) Framework” to develop a prototype framework for sharing planning and operations data between State and local transportation agencies from multiple sources within a region. The framework will bring together many types of transportation data to give planners and operators a multifaceted view of transportation performance both over time and by location. The purpose of the VDA Framework is to improve the breadth of available data and reduce the barriers to the use of those data so that transportation agencies across a region can advance their decision making and performance reporting capabilities in the area of operations.

The purpose of this state-of-the-practice review was to lay both technical and institutional foundation for all aspects of the development of the VDA Framework. The review focused on current data sharing and integration practices among State and local agencies, example data environments, technical integration formats, and business rules for integration and sharing. State, local, and regional transportation operators, planners, and data professionals can use this report to enhance their data sharing and integration efforts by building on the experiences and effective practices of other agencies documented in the report.

Geospatial Data Collaboration initiative

FHWA’s Geospatial Data Collaboration (GDC) initiative encourages State Departments of Transportation (DOTs) and others to use geospatial tools to increase collaboration, improve information-sharing, and streamline transportation decision-making. FHWA established GDC as one element of its Every Day Counts (EDC) initiative. EDC aims to produce innovations, resources, and partnerships to shorten project delivery, enhance safety, and protect the environment. Both EDC and GDC leverage and support other ongoing FHWA efforts such as Planning and Environment Linkages (PEL) and Eco-Logical. All of these efforts are helping stakeholders work better together to achieve faster and more informed transportation decisions and projects.

Smart Cities

Lastly, recent efforts revolved around connected/smart cities, representing the culmination and evolution of the above research efforts. With ITS laying the groundwork for innovative transportation solutions, many cities are currently serving as laboratories for new types of transportation services. Smart cities are emerging as a next-generation approach for city management, taking the steps forward along the transportation technology continuum. Integrating ITS, connected vehicle technologies, automated vehicles, and other advanced technologies – along with new mobility concepts that leverage the sharing economy – within the context of a city provides the enhance travel experiences and make moving people and goods safer, more efficient, and more secure. By
enhancing the effective management and operation of the transportation system, smart city solutions can leverage existing infrastructure investments, enhance mobility, sustainability, and livability for citizens and businesses, and greatly increase the attractiveness and competitiveness of cities and regions.

V. RESEARCH OBJECTIVE

The objectives of this research are to: (1) review existing studies and practices on data sharing within a region; (2) provide guidance on the planning, design, deployment and on-going operations of a data warehouse and data sharing system based on the user needs of the regions for ICM, Regional Mobility, and Smart Cities; and (3) develop the Contents and Structure of Message(s) to Extend and/or Supplement the TMDD standard to include transportation management strategies for common implementation between government, industry, travelers and intelligent devices. Current ITS standards will be associated with data types for the various connections and data standard needs identified. In addition to ITS standards, this research will investigate the role of the Regional ITS Architecture on data consistency and coordination.

The end products of this research are: (1) a comprehensive report of existing data sharing mechanisms, processes, and standards needed for integrated corridor management; (2) best practices for data warehousing guidance document; and (3) memorandum of understanding templates for inter-agency and 3rd party data sharing agreements.

This research will require the following tasks:

Task 1: Current Practices and Gaps in Data Sharing
Based on experiences in many metropolitan areas gaps exist in the use of ITS standards and regional ITS architectures. This task will document the common issues among metropolitan areas in data sharing and integration, and identification of gaps in existing standards for day to day operations. In addition, the analysis will investigate the reasons for unavailability (or lack of usage) of ITS Architectures.

Task 2: Data Sharing Practice Document
In order to improve regional mobility, data needs to be shared among several key actors:
1. Travelers and ride sharing companies - They choose how and when (within constraints) they travel. They choose how to respond to an incident.
2. City, regional and state transportation agencies
3. Public safety and emergency management agencies
4. Navigation management industry
5. Freight management industry
6. Intelligent devices - Smart traffic signals, ramp meters, and soon to be smart cars.

This task will survey representative groups from the key actors in order to identify data sharing requirements and data security protocols for:
1. Sharing traffic management goals (reduce congestion, reduce emissions, reduce traffic in a certain area, etc.)
2. Sharing traffic management response plans
3. Sharing high level decision making data that will let the actors above to work in concert.
4. Sharing data between mobile devices
5. Sharing connected vehicle data

Based on the findings of these surveys, a data sharing practice document and recommended institutional coordination processes document will be developed. This will include the development of recommendations for development and setup of a data sharing environment and a data sharing framework, including access to agency data to develop connected vehicle applications.
A-13/5

Task 3: Institutional Coordination

There must be open communication and cooperation among agencies and third party traffic information providers to share data for integrated corridor management. Coordination between government and industry are often working at cross purposes. Some data needs are truly regional in nature (e.g., traveler information), while others are perhaps localized to a corridor or a specific junction between two agencies (state DOT and city sharing freeway and signalized ramp terminals data for queue management at a ramp meter). The data sharing can be done informally or more formally (i.e., through intergovernmental agreements or MOUs that define roles and responsibilities). Additionally, private sector data, data analytics, and use of social media provide additional data exchange and data fusion opportunities to produce multi-modal and user friendly transportation information. For this task, the research will focus on the following institutional challenges of implementing regional data warehouses and data sharing between regional agencies:

- Institutional arrangements and approaches for successful system management, both between public sector and public-private arrangements.
- Change in planning practices to focus on regional mobility
- Recommended language for MOUs

Task 4: Develop Message Sets and Data Mapping for ICM

Mapping information and data flows to the architecture and standards if there are gaps would appear to be something worthy of pursuing. Development of an operational concept and requirements document will be developed, which builds off of work people have been pursuing for all types of ICM applications to determine the range of messages, data elements and protocol uses to facilitate these exchanges. This would provide the basis for comparing what is in the architecture and related standards.

Task 5: Implementation Guide for Common Data Sharing

Develop the Contents and Structure of Message(s) to Extend and/or Supplement the TMDD standard to include transportation management strategies for common implementation between government, industry, travelers and intelligent devices.

Task 6: Knowledge Transfer

Make best practices, data and methodologies available to the transportation community. Develop Data Warehouse Guidance Document on the key items and best practices to consider when implementing a Data Warehouse for integrated corridor management.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$ 600,000

Research Period:

18 months

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

There is increasing awareness and deployments of integrated corridor management systems and there is a need for data sharing and integration among agencies, and private sector services to deploy systems that are cost-efficient and produce benefits.

VIII. PERSON(S) DEVELOPING THE PROBLEM

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IX. PROBLEM MONITOR

Selected members from the TRB Freeway Operations (AHB20) Committee would be available to serve on the technical review panel for this project.

X. SPONSORSHIP: This Research Problem Statement has been sponsored by:

AASHTO Transportation System Operations Committee
TRB Freeway Operations Committee;
TRB Regional Transportation Systems Management and Operations Committee; and
TRB Joint Subcommittee on Active Traffic Management

XI DATE AND SUBMITTED BY

Shailen Bhatt, Executive Director, Colorado DOT & Chair, AASHTO Committee on Transportation Systems Operations

NCHRP Review of A-13

Reviewed By:
William C. Rogers
wrogers@nas.edu

Comments:

This is a worthwhile project, but the research period should be increased to 30 months.

Review Date:
11/16/2017

FHWA Evaluation of A-13
A-13/7

Tianjia Tang/HPPI-30 - Suggest that the A-13 and B-05 be merged as a single study subject.

AASHTO Committee Evaluation for A-13

Improving Data and Information Sharing for Collaborative Regional Operations and Traveler Information

Submitted By:
Galen McGill
Research Coordinator
Committee on Transportation System Operations (CTSO)

Comments:
The membership of CTSO collectively decided this is the #1 priority. This is especially important to the CTSO Working Groups on ITS, Systems Integration, and Operations Strategies.

Submitted By:
Lorenzo Parra
Vice Chair
Committee on Transportation System Security and Resilience (CTSSR)

Comments:
Committee on Transportation System Security and Resilience (CTSSR) #1 priority

Submitted By:
Sharon Edgar
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel
Council on Public Transportation

Comments:
consider all modes
Problem Statement Special Note: This problem statement was endorsed by the AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM).

PROBLEM NUMBER 2019-A-14

PROBLEM TITLE

Strategies for Incorporating Resilience into Transportation Networks

STATEMENT OF THE RESEARCH PROBLEM

Over the past 25 years, the global goods movement system has suffered from many large-scale disruptions such as the 2011 Japanese tsunami that crippled worldwide auto manufacturing or the 2010 Iceland volcanic eruptions that affected millions of travelers and thousands of time-sensitive shipments. Unfortunately, these incidents appear to be increasing in both severity and frequency, as illustrated by the 2017 hurricane season. Over this same period, longer and more complex supply chain management techniques such as just-in-time/just enough production, inventory, and distribution systems have created demands for more reliable and resilient delivery systems that, in turn, depend on a reliable and resilient multi-modal freight transportation infrastructure. Disruptions to this system, especially to critical components, can cause significant economic damage to companies, local communities, and increasingly to national and global interests. Moreover, increased interconnectedness and interdependencies between companies have introduced new risks and result in greater economic damages. For example, a recent Accenture study estimated that significant supply chain disruptions reduced the share price of affected companies by as much as seven percent. Not surprisingly, companies worldwide see better protection, reliability, and resilience of their supply chains as a major priority.

Methodologies to Estimate the Economic Impacts of Disruptions to the Goods Movement System (NCHRP Report 732, 2012) described the impacts of bottlenecks and interruptions to the flow of goods through the nation’s freight system, the dynamics of that flow in response to disruptions, and the full economic impact on public and private freight interests. Although the project explored the feasibility of developing a high-level and a more detailed level methodology for assessing the economic impacts of disruptions to freight networks, the researchers indicated that it would be very useful to further develop their approach by including the economic impacts due to varying degrees of resiliency (i.e., the amount of time and effort necessary to recover or restore supply chains from a significant disruption), particularly of the publically funded transportation infrastructure.

Transportation network resiliency is one of the most important aspects of determining the ultimate economic impact of a disruption. The degree to which a network (i.e., infrastructure) can bounce back from a significant disruption (generally defined as >96 hours) is directly related to the level of economic impact. If a rail line that is disrupted can be restored or traffic diverted in a short period of time, the economic impact is likely to be not as great as a disrupted line that causes weeks of delay. The concept of resiliency, and how it relates to economic impact and the strategies for incorporating resiliency in networks, is an important topic in the broader investigation of economic impacts of network disruptions.

The fundamental problem is this: public sector infrastructure managers are often unaware of the supply chain requirements of their users and the impact their resilient-related decisions have on multiple supply chains while supply chain managers have little opportunity to influence public infrastructure reliability and resilience investment decisions. The economic implications of this disconnect are profound. Transport services are protected, restored, or enhanced using “worst first” approaches, often without regard for supply chain impacts.
Related to the previous issue, research would be useful in identifying the costs and benefits of different investment strategies to enhance the reliability, resiliency and cost efficiency of multi-modal freight networks. What strategies make the most sense given the different magnitudes of economic costs to likely disruptions? What are the benefits of implementing such strategies? What are the costs associated with this implementation?

LITERATURE SEARCH SUMMARY

Much of the supply chain literature generally focuses on specific commodities (e.g., oil, fuel, coal, auto parts, or consumer electronics) where transportation disruptions are viewed as *force majeure* events. Network resilience strategies are couched in risk management terms where rerouting is the most commonly used remedial approach. Since the supply chain owner rarely owns or controls the infrastructure, little mention is made of infrastructure resilience strategies.

In supply chain freight models, the origin of the freight is the shipper of the freight and the destination of the cargo is the receiver of that freight. This is different from trip-based models that maintain a single mode for the freight, but then need to treat the transfer between modes as the origin of a new trip, typically as a special generator. A supply chain model would link all of these transfer trips. Supply chain models are similar to truck touring models in that they link many trips. They differ from truck touring models in that supply chain tours potentially include multiple modes. However, they do not include all trucks moving in tours, just those that carry cargo defined as freight.

To date, these models have not developed the input to this supply chain choice process, which is a multi-supply chain OD freight table. All existing supply chain models use the FAF by aggregating all reported supply chains by commodity to a total. While it is possible to develop models that create this table, as estimated from a supply chain-based commodity flow database (i.e., the FAF), this has not yet been done.

In addition, freight fluidity measures hold particular promise for application in the US. Such measures are end-to-end, cross-modal transportation performance analyses of supply chains. In the U.S., they are focusing on speed (transit time), reliability (transit time variability) and cost (market prices) for major supply chain types. The key work thus far has been done in Canada, where the concept was first developed and where an on-going program exists in major trade lanes. However, very little research on models that lead to such performance measures prediction has been conducted.

A complementary area of research involves the resilience of various transportation infrastructures, most commonly air and maritime ports, usually with regards to natural disaster (e.g., storms/flooding, sea level rise) or human-caused risks (e.g., strikes/riots/vandalism, human error/operating error). Not surprisingly, since infrastructure owners support multiple performance measure supply chains without relying on any one of them operationally, there is little mention made of specific supply change impacts. Most researchers accept that improvements to improve infrastructure resilience will make supply chains more resilient, without directly linking the two.

The consequence of these two research traditions is two distinct types of resilience: the resilience of the transportation link of a supply chain as a separate idea from the resilience of the transportation infrastructure supplying transport services. Although a logical consumer-producer relationship between these two perspectives exists, little research modeling the physical, economic and operational connections between these two domains has been discovered.

RESEARCH OBJECTIVE

Develop and apply a conceptual model and guidelines for linking supply chain economic (i.e., cost efficiency) impacts (i.e., risk, benefit) with transportation infrastructure investment decisions affecting network resilience. This unified resilience model should encompass port, project, corridor, regional and statewide scales.
TASKS

Some of the tasks for this research could include:

1. Review of current freight analysis models and critique with respect to representation of supply chain performance
2. Outline key characteristics of the supply chain and how such characteristics can be represented in model form
3. Conduct case studies of typical supply chains and describe how existing models can (or cannot) be used to model the supply chain flows
4. Identify gaps in supply chain modeling and propose research plan to fill these gaps
5. Subject to the budget, identify a subset of these gaps and develop models and methodologies to improve supply chain modeling that can be used to improve transportation decision making

ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $600,000
Research Period: 24 months

PERSON(S) DEVELOPING THE PROBLEM

AASHTO SPECIAL COMMITTEE ON TRANSPORTATION SECURITY AND EMERGENCY MANAGEMENT (SCOTSEM)

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PROBLEM MONITOR
Since 2007, the AASHTO Special Committee on Transportation Security and Emergency Management (SCOTSEM) has demonstrated a performance-based work planning and engagement approach for the Committee that combined its strategic goals, past accomplishments and planned activities into unified work and engagement plans. Research support projects for SCOTSEM created interactive methodologies to identify research needs and prepare problem statements that led to funded projects.

At its final meeting in July 2017 in Houston, Texas, SCOTSEM applied that methodology to identify four priority projects for NCHRP funding:

Priority #1 of 4. Deploying Transportation Security Practices in State DOTs

Priority #2 of 4. Assessing the Value of Risk and Resiliency Alternatives by State DOTs

Priority #3 of 4. Strategies for Incorporating Resilience into Transportation Networks

The objective of this research is to develop and apply a conceptual model and guidelines for linking supply chain economic (i.e., cost efficiency) impacts (i.e., risk, benefit) with transportation infrastructure investment decisions affecting network resilience. This unified resilience model should encompass port, project, corridor, regional and statewide scales.

This is a well-written problem statement on an important topic. The budget is appropriate to the scope. The work would build on that nearing completion in NCFRP 50, Improving Freight Transportation Resilience in Response to Supply Chain Disruptions, which is anticipated to be completed in July 2018.

Priority #4 of 4. Building a Resilient Workforce in State DOTs

Review Date:
12/12/2017
Chair
Committee on Planning

Comments:
COP's third highest ranking.

Submitted By:
Lorenzo Parra
Vice Chair
Committee on Transportation System Security and Resilience (CTSSR)

Comments:
Committee on Transportation System Security and Resilience (CTSSR) #3 priority
Research Field B

TRANSPORTATION PLANNING
NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-B-01

II. PROBLEM TITLE

Tool and Guidebook to Identify Commercial Delivery Parking Needs for Loading and Unloading in Metropolitan Areas

III. RESEARCH PROBLEM STATEMENT

In recent decades, major shifts in supply chain organization have changed the way that goods move in metropolitan areas. Historically, deliveries to commercial establishments were large and relatively infrequent. Computerization and tracking technologies led to the emergence of just-in-time supply chains reliant on smaller, more frequent deliveries to replenish stock or meet production demands in near real-time. More recently, the rapid emergence of e-commerce, and associated increasingly on-demand delivery models, has further changed the frequency, speed, and end location of deliveries. According to Morris (2004), between 1974 and 2004, deliveries to commercial properties in cities increased by 300%.

Despite these rapid changes in trip frequencies, end delivery locations, and trip times, few metropolitan areas have made comprehensive updates to the way that they manage commercial loading space (Morris, 2004; Chen et al., 2017). As a result, mismatches between freight demand and available parking and loading capacity result in expensive delays for operators, detrimental traffic and environmental impacts from double parking, and potentially dangerous multimodal conflicts (Conway et al., 2013). Without an adequate understanding of commercial vehicle parking needs, it is difficult for Departments of Transportation and other street operators to account for freight activity when prioritizing on-street space for multi-modal users. It is also difficult for planning agencies to update zoning codes with appropriate parking and loading dock requirements. To enable informed updates to both on-street curb management strategies and off-street zoning requirements for commercial deliveries, there is a need for a better understanding of freight parking demands at a building or curbside scale.

While general freight demand models exist to predict commercial truck trip frequencies as a function of land use (Holguín-Veras et al., 2012), these do not address all of the variables that impact parking and loading space requirements. For some sectors, such as ecommerce, even daily trip demands are not yet well understood, and are rapidly changing. To quantify the space required for freight loading and unloading, in addition to daily trip demands, there is a need to understand additional trip characteristics such as the temporal distributions of different delivery types, the vehicles used for these movements, and the duration of delivery events. Methods are needed to identify and obtain relevant data from public or private sources, measure and quantify these variables, and to apply them for estimation of freight parking and loading space demand.

Further complicating the challenge of implementing effective space management strategies for commercial vehicles is the fact that different municipal departments and private stakeholders typically handle functions related to parking and loading management such as planning, design, building, permitting, entitlement processes, scheduling, and enforcement. Very frequently, communication between these stakeholders is limited, and the knowledge of individual stakeholders may only address specific aspects of the issue. As a result, there is often a disconnect between functions. Research is also needed to identify effective strategies for multi-stakeholder coordination in implementing freight loading management strategies.
To support state departments of transportation (DOTs) and their partnering agencies, the proposed research should address three aspects of this freight parking problem:

- The analytical aspect – developing quantitative and analytical tools to estimate freight parking and loading demands.
- The regulatory aspect – developing methodologies to apply freight parking and loading demand estimates to evaluate curb management alternatives and off-street loading space requirements.
- The coordination aspect – identifying methods and requirements for effective collaboration of different stakeholders to implement strategies to address parking needs for deliveries in a metropolitan area.

The product of this research would be a comprehensive analytical tool and guidebook that integrates these three critical aspects to assist transportation planners and engineers to plan, implement and operate new initiatives related to last-mile deliveries/pick-ups in metropolitan areas. This information will assist transportation professionals in state DOTs, metropolitan planning organizations (MPOs), and municipal governments.

**IV. LITERATURE SEARCH SUMMARY**

This project is expected to build on existing work in the areas of freight demand estimation and commercial vehicle parking management. The proposed work seeks a "data-informed" method based on demand estimation to identify commercial vehicle parking demand and evaluate loading space management strategies.

For estimation of business-related commercial truck trips, the proposed work may benefit from the National Cooperative Highway Research Program (NCHRP) Project 08-80/National Cooperative Freight Research Program (NCFRP) Project 25; this study employed Commodity Flow Survey data to estimate freight trip generation (FTG) rates as a function of land use (Holguín-Veras et al., 2012). These FTG models were employed by the District Department of Transportation in Washington, DC to evaluate the need for loading zones at business establishments (Holguín-Veras, Lawson, and Cleckley, 2017). For markets not covered by these models – such as home-based e-commerce – recent studies have used use "proxies" or indirect (allegedly correlated) data to assess demand. For instance, Clarke et al. (2015) found the geo-demographic characteristics of age, income, rural/urban location, and physical store accessibility were important factors affecting online shopping frequency. Wang and Zhou (2015) found that a number of demographic factors were highly correlated to the number of online purchases delivered to home, including web use frequency, education level, age, gender, self-employed status, race, household income, households owning more vehicles, and households with child. In the international community, an Engineering and Physical Sciences Research Council (EPSRC)-sponsored Freight Traffic Control 2050 project has been looking into the potential for using parcel carrier manifest data to investigate freight generation by land use type in central London. As manifest data are routinely collected by carriers, analyses are far more cost effective than manual surveys conducted by the roadside or in-vehicle.

Several studies have examined freight parking choice, behavior, and availability at the curbside. Some have relied on field observation (e.g. Conway et al., 2016; Zou et al., 2016) or microsimulation (e.g. Muñuzuri, Racero,, and Larrañeta, 2002; Nourinejad et al., 2014) to examine parking behaviors and related traffic impacts. Others have implemented GIS-based analysis methods to quantify available parking and loading space (Jaller; Chen and Conway, 2017). Still other studies analyze curbside parking space from subjective data; for example Allen, Piecyk, and Pietrowska (2017) noted that from a parcel carriers’ perspective, extremely limited curb parking space is one of the important factors that result in longer walking distance and longer time spent on foot making deliveries, potentially resulting in unreliable service or even financial penalties such as parking fines.
The proposed study is envisioned to investigate available methods of data collection and analysis and to integrate analytics, regulations and coordination to provide more efficient solutions than work that has not considered these three aspects together.

References:


V. RESEARCH OBJECTIVE

The research objective is to develop an analytical tool and guidebook to assist agencies in identifying, designing, and implementing commercial delivery parking solutions for States and metropolitan areas.

For estimation of freight parking and loading demand, the tool should consider operational variables such as demand, type of business and the commodities handled, square footage, vehicle type, dwell time, and times of delivery. The tool should also consider infrastructure variables such as curb regulations, zoning requirements, and competing uses (e.g. transit) for available space. The tool should be adaptable to metropolitan areas of varying sizes and densities with varying parking and loading infrastructure (e.g. curb loading, alleys, off-street parking). As part of the research, a method for the planning and implementing improved loading management strategies will be developed, considering policy and coordination aspects.

The produced guidebook should describe the methodology underlying tool development as well as the steps for implementation by public and private practitioners who are responsible for allocating space for freight deliveries/pick-ups. The guidebook would include specific recommendations on policies and strategies that state DOTs and local agencies could implement with private stakeholders to better meet freight demands and reduce congested roadways due to freight deliveries.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$450,000

Research Period:

24 months

VII. URGENCY AND POTENTIAL BENEFITS

Currently, many metropolitan areas face severe challenges in providing freight parking. Frequently, double parked freight vehicles obstruct travel lanes for both motor vehicles and bicycles, resulting in traffic congestion, excessive emissions, and dangerous multimodal conflicts. Often, the lack of available parking and loading space for commercial vehicles is due to limited available data at the local level to assess freight parking needs and limited institutional expertise in freight delivery activity and parking behavior. These problems are further exacerbated by a lack of coordination between multiple public and private sector entities who manage different aspects of the planning, operations, management, and enforcement.

This guidebook will provide a user-friendly tool and guidance to assist DOTs and other relevant agencies to estimate local demand for commercial vehicle parking and loading space; to identify and evaluate improved strategies for space management; and to coordinate between relevant stakeholders to achieve successful implementation.

VIII. IMPLEMENTATION PLANNING

The tool and Guidebook produced by this proposed research will provide implementable benefits to state DOTs, MPOs and municipal governments. Managers and staff in these organizations responsible for planning functions will benefit greatly from the tool and Guidebook.
The Minnesota DOT has agreed that they would be willing to evaluate the research products in their agency, and leadership in the Federal Highway Administration Freight Management and Operations has indicated their support of this statement and willingness to distribute/implement the work with their state DOT network.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

To be assigned by NCHRP staff.

XI. SUBMITTED BY

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NCHRP Review of B-01

Reviewed By:
William C. Rogers
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Comments:
This is a high priority project. The demand for commercial vehicle parking space (both for freight and service vehicles) in metropolitan areas will only increase, driven in large part by the ease of ordering goods and services via the internet, an aging population who may be unable to drive, and the high cost of automobile ownership in dense urban areas. Developing a guide and analytical tool that accounts for the myriad of factors influencing commercial vehicle parking demand would be very beneficial to metropolitan decision makers.

Review Date:
11/16/2017

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FHWA Evaluation of B-01

Sarah Sun/HEPP-30 - Managing access to urban parcels with commensurate demands on curb space, loading zones, and other facilities is a longstanding challenge. Renewed emphasis on mixed use developments, curb space competition with TNCs, and changes in last mile delivery services have made the governance task more complex. Operations and enforcement/compliance deserve extra attention in this effort. Jumping into tool development will be a distraction from developing a sound study design and validating research findings. Recommend deferring tool development pending formal confirmation of research readiness.

AASHTO Committee Evaluation for B-01

Tool and Guidebook to Identify Commercial Delivery Parking Needs for Loading and Unloading in Metropolitan Areas

Submitted By:
Sharon Edgar
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel
Council on Public Transportation

Comments:
consider impacts on transit operations and users, as well as bike and ped needs
I. PROBLEM NUMBER

2019-B-02

II. PROBLEM TITLE

Environmental Impacts of Access Management

III. RESEARCH PROBLEM STATEMENT

Access management has been proven to be a transportation technology that is capable of reducing crashes and improving traffic operations in a very cost effective manner. However, the environmental impacts of access management projects can differ greatly, particularly with access management retrofit projects, which can change the existing access layout along a corridor already in use.

In today’s age of moving towards greater environmental and economic stewardship, it is important to develop and increase usage of proven technologies which assist not only in safe and efficient multi-modal travel, but also in protection of the human and natural environments. This research proposes to evaluate the environmental impacts of access management as defined in the TRB Access Management Manual. This project will look at sustainability, air quality impacts and greenhouse gas quantities for access management projects. Currently, there is a renewed interest nationally and internationally in vehicular emissions, particularly as it relates to the formation of greenhouse gases. To date, there has been no research specific to the environmental impacts of implementing access management treatments.

Access management treatments separate speed differentials, remove turning traffic from through lanes, and restrict left turns to improve traffic flow and improve safety. Access management has been shown to be highly effective in terms of improving both traffic safety and traffic flow. Crash rate reductions as high as 30 percent are well-documented, by the Federal Highway Administration, in before and after research where access management has been implemented. The 2nd Edition of the Access Management Manual documents similar benefits including a reduction in crashes by 50%, increase roadway capacity by 23% to 45%, and reduce travel time and delay by 40% to 60%. It is not uncommon for the peak hour mean travel speed of urban arterials to improve by 10 miles per hour after access management treatments have been implemented, based on studies from FHWA and the Florida Department of Transportation. While the improved traffic flow implies improved fuel economy and reduced emissions, it has not been quantified. It is well-known that motor vehicles traveling at a near constant speed of 35 to 50 miles per hour tend to produce considerably less pollutant emissions than those involved in "stop and go" traffic, based on a literature performed by the Washington State Department of Transportation.

For arterials, since access management techniques/treatments tends to produce urban arterial roadways that operate at free flow speeds of 35 to 50 miles per hour, according to the Florida DOT, there could be demonstrable energy efficiency, air quality, and greenhouse gas emissions benefits from wider implementation of access management treatments, not to mention that these implementations have been proven to provide economic benefits to business and society overall as documented in Chapter 2 of the 2nd Edition of the Access Management Manual. A method to measure the environmental effects of access management treatments that result in improved access to transit and bicycle and pedestrian facility networks, and potential mitigation of storm
water runoff through the reduction of impervious surfaces from numerous driveways and/or the use of green infrastructure in medians would provide value to transportation practitioners and others.

Metropolitan Planning Organizations, state transportation and environmental agencies, and the U.S. Environmental Protection Agency (USEPA), are constantly looking for ways to reduce emissions, and increase sustainability. In this work, researchers will develop relationships between various access management treatments (or variations thereof), fuel consumption, produced emissions, societal benefits and economic improvements. Collected field data, in conjunction with a fuel consumption and emissions model, will be used to extrapolate the empirical data to develop a methodology to estimate corridor and area-wide air quality impacts of access management treatments. Furthermore economic and societal benefit data will be collected based on resident and business surveys. The air quality data could also be used for conformity determination. For the sustainability of these techniques, the report will look to better quantify the Performance Measures for Sustainability Goals, as defined in Exhibit 3-6 of the 2nd Edition of the Access Management Manual, which are:

- Reduce environmental impacts
- Reduction in emissions and air pollution metrics
- Reduction in energy use per person
- Reduction in fuel consumption
- Improvement in level of environmental enhancements and landscaping

These goals further the definition of Sustainable Transportation which, as also defined in the Access Management Manual is:

- Preserving and restoring environmental and ecological systems
- Fostering community health and vitality
- Promoting economic development and prosperity
- Ensuring equity between and among population groups and other generations

This research will evaluate whether access management projects not only provide safe and efficient travel, but also reduce emissions, improve air quality (especially hot spots near trip attractors), reduce fuel consumption, reduction in travel time thus congestion and by extension reduced emissions. Furthermore, researchers will identify any secondary benefits that these improvements also produce.

IV. LITERATURE SEARCH SUMMARY

The project statement authors are not aware of research directly applicable to this area of study. Air quality studies related to access management treatments were not readily found in the literature. However, numerous studies have been performed using onboard portable emissions testing devices (PEMS) and applying macroscopic and microscopic emissions modeling, which can be applied in conjunction with access management implementation to quantify air quality impacts. While multiple studies were found correlating greenhouse gas emissions to transportation, none specifically address access management. Those studies, however, will provide guidance to this study. Furthermore, no specific study was found directly relating the topics of access management and sustainability but many studies were found documenting the relationship between transportation and sustainability and these will be utilized to guide the development of the report and analysis for this project.
V. RESEARCH OBJECTIVE

The research objective is to develop and test a methodology to estimate corridor and area-wide environmental impacts and sustainability impacts as a function of access management implementation.

To satisfy this objective, the following tasks are anticipated:

1. Perform a literature review of sustainability as it relates to transportation and greenhouse gas and air quality studies including applicable modeling activities, information on other measurable environmental effects of AM treatments should also be gathered (such as impacts related to water quality/storm water runoff).
2. Develop an experimental design to collect field emissions data from corridors with different access management treatments (or variations thereof), different congestion levels (peak and off-peak), different driving behaviors, and different access density levels. Additionally, the surveys will be developed in this task which will be utilized to analyze the more qualitative elements of overall sustainability.
3. Develop Interim Report on findings of Tasks 1 and 2, and allow one (1) month for panel review time;
4. Finalize experimental design based on panel review and collect field and survey data;
5. Develop corridor and area-wide models using the finding from the field data and microscopic emissions models; Utilize the results of the modeling to inform the design, and revisit if needed; run models a second time with the revised analysis parameters if needed.
6. Run a pilot test in same locations – in other words, (may be a Phase II, for future round of funding) and require additional time and resources) – IMPLEMENT the results in the real world and see if projections met expectations. In same corridors where field conditions were collected. This is key if this kind of research will truly lead to being utilized and beneficial.
7. Document research results in final report and allow three (3) months for panel review; and
8. Disseminate the information to the transportation community in the form of a written document and other press releases

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:
It is estimated that this research would require $450,000 to complete.

(Note: This estimate may be changed by the AASHTO Standing Committee on Research.)

Research Period:
It is estimated that this research would take approximately 24 months to complete.

(Note: This estimate may be changed by the AASHTO Standing Committee on Research.)

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

This research has the potential for a large benefit in terms of cost and sustainability. Access management is a proven traffic safety and operational technique and quantifying improvements in environmental impacts and overall sustainability will only further the implementation of these proven techniques. Transportation engineers and planners can use the research results to better plan and implement access management treatments that are the most environmentally friendly (and under what traffic conditions these occur). Furthermore, the models developed as part of this research will assist many stakeholders. State transportation and environmental agencies and the USEPA are constantly looking for ways to reduce emissions. The results can
be used to persuade local agency decision-makers (elected officials, city managers, etc.) of the air quality benefits of access management. Private shipping companies will find the information valuable as they can use the results to identify roadways with desirable geometric roadway characteristics that can facilitate efficient package delivery and reduce fuel consumption and emissions. For example, UPS uses in-house mapping software to plan trips to avoid making left-hand turns. A UPS press release stated, “In the last year alone, this system has shaved nearly 30 million miles off UPS’s delivery routes, saved 3 million gallons of gas, and reduced emissions by 32,000 metric tons of CO₂ ….” The research community, and those promoting access management, will also benefit from quantification of the sustainability and environmental impacts of access management.

There is urgency in the U.S. to provide low cost solutions to provide greater sustainability, reduce vehicular emissions and the resultant formation of greenhouse gases. The results of this research can be used to determine how effective access management can be in this effort. The payoff potential may be very high, this research is necessary to make this determination.

VIII. PERSON(S) DEVELOPING THE PROBLEM

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IX. PROBLEM MONITOR

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X. DATE AND SUBMITTED BY

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Questions on the process can be directed to the same address or cjencks@nas.edu.

NCHRP Review of B-02

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:

The motivation for the project is to expand current assessments of travel time and safety benefits of access management projects to include environmental, social, and economic benefits that fit into a broader sustainability framework. The focus on access management could provide a useful method for state DOTs to more fully evaluate the benefits of retrofit projects. The proposed project includes collecting a considerable amount of field data, and developing a prototype model and experimental design to pilot the method at several sites with a pre- and post-project design. The recommended budget and research period is unlikely to accommodate the extensive field work required or proposed multiple pre- and post-project pilot tests (the problem statement suggests the pilots be conducted through a continuation of the proposed project).

Measuring and validating GHG emissions via field work is unlikely; GHG emissions are largely a function of overall energy consumption. Currently, some agencies are using MOVES for project-level GHG assessments while others use higher-level, more strategic methods to measure GHG emissions changes.

The value of the proposed project depends on the ability of a research team to develop a robust model, the likelihood of future additional funding of an effort to validate the model, and the ability to coordinate a series of pre- and post-project studies across the country. One potential reduction in scope could be to focus on AQ and WQ benefits; such a focus could inform streamlining and benefits related to permitting while also expanding the assessment of benefits beyond improvements for traffic and safety.

Note that NCHRP has a project in development on methods to measuring GHG emissions reductions that are appropriate for state DOT decision-making processes and for evaluation of GHG emissions reductions from transportation strategies (NCHRP 25-56; project page: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4384 ). It is likely that systematic approaches to access management would be considered among these strategies to reduce GHG emissions. This project will also include a substantial implementation component.

Review Date:
11/21/2017

FHWA Evaluation of B-02

Karen Perritt/HEPN-10; Susan Jones/HEPE-30 - In terms of air quality impacts only, it may be difficult to generalize the air quality impacts of access management strategies based on limited field data. Additionally, some tools may already be available to local transportation partners to capture the impacts
of some access management strategies. Other strategies may benefit from more detailed information such as before/after drive cycles. The usefulness to transportation conformity is unclear. Access management and stormwater has no documented relationships and this project merely indicates stormwater as a possible linkage. This research does not benefit stormwater or water quality practitioners.

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AASHTO Committee Evaluation for B-02

Environmental Impacts of Access Management

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – This research could provide benefits by being better able to estimate corridor and area-wide impacts as a function of access management. To ensure all perspectives are considered, the panel should include experts in roadway geometric design, roadway operations, bicycle and pedestrian design and operations, air quality, and roadside water quality.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-B-03

II. PROBLEM TITLE

Initiating the Systems Engineering Process for Rural Connected Vehicle Corridors

III. RESEARCH PROBLEM STATEMENT

The National Connected Vehicle Field Infrastructure Footprint Analysis is a starting point for agencies that are looking ahead to a connected and automated vehicle environment. Connected vehicle research continues to progress, developing potential safety, mobility, and environmental applications for a variety of scenarios and users. Findings and lessons learned from the USDOT Connected Vehicle Pilot Deployments will be very helpful to inform other agencies planning for connected vehicle deployments in their jurisdictions.

However, given the fast-paced evolution of connected vehicle technologies, agencies need a vision now for long-term planning regarding deployments. To date, most connected vehicle research has focused on applications in urban areas, but agencies need to also plan for the responsibilities and resources required for deploying, operating, and maintaining infrastructure on rural freeways. Rural freeways often include long stretches of highway with limited power and communications. Similarly, there are often long distances between cities or services for travelers and long distances of roadway infrastructure to be maintained and operated. The Wyoming Connected Vehicle Pilot Deployment serves as a logical example of applications on a rural freeway setting, yet a series of questions remain to be answered related to rural deployments of connected vehicle applications, including:

- What applications will be most relevant on rural freeway corridors? Given relatively higher percentages of long-distance freight and recreational travelers, the information and applications needed may differ from other locations with higher percentages of local and commuting traffic.

- How should an agency prioritize when and where infrastructure should be deployed? Some agencies have developed policies and warrants regarding the spacing and placement of cameras and dynamic message signs (DMS) along rural freeway corridors. How do these policies and the placement of other ITS deployments translate to the needs, prioritization, placement, and spacing for deploying equipment to support connected vehicles?

- What scale of deployments should agencies anticipate on rural freeway corridors within five, ten, and twenty years, respectively? Specifically, what density and types of equipment should an agency expect for rural freeway corridors?

- What level of multistate coordination may be required for connected vehicle applications on rural freeway corridors, given relatively high percentages of long-distance recreational and freight travelers? For example, freight traveling from Chicago to Seattle could be routed along I-90 in the event of poor travel conditions on I-94 in North Dakota, but would need that information to make that decision before leaving Wisconsin.

- How will connected vehicle deployments in rural areas change agency operations? What activities will be needed to support operations and maintenance, and what activities will no longer be needed? When could legacy ITS assets be de-commissioned?
• Will connected vehicle deployments on rural freeways create efficiencies or increase demands on agencies and transportation management centers (TMCs), as related to data needs, data processing and archiving capabilities, communications, staffing considerations, and software requirements? How will the agencies technical resource requirements evolve?

• How can rural data backhaul challenges be addressed?

IV. LITERATURE REVIEW

Past studies of connected vehicle technology have focused primarily on hardware and communication protocols used for vehicle-to-vehicle and vehicle-to-infrastructure connectivity. Studies of vehicle-to-infrastructure connectivity have concentrated on urban applications, such as traffic signals. No study has examined the strategic deployment of vehicle-to-infrastructure in rural freeway environments, with long distances and relatively sparse communications infrastructure to support backhaul.

V. RESEARCH OBJECTIVE

The objective of this research is to help agencies anticipate the needs of connected vehicles on rural freeway corridors, including the anticipated roles and responsibilities of agencies in deploying, operating, and maintaining equipment and the associated needs related to staffing and resources. Recognizing the value of the systems engineering process, this project will develop a model Concept of Operations and Requirements document to serve as a starting point for agencies responsible for rural highways to use as they begin to document their needs, operational concepts, scenarios, and requirements. Tasks anticipated in this project could include the following:

1. Outreach, Research, and Synthesis of Rural Connected Vehicle Findings. Efforts in Task 1 will conduct outreach to the rural transportation community to share the goals and activities of this project. The research team will research the findings, conclusions, and results of previous research studies, demonstrations, and deployments of connected vehicles in rural areas or along multi-state corridors to capture any conclusions regarding the infrastructure needs. Suggested approaches include contacting representatives of agencies that have deployed, planned or prepared proposals for CV deployments in rural areas to discuss their planned or actual deployments, with particular emphasis on the preliminary and/or final results of the CV Pilot deployment in Wyoming. Work with existing CV groups (e.g. CV Pooled Fund Study, V2I Deployment Coalition, etc.) to the extent possible.

(Deliverables: Technical Memorandum 1 – Synthesis of Rural Connected Vehicle Findings)

2. Rural Corridor Connected Vehicle Needs Assessment. Efforts in Task 2 will conduct outreach and engagement with a number of state and/or local DOT representatives responsible for operating rural freeways, with an emphasis on multi-state corridors, to gather their input and perspective on at least two key issues:

(a) To develop an understanding of the needs not currently addressed by other solutions that might be addressed by Connected Vehicles; and

(b) To document the potential positive and negative impacts of rural corridor connected vehicle deployments on operations and maintenance of systems and technology components (e.g. demands for staffing time and skills to perform operations, maintenance, troubleshooting)

Task 2 is proposed to be a detailed needs assessment to help understand the need for and potential of CV applications in rural areas. It is expected that multiple representatives would
be involved from each of the DOTs contacted as part of this project, representing areas such as operations, maintenance, freight, planning, traveler information, safety, information technology (IT), etc. A considerable effort is anticipated to find and engage the appropriate individuals to allow for a broad discussion about the needs and possible impacts of CV application deployment. As a result of this desire to work with multiple groups within the DOTs involved, the total number of DOTs included may be limited. The activities to accomplish the outreach and needs assessment is expected to include a variety of in-person meetings (one-on-one or workshops) with a representative set of DOT staff who can offer input on the needs assessment. The exact format of outreach is to be proposed by the researcher.

(Deliverables: Completion of Outreach Meetings & Documentation of Findings into Technical Memorandum 2)

3. Rural Corridor Connected Vehicle Concept of Operation and Requirements. Using the needs documented in Task 2, the research team will develop a model Concept of Operations and Requirements document for a Rural Connected Vehicle Corridor. The Concept of Operations will build upon the stakeholder needs to define operational concepts (including most likely connected vehicle application deployments), scenarios, stakeholder roles, and high level functional requirements. The intent of this model document will be to serve as a resource for agencies operating rural highways to use with their local stakeholders as a resource as they start their local systems engineering process. The model document will not go into the level of detail that a local site would include, but instead would provide a basis for the more detailed discussions each agency will need to conduct. It is anticipated that the DOTs contacted in Task 2 would continue their involvement contributing to the model Concept of Operations draft versions.

(Deliverables: Model Concept of Operations and Functional Requirements for Rural Connected Vehicle Deployments)

4. Final Report and Presentations. Efforts in Task 4 shall assemble all information gathered, describe the context and intended use of the model Concept of Operations, and create and compile a Final Report and presentation materials describing the results of the project. Two presentations at national venues would be included to share results of this project.

(Deliverables: Final Report and two presentations of findings)

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:
Recommended funding for the research is $350,000.

Research Period:
The research effort is expected to take approximately 18 months.

VII. URGENCY AND POTENTIAL BENEFITS

The state and local DOTs that own and operate the transportation infrastructure are beginning to plan for a major investment of resources to prepare their infrastructure to integrate connected vehicles. While much of the emphasis has been dedicated to urban areas, connected vehicle deployments in rural areas hold tremendous potential for improvements in safety, mobility and efficiency. Rural areas typically have less ITS infrastructure than metro areas, and deploying the backhaul communications and roadside equipment will likely take longer. Therefore, it is critical that the agencies that operate the rural infrastructure have a vision towards their likely deployment as soon as possible.
VIII. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Corey Johnson, Minnesota Department of Transportation
Robert Koeberlein, Idaho Transportation Department
Dean Deeter, Athey Creek Consultants
David L. Huft, South Dakota Department of Transportation

IX. AASHTO MONITOR

David L. Huft, Research Program Manager
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X. SUBMITTED BY

David Huft, Chair, North/West Passage Pooled Fund Study TPF-5(190), on behalf of the
Washington, Idaho, Minnesota, Montana, North Dakota, South Dakota, and Wyoming Departments
of Transportation

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NCHRP Review of B-03

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:

This problem statement outlines a project to develop early responses to the deployment of connected
vehicles on rural freeway corridors. By emphasizing those segments of the network that often cross state
borders, the project could provide good insights into inter-jurisdictional issues and help agencies avoid
the hazards of uneven or conflicting regulatory and technology regimes. However, it is unclear why the
project is limited to V2I technology, given the high interest and impending adoption of AV technology by
the freight industry.

The proposed project describes an early implementation effort, which needs to be informed by several
ongoing NCHRP projects, including NCHRP 20-102 Task 15
(http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4224 ), and other projects managed
under the NCHRP 20-24 Connected/Automated Vehicle Research Roadmap for AASHTO.

Review Date:
11/21/2017
AASHTO Committee Evaluation for B-03

Initiating the Systems Engineering Process for Rural Connected Vehicle Corridors

Submitted By:
Sharon Edgar
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel
Council on Public Transportation

Comments:
Include mobility as a service using CV

Submitter Response for 2019-B-03
Initiating the Systems Engineering Process for Rural Connected Vehicle Corridors

From: [email: dave.huft@state.sd.us]

Comments:
Sharon Edgar’s suggestion to include mobility as a service using CV technology is sound.

Ann Hartell makes very good points regarding potential insights that can be gained into inter-jurisdictional issues and consistency among states. In response to her question about the focus on connected—rather than automated—vehicles, I would say that connectivity is the primary concern because it can be particularly difficult and costly for highway agencies to achieve in rural environments. Ann’s mention of NCHRP 20-102 is very pertinent. As a member of the 20-102 project panel, I would strive to ensure that this project would be informed by and well coordinated with other 20-102 projects.

Contact Info: David Huft, SDDOT

Review Date: 12/18/2017
I. PROBLEM NUMBER

2019-B-04

II. PROBLEM TITLE

Operationalizing Accessibility Metrics to Support Transportation Planning and Performance Management

III. RESEARCH PROBLEM STATEMENT

Recent years have seen rapid growth in the research and use of accessibility metrics in transportation planning and performance management. Accessibility metrics indicate the ease with which travelers can reach valued destinations. They combine metrics indicating the cost of travel, such as travel time or financial cost, with the potential benefits — the destinations that could be reached at a given cost. This approach allows accessibility metrics to provide a uniquely comprehensive indicator of a transportation system's ability to provide opportunities to its users. For example, an accessibility metric focused on access to jobs might indicate that residents of a particular area could reach 100,000 jobs within 15 minutes by car.

Because few federal or state guidelines exist regarding the use of accessibility metrics, this recent increase in use generally represents ad-hoc efforts at state and local levels to meet local planning and performance management needs. The national transportation community would benefit from an analysis of these many different ways of operationalizing accessibility.

Accessibility metrics can be implemented in a wide variety ways, each of which can be useful for different purposes or different subject domains. For example, an accessibility metric designed for use in public-facing communication regarding a new highway segment could use very different data and methods than one intended for use by professional planners to identify high-priority freight corridors. However, little organized guidance is available on the selection of accessibility metrics for particular use cases. An analysis and categorization of the existing and proposed approaches to measuring accessibility can help practitioners identify the most useful accessibility metrics for their purpose, without lengthy investigation and testing.

Several tools and data sources focused on accessibility exist. Tools range from large software packages to local implementations by city staff or academic researchers, and exist in both open-source and commercial forms. Data sources include university-led national data processing projects, outputs from MPO planning efforts, and comparative metropolitan analyses from advocacy groups for non-motorized transportation. Both tools and data sources vary in the exact ways that they implement accessibility measurements. Regardless of the scale, scope, or subject, these tools and data sources are typically quite robust. But the fragmented landscape provides little opportunity for understanding how they relate to one another, or which would be most appropriate to support a particular planning or performance management goal. An analysis of existing accessibility tools and data sources can help connect potential users with the most appropriate resources, while also identifying opportunities to both streamline and expand the field.

Transportation agencies are currently using accessibility metrics to support a variety of planning and performance management goals. These range from states using accessibility metrics to inform project prioritization, to MPOs setting accessibility goals in long-range plans, to counties using them to support local travel demand management programs. An investigation of these case
studies can help to identify the types of applications where accessibility metrics can have the largest impact, compile lessons learned from these implementations, and share best practices with the wider transportation community.

IV. LITERATURE SEARCH SUMMARY

Much contemporary work on the implementation of accessibility metrics builds off of Handy & Niemeier’s work which investigates the gap between accessibility concepts and their practical applications [1]. This research thread has been continued by Geurs & van Wee [2] and Geurs et al. [3]. Together, these provide a summary of outstanding research issues in the field of accessibility evaluation.

Recent research links accessibility metrics to travel behavior indicators such as mode choice [4] and VMT [5], suggesting that improvements in accessibility metrics may also improve related fields such as travel demand modeling.

Over the past 10-20 years, accessibility metrics have been deployed regularly in Europe to support transportation planning. A series of research summarizes European case studies [6] and evaluates their impact both in planning outcomes [7] and on the skills and experience needed by planning professionals [8]. These highlight the need for transportation agencies to integrate accessibility metrics tightly into planning processes, rather than approaching them as an add-on. They also suggest that identifying the most appropriate accessibility metrics for different uses is more valuable than searching for one “ultimate” metric.

Boisjoly & El-Geneidy investigate worldwide examples of the use of accessibility indicators in transportation planning [9], finding that clear definitions of accessibility, as well as strong links between plans and performance metrics, are a key success factor. They also highlight the need for practitioners to understand how accessibility metrics are perceived by their intended audience [10].

The Brookings Institution identifies accessibility as a key emerging tool for successful planning and management of transportation systems, and notes in particular the need for consistent approaches to measuring accessibility across modes and locations. [11]

There are ongoing efforts to implement large-scale accessibility measurement in the U.S. These include multimodal programs [12, 13] as well as some focused on individual modes. Additionally, accessibility evaluations are undertaken with a focus on individual metropolitan areas, sometimes including the development and testing of new types of accessibility metrics [14, 15]. However, these efforts are often not tied directly to transportation planning processes. An important exception is the Virginia Department of Transportation’s Smart Scale project prioritization program, which uses accessibility as a key input factor [16].

References

V. RESEARCH OBJECTIVE

The primary objective is to identify and analyze various implementations of accessibility metrics in order to provide guidance for the broader transportation community. This research is anticipated to proceed in five major tasks:

1. Classification of Accessibility Metrics
   Conduct a comprehensive synthesis of accessibility metric definitions in published research and technical reports from practice. Develop a classification framework for accessibility metrics, focusing on their suitability for different use cases, modes, and destination types. Develop decision-making recommendations for the selection of accessibility metrics for different use cases, and identify priority areas for additional research or development.

2. Comparative Analysis of Accessibility Tools and Data
   Conduct a survey of existing tools and data sources that can be used to produce accessibility metrics. Evaluate these tools and data by using them to implement accessibility evaluations based on real-world examples and data. Report and analyze the costs, effort, strengths, and weaknesses associated with each tool and data source, including an evaluation of which metrics identified in Task 1 can be produced. Develop decision-making recommendations for the
selection of accessibility tools and data sources, and identify priority areas for additional research or development.

3. Identify and Document Case Studies
Conduct a survey of existing cases where accessibility metrics are in use for transportation planning or performance management. Collect documentation from identified case studies and conduct interviews with relevant parties, focusing on selection of accessibility metrics, implementation of the metrics, and impact or response. Identify and document lessons learned and best practices. Identify priority areas for additional research or development.

(Task 1, 2, and 3 are expected to proceed roughly in parallel)

4. Development of Accessibility Tools and Data
Guided by the findings in Tasks 1–3, identify the highest priority areas for additional development of accessibility methods, tools, and data. Prioritization should be focused on reducing barriers to implementation and use by transportation professionals. Develop new tools or enhance existing tools to address the highest-priority needs.

5. Plan for Transfer to Practice
Prepare a report summarizing the activities and findings of the project. Develop materials for, plan, and organize one or more workshops or peer exchanges designed to guide professionals in the selection and use of accessibility metrics for transportation planning and performance management. Present project findings at relevant research and professional conferences.

Prepare proposals for developing a guidebook and implementation plan for operationalizing accessibility metrics. The guidebook will summarize the findings of Tasks 1–4 in this project, targeting an audience of transportation professionals and with a focus on guidance for decision-making and implementation. The implementation plan will lay out an immediately actionable set of steps to facilitate the adoption of accessibility metrics in the planning and performance management activities of at least three state DOTs.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$500,000

Research Period:

24 months

VII. URGENCY AND POTENTIAL BENEFITS

Because accessibility metrics directly measure one of the fundamental purposes of transportation — connecting people to opportunities — they offer a unique set of potential benefits to transportation planning and performance management.

Improved Transportation Planning Outcomes
Accessibility is a key factor in long-term economic development. By evaluating accessibility during the planning process, transportation agencies can direct scarce funding to projects which offer the greatest potential return on investment.

Accessibility metrics can provide very detailed estimates of what areas will gain and which will lose access in response to transportation system changes. When paired with demographic data, this allows more nuanced evaluation of the equity impacts of transportation decisions.

Greater Transparency in Transportation Planning
Many accessibility metrics are fundamentally quite simple compared to other common transportation performance statistics. When paired with effective communication, this can improve public understanding of transportation planning decisions and performance metrics which incorporate accessibility.
Decreased Costs of Implementing Accessibility Metrics
By providing actionable guidance for the selection and implementation of accessibility metrics, this project can help reduce development costs for transportation agencies who are already beginning to use them.

VIII. IMPLEMENTATION PLANNING

The target audience for the research findings and products of this work will be State DOTs, MPOs, transit agencies and other transportation agencies. The key decision-makers who can approve, influence, or champion implementation of these research products are the senior staff and CEOs of the transportation agencies. The AASHTO committees that will be involved in the adoption and implementation of the results will be the AASHTO Committees on Performance-Based Management and its subcommittees and the Committee on Planning.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

AASHTO Committee on Performance-Based Management
Chair: Russell McMurry, Georgia DOT
Vice-Chair: Christos Xenophontos, Rhode Island DOT
Research Task Force: Jim Ritzman, PennDOT

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X. AASHTO MONITOR

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NCHRP Review of B-04

Reviewed By:
Andrew C. Lemer
alemer@nas.edu
Comments: The objectives and scope of this proposed research are clearly stated and appropriate for NCHRP funding. The work should be constrained to avoid developing or modifying analytical tools, network-based or otherwise, and could usefully be extended to explore relationships between accessibility measures and indicators of economic performance, community health and well-being, and other aspects of environmental quality.

Review Date:
11/22/2017

FHWA Evaluation of B-04

Pete Stephanos/HIPA-01 - Proposed research is needed to provide a better understanding of the state of practice in measuring and applying accessibility measures to decision making. This proposal is being submitted by the Committee on Performance-based Management as one of their top priorities. FHWA has been involved in a liaison capacity as this proposal was being developed. Although this proposal is not included, as written, in the TPM Research Roadmap, it does support the multimodal performance research needs noted in this document. FTA initiated a research effort in 2016 to develop a methodology to measures "connectivity". It may be worth evaluating the status of this work before prioritizing this proposal. Gary Jensen/HEPH-10, Wesley Blount/HEPH-10, Harlan Miller/HEPP-10 - This problem statement may complement existing work, but care should be taken not to duplicate the following and these additional references should be added: The Why and How of Measuring Access to Opportunity, Governors? Institute on Community Design (http://www.govinstitute.org/resource/measuring-access-to-opportunity/); Guidebook for Developing Pedestrian and Bicycle Performance Measures, FHWA (https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/performance_measures_guidebook/); and the Guidebook for Measuring Multimodal Network Connectivity, FHWA (forthcoming). These resources key in on some of the work being proposed, especially in livability and pedestrians and bicycles. Moving forward with this research, it would be good not to just focus on what type of destination to include in the accessibility metric and where they are located, but also the availability of alternative and multimodal routes to get to an destination, especially when access to opportunity is factored into the process. Terminology may need to be addressed, as "accessibility" can be confused with accessibility under ADA, and some work is using the term "connectivity."

AASHTO Committee Evaluation for B-04

Operationalizing Accessibility Metrics to Support Transportation Planning and Performance Management

Submitted By:
Elizabeth Robbins
Chair
Committee on Planning

Comments:
COP’s first highest ranking
Submitter Response for 2019-B-04
Operationalizing Accessibility Metrics to Support Transportation Planning and Performance Management

From: [email: deanna.belden@state.mn.us]

Comments: Thank you all for the comments of support. We agree that the FHWA suggested additional references should be added. We also agree with the NCHRP comment that that accessibility metrics have historically been under-applied in areas beyond transportation demand modeling, and we agree that there is no need to focus on the development of demand modeling tools in this project. Instead, we see an opportunity for developing and/or improving accessibility calculation tools with the goal of reducing the effort needed to include accessibility data as inputs in a wide range of different applications. As much as possible, the data and tools developed in this project will be designed so that they are useful to practitioners in any discipline, and so that they support flexible application to any geographic or demographic context. We will look for ways to clarify the goals of the project (and especially Task 4) in any future revisions.

Contact Info: Deanna Belden, deanna.belden@state.mn.us

Review Date: 12/20/17
I. PROBLEM NUMBER

2019-B-05

II. PROBLEM TITLE

Data and information sharing gaps and practices for coordinated operations and traveler information for Integrated Corridor Management

III. RESEARCH PROBLEM STATEMENT

Modern data management applications in the transportation industry make static and real-time data available to regional partners or to the public through various standards-based connections. Extensive regional integrated datasets are made available to the various stakeholders through the use of analytics, data warehousing, and business intelligence tools.

Some standards exist for data sharing within regional mobility management, but usually in specific segments of the operation (i.e. Traffic Management Data Dictionary (TMDD), Center to Center (C2C) protocols) which do not include all data elements needed for Integrated Corridor Management (ICM), and regional mobility management. For instance, TMDD works well for data sharing between traffic management centers, but does not include some data or granularity of data needed for decision support systems and modeling systems within ICM and Smart Cities. For instance, lane data (speed, volume, occupancy) is only available in most C2C systems at the macroscopic level (all lanes combined). Transit data within C2C systems is mostly static information, and does not include real-time vehicle location and passenger count information.

Lessons learned from the ICM implementations, Smart City programs, and regional mobility programs in the U.S. point to research gaps and ideas that can help data sharing programs. These gaps can be organized along three general areas: a) data warehousing and data sharing standards, b) use of Intelligent Transportation Systems (ITS) standards and regional ITS architectures, and c) institutional coordination. This problem statement further expands on these topics.

The FHWA and several Transportation Research Board (TRB) Committees have identified research in this area as a high priority. This problem statement was identified as the 9th highest research need of over 100 needs identified in Transportation Research Circular E-C218: Advancing Freeway Operations through Strategic Research (TRB, 2016).

IV. LITERATURE SEARCH SUMMARY

Kendra Levine, the director of the Transportation Library for the UC Berkeley Institute of Transportation Studies did a literature search in relation to this problem statement. Her summary is:

“In searching TRID, Google Scholar, the Google Transportation Meta Search, and Web of Science, there is very little about extending relationships between DOTs and other transportation agencies and private industry beyond data licensing. There has been lots of research on how to use industry data to supplement or validate agency data, but nothing where agencies partner with routing software companies to proactively alter routes.”
It is our experience that there is considerable literature related to data exchange and data formats between government agencies and with data moving from industry to government. There is little to research on operational real time planning data moving from government to industry.

**U.S. National ITS Architecture**
The National ITS Architecture provides a common framework for planning, defining, and integrating intelligent transportation systems. It is a mature product that reflects the contributions of a broad cross-section of the ITS community (transportation practitioners, systems engineers, system developers, technology specialists, consultants, etc.).

The architecture defines:
- The functions (e.g., gather traffic information or request a route) that are required for ITS.
- The physical entities or subsystems where these functions reside (e.g., the field or the vehicle).
- The information flows and data flows that connect these functions and physical subsystems together into an integrated system.

A well maintained Regional ITS architecture will include the data sharing standards and methods needed for regional mobility management and identify the sources and protocols for sharing data between agencies and with the public.

**Center to Center (C2C) Standards**
C2C communication involves peer-to-peer communications between computers involved in information exchange in real-time transportation management in a many-to-many network. This type of communication is similar to the Internet, in that any center can request information from, or provide information to, any number of other centers.

**Transportation Management Data Dictionary (TMDD)**
The TMDD Standards were developed to support center-to-center communications as part of the regional deployment of ITS in order for centers to cooperate in the management of a corridor, arterial, traffic incidents, special events, etc. Hence the TMDD provides the dialogs, message sets, data frames, and data elements to manage the shared use of these devices and the regional sharing of data and incident management responsibility.

**Transit Communications Interface Profile (TCIP)**
TCIP is an American Public Transportation Association Standard that provides a library of information exchange building blocks which allow transit agencies and transit suppliers to create standardized tailored interfaces. APTA TCIP is based on the earlier TCIP work performed by ITE, AASHTO, and NEMA and published as the NTCIP 1400-series standards. APTA TCIP extended the NTCIP Standards to include a Concept of Operations, Model Architecture, Dialog Definitions, and a rigorous, modular approach to conformance. Both the APTA TCIP development and the earlier NTCIP development were sponsored by the US DOT ITS Joint Program Office.

**Integrated Corridor Management (ICM)**
Many jurisdictions have implemented a variety of strategies for maximizing flow on facilities by using all available pavement and managing their facilities by using new technologies and better techniques. Most recognize the importance of interjurisdictional coordination with emergency responders, maintenance and incident response, and construction management, as well as providing timely notification to the public in managing their systems. Monitoring traffic operations through traffic management centers with reliable detection and surveillance and available deployment strategies (e.g., incident response) is an active engagement in reducing recurring and nonrecurring congestion.

NCHRP Scan 12-02 identified some key aspects of ICM deployments related to data sharing and data warehousing. Sharing data among agencies is a key component of an ICM system. This can be accomplished through manual methods (e.g., phone calls, text messages, and on-line...
messaging) or through more-automated systems. Most of the sites the team visited have some form of an ITS standards-based C2C system that allows automated exchange of data among agencies. However, many sites do not use the full functionality of the C2C systems, and not all partner agencies are connected to the systems. The report identified data fusion as a key area for ICM, and defined the maturity of data fusion as follows:

The data fusion process area relates to transportation agencies’ ability to accept and disseminate information across multiple modes to enable informed decision-making. This integration extends the security and privacy concerns arising from data collection because it increases the scope and reach of the information generated. Data collection functions provide necessary “raw material” for transport network management; however, decisions cannot be made on data. In fact, many transportation agencies have too much data. To be useful, the data must be integrated and transformed into information.

Specific Goals and Practices:

- **Level 1**: Individual agencies have data on their systems, and some sharing is done either through a data feed or manually.
- **Level 2**: Multiple agencies have near real-time data, which is provided to the travelers in the corridor; however, the data is not centralized.
- **Level 3**: Multiple agencies have near real-time data, which is integrated into a central data system and provided to the travelers in the corridor. Data is only one way; that is, agencies provide data to the central system, but do not receive fused data from the central system.
- **Level 4**: Multiple agencies have near real-time data, which is integrated into a central data system and provided to the travelers in the corridor. Data is provided to the agencies, so that their operational systems are updated with fused data.
- **Level 5**: Multiple agencies and modes have near real-time data, which is integrated into a central data system and provided to the travelers in the corridor. Data is provided from both private and public sources and fused together to provide more coverage of the entire corridor. Data is provided back to the agencies, so that their operational systems are updated with fused data.”

State of the Practice on Data Access, Sharing, and Integration Document

In 2012, the Federal Highway Administration (FHWA) initiated a 3-year project entitled “Virtual Data Access (VDA) Framework” to develop a prototype framework for sharing planning and operations data between State and local transportation agencies from multiple sources within a region. The framework will bring together many types of transportation data to give planners and operators a multifaceted view of transportation performance both over time and by location. The purpose of the VDA Framework is to improve the breadth of available data and reduce the barriers to the use of those data so that transportation agencies across a region can advance their decision making and performance reporting capabilities in the area of operations.

The purpose of this state-of-the-practice review was to lay both technical and institutional foundation for all aspects of the development of the VDA Framework. The review focused on current data sharing and integration practices among State and local agencies, example data environments, technical integration formats, and business rules for integration and sharing. State, local, and regional transportation operators, planners, and data professionals can use this report to enhance their data sharing and integration efforts by building on the experiences and effective practices of other agencies documented in the report.

Geospatial Data Collaboration initiative

The Federal Highway Administration’s (FHWA) Geospatial Data Collaboration (GDC) initiative encourages State Departments of Transportation (DOTs) and others to use geospatial tools to increase collaboration, improve information-sharing, and streamline transportation decision-making. FHWA established GDC as one element of its Every Day Counts (EDC) initiative. EDC aims to produce innovations, resources, and partnerships to shorten project delivery, enhance safety, and protect the environment. Both EDC and GDC leverage and support other ongoing FHWA efforts such as Planning and Environment Linkages (PEL) and Eco-Logical. All of these efforts are helping
stakeholders work better together to achieve faster and more informed transportation decisions and projects.

**Smart Cities**
Lastly, recent efforts revolved around connected/smart cities, representing the culmination and evolution of the above research efforts. With ITS laying the groundwork for innovative transportation solutions, many cities are currently serving as laboratories for new types of transportation services. Smart cities are emerging as a next-generation approach for city management, taking the steps forward along the transportation technology continuum. Integrating ITS, connected vehicle technologies, automated vehicles, and other advanced technologies – along with new mobility concepts that leverage the sharing economy – within the context of a city provides the enhance travel experiences and make moving people and goods safer, more efficient, and more secure. By enhancing the effective management and operation of the transportation system, smart city solutions can leverage existing infrastructure investments, enhance mobility, sustainability, and livability for citizens and businesses, and greatly increase the attractiveness and competitiveness of cities and regions.

V. RESEARCH OBJECTIVE

The objectives of this research are to: (1) review existing studies and practices on data sharing within a region; (2) provide guidance on the planning, design, deployment and on-going operations of a data warehouse and data sharing system based on the user needs of the regions for ICM, Regional Mobility, and Smart Cities; and (3) develop the Contents and Structure of Message(s) to Extend and/or Supplement the TMDD standard to include transportation management strategies for common implementation between government, industry, travelers and intelligent devices. Current ITS standards will be associated with data types for the various connections and data standard needs identified. In addition to ITS standards, this research will investigate the role of the Regional ITS Architecture on data consistency and coordination.

The end products of this research are: (1) a comprehensive report of existing data sharing mechanisms, processes, and standards needed for integrated corridor management; (2) best practices for data warehousing guidance document; and (3) memorandum of understanding templates for inter-agency and 3rd party data sharing agreements.

This research will require the following tasks:

**Task 1: Current Practices and Gaps in Data Sharing**
Based on experiences in many metropolitan areas gaps exist in the use of ITS standards and regional ITS architectures. This task will document the common issues among metropolitan areas in data sharing and integration. In addition, the analysis will investigate the reasons for unavailability (or lack of usage) of ITS Architectures.

**Task 2: Data Sharing Practice Document**
In order to improve regional mobility, data needs to be shared among five key actors:
- Travelers and ride sharing companies - They choose how and when (within constraints) they travel. They choose how to respond to an incident.
- City, Regional and State Transportation agencies
- Navigation management industry
- Freight management industry
- Intelligent devices - Smart traffic signals, ramp meters, and soon to be smart cars.

This task will survey representative groups from the five key actors in order identify data sharing requirements for:
- Sharing traffic management goals (reduce congestion, reduce emissions, reduce traffic in a certain area, etc.)
• Sharing traffic management response plans
• Sharing high level decision making data that will let the 5 actors above work in concert.

Based on the findings of these surveys, a data sharing practice document and recommended institutional coordination processes document will be developed.

Task 3: Institutional Coordination
There must be open communication and cooperation among agencies and third party traffic information providers to share data for integrated corridor management. Coordination between government and industry are often working at cross purposes. Some data needs are truly regional in nature (e.g., traveler information), while others are perhaps localized to a corridor or a specific junction between two agencies (state DOT and city sharing freeway and signalized ramp terminals data for queue management at a ramp meter). The data sharing can be done informally or more formally (i.e., through intergovernmental agreements or MOUs that define roles and responsibilities). Additionally, private sector data, data analytics, and use of social media provide additional data exchange and data fusion opportunities to produce multi-modal and user friendly transportation information. For this task, the research will focus on the following institutional challenges of implementing regional data warehouses and data sharing between regional agencies:
• Institutional arrangements and approaches for successful system management, both between public sector and public-private arrangements.
• Change in planning practices to focus on regional mobility
• Recommended language for MOUs

Task 4: Develop Message Sets and Data Mapping for ICM
Mapping information and data flows to the architecture and standards if there are gaps would appear to be something worthy of pursuing. Development of an operational concept and requirements document will be developed, which builds off of work people have been pursuing for all types of ICM applications to determine the range of messages, data elements and protocol uses to facilitate these exchanges. This would provide the basis for comparing what is in the architecture and related standards.

Task 5: Implementation Guide for Common Data Sharing
Develop the Contents and Structure of Message(s) to Extend and/or Supplement the TMDD standard to include transportation management strategies for common implementation between government, industry, travelers and intelligent devices.

Task 6: Knowledge Transfer
Make best practices, data and methodologies available to the transportation community. Develop Data Warehouse Guidance Document on the key items and best practices to consider when implementing a Data Warehouse for integrated corridor management.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

<table>
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<tr>
<th>Position</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle Investigator</td>
<td>$80,000</td>
</tr>
<tr>
<td>Outreach/Communications</td>
<td>$120,000</td>
</tr>
<tr>
<td>Software Engineer</td>
<td>$100,000</td>
</tr>
<tr>
<td>Data Engineer</td>
<td>$100,000</td>
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</tbody>
</table>
Technical Writer $70,000
Traffic Engineer $70,000
Travel $30,000
Supplies $30,000
$600,000

Research Period:
18 months

VII. URGENCY AND POTENTIAL BENEFITS

There is increasing awareness and deployments of integrated corridor management systems and there is a need for data sharing and integration among agencies, and private sector services to deploy systems that are cost-efficient and produce benefits.

Right now when an ICM system deploys a diversion route this information is not provided to:

• Ride sharing companies - They choose how and when (within constraints) they travel. They choose how to respond to an incident.
• Navigation management industry
• Freight management industry
• Intelligent devices - Smart cars.

Because this information is not distributed the goal of improving traffic is not met. Waze will reroute travelers where they want because they have no better information. Truckers do not know if they can take a reroute so they often stay on the freeway.

This research envisions working with representatives of these industries (Waze) for example, creating exchange standards and then using an existing ICM system as a use case for implementing the results.

VIII. IMPLEMENTATION PLANNING

1) The target audience are:
   a. Ride sharing companies
   b. City, Regional and State Transportation agencies
   c. Navigation management industry
   d. Freight management industry
   e. Intelligent devices manufacturers

2) Key Decision Makers are executives from the above agencies who we hope to meet with as part of this effort

3) AASHTO committees and other organizations
   a. AASHTO Data Management Committee
   b. AASHTO Subcommittee on Transportation Systems Management and Operations
   c. Freight industry organizations such as the American Trucking Association
   d. Orange Silicon Valley

4) Early Adopters
   a. Caltrans (Ali Zaghari) and PATH (Joe Butler) as part of the I-210 Connected Corridors ICM program in Los Angeles
   b. Other ICM efforts in the United States

5) Barriers

B-05/6
a. The largest barrier is that most state agencies are not accustomed to sharing roadway management with industry partners. And yet, Waze now has more say on traffic patterns during an incident than state agencies. So the barrier is a culture that does not look for real time cooperation with industry for traffic management.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

- Kevin Miller, ICM Practice Lead, Kapsch TrafficCom Transportation, 313-354-2126, kevin.miller@kapsch.net
- Ali Zaghari, Deputy District Director of Operations, Caltrans District 7, 100 South Main Street, Suite 100, Los Angeles, CA 90012, 213-897-0362, ali.zaghari@dot.ca.gov
- Peter Thompson, Senior Technology Program Analyst, San Diego Regional Traffic Engineers Council, 401 B Street, San Diego, CA 92101, (619) 699-4813, Peter.Thompson@sandag.org
- Joe Butler, Program Manager. California PATH 409A McLaughlin Hall, MC 1720, Berkeley, CA 94720, joe.butler@path.berkeley.edu
- James Colyar, Transportation Specialist, FHWA, Office of Transportation Management, 711 South Capitol Way, Suite 501, Olympia, WA 98501, 360-753-9408, James.Colyar@dot.gov

X. AASHTO MONITOR

We recommend:

Ali Zaghari, Deputy District Director of Operations, Caltrans District 7, 100 South Main Street, Suite 100, Los Angeles, CA 90012, 213-897-0362, ali.zaghari@dot.ca.gov

Dr. Nick Compin

XI. SUBMITTED BY

Joe Horton
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NCHRP Review of B-05

Improving data collection, sharing, and management with an objective of improving the decision-making process is a desirable objective for continued research. The process must build on previous studies as well as those currently underway or about to begin. One example of a study only just getting underway is NCHRP 08-116: Framework for Managing Data from Emerging Transportation Technologies to Support Decision-Making. Translating the highly technical approach championed by B-05 into a useful guide while building on other research could be a challenge. I believe it would be helpful to add a function to this problem statement that examines effective techniques for implementing the outputs envisioned by the research with examples of practical application. This would constitute an expansion of and emphasis on Task 6 as described in the problem statement.

FHWA Evaluation of B-05

Tianjia Tang/HPPI-30 - Suggest that the A-13 and B-05 be merged as a single study subject.
AASHTO Committee Evaluation for B-05

Data and Information Sharing Gaps and Practices for Coordinated Operations and Traveler Information for Integrated Corridor Management

Submitted By:
Galen McGill
Research Coordinator
Committee on Transportation System Operations (CTSO)

Comments:
This is very similar to A-13, so we recommend adding project B-05 to A-13.

Submitted By:
Sharon Edgar
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel
Council on Public Transportation

Comments:
consider travelers on all modes
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-B-06

II. PROBLEM TITLE

Measuring Economic Benefits and Costs for the Inclusion of Sustainable Elements on Aging Transportation Systems

III. RESEARCH PROBLEM STATEMENT

In the 1970’s studies were conducted on economic and social considerations in highway programs as Departments of Transportation (DOT) and the Federal Highway Administration (FHWA) were realizing the expansion of the Interstate highway system nationwide. Beginning in the mid-1990s studies were aimed at better understanding how transportation affects community quality of life and social wellbeing. In 1992 NCHRP funded a study titled “Synthesis of Highway Practice Assessing the Effects of Highway Widening Improvements on Urban and Suburban Areas”. It looked at highway widening and its impacts socially, economically and environmentally. At the time of these studies, context sensitive solutions and sustainable transportation strategies were either unheard of or a new concept.

We are now well into the 21st century with an aging infrastructure and limited funding sources. How do DOTs determine and measure the economic benefits and value of investing in sustainable elements on an aging transportation system that includes social and community considerations, safety, and aesthetics? There isn’t a national web-based program transportation agencies can utilize to quickly evaluate the economic values of sustainable elements along our roadides. Without any metrics to provide possible opportunities and or constraints it’s difficult for designers to be transparent with why additional sustainable elements are necessary to be funded and implemented.

IV. LITERATURE SEARCH SUMMARY

Moving Towards Sustainability: New York State Department of Transportation’s GreenLITES Story
2010 Green Streets and Highways Conference, 2010, pp 461-479

Analyzing sustainability in a land-use and transport system

Sweden - National Report Strategic Direction Session ST2: Roads and quality of life: Planning For a Sustainable Transport System
Proceedings of the 22nd Piarc World Road Congress, 19-25 October 2003

Strategic Environmental Assessment of Transport Infrastructure Investments
World Transport Research: Selected Proceedings of the 8th World Conference on Transport Research, 1999, p. 183-196

Economic and Social Impact Consideration in Highway Programs
http://openscholarship.wustl.edu/cgi/viewcontent.cgi?article=1833&context=law_urbanlaw

Assessing the Effects of Highway-widening Improvements on Urban and Suburban Areas
Transportation Research Board Synthesis 221, 1996

Aesthetic and ecological disharmonies of highways
V. RESEARCH OBJECTIVE
The objective is to identify metrics that can be used as indicators in comparing economic value achieved by improving the sustainable quality of the transportation system. Sustainable elements for comparing economic value include aesthetics, use of native landscapes, promotion of environmentally friendly habitat, incorporation of multi-modal transportation options increasing community’s quality of life, utilization of recycled materials, carbon emission reduction, carbon sequestration, art installation, wildlife identification signage and protection has all influenced the perception of the highway. In addition it is important to separate the comparison between the different roadway types and environments that exist nationally. This would include rural, suburban and urban roadways which when calculated the return on investment are all viewed differently and may have different metrics in determining its value to the Department.

Transportation professionals are expert at identifying and using pertinent measures related to transportation outcomes (i.e., motorized vehicle level of service, vehicle miles traveled, and costs of travel delay). Yet, the understanding and measurement of the economic benefits realized through programmatic investment in sustainable elements such as aesthetics, green infrastructure, landscaping, community quality of life outcomes is far less developed. These elements are typically seen as a financial liability rather than an asset. The research will examine challenges to implement sustainable elements into roadway projects, metrics and strategies needed in supporting strategic decision making by officials responsible for the transportation system. A web-based tool or adding to the current FHWA INVEST (Infrastructure Voluntary Evaluation Sustainability) tool that focuses on providing designers a way to measure the economic benefits of investing in sustainable roadside elements is a key part of this research. Without a way to quickly show how sustainable roadside elements are a necessary part of funding transportation projects by its economic value transportation agencies cannot get the appropriate funding necessary for the project.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:
$450,000

Research Period:
24 months

VII. URGENCY AND POTENTIAL BENEFITS
With aging infrastructure nationwide, DOTs must best use limited funding to meet the mobility needs while including sustainable solutions demanded by stakeholders? A set of measurement tools are needed to help analyze competing needs and evaluate alternate scenarios for improving sustainable elements and for multiple, sometimes competing modes. There are few economic metrics in use nationally and often the existing metrics measure outcomes without measuring sustainable opportunities (or inputs).

VIII. IMPLEMENTATION PLANNING
Provide a web-based program to enable cost benefit evaluation of the economic aspects of adding sustainable elements into a roadway project or include added program elements within FHWA INVEST program tool. Information can be shared with staff in all DOT programs who are working on roadway projects whether it is planners, engineers, landscape architects, executive managers, and/or transportation agency partners will all benefit this new information.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT
Keith Robinson, Principal Landscape Architect, Caltrans 916-654-6200, keith.robinson@dot.ca.gov
Jennifer Taira, Senior Landscape Architect, Caltrans, 916-654-4817, jennifer.taira@dot.ca.gov
NCHRP Review of B-06

Reviewed By:
B. Ray Derr
rderr@nas.edu

Comments:

The proposed research is appropriate for the NCHRP and the intent is worthy but I am skeptical that the desired outcome can be achieved.

There has been significant research over the past several years to move towards performance-based planning and design. These approaches focus on infrastructure state of good repair, safety, and operations. Techniques have been developed to quantify each of these criteria and further work has looked at how tradeoffs between them can be analyzed. This has been a substantial effort (several millions of dollars) and further work is needed to fully develop this approach, particularly to incorporate them into existing agency practices.

The problem statement adds additional criteria to this matrix, including aesthetics, habitat protection, and community quality of life for rural, suburban, and urban roadways of all types. I agree that these criteria and obtaining project resources for them are important but am concerned that development of a return on investment approach is not possible and, even if successful, may not produce the desired result. Advancing these criteria depends on agency policy and negotiations with the stakeholders throughout the planning and design processes. A scan of how agencies are dealing with these topics may be useful, particularly since the literature cited is fairly old.

The problem statement recommends developing a web-based program for calculating the costs and benefits. While the NCHRP can develop web tools, we lack the resources to host, maintain, and support them. A viable long-term plan should be laid out before the NCHRP begins development. If the FHWA supports inclusion of this material in the INVEST Tool, some indication of that along with restrictions and conditions would be helpful.

Review Date:
11/17/2017
FHWA Evaluation of B-06

Becky Lupes/Connie Hill Galloway/HEPN-30; Stefan Natzke/HEPH-20; Nathaniel Coley/HIF/HIPM-10; James Garland/Scott Allen/HEPP-20 - A web based BCA tool would have a limited shelf-life since there would need to be funding to host the software, any economic values could change, and internet protocols are ever-evolving. This problem statement could be restated to reflect a need more focused on a framework for conducting a benefit cost analysis by state DOTs. A framework for calculating the sought-after values to support decision making might be more useful and could be synthesized from available resources. There are techniques that are used to value non-market goods and services, which may or may not be applicable to the valuation of sustainable elements. A synthesis study to research the state-of-the art of such techniques regarding sustainable elements could be helpful. FHWA is receptive to the study including recommendations on how to incorporate findings into INVEST. Regarding the scope of the research, examining the metrics and indicators? potential as an input for scenario planning modeling efforts could strengthen the research. The concept is widely applicable for State DOTs, MPOs, RTPOs, transit agencies, and local governments. Nadarajah Sivaneswaran/HRDI - While transportation investment decision making has long focused on direct costs and a narrow set of direct benefits (economic and, more recently, environmental) and the more broader and tangential benefits discussed in this problem statements are only now getting the needed attention. A systematic and transparent process for quantifying and accounting such benefits will help agencies make case investment decisions that considers those benefits in addition to direct benefits. Bingxin Yu/HPTS-30 - What's the focus area of this study? If the stated goal is to "identify metrics", why are these benefits important, what's the relative scale of them compared with other traditional indicators such as travel time saving and safety improvement? Will the metrics help develop parameters that can be used in refine the measurement of economic benefits? How will it be used by State and local governments? The requested funding is also quite high even after taking account of developing a web-based tool.
I. PROBLEM NUMBER: 2019-B-07
II. PROBLEM TITLE: Metropolitan Planning Organizations: Transportation Partnerships for the 21st Century

III. RESEARCH PROBLEM STATEMENT

Metropolitan Planning Organizations (MPOs) and state DOTs together invest hundreds of billions of taxpayer dollars to produce the urban transportation systems that U.S. businesses, workers, families, and freight services rely on every day. The partnership between MPOs and DOTs dates to the 1962 Federal Aid Highway Act, which introduced the vision of so-called “3-C” cooperative, comprehensive, and continuing planning between local communities and states (Morehouse, 1969). This institutional framework underpins contemporary planning and funding of transportation investments in U.S. metropolitan regions. It has evolved incrementally since its introduction. Federal transportation and environmental laws and regulations enacted since 1962 have gradually formalized and transformed MPOs as organizations, articulated their responsibilities, and defined performance expectations. The gradual emergence of MPOs and their future roles in the rapidly changing transportation policy environment have not been carefully studied. For example, a series of seven NCHRP 20-83 Projects addressed “Long Range Strategic Issues Facing the Transportation Industry,” but did not include an examination of the planning and governance functions of MPOs and their responsibilities for long range transportation planning.

The proposed project would directly inform efforts by Metropolitan Planning Organizations (MPOs), state Departments of Transportation (DOTs), and local and state policymakers to enhance metropolitan transportation planning and the capacities of MPOs responsible for it. This work would deliver a heretofore-absent historical review and contemporary analysis of the institutional structures and performance of MPOs to arrive at conclusions and lessons learned from this history that are relevant to current challenges. It would address ways in which these institutions can respond more nimbly and effectively to rapidly changing transportation demands, conditions, and technologies in the 21st century. It would provide a menu of strategies and tools—drawn from cases and practice—for better equipping 21st century MPOs and MPO-state partnerships to plan, maintain, and improve transportation systems for U.S. metropolitan areas and the economies reliant on those systems. MPOs and DOTs collaborating in specific regions and state and federal policymakers could use these tools and strategies to enhance U.S. planning and decision-making institutions for the metropolitan challenges and changing transportation paradigms of the 21st century.

Metropolitan planning and MPOs have been the subject of various scholarly and government-led studies, but no work to date has undertaken a comprehensive or critical review of their institutional framework or its strengths or weaknesses in light of 21st century transportation trends. We know little about whether or to what degree the metropolitan planning framework ensures effective regional planning or maximizes efficiency in federal, state, and local transportation expenditures across metropolitan regions. We know even less about what modifications to this institutional framework might enhance the ability of MPOs and state DOTs to work effectively as partners in the rapidly changing landscape of urban transportation. The NCHRP is uniquely well situated to address these questions in a manner that can lead to useful outcomes for states and MPOs.

Much has changed since the passage of the 1962 Federal Highway Act, including the introduction of federal transit funding, the rise of active transportation modes, increased concerns surrounding coordinated growth, planning for environmental and sustainability, requirements related to metropolitan freight; increased urgency surrounding basic maintenance and operations needs and less focus on capacity enhancements. Responsibility for transportation funding has also increasingly devolved away from federal and toward state and local levels of government. Growth in fuel-efficient and alternative fuel
vehicles and the emergence of autonomous vehicles already signal significant shifts in transportation policy and funding conventions.

Over time, the MPO framework has adapted bit-by-bit to these changes; Federal and state governments have overlaid new instructions, tasks, and requirements onto the MPO planning process to address these changes and evolving policy concerns. Systematic review of the history, legal basis, and present functions of MPOs and regional transportation planning is needed to assess how well these organizations and processes serve contemporary needs in light of rapid changes in transportation technologies and rapidly growing metropolitan areas.

IV. LITERATURE SEARCH SUMMARY

A large body of existing scholarship has addressed regional scale planning in general (Altshuler et al, 1999) and various advocacy and professional groups have recommended “best practices” for metropolitan transportation planning (Transportation for America, 2014). Very few studies, however, have attempted to examine more comprehensively the origins, evolution, legal basis, and present performance of MPOs and regional transportation planning. Where such reviews do exist, they address MPOs as a group and fail to capture the significant diversity among MPOs’ regional contexts and institutional arrangements (Nelles, 2014).

Existing studies of MPOs and the metropolitan planning process nonetheless provide a starting point for assessing MPOs’ underpinnings, evolution, and potential enhancement. In particular, studies of metropolitan planning over the last 15 years have emphasized three specific dimensions of MPOs’ function and performance: (1) participation in MPO planning; (2) relevance and influence in planning and decision-making; (3) regional transportation equity.

Participation. Key themes in studies about MPO participation include MPO board and voting structures and the persistent challenge of crafting organizations that are representative of metropolitan populations (Lewis & Sprague, 1997; Benjamin, Kincaid & McDowell, 1994; Luna, 2013; Nelson, Sanchez, Wolf & Farquhar, 2004), or of various modal entities (Hoover, McDowell, & Sciara, 2004; Bond & Kramer, 2010).

Relevance and influence. Works that examine MPO decision-making emphasize various limitations in MPO control over planning and funding (Edner & McDowell, 2002; Bond & Kramer, 2010; Goetz, Dempsey, & Larson, 2002; Lowe, 2014) and generating revenue (Sciara & Wachs, 2007). MPOs seen as influential and relevant often have robust staff and technical capacities (Goetz, Dempsey, & Larson, 2002), yet many MPOs report limited technical abilities along with planning and staffing constraints (GAO, 2009). Challenges in addressing the effect of local land use on regional transportation have also been noted (Burnes, Newmark, & White, 2012; Lewis, 2001).

Transportation equity. Particular scrutiny has focused on MPOs’ ability to ensure that or evaluate if transportation benefits and costs are distributed equitably (Amekudzi, Smith, Brodie, Fischer, & Smith, 2012; Karner & Niemeier 2013).

V. RESEARCH OBJECTIVE

The proposed project will produce findings and recommendations for policymakers based upon the literature review, case studies, and results of the focus groups and workshops; These will serve as a comprehensive resource for federal policy makers and MPOs, state DOTs, and state, regional, and local officials who seek to make metropolitan planning and MPOs more effective in the 21st century. These findings—and the follow-on conference presentations, webinars, and workshops that would be crafted around their completion—will address MPOs and metropolitan planning from a variety of perspectives. They will help state, regional, and local actors understand the challenges and opportunities for MPOs and their partnerships with DOTs in light of dramatic shifts in ways transportation is consumed and delivered. Three overarching questions would inform the proposed study that will emphasize challenges and opportunities.
First, how do MPO structures and responsibilities differ from organization to organization and from state to state? How have these features evolved over time? Over 400 MPOs operate in the U.S. today, and they are highly heterogeneous. In different places, their structures, roles, and responsibilities have evolved differently. The research will explore lessons learned from these different institutional and organizational arrangements.

Second, to what degree have MPOs fulfilled their designated functions as those functions have evolved over time? What obstacles have MPOs faced in the execution of their missions? Regional plans and programs are intended to complement the state DOT efforts and resources and to coordinate local jurisdictions’ investments, programs, and policies. Scholars and policy makers have long argued that the benefits of regional-scale planning outweigh the costs of overcoming political roadblocks to implementation (Dreier, Mollenkopf, & Swanstrom 2004; Orfield 2011). Taking these arguments into consideration, to what degree have MPOs fulfilled their intended functions and adjusted to contemporary expectations? Which MPOs have been most successful, in terms of generating cooperative, participatory planning; influencing regional transportation outcomes; and distributing transportation benefits equitably? What has enabled individual MPOs to succeed?

Third, what have been MPO experiences with and what are their abilities for handling rapid change? How can MPOs and DOTs working in different jurisdictional, geographic, and institutional settings reinforce their mutual abilities to develop effective transportation systems and solutions for the 21st century? For instance, the 21st century transportation mission and the funding landscape are shifting (including more cities, counties, MPOs, transit agencies and P3 road projects). How can MPOs and DOTs coordinate to address these new opportunities and challenges?

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

A budget of $390,000 is proposed for this research. The research is envisioned to consist of documenting the historical background of how MPOs have evolved over the past 50 years to indicate what has worked well and where opportunities might have been missed. This history is intended to share lessons learned for immediate use by MPOs and DOTs as well as to understand how to enhance partnerships and roles to meet 21st Century needs. The research will also include focus group discussions with DOTs and MPOs. A survey of MPOs to identify current roles, functions and DOT relationships is envisioned as well as forum discussions at AMPO and AASHTO conferences. Case studies of 5 to 6 MPOS will also be included in the research. The budget is envisioned to be allocated as follows:

**Problem funding and key activities:**

- **Task 1. Literature and historical research:** $30,000
- **Task 2. Focus groups with DOT & MPO staff:** $60,000
- **Task 3. AMPO and AASHTO forum discussions:** $30,000
- **Task 4. Survey of MPOs:** $50,000
- **Task 5. Case studies of selected MPOs:** $120,000
- **Task 6. Reports and panel communications:** $100,000

**Research Period:**

An 18 to 24 month schedule is proposed for this research, which will include the literature review, outreach surveys, MPO and DOT focus groups and conference forum discussions.

VII. URGENCY AND POTENTIAL BENEFITS

The proposed research would benefit state DOTs and MPOs through the publication of shared lessons learned and strategies for strengthening the future delivery of coordinated transportation investments in a rapidly changing environment. MPOs and state DOTs invest hundreds of billions of taxpayer dollars to produce a system that we all rely on every day. In 2020, the FAST Act will expire and there will be a
Presidential election. Additionally, the 2020 decennial census will report the latest trends in metropolitan growth, and planning for the deployment of connected and autonomous vehicle technologies will be well underway in many metro areas. Given this approaching convergence, this is a critical time to assess what has worked well and what needs improvement. If this work is not funded, states, regions, and local communities could miss opportunities to consider metropolitan planning performance and to apply lessons learned to make it more effective. Federal policymakers would not have the benefit of basic research for weighing future improvements to the MPO framework when opportunities to do so arise in authorization or other bills or regulatory guidance.

VIII. IMPLEMENTATION PLANNING

The target audience for this research is federal officials, DOTs and MPOs. The core audience would include AASHTO, the American Association of Metropolitan Planning Organizations (AMPO), the National Association of Regional Councils (NARC) and federal agencies including FHWA and FTA. The research should reinvigorate discussions about how best to plan and program transportation projects to meet America’s 21st century transportation needs. AASHTO committees on planning and on performance management and AMPO should have strong interest in translating the findings into policy and practice.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

The statement was developed by members of the TRB Committee on Transportation History, Asha W. Agrawal (Committee Chair), Emil Frankel, Gloria Jeff, Peter C. Martin, Gian-Claudia Sciara, and Martin Wachs.

Contact information for Dr. Agrawal, Chair of the TRB Committee on Transportation History (ABG50): asha.weinstein.agrawal@sjsu.edu; 510-847-1895 (cell)

X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. SUBMITTED BY

Joe Horton
California Department of Transportation
DRISI
1227 O Street, 5th floor
Sacramento, CA 95814
(916) 654-8229
Joe.Horton@dot.ca.gov

Please submit completed problem statement at:
Questions on the process can be directed to chedges@nas.edu.


NCHRP Review of B-07
Integrating MPOs into the transportation process more effectively is a positive objective, involving a significant institutional analysis encompassing a complex series of issues. This should be a useful study.

FHWA Evaluation of B-07
Harlan Miller/HEPP-10 - This research is timely considering recent legislation implementing performance management and the general transition away from building new infrastructure and continuing movement toward the maintenance and operation of existing facilities and systems. The discussion forums should include not only State DOTs and MPOs, but also public transit agencies and representatives from local governments in metropolitan areas. The MPOs should be evaluated in terms of MPO size (small, medium, and large) as the technical capacity, complexity of the planning process, and functioning of the MPO varies greatly depending on the size (population) of the metropolitan area served by the MPO. Key aspects of the MPO's planning process should be considered such as stakeholder engagement, public involvement, plan and program development and management, environmental justice, transportation conformity, multimodal planning (freight, transit, roadway), emerging technologies (CA/CV, shared mobility), coordination with state and local governments, and transportation performance management.

AASHTO Committee Evaluation for B-07
Metropolitan Planning Organizations: Transportation Partnerships for the 21st Century

Submitted By:
Sharon Edgar
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel
Council on Public Transportation

Comments:
#1 Priority for Council on Public Transportation.
I. PROBLEM NUMBER

2019-B-08

II. PROBLEM TITLE

Quantifying and Estimating VMT Reduction from Transportation Demand Management (TDM) Measures in Rural Communities.

III. RESEARCH PROBLEM STATEMENT

It is unclear what Transportation Demand Management (TDM) measures are most effective in rural areas which are often underserved by bicycle facilities, pedestrian facilities, transit facilities, and lack the proximity of destinations typical in urban areas.

Of the TDM measures appropriate for rural areas, the level of VMT reduction derived from individual measures is unknown.

Clarity is sought on which TDM measures to apply in rural areas, and the VMT reduction benefits derived.

Additionally, the ability to estimate VMT reduction from application of rural TDM measures is needed. This helps future projects estimate the breadth of rural TDM measures that need to be applied.

IV. LITERATURE SEARCH SUMMARY

The research builds upon prior NCHRP efforts, shown below, by identifying actual vehicle miles travelled (VMT) reductions from individual transportation demand management (TDM) measures and creating a methodology for applying the VMT reduction assumptions to future projects. The difference is that this proposed research helps future projects estimate VMT reduction.

- Mitigating Vehicle-Miles Traveled (VMT) in Rural Development (15-0821). Summary: Vehicle-miles traveled (VMT) as an environmental review metric is more effective at combating climate change than level of service (LOS), and policymakers are beginning to advance its adoption for this purpose. Years of research and development prove that VMT mitigation strategies such as density, diversity, and design succeed in urban areas, but doubts remain about how VMT can be mitigated in rural development. This report reviews the current understanding of both urban VMT mitigation and rural development. Finally, additional literature and evidential case studies are explored to identify urban VMT mitigation strategies that can be modified for the rural scale as well as mitigation strategies unique to the rural context.

- Transportation Impacts of Transit-Oriented Development in Rural Towns Project (01569197). Summary: This project will investigate the relationship between land use development, which implements smart growth principles, and its impact on transportation by looking at different build out scenarios for brownfield/infill development in existing cities and/or towns. Researching the vehicle miles traveled (VMT) changes associated with different land use build out scenarios should answer the following questions: Does implementing higher density mixed use development in towns in a rural State result in a reduction in VMT in a specific geographic area? If so, by how much? What range? What percent(s)? This project will
engage town officials, citizens, and planners to develop alternate visions of future municipal development, both with and without mixed land use transit oriented developments (TOD). It will quantify the changes, both positive and negative, on total vehicle miles traveled (VMT) and vehicle air emissions under different future scenarios. VMT is a key measure used by transportation planners for identifying the magnitude of transportation impacts. In this project, two Maine towns will be modeled using a transportation planning model (Trans CAD or something similar), that incorporates land use designations into VMT estimates. The impacts of TOD on vehicle miles traveled and vehicle emissions will be estimated. Scenario planning techniques, which have proven useful for land use planning in other states, will be used to select the locations for TOD as well as the make-up of the developments. Scenarios might consist of a spatial re-arrangement of future projected development for the entire town into appropriate concentrated parcels. In this way, the community will not only contribute to the research project but also experience a learning discussion about how land use patterns impact automobile travel. The suggested scenarios are: Assume build-out in the town is status quo and based on historic land use patterns. Assume build-out in the town incorporates 1-2 transit-oriented developments. Assume build-out in the town incorporates 2-4 transit oriented developments this is an important project because at present there are no known estimates of the magnitude of how transit oriented development could affect VMT in a rural state such as Maine. This project will provide estimates of the potential impacts of TOD in a rural environment using a real municipality, town or city and future land use assumptions developed in conjunction with local officials, planners, civic leaders and citizens. The project is a research and planning study; therefore it will not promote any individual existing projects or developments, nor will it necessarily tie in with any existing planning studies. It will be conducted over a two-year period and will be completed by the summer of 2010.

V. RESEARCH OBJECTIVE

The research proposed in this problem statement addresses rural area questions. The research breadth should include both local land use development projects, and transportation projects.

The research will result in:
- a list of Transportation Demand Management (TDM) measures applied successfully to projects in rural areas,
- quantification of the resulting vehicle miles traveled (VMT) reduction, and
- methodologies to apply VMT reduction to future, planned projects in rural areas. That is, develop a way to apply the research findings to estimate VMT reduction for other rural projects.

Research steps may include:
- Identify rural TDM measures applied across the U.S. in rural areas.
- Identify VMT reductions from each TDM measure
- Quantify the VMT reduction from application of the measure
- Create methodology for estimating VMT reductions from future applications of the TDM measure.

Supplemental activities include presentation of the information to states that are evaluating whether level of service is an appropriate metric in environmental documents.

Understanding what TDM measures are successful in rural areas, and the attendant reduction in vehicle miles traveled will be helpful to future environmental practice.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
**Recommended Funding:**

$300,000

**Research Period:**

18 months

**VII. URGENCY AND POTENTIAL BENEFITS**

- The research can help improve the breadth and depth of technical data quantifying transportation demand management (TDM) measures’ application in rural areas and the resulting reduction in vehicle miles traveled (VMT). The information can be used by states, regional agencies, cities, counties, and air pollution control districts as they develop and apply TDM measures.

- Rural areas around the county experience air quality issues and transportation systems that may be dominated by vehicular travel. If the research isn’t funded, a gap of knowledge will continue regarding how to successfully apply TDM measures that work in rural areas to support realistic application of bicycle, pedestrian, and transit facilities and services.

**VIII. IMPLEMENTATION PLANNING**

(a) Target audience is planners and engineers at the local, regional, and state levels; consultants; and environmental practitioners who address vehicle miles traveled (VMT) within environmental documents or transportation studies.

(b) Unknown

(c) Unknown

(d) Unknown

(e) Unknown

**IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT**

Alyssa Begley, SB 743 Program Implementation Manager, California Department of Transportation, (916) 261-3389, alyssa.begley@dot.ca.gov

**X. AASHTO MONITOR**

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

**XI. SUBMITTED BY**
Contact information for individuals submitting or supporting this problem statement.

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NCHRP Review of B-08
I believe this should be a useful study, but the allocation of $300,000 would not seem to be sufficient to accomplish all of the expected products, especially if one were to add a step that includes verification of proposed methods for estimating VMT reductions. A case study verification would add to the validity of the output.

FHWA Evaluation of B-08

Brian Gardner/Jeremy Raw/ Joseph Hausman/HEPP-30; David Kall/HEPN-10 - Good project, of great interest to California, but also of broad interest to agencies pursuing comprehensive performance management; Project should look beyond "bikes, pedestrians and transit" to include movement of goods, as well as new transportation technologies (both for personal movement and goods movement); Project should include examination of rural land and economic development patterns in relation to VMT, and use an expansive definition of what a TDM "measure" or "strategy" might be (including economic and development incentives or disincentives); We're concerned that by focusing on too narrow a set of "TDM measures", the results will not be helpful for the underlying goal of addressing rural mobility and economic development needs more efficiently. It is unclear how this research adds to the body of available information and/or current standards of practice. There are several resources currently available from FHWA and others to help quantify VMT reduction from transportation demand management measures. These include FWHA CMAQ Emissions Calculator Toolkit (https://www.fhwa.dot.gov/environment/air_quality/cmaq/toolkit/), FWHA CMAQ Cost Effectiveness Tables (https://www.fhwa.dot.gov/environment/air_quality/cmaq/reference/cost_effectiveness_tables/), and Multi-Pollutant Emissions Benefits of Transportation Strategies (https://www.fhwa.dot.gov/environment/air_quality/conformity/research/mpe_benefits/mpe00.cfm). In many cases the same calculation methodologies could be used between urban and rural areas, but certain inputs, such as length of trips reduced, number of riders, etc. would be different in rural areas. It is uncertain if this research would address differences in typical inputs for quantitative analyses in rural areas (verses creating new VMT reduction methodologies) and whether it would include information on successful implementation of TDM strategies in rural areas.

AASHTO Committee Evaluation for B-08

Quantifying and Estimating VMT Reduction from Transportation Demand Management Measures in Rural Communities

Submitted By:
Sharon Edgar
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel
Council on Public Transportation

Comments:
Consider value of transit, bike and ped in providing for mobility even when it does not reduce VMT.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-B-09

II. PROBLEM TITLE

Sources of Zinc in Highway Runoff

III. RESEARCH PROBLEM STATEMENT

This problem statement was developed by the TRB Standing Committee on Stormwater, AFB65. Zinc is a pollutant of concern in highway runoff (NCHRP, 2014). Zinc is also the cause of the listing of impaired waterways (CWA 303(d) list) across the US. These listings result in the preparation of Total Maximum Daily Loads (TMDL) that include DOTs as stakeholders. Highways have a variety of potential emission sources for zinc including tires, motor oil, paint, vehicle parts, exhaust emissions, appurtenances, brakes, storm drains, fencing, signposts, and other metal structures such as bridges and overpasses.

There have been very limited studies that assess the mass balance of zinc in the highway environment. This is especially important if DOTs are assigned a TMDL waste load allocation and must effectively reduce the concentration of zinc in highway runoff. The identification of specific sources is also essential in those states where DOTs are required to comply with water quality standards for discharges from the highway right-of-way into receiving waters. Zinc is one of the pollutants that most frequently exceed water quality standards at the point of discharge.

This project would build off of a finding from NCHRP Project 20-68A, the U.S. Domestic Scan Program: Scan Report 08-03 Best Practices in Addressing NPDES and Other Water Quality Issues in Highway System Management. The Domestic Scan report (Report) identified research gaps and recommendations for national discussion and noted that research on source control to address pollutants of concern was an immediate need for the DOTs. The Report indicated that source control would be the “most effective and least costly approach to surface water improvement” and would also support compliance with NPDES permits. The final project report can be found at http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-68A_08-03.pdf

This proposed research project targets source control for a pollutant of concern (zinc) that is named in statewide TMDLs as emanating from transportation systems and as a pollutant of concern from highways. The source control approach provides a more efficient and cost effective method to avoid and minimize pollution of our nation’s water bodies compared with end-of-pipe treatment. This project will enable DOTs to work collaboratively with resource agencies and comply with current and future regulations.

IV. LITERATURE SEARCH SUMMARY

Online search of TRB’s TRIS and RIP databases found many records (142) on characterizing the concentration of zinc in highway runoff, as well as practices for removing zinc in highway runoff, but none that assess and define the relative contribution of identified sources of zinc in the highway environment. Two studies were found in broader literature reviews that are pertinent to the research:
Zinc Sources in California Urban Runoff. TDC Environmental, LLC, 2015. This study was commissioned to develop scientific information to inform decision-making by the California Stormwater Quality Association and stormwater permittees for the reduction of zinc as a water pollutant and to identify major and minor sources of zinc in order to assist agencies to focus control measures in a cost-effective manner. The report found that the major sources of zinc in urban runoff are outdoor zinc surfaces and tire wear debris. The report did not develop quantitative estimates of zinc contributions from sources in a study watershed.

State of Knowledge Report, Contribution of Zinc to Watersheds from Building Materials, Consumer Products Tires and Other Sources. Cardno Chem Risk, 2016. This study notes that, “To date, there have been no publicly-available reports of efforts to create a comprehensive Zn emissions inventory or mass balance in any U.S. city or watershed.” The study further indicates that, “Zn loads are highly variable between watersheds, and it is not possible to develop a generic characterization of major or minor sources within U.S. watersheds. Therefore, a comprehensive source emission inventory in ... areas of the country considering loading of Zn to the environment is necessary to understand the potential efficacy of mitigation measures regarding galvanized metals, batteries, tires and other consumer products.”

Other references that were not reviewed, but likely have supporting information are:


V. RESEARCH OBJECTIVE

The objective of this research is to assess the relative contribution of sources of zinc in the highway environment. Typical urban areas at three locations in the US are proposed to be assessed to
determine the relative contributions of zinc from the identified sources in the right-of-way. The investigator may also propose variations on roadway types for consideration by the Panel.

**General Scope of Work:**

**Task 1:** Literature Review. Complete a literature review to determine the sources of zinc in highway runoff. The literature review should also attempt to determine if there is the potential to reduce zinc oxide in tire tread. The review should include assessments of shredded tire lightweight fill and crumb rubber in pavement. The literature review should examine research completed internationally as well as in the US. The findings of the literature review will serve as the basis for the subsequent tasks in the research to assign relative contributions to each of the identified sources.

**Task 2:** Identify three catchments in urban areas across the US to perform the field investigations. The selected catchments should reflect the potential sources of zinc identified in Task 1 including aerial deposition and contributions from site soils and pavements, should be geographically diverse, and should have multiple zinc TMDLs.

**Task 3:** Laboratory and Field Study Plan. Develop a laboratory and field study plan for bench scale testing and the selected catchments, and based on the findings of the literature review to quantitatively assess the relative contributions of zinc from the identified sources in the highway right-of-way. This includes relative contributions in highway runoff and overall estimated contributions to the watershed. Laboratory work should be completed to preliminarily assess the potential relative contributions from tire wear, appurtenances such as guard rail, fences and sign posts/bridges and zinc coated storm drain pipe.

**Task 4:** Perform the field study over a two-year period to gather data that will enable a characterization of the relative contribution of identified sources of zinc in highway runoff. Sources will often be site-specific. This task will include the following goals:

1. Identify the sources and relative contribution from vehicles: tires, motor oil, other vehicle parts, etc. This will include edge-of-pavement runoff monitoring
2. Identify the sources and relative contribution from other sources in the right-of-way: galvanized drainage pipes, fencing, signage, structures such as overpasses, and the soil reservoir (from previous deposition from particles carried to the roadside by vehicle-induced and natural air movement).
3. Assess localized zinc loading to runoff contributed by segments of the roadway constructed with rubberized asphalt concrete (laboratory only).
4. Assess aggregate contributions from highways compared with other sources in the watershed.

**Task 5:** Draft Report. Prepare a draft report summarizing the findings from Tasks 1 – 4.

**Task 6:** Final Report. Prepare a final report that includes recommendations for source control measures that can be implemented by DOTs or with the assistance of other entities to reduce the concentration and load of zinc in highway runoff. The recommendations should focus on technical feasibility.

**Task 7:** Publish the final report and provide a list of recommended future studies or recommended research needed to further advance DOTs towards meeting water quality standards for zinc in highway runoff.

**VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD**

**Recommended Funding:** $750,000

**Research Period:** 48 months (including two-years for field study)
VII. URGENCY AND POTENTIAL BENEFITS

Departments of transportation are required to comply with the requirements of the Clean Water Act (CWA) as well as state environmental regulations. Nationally, the EPA lists 323 waterbodies as impaired by zinc. This represents about 13% of all waterbodies nationally identified as impaired by metals, and is the 5th ranked metal causing impairment behind arsenic, selenium, copper, iron and lead. Zinc is a common constituent of concern in highway runoff. Zinc, plus copper and lead are the metals that most frequently exceed water quality standards at the point of discharge. Copper and lead loadings are expected to decrease significantly as legislative and other controls reduce their use in the transportation environment. Unfortunately, no similar efforts are underway for zinc. DOTs are being required to reduce the concentration of zinc in their runoff not only to comply with TMDLs but also to prevent exceedances of water quality standards. This research will provide DOTs with the information needed to determine the highest priority sources of zinc within their right-of-way, and the most economical approach to reducing each identified source.

VIII. IMPLEMENTATION PLANNING

DOTs must find ways to utilize stormwater program resources in a cost efficient manner. The benefit of this research statement will be to allow DOTs to focus their resources in the most cost effective manner. DOTs have a variety of best management practice (BMPs) available for use that differ in cost and effectiveness. This project will allow DOTs to reduce zinc pollution at the source for the most significant sources in the right-of-way.

The target audience for the deployment of the results from this research would be state department of transportation (DOT) stormwater practitioners, asset managers responsible for the operation and maintenance of highway appurtenances that might contain zinc, and state and federal regulatory officials. Key decision-makers who would influence and champion implementation of the research products from this project are those individuals in state DOTs that direct the selection and deployment of stormwater BMPs such as environmental managers and state hydraulic engineers. Organizations likely for responsibility to adopt the research results are the AASHTO Standing Committee on the Environment (SCOE), Subcommittee on Design (SCOD) Technical Committee on Hydrology and Hydraulics (TCHH), and the AASHTO Center for Environmental Excellence Stormwater Community of Practice. Also, the TRB Hydrology and Hydraulics Committee (AFB60) and Standing Committee on Stormwater (AFB65).

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

TRB Standing Committee on Stormwater (AFB65)
Scott Taylor, Chair
Michael Baker
International 760 603
6242
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X. AASHTO MONITOR

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XI. SUBMITTED BY

Same as AASHTO Monitor (Kenneth M. Stone)

NCHRP Review of B-09

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:
Understanding the sources of zinc is an important element of designing a robust TMDL. The proposed research period is 48 months, longer than the typical NCHRP project, although reasonable given the need for multiple field data collection sites. If needed the proposed project could perhaps be adjusted in scope to focus on sources within state DOT purview (i.e. rubberized asphalt concrete, roadside appurtenances).

Note that a related NCHRP project is underway to evaluate the effectiveness of ferric oxide filters in removing metals from highway runoff, including zinc. The project includes a single field monitoring site and lab testing. Scheduled completion is September 2018. (NCHRP 25-54; project page: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4068)

Review Date:
11/21/2017

FHWA Evaluation of B-09

Susan Jones/HEPE-30 - Studies do show a strong zinc correlation to traffic count and how zinc is common in highway runoff, mostly from tires. However, finding a relative percentage of how much highways are contributing to zinc concentration with just 3 sites and laboratory work is difficult and site specific based on if there are significant zinc producing products in the area. Laboratory work is expensive. Would like a scaled down approach to look at site specific sites first, then a follow-up study for the laboratory work to reduce upfront costs.

AASHTO Committee Evaluation for B-09

Sources of Zinc in Highway Runoff

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design
Comments:
Committee on Design – While the proposed research could be beneficial to discover ways to utilize BMPs to reduce zinc concentrations, research into reducing the zinc emissions at the source would be helpful as well.

Submitted By:
Samantha Hoilett
AASHTO Liaison on behalf of CES Leadership
Committee on Environment and Sustainability

Comments:
Submitted by Stormwater Committee AFB65. There are several potential sources of zinc in the typical highway right of way. This research would quantify zinc inputs from specific sources to lead to effective reduction of the concentration of zinc in highway runoff. TMDL related.

Submitter Response for 2019-B-09
Sources of Zinc in Highway Runoff

From: Ken Stone, WA State Dept. of Transportation [email: stonek@wsdot.wa.gov]

Comments:
AASHTO Evaluation Submitted By:
Patricia Bush, AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – While the proposed research could be beneficial to discover ways to utilize BMPs to reduce zinc concentrations, research into reducing the zinc emissions at the source would be helpful as well.

AFB65 Response (by Scott Taylor, committee chair):
We completely agree that reducing zinc emissions at the source will be the highest performing BMP. This research will enable DOTs to accomplish this very task. It is important to understand the relative contribution of the various sources of zinc within the ROW, so the most important can be targeted. For example, zinc from auto tires may be as much as half of zinc loading, while appurtenances, such as sign bridges may be single-digit contribution. This information would allow DOTs to work with manufacturers to focus on reformulation of tires. Currently, all sources of zinc are assumed to have the same importance, since there is no information on relative contribution. This research eliminates that problem.

Submitted By:
Samantha Hoilett
AASHTO Liaison on behalf of Committee on Environment and Sustainability (CES) Leadership

Comments:
Submitted by Stormwater Committee AFB65. There are several potential sources of zinc in the typical highway right of way. This research would quantify zinc inputs from specific sources to lead to effective reduction of the concentration of zinc in highway runoff. TMDL related.

AFB65 Response:
This is a good summary of the project. It is correct that this research would enable DOTs to more efficiently and effectively comply with TMDLs for zinc.

FHWA Evaluation Submitted by:
Susan Jones/HEPE-30

Comments:
Studies do show a strong zinc correlation to traffic count and how zinc is common in highway runoff, mostly from tires. However, finding a relative percentage of how much highways are contributing to zinc concentration with just 3 sites and laboratory work is difficult and site specific based on if there are significant zinc producing products in the area. Laboratory work is expensive. Would like a scaled down approach to look at site specific sites first, then a follow-up study for the laboratory work to reduce upfront costs.

AFB65 Response:
We agree that there is the potential for the results of this study to be viewed as site-specific. However, we are certain with careful selection of the test sites, to reflect typical highway conditions, that we can isolate the relative contribution of sources. That said, it is a good point that it will be difficult to parse the contributions between the nine sources we have listed as within the highway ROW. We can reduce the number of sources in the ROW to:
1. Vehicle sourced
2. Appurtenances (fences, guardrails, sign posts)
3. Pavement
4. Storm drain conduits.
The literature review and initial laboratory evaluation can be used to identify the likely larges sources, and the field monitoring can verify and quantify the sources. Lab work is relatively inexpensive compared to field work, and can narrow the potential source contributions quickly and relatively cheaply.

NCHRP Evaluation By:
Ann M. Hartell
ahartell@nas.edu
Comments:
Understanding the sources of zinc is an important element of designing a robust TMDL. The proposed research period is 48 months, longer than the typical NCHRP project, although reasonable given the need for multiple field data collection sites. If needed the proposed project could perhaps be adjusted in scope to focus on sources within state DOT purview (i.e. rubberized asphalt concrete, roadside appurtenances).

Note that a related NCHRP project is underway to evaluate the effectiveness of ferric oxide filters in removing metals from highway runoff, including zinc. The project includes a single field monitoring site and lab testing. Scheduled completion is September 2018. (NCHRP 25-54; project page: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4068)
Review Date: 11/21/2017
AFB65 Response:
The approach to this project would be to focus on sources within the ROW. Sources beyond the purview of the DOT would be important to identify, to enable efforts to reduce or eliminate them since the DOT is responsible for the quality of runoff discharged through its system regardless of the pollutant source. The authors of this Research Problem Statement are very familiar with NCHRP 25-54, having been the investigators for the precursor study, NCHRP 25-32, Removal of Dissolved Metals.

Contact Info:
Ken Stone, WSDOT, stonek@wsdot.wa.gov
Scott Taylor, AFB65 Chair, STAYLOR@mbakerintl.com

Response Date: 12/18/17
I. PROBLEM NUMBER

2019-B-10

II. PROBLEM TITLE

Innovative Mitigation Strategies for Highway Noise

III. RESEARCH PROBLEM STATEMENT

The objective of this project is to identify innovative methods to avoid transportation noise impacts or to reduce impacts where traditional noise mitigation methods are not feasible and reasonable. These methods could help reduce the overall cost of a project, when compared to what it would cost if traditional noise mitigation was used, and provide relief to communities where traditional methods are not applied. In addition, these methods may increase the effectiveness of traditional mitigation methodologies when used in conjunction.

Highway noise impacts require agencies to implement expensive noise abatement measures when feasible and reasonable to protect nearby communities. Highway noise mitigation typically uses noise barriers as the most common abatement measure. Due to the high cost of noise walls (an average of two million dollars a mile for a single direction) and acoustic feasibility or constructability issues, barriers may not be built, leaving portions of communities unmitigated.

This project will identify non-traditional methods to reduce highway noise (non-traditional methods are listed in the next section). There are methods currently being applied, as well as promising theoretical methods, focused on changing project design aspects or determining better material selection to reduce highway noise. In some cases, these methods would result in avoiding noise impacts and eliminating the need to build noise walls. In other cases, these methods would help to reduce noise levels where traditional methods are not feasible or reasonable or desired by adjacent residents.

IV. LITERATURE SEARCH SUMMARY

The research will include a literature review and survey of highway agencies, noise consultants, and academic researchers. Results will benefit local governments, highway agencies, researchers, and noise practitioners by providing guidance and ideas on how to best protect communities near highway corridors from excessive noise as well as reducing overall project costs.

TRID (http://trid.trb.org) and Research in Progress database (http://rip.trb.org/) will be consulted.

V. RESEARCH OBJECTIVE

The objective of this research is to gather information including, but not be limited to the following:

- Use of solid safety barriers in place of guard rails
- Use of a sound-absorbing ground surface adjacent to the highway
- Vegetated swales/retention basin location, size, design
• Use of quieter pavements for highways and highway shoulders
• Quieter bridge decks and joints
• Quieter rumble strips
• Retrofitted absorptive sound wall treatments
• Retrofitted vegetative sound wall treatments
• Retrofitted lightweight noise wall overhang
• Bike path and bike path separation zones- materials, width, location
• Use of on-board sound intensity measurements to identify loud sections for targeted rehabilitation for highways
• Use of small height berms (3’-6’ tall)
• Use of any other practical methods identified through the literature review and survey
• Examples of alternatives that made situation worse?

This topic was discussed during a recent TRB committee meeting (Committee on Highway-Related Noise and Vibration, ADC40). Many practitioners discussed applying non-traditional methods at the project level, spurred on by a presentation made during the meeting on sound absorbing ground surfaces. Committee members and friends, including state highway agencies, recognized the value in synthesizing related information to immediately help others with highway projects. In addition, it was discussed that the synthesized information would help to define research needed in this area, ultimately leading to a research project statement to be submitted by state highway agency representatives who are actively involved with the committee.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $250,000

**Research Period:**

24 months

*(Note: This estimate may be changed by the Project Panel.)*

VII. URGENCY AND POTENTIAL BENEFITS

This project has high urgency for states that have projects with noise impacts that could be avoided using methods that provide small reductions in noise levels and for states that have a large number of capacity adding projects.

Lack of funding for the project will result in continuing to rely on expensive and outdated methods of noise abatement.

The potential benefit of the project is to provide additional tools and technologies to states to provide noise mitigation in locations where traditional forms of abatement, such as noise barriers, are not feasible or reasonable.

VIII. IMPLEMENTATION PLANNING

The target audience for this project is state highway agencies that are looking for new tools and technologies to avoid, minimize or mitigate the impacts of highway noise.

Champions of the project will include state highway agency environmental program managers and the AASHTO Committee on Environment Noise Working Group.
IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. SUBMITTED BY

This project statement is supported by the TRB Committee on Transportation-Related Noise and Vibration (ADC40), including the following highway agencies/individuals:

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Washington, DC 20003
(Note: While anyone can write or contribute to preparing a problem statement, only state DOTs, AASHTO committees or councils, or the Federal Highway Administration can submit a problem statement to NCHRP.)
NCHRP Review of B-10

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:
This problem statement proposes a project to collect and synthesize information on noise mitigation strategies other than traditional noise barriers, as well as potential methods to identify highway segments for targeted retrofits. Forthcoming research from NCHRP is demonstrating the limitations to the effectiveness of traditional noise barriers (NCHRP 25-44: Field Evaluation of Reflected Noise from a Single Noise Barrier, project page: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3428; NCHRP 25-52: Meteorological Effects on Roadway Noise, project page: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3892 ). The proposed project offers a logical next step to investigate potential alternatives and new directions in noise mitigation practice.

Review Date:
11/22/2017

FHWA Evaluation of B-10

Adam Alexander/HEPN-10 - This project could be helpful to inform on new mitigation strategies for impact avoidance as we work on a new rulemaking. A concern is the amount of time this project may take to complete.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-B-11

II. PROBLEM TITLE

Practitioners Handbook for the Noise Analysis Process for Design Build Projects

III. RESEARCH PROBLEM STATEMENT

Design build project delivery raises challenges for state DOT implementation of the noise analysis process. These challenges include ensuring compliance with the requirements of the state highway agency noise policies, NEPA, the FHWA noise regulations (23 CFR 772); oversight of design build team (DBT) changes to proposed noise abatement measures; and verification that environmental commitments are satisfied.

IV. LITERATURE SEARCH SUMMARY

There is a body of previous research on design build as an alternative program delivery method. Among the literature are works focusing on disciplines such as material acceptance and roadway safety, but there is no previous work with specific focus on the challenges of design build projects specific to the noise analysis process or other processes subject to environmental review.

Related projects from TRID (http://trid.trb.org) and Research in Progress database (http://rip.trb.org/)

Title: Develop New Methods for Material Acceptance on Design-Build Projects
Accession Number: 01618973

Title: Analysis of Roadway Safety under the Alternative Project Delivery Systems
Accession Number: 01629731

V. RESEARCH OBJECTIVE

The objective of this research is development of a Practitioners Handbook for the Noise Analysis Process for Design Build Projects. The completed handbook will provide state highway agency staff and supporting consultants with a streamlined process flow including QA/QC information necessary to satisfy regulatory requirements for design build projects, including:

- Addressing existing noise mitigation and new mitigation that is recommended at the beginning of the project or because to design changes
- Triggers, methods, and reporting requirements for noise analysis and mitigation
- Triggers for DOT involvement (e.g., inspections, reviews)
- Minimum mitigation construction requirements (e.g., no gaps within or between the wall, no gaps between bottom of wall and finished grade)
- Template or minimum requirements for Environmental Compliance Work Plan (i.e., contractor document submitted to DOT to explain how contractor will comply with DOT contract requirements)
- DOT needs/perspective versus contractor needs/perspective
• Providing solutions to issues from prior design build projects (e.g., project phasing, construction noise, submittals, construction issues, and noise analysis reevaluations)

In order to develop the handbook development, research shall be conducted nationwide and internationally. DOTs will be contacted to obtain tools that have already been developed by states (e.g., design build handbooks, contract templates) and to learn what types of issues have come up in prior design build projects.

Once the handbook has been developed, a training presentation will be provided via a webinar.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $250,000; Approximately:

- 50 percent: Research
- 45 percent: Writing Handbook
- 5 percent: Training

Research Period:

27 months

(Note: This estimate may be changed by the Project Panel.)

VII. URGENCY AND POTENTIAL BENEFITS

This project has high urgency for states that use design build and need to ensure compliance with regulatory requirements. The benefits of the project will be:

• Improved administration and uniformity in approach of the noise analysis process for design build projects
• DOTs can write better contracts that build on past lessons learned including having more clear triggers for DOT involvement (e.g., when, why, how frequent, how soon before approval is needed, methods to ask questions)
• Construction projects will be more likely to meet all applicable regulations
• DOTs will more easily identify the level of DOT personnel resources needed for the project

Lack of funding for the project will result in a continued state of risk for states when trying to implement the noise analysis process on design build projects.

VIII. IMPLEMENTATION PLANNING

The target audience for this project is state highway agencies using design build as a form of alternative project delivery. Champions of the project will include state highway agency noise and environmental program managers and the AASHTO Committee on Environment Noise Working Group.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Provide name, title, organization, telephone number, and email address.

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X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. SUBMITTED BY

Contact information for individuals submitting or supporting this problem statement.

Please submit completed problem statement at:


Questions on the process can be directed to lsundstrom@nas.edu.

NCHRP Review of B-11

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:

The problem statement outlines the development of a detailed handbook to ensure compliance and track mitigation commitments. The budget and research period seem feasible for the effort.

Note that there is a project currently under development on tracking environmental commitments, including noise, for DB and P3 projects (NCHRP 25-25, Task 109), which is anticipated to begin in early 2018.
FHWA Evaluation of B-11

Adam Alexander/HEPN-10 - This project is on the noise program research plan and is a critical piece of information for states to have when looking at integrating the noise analysis and design build processes.
I. PROBLEM NUMBER
2019-B-12

II. PROBLEM TITLE
Census Transportation Data Use and Application Field Guide

III. STATEMENT OF THE RESEARCH PROBLEM
The Census Transportation Planning Products (CTPP) data sets and the American Community Survey (ACS) are critical data elements that support the planning and analysis of transportation plans, policies, programs and project selection. Changes in the data products over the last 10 years and ongoing staff turnover have left a void of expertise in effectively using this data to support transportation planning. Additionally, there is no centralized resource location where one can go to learn how to use the data for real world applications. This results in wasted time, squandered resources and at times questionable analysis.

The Field Guide will fill this void and provide the following:

- Serve as the training manual on the uses and application of the ACS, CTPP and Public Use Micro Sample (PUMS) data sets.
- Provide practitioners with a thorough understanding of the data including its strengths and weaknesses.
- Describe the data elements, table structures and variable definitions.
- Instruct users on when and how to use the data.
- Use real world and visual examples on how to apply the data.
- Draw in examples from different types of transportation agencies including states, MPOs and transit.

The Field Guide will play a critical role in enabling junior-level planners to learn about the data and how to utilize it to support required planning functions. The Field Guide will be comprehensive and cover the broad range of applications where these data are used.

IV. LITERATURE SEARCH SUMMARY
Following the NCHRP recommendation to examine the TRID database for previous work, a search of the database using “Census Data” as the keyword was done. It yielded none which provided instructions for using the data. They were all centered on different studies that had used census data. This in turn was deemed an unsuccessful source of information for learning and training purposes. A refinement to the search with “Census Data” in the title returned 183 entries. A review of these entries showed only one document remotely similar to the Field Guide proposed here. This was “NCHRP Report 588 - A Guidebook for Using American Community Survey Data for Transportation Planning”. It was published in 2007 and was developed prior to the release of the ACS small area data. Therefore, the referenced case studies are hypothetical. The report was also based on assumptions of what data would be delivered in the ACS. For example, it talks about a data retrieval system (Factfinder) that is being replaced, the use of 3-year tables that have since been dropped, and there are no examples drawing from the CTPP ACS derived data product. In fact, Report 588 was produced before the CTPP ACS derived data product was designed so direct application to the CTPP is not applicable. While NCHRP 588 does have some utility, it falls short for the reasons stated above. Simply put, we now know more about the ACS than we did when Report 588 was done. The proposed Field Guide is envisioned to...
overcome these and other shortcomings. The field guide will benefit from having both a mature ACS data program and a CTPP data product to draw upon.

V. RESEARCH OBJECTIVE
This project will develop a Field Guide for the transportation community on how to effectively use Census data including the ACS, CTPP and PUMS to address transportation issues.

It will:
• Depict applications that cross sectors (public and private), are statewide and regional, depict small and large studies, and are multimodal where possible.
• Delve into the perennial issues facing the transportation community as well as those that are emerging like Environmental Justice and Title VI, providing context for resiliency planning, millennial travel patterns and alternative commute opportunities, etc.
• Assure there are sufficient applications depicting various levels of analytical complexity that are covered and reported.

When the ACS was introduced by the Census Bureau as the replacement to the Long Form it brought with it a change in how the data was collected and packaged for public release. This in turn brought a whole new set of data issues for the transportation analyst to understand and cope with. Margins of error, privacy protection rules and procedures, imputation, rounding, data suppression, changes to the survey instrument and variables, and period estimates all have stretched the learning curve for the user. Staff from the states, MPOs and transit operators all have struggled with the use and application of the ACS and data products derived from it like the CTPP and PUMS.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $375,000
Research Period: Eighteen months

VII. PERSON(S) DEVELOPING THE PROBLEM
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All members of the AASHTO CTPP Oversight Board (http://ctpp.transportation.org/Documents/CTPP_Oversight_Board_Roster_122916.pdf)

VIII. PROBLEM MONITOR
Greg Slater, Administrator, Maryland Dept. of Transportation State Highway Administration, 707 North Calvert Street, Baltimore, Maryland 21202, 410-545-0412, gslater@sha.state.md.us

IX. SUBMITTED BY
Greg Slater, Administrator, Maryland Dept. of Transportation State Highway Administration, 707 North Calvert Street, Baltimore, Maryland 21202, 410-545-0412, gslater@sha.state.md.us
NCHRP Review of B-12
Building on previous studies, this research effort would appear to be timely and useful. It should address inclusion of new forms of data that are emerging and being studied under other NCHRP projects.

FHWA Evaluation of B-12
Brian Gardner/Joseph Hausman/HEPP-30 - The project statement is well developed. The American Community Survey (ACS) and resulting Census Transportation Planning Products (CTPP) are the primary ground truth programs that support the U.S. transportation community providing the fundamental data in the journey to work calculations. FHWA is a major supporter of these programs and building this sort of "Data Use and Field Guide" is critical for introducing new practitioners to the field. Jasmy Methiapara/HPTS-10 - The research includes summarizing the strengths and limitations (thereby discussing issues like representativeness, frequency, usefulness in a particular subject, etc.). It also asks for real world examples that staff from MPOs or state agencies could pull from. The only thing "missing" might be to include possible changes going forward and how that could affect things.

AASHTO Committee Evaluation for B-12
Census Transportation Data Use and Application Field Guide

Submitted By:
Penelope Weinberger
Liaison
Data Management and Analytics

Comments:
This is Data's number two priority. The ACS and the CTPP are widely used for planning and demand modeling. They're rather extensive datasets and the updated field guides will help out enormously with understanding, accessing and applying the data. Please support
From: [email: pweinberger@aashto.org]

Comments: All comments are great, I caution against a scope that becomes too broad with the inclusion of many other data types (NCHRP comment)

Contact Info: Penelope Weinberger, Transportation Data Program Manager, AASHTO

Review Date: 12/19/17
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER
2019-B-13

II. PROBLEM TITLE
Developing Data Standards and Guidance for Transportation Planning and Traffic Operations—Phase 1

III. RESEARCH PROBLEM STATEMENT

Planning and operating transportation systems involve the exchange of large volumes of data. The lack of common data formats has been a limiting factor for transportation agencies and all practitioners involved in data analysis and reporting. Well-designed data standards can be a viable solution to this problem since they improve the efficiency of data-driven processes and can support innovation.

The AASHTO Data Management and Analytics committee considers this research and the development of standards and guidance a cornerstone of its purpose. This work is also relevant to the Committee on Planning

NCHRP 8-36 Task 129 examined the feasibility of developing standards for transportation planning and traffic operations. The report revealed that it is difficult to predict standard adoption. There are many well-designed and technically superior standards that have failed and become marketing case studies. Based on the research, a business case and clear incentives for a critical mass of supportive stakeholders is required for market adoption.

Transportation data standards and guidance for planning and operations are feasible and desirable. Standards are most successful if they:

• Have a clear business purpose;
• Are clear in application, specificity and versioning;
• Are developed with broad outreach and buy-in;
• Are well defined and simple;
• Are open standards;
• Are forward looking; and
• Involve a national or worldwide community.

There are also many challenges associated with standard development. These include:

• Reluctant data vendors;
• Dynamic data content—Standard may be outdated soon after it release;
• Complexity of data to be standardized;
• Standardization process takes too long to complete;
• Standardization process does not take into account a critical mass of would be users or decision makers;
• There are significant disincentives or conflicts of interest;
• Limited outreach-Agencies may be unaware of the benefits of adoption; and
• Inadequate resources to overcome the barrier of entry.

The report concluded that standards are feasible and desired. Five specific areas or “bundles” of standards were identified to be ripe for standardization. They are travel time, demand, incident and work zones, network and transit.

IV. LITERATURE SEARCH SUMMARY

The following are reports and research that have addressed national-level data standards issues.

• NCHRP 8-36 Task 129—Scoping Study to Establish Standards and Guidance for Transportation Planning and Traffic Operations—Also, see Literature review for this report.
• TRB Special Report 304, How We Travel, which defines a sustainable approach to national travel data monitoring.
• The literature review accomplished as part of NCHRP 8-36 Task 129 is comprehensive and should be referenced.

V. RESEARCH OBJECTIVE

The objective of this study is to prioritize transportation planning and traffic operations standard areas and develop standards and/or guidance to be used and adopted by the transportation community.

The five standard data areas or “bundles” to be evaluated for further standard development include travel time, demand, incident and work zones, network and transit. Each bundle includes various data categories. The researcher may evaluate bundles or data categories as appropriate for moving to the next stage of standard development.

Direct reference must be made to NCHRP 8-36, Task 129. Note that a "standard" is a method or process that:

• Has a legal basis and can be made mandatory;
• Is a normative document from a formal standard body;
• Is passed through a full and open consensus process; and
• Is implemented on a national level and there is a strong mandate to apply them.

Guidance includes methods and documentation of processes that are informative and do not necessarily require consensus.

Proposed tasks include the following:

1. Develop a comprehensive stakeholder outreach plan.

2. Prioritize and select for further standard development -One or more of the bundles described in NCHRP 8-36 Task 129 (Chapter 3) (depending on available funding).

3. Follow steps identified in NCHRP Task 8-36 Task 129 Standards Development Steps (provide specific reference) to develop each standard.

4. Summarize lessons learned.
5. Develop Phase 1 of Transportation Standards and Guidance.

6. Provide recommendations for the next phase of standards and/or guidance development.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:
$250,000 per year

Research Period:
24 months

VII. URGENCY AND POTENTIAL BENEFITS

This research project was developed by NCHRP Task 8-36 Task 129. States and MPOs are currently faced with a plethora of issues related to data compilation for MAP-21 and FAST. Standards will be extremely useful in resolving many of the issues related to system data integration, compilation and reporting.

This project was identified as a High Priority project by AASHTO Data Management and Analytics Committee and the Committee on Planning because of the current FAST and MAP-21 performance management requirements and concerns over broader data collection, management and analysis issues.

The potential benefits of this research include the following:

1. Provide a framework for a phased approach to standard/guidance development for transportation planning and traffic operations.
2. Develop at least one bundle of standards or guidance as deemed high priority by the transportation community.
3. Provide feedback on lessons learned for future standard and guidance development.

VIII. IMPLEMENTATION PLANNING

This research is critical to data users. State DOT CIOs, Members of the AASHTO Data Management and Analytics Committee and the Committee on Planning are the expected champions for implementation of this research.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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NCHRP Review of B-13

This study should be aligned with the previously completed NCHRP 08-36/Task 129 study if it is to be useful.

FHWA Evaluation of B-13

Jeremy Raw/HEPP-30 - As written, the project is too vague and open-ended (deferring, for example, the question of which of the five broad areas identified in NCHRP 8-36 Task 129 should be the focus of this effort). It does not address the question of why we need standards, nor the very basic questions of to whom, or to what would these standards apply. Though they describe the characteristics of good
standards, the proposal does not address how the questions might be answered. Since there are very different applications and requirements for data in each of the five areas, pursuing this effort generically (the way it's formulated) will not yield a useful product. Prefer to see a proposal focused from the start on a specific area, and with clear focus on why a standard would be useful and for whom.

**AASHTO Committee Evaluation for B-13**

**Developing Data Standards and Guidance for Transportation Planning and Traffic Operations - Phase 1**

Submitted By:
Sharon Edgar  
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel  
Council on Public Transportation

Comments:
Consider transit operations

Submitted By:
Penelope Weinberger  
Liaison  
Data Management and Analytics

Comments:
This is Data's number one priority. Lack of defined standards results in potentially flawed/inconsistent data standards that we are utilizing when we look to prioritize funding projects. This is good research that defines crucial needs.

**Submitter Response for 2019-B-13**

**Developing Data Standards and Guidance for Transportation Planning and Traffic Operations - Phase 1**

From: [email: pweinberger@aashto.org]

Comments: Regarding FHWA comment that the problem statement "does not address the question of why we need standards, nor the very basic questions of to whom, or to what would these standards apply." The feasibility study (NCHRP 8-36 129) that this problem statement follows, does well state the desirability and need for standards (and to suggest that standards may not be needed seems odd).

The problem statement is open as to how to start (which bundle to pursue), relying on researcher expertise to get the most robust proposal. The developers of the problem statement did not want to over prescribe the research, in case some development in the field made one choice more logical than another. There was never any intention to pursue "generically" but rather that the industry, available funds and available expertise would inform the direction of specificity.

Agree with NCHRP statement, and that is the intention.

Contact Info: Penelope Weinberger

Review Date: 12/19/17
This research needs statement describes a project to develop a practice ready guide that examines the role of transportation in attracting and retaining jobs and how Departments of Transportation/Metropolitan Planning Organizations (DOTs/MPOs) and Economic Development Organizations (EDOs) can work together on this shared issue of supply chain site selection.

Studies have shown that freight and transportation infrastructure and supply chain efficiency are increasingly important factors in attracting and retaining industry. As a result, companies and site location consultants use sophisticated supply chain modeling to determine site location transportation competitiveness.

However, states, regions, and communities tend to rely on static transportation characteristics rather than dynamic supply chain analysis creating information asymmetry in site location negotiations (See Table). Some states DOTs and EDOs, such as Iowa, have been working together on using supply chain modeling to aid their industrial recruitment efforts. This is one of many ways that DOTs/MPOs and EDOs are and can work together to create quality jobs.

According to the 2016 Area Development’s Annual Survey of Site Location factors, next to skilled labor availability, transportation is the most important factor for industrial/commercial site selection. This makes effective cooperation between DOTs/MPOs and EDOs essential for job creation, however, these agencies often do not strategically cooperate.

One particular shared problem area is supply chain and site selection analysis. Companies and site location consultants making decisions on locations for expansions and new facilities have

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1 Site Selection Standards (2016) International Economic Development Council
tools and procedures for optimizing supply chains. Meanwhile economic developers lack the ability to fully understand their transportation competitiveness situation in the company’s location decision process. This knowledge disconnect gives companies a competitive advantage when negotiating these economic development projects and does not allow EDOs and DOTs to work together effectively to improve their transportation competitiveness and increase employment opportunities.

The Transportation Research Board (TRB) Committee on Transportation and Economic Development (ADD10) developed and vetted this research need. The Committees includes members from several DOTs, Federal Highway Administration, and numerous transportation researchers.

IV. LITERATURE SEARCH SUMMARY

Following the Transportation Research Circular E-C194, “Literature Searches and Literature Reviews for Transportation Research Projects guidelines, a University of Southern Mississippi graduate capstone project found that site location consultants use a variety of tools and approaches to determine optimal locations based on transportation factors (Nickens 2016). A number of site location consultants utilize either their own or off-the-shelf supply chain network optimizations tools. Llamasoft is a common tool. Other site location consultants will broadly determine the optimal regions and then contact 3PL providers for actual quotes and recommendations on shipping routes. Nickens (2016) research found that economic developers need resources to better understand their supply chain situation and make informed transportation improvements.

There are many examples of economic development practitioners engaging in freight and supply chain research. Recent efforts such as the paper “Analyses Considering Partner Selection and Joint Decision making: Investigation of Freight Demand with Spatial Matching Models” by Zhang and Wang; for example, highlights the importance of transportation efficiency and supply chain optimization for economic development agencies and even propose a model for supply chain partner selection (Zhang & Wang, 2016). However, while many of these researchers use data from transportation officials, there are few truly collaborative efforts to produce freight and supply chain decision making guides and models.

The absence of many truly collaborative efforts to create supply chain transportation efficiency models or guides does not suggest a lack of need for such products. In their article “Transport, Logistics and the Supply Chain: How Changes Reshape the Research Agenda” Vaneislander and Musso acknowledge that there is an increased demand for supply chain decision making models and software (Vaneislander & Musso, 2015). Additionally, there is a significant amount of recent and ongoing research that outlines the dangers an inefficient supply chain and freight transportation infrastructure pose to communities worldwide (Hensher, Zhang, & Rose, 2016). These findings represent a clear need for collaborative efforts to produce models and guides oriented towards improving supply chain functionality (Kearns, 2015).

Though there have only been limited recent efforts by department of transportation personnel and economic development practitioners to produce supply chain/freight decision-making tools, the products of such collaborations appear to provide tremendous value to the regions in question. The Defense Manufacturing Assistance Program, hereafter referred to as DMAP is an ongoing program that helps businesses and communities who may have been negatively impacted by reduced defense spending; however the organization also works to ensure that the defense supply chain remains operational and proficient. DMAP has created a map showing the supply chain for the defense industry in Michigan, Indiana, and Ohio (Defense Manufacturing Assistance Program, 2015). The map highlights the varying strength of contractors and manufacturers for the military and defense agencies.
Similarly, the Iowa Department of Transportation under the leadership of Paul Trombino partnered with Quetica Consulting to create a decision making methodology that uses a demand-based supply chain network design to identify optimal facility locations (Bi-State Regional Commission, 2016). Their method allows Iowa based businesses to analyze constraints and opportunities to make more informed site selection decisions. Early results from utilizing this resource appear to be positive.

In many ways the decision makers for what companies locate in a given community are the site selecting consultants who suggest communities to industry leaders. Therefore, the values of these consultants should be considered by EDO’s and DOT’s wishing to improve the competitiveness of their community. One of these values is transportation and logistics capabilities (Myers, 2016). According to Lindsey M. Myer’s report, “Transportation and Logistics Impact on Site Selection” transportation and logistics capabilities are one of the most important aspects of the site selection process and are projected to continue increasing in importance in the future. Freight, logistics, and transportation infrastructure all play a role as drivers in manufacturing, headquarters, and distribution location decisions (Myers, 2016).

Documented collaborations between DOTs and EDOs have already yielded valuable marketing tools for communities. With current trends in site selection emphasizing transportation capabilities and supply chain efficiency, both parties have the opportunity for a mutualistic relationship. The unique expertise of both DOTs and EDOs can be harnessed to produce products such as those created by Paul Trombino when he was with the Iowa Department of Transportation, which benefit all parties through increased recruitment capabilities; as well as, opportunities to improve existing transportation capabilities thus increasing the likelihood of business retention. The best practices guide produced by this research would allow future collaborative efforts to maximize their potential, and avoid mistakes that may have hampered these types of partnerships in the past.

A recent study on truck parking and State DOTs (Lambert, 2016) identified a need to understand key industries and supply chains to better anticipate and plan for truck parking needs. Site location supply chain modeling could also be used to address this DOT concern.

Cited References:


Nickens, J (2016) Gauging Regional Competitiveness: A Survey on the Relationship between Economic Development Competitiveness and Transportation Capabilities in Mississippi. University of Southern Mississippi Capstone project, Hattiesburg, MS
V. RESEARCH OBJECTIVE

This will be a practice ready guide similar to Steele, Hodge, et al. (2011) in NCFRP Report 13, *Freight Facility Location Selection: A Guide for Public Officials* which was developed as a guide to assist communities with location decisions for freight transfer facilities and best practices for transportation, land use, economic development, and regional partnerships, but focused on best practices of interagency cooperation on supply chain analysis and site selection.

This report will be different from NCFRP Report 13 as it will focus on industrial site location practices as opposed to intermodal facility locations and it will focus on how the private sector makes its transportation driven location decisions. It will include best practices on EDO and DOT interagency cooperation for transportation driven industrial site location decisions, but also reveal to transportation professionals how logistics drives industrial location decisions. Whether it is the new 4,000 employee Toyota-Mazda assembly plant or the 50,000 Amazon Headquarters Two, transportation will influence where these projects go. This guide will allow transportation officials to understand how those decisions are made and how transportation assets can be improved to make a region more competitive.

Tasks: It will require collecting information from DOTs, MPOs, EDOs and site location consultants on their challenges and best practices. It will require an analysis of how transportation influences facility location decisions and techniques for supply chain modeling of locations. Policy and administrative recommendations will need to be developed. In addition to a thorough review of studies and reports, this research will require at least 100 interviews of key decisions makers at EDOs, DOTs, corporate real estate offices, and site selectors.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Approximate Funding:**

The proposed research budget is approximately $280,000.

**Research Period:**

The full project is expected to take 16 months. The research is expected to take 12 months with three months for review and revision of a draft final report, and one month for review and revision of each interim report.

VII. URGENCY AND POTENTIAL BENEFITS

The practice ready guide will improve DOT and EDO collaboration and increase the economic development competitiveness of states that adopt best practices. It will facilitate more efficient development of job creating transportation infrastructure.

VIII. IMPLEMENTATION PLANNING
(a) the appropriate target audience for the research findings and products is State DOTs and EDOs in states with active economic development recruitment programs

(b) The key decision-makers who can approve, influence, or champion implementation of the best practice guide are the leaders of State EDOs and DOTs.

(c) The AASHTO Special Committee on Intermodal Transportation and Economic Expansion in addition to economic development organizations such as the International Economic Development Council (IEDC) should be involved with implementation

(d) Mississippi “early adopters” – state DOTs that would be willing to evaluate the research products in their agency. Any institutional or political barriers to implementation of the anticipated research products should also be identified.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Chad R. Miller Ph.D.  
Associate Professor  
Masters of Science in Economic Development Program  
College of Business  
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X. SUBMITTED BY

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This research problem statement is endorsed by TRB Committee on Transportation and Economic Development (ADD10). It is supported by the Massachusetts Department of Transportation, Office of Transportation Planning.

NCHRP Review of B-14

Reviewed By:  
Ann M. Hartell  
ahartell@nas.edu
Comments:

The problem statement outlines a project to educate state DOTs and local economic development authorities on how firms assess transportation in their industrial site location decisions. One challenge to the proposed project will be whether consultants to industry will be willing to provide detailed information about their models and analytic methods to a research team contracted to publish a publicly available report. A larger question will be whether transportation factors are in fact highly influential in site location decisions and how they are balanced with other considerations including labor force, tax environments, natural hazard risk, and government incentives. Understanding whether or not a state DOT’s decisions have an influence on site location decisions means that all the other factors that are considered in industrial site location decisions must also be unpacked. The research results are likely to be interesting to state DOTs involved in recruiting major employers, however the implications for the majority of economic development efforts that address more diffuse, broad-based economic development by supporting growth of existing firms (as opposed to relocating firms) and start ups of small firms, which are unlikely to hire a site decision consultant, may be limited.

The proposed budget and research period must be increased if the proposed scope of work is retained.

Review Date:
11/21/2017

FHWA Evaluation of B-14

James Garland/Scott Allen/HEPP-20; Kevin Adderly/HEPH-20 - FHWA HEP has current research regarding private sector site selection that could support this proposal. This research has the potential to strengthen the integration of economic development considerations into the transportation planning and programming process not only for State DOTs, but MPOs, RTPOs, and local governments. The Guidebook as it is presented could be enhanced by presenting case studies on how planning agencies have/could use private sector industrial site selection considerations to enhance transportation project selection criteria and processes for the Long -Range Transportation Plans, Statewide Transportation Improvement Programs (STIPs), and Transportation Improvement Programs (TIPs). The scope of the research could also be expanded to explore which existing public transportation agency data is most useful for private sector industrial site selection, including, but not limited to, International Roughness Index (pavement quality measurement), Average Annual Daily Traffic and Vehicle Miles Traveled (traffic data), Bridge Condition, roadway segment Level of Service (reliability). The resource could also be used to support coordination and communication efforts with local businesses and economic development organizations to leverage non-federal revenue. Bingxin Yu/HPTS-30 - One missing pieces is to have an indepth understanding of the decision making process of privator sectors, what tools and procedures used and major factors influencing facility selection. Specifically, knowledge on the role of transportation in industrial site selection practices. The problem statement mentions, but does not elaborate, unsuccessful experiences of economic developers to underutilize local transportation competitiveness in the private sectors' location decision process. It will be helpful to document successful experiences like Iowa DOT on how to promote collaboration across agencies, through specific channels, and idenfy major players and champions. Another issue is to development a guide that is industry- and mode-specific.

AASHTO Committee Evaluation for B-14

Best Practices Guide for State Department of Transportation and Economic Development Collaboration on Site Selection
Submitted By:
Sharon Edgar
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel
Council on Public Transportation

Comments:
Consider availability of existing transit services in site selection, including ability to access and retain workers
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-B-15

II. PROBLEM TITLE

Development of Programmatic Agreements for Project-level Particulate Matter “Hot-Spot” Air Quality Analyses

III. RESEARCH PROBLEM STATEMENT

Transportation project-level particulate matter (PM) analyses are challenging, both from a technical complexity standpoint and a resource-usage perspective. They are considerably more challenging than corresponding carbon monoxide (CO) “Hot Spot” analyses since CO analyses can use various simplifying conditions that are not available for PM. Yet State DOTs undertake these complex and resource-intensive analyses when various transportation project types or conditions indicate a potential exceedance of a PM ambient air quality standard. In most cases, the analysis finds that the project will not cause an exceedance of a PM air quality standard. Consequently, State DOTs and others need a mechanism to avoid unnecessary PM “Hot-Spot” analyses.

The proposed research into Programmatic Agreements (PAs) offers a meaningful way to accomplish that objective. PAs are agreements among agencies (for transportation projects, usually between the State DOT and the FHWA Division Office, although other involved agencies may participate as well) that describes under what conditions an analysis will be undertaken, agency coordination roles, appropriate models and model inputs, administrative roles and responsibilities (e.g. review times) of the agencies, etc. NCHRP 25-25, Task 78 successfully explored the application of PAs to CO “Hot-Spot” analyses. It developed a template of a PA, as well as a Technical Support Document (TSD), that could be used to establish state-specific PA for CO analyses. The upcoming NCHRP 25-25 Task 104 will take the lessons learned from Task 78 and develop a number of state-specific PAs for CO “Hot-Spot” analysis. This proposed research will take a similar approach for PM analyses.

The research will be done in two phases. The first phase will look at the feasibility of a PA for PM “Hot-Spot” analyses and will lead to a generic template for a PM that can be applied by State DOTs nationwide. The second phase will then develop state-specific PAs for a number of State DOTs. The parameters that this research will evaluate could demonstrate the circumstances for which PAs for PM “Hot-Spot” analyses are reasonable and feasible, resulting in substantially fewer unnecessary PM analyses across the country.

The proposed study is consistent with and included in the AASHTO Strategic Plan for air quality research.

IV. LITERATURE SEARCH SUMMARY

As part of the research effort for NCHRP 25-25, Task 78, the research team performed an exhaustive review of State DOT PAs. That effort uncovered that there were few PAs dedicated to air quality and those that did exist were generic, related to transportation conformity, or dealt with CO analyses. While some states may have agreements or similar arrangements for PM, none that established substantially higher thresholds than the equivalent of the example provided in EPA guidance of a new highway with 125 thousand ADT with 8% diesel trucks were identified. Therefore, it is unlikely that this research would be duplicative of previous or ongoing work. A
literature search performed on the TRB TRID database did not result in the identification of other research on this topic.

V. RESEARCH OBJECTIVE

Research is needed to identify and address challenges, both technical and procedural, with development and implementation of PAs to be used by state DOTs to determine and document under what project types and conditions (e.g. road grade, number of lanes) a project-level PM hot-spot analysis would not be needed. The research would encompass the entire process of PA development and implementation, from start through needed approvals and implementation. The research would also examine other related factors to take a weight-of-evidence approach to PM analysis and PA development. The outcome would be a generic template PA for this pollutant. Lessons learned from this aspect of the research could then be used to inform the process for PA development and implementation for one or two state-specific PAs for state DOTs. The generic templates will be of national scope and, therefore, contain conservative features so that they are applicable anywhere in the nation. Using these findings and the lessons learned from this phase of the research, the research will further produce a number of PAs and TSDs that are specific to a particular State DOT, using assumptions and features of the particular state, and therefore, likely less conservative.

This research will take a multi-faceted “weight-of-evidence” approach to determining the feasibility of PAs for PM analyses to minimize unnecessary work and expense for State DOTs.

- First, an important feature of the research will be a modeling exercise using approved emission and dispersion models. The objective of this aspect of the research is to identify transportation project types and/or conditions that can be demonstrated by modeling alone to not require a project-specific “Hot-Spot” analysis. However, if the modeling approach proves infeasible, that is, unlikely by itself to establish thresholds higher than the equivalent of the EPA example of a new highway with 125 thousand ADT with 8% diesel trucks, the study will focus on the other aspects of the weight of evidence approach that may be more promising as outlined below.

- The research will include a review ambient air quality monitoring data and trends to identify facility types and operating conditions that are unlikely to show exceedances of the national ambient air quality standards (NAAQS). This review will cover background concentrations as well as near-road.

- Similarly, a review will be completed of PM “Hot-Spot” analyses to compile findings to demonstrate the history and likelihood of uncovering potential exceedances of PM air quality standards. This will serve to identify additional facility types and operating conditions that are unlikely to show exceedances of the NAAQS.

- Lastly, as part of the overall weight-of-evidence approach, the research will consider other factors such as trend in emission from other sources such as stationary and/or area sources (e.g. construction) that have an impact on ambient PM levels, trends in vehicle and fuel technology improvements (e.g. use of electric vehicles) that could further reduce future PM ambient levels, and improvements in tires and brakes that could reduce future emissions from brake and tire wear (an important component of PM emissions from vehicles).

Successful outcomes will lead to streamlined and more cost-effective environmental clearances for air quality, with less expenditure of resources on unnecessary PM “Hot-Spot” analyses. Implementation of the research findings could be accomplished through presentations at conferences and meetings, including AASHTO and TRB, and workshops or peer exchanges aimed specifically at State DOT air quality or environmental staff.
VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

The requested funding is $300,000.

**Research Period:**

The research period is 24 months.

VII. URGENCY AND POTENTIAL BENEFITS

If the research finds sufficient common aspects and favorable outcomes that lend themselves to the development of a PA for PM “Hot-Spot” analysis, the anticipated products of the research will be a template of a PA and a template for a TSD that State DOTs can adopt to govern and reduce their need to perform PM “Hot-Spot” analyses. With “shovel-ready” research products, it is highly likely that many State DOTs will adopt and implement the research products, in addition to the State DOTs that will realize a PA specific to their state. No negative impacts are anticipated from this research. Indeed, if successful, this research will likely substantially reduce the number of PM “Hot-Spot” analyses performed by State DOTs and result in a significant savings in analytical costs.

VIII. IMPLEMENTATION PLANNING

State DOTs, their consultants who perform PM “Hot-Spot” analyses, and FHWA Division Offices will be the primary target audience for the research findings and products. The AASHTO SCOE Air Quality, Climate Change and Energy Subcommittee (AQCCES) will be the key decisionmakers who can influence and champion the implementation of the research products. This same Subcommittee will be the organization responsible for the adoption of the results. Likely, several State DOTs (yet to be identified) will be “early adopters” of the research products.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

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XI. SUBMITTED BY

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NCHRP Review of B-15

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:
The problem statement proposes beginning with an experimental modeling approach, which may or may not be acceptable to regulatory partners for the purposes of a PA. The additional review of completed analyses is likely to be necessary to compare the modeling results with the results of empirical analyses. It will be useful to resolve the question of acceptability of either approach with regulatory partners prior to finalizing the scope and budget of the proposed project.

Review Date:
11/21/2017

FHWA Evaluation of B-15

Karen Perritt/HEPN-10 - The degree of applicability/success for this effort is questionable. Programmatic agreements cannot be used for PM hotspot analyses. Even in the NEPA context (not CAA), the variation in PM inputs/factors make the range of error significantly wide to be useful to the projects most likely to use this type of arrangement. Many of the projects that are unlikely to produce an exceedance of the NAAQS are already filtered out based on current CAA-related requirements and procedures, some of which can be utilized in the NEPA context if desired. In the NEPA context, the emphasis is on a comparison of alternatives, not a threshold-based evaluation comparison to the NAAQS.

AASHTO Committee Evaluation for B-15

Development of Programmatic Agreements for Project-level Particulate Matter "Hot-Spot" Air Quality Analyses

Submitted By:
Samantha Hoilett
AASHTO Liaison on behalf of CES Leadership
Committee on Environment and Sustainability

Comments:
B-15 holds the promise of streamlining a new and challenging area in air quality analyses, namely PM hotspot analyses, through the development of a programmatic approach.
Submitter Response for 2019-B-15
Development of Programmatic Agreements for Project-level Particulate Matter "Hot-Spot" Air Quality Analyses

From: [email: Tim.Hill@dot.ohio.gov ;shoilett@aashto.org]

Comments:
We agree with the issues raised by the reviewers regarding the proposed Research Statement. However, we see those issues as arguments for doing the proposed research. We agree that a NEPA analysis is a comparison of alternatives and not necessarily a comparison to the National Ambient Air Quality Standards. However, if, in the alternatives analysis, an alternative or alternatives are found to exceed an air quality standard or exacerbate an existing violation of the standard, that occurrence will likely be deemed as an air quality impact. As such, potentially resource-intensive mitigation will have to be considered or those alternative(s) may not be able to proceed. State DOTs would greatly benefit with a Programmatic Agreement that assured this situation would not occur or provided guidance on how to avoid this situation. With a Programmatic Agreement in place, this type of information would be available early in the project development process.
We also agree that the range of inputs/factors for particulate matter can vary significantly, compared to carbon monoxide, for example. For this reason, we structured this research project into two phases. The first phase would determine the feasibility of Programmatic Agreement for particulate matter. This phase will explore if, with the appropriate consideration of inputs/factors, there are sufficient transportation project types and conditions to warrant the development of a Programmatic Agreement. If the research in the first phase discovered that a Programmatic Agreement was not feasible, the research project would not move on to the second phase. Many projects in the NCHRP program are phased so that subsequent phases are not approved by the Research Panel if earlier phases uncover findings that make further research infeasible or unlikely to come to a successful conclusion. That is what we are proposing for this research project.
Finally, we also agree that acceptance of this research by regulatory partners is critical. We, therefore, urge that regulatory agencies be appropriately included in the make-up of the Research Panel.

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Review Date: 12/19/2017
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-B-16

II. PROBLEM TITLE

Methodology for analyzing noise and vibration impacts on different terrestrial species

III. RESEARCH PROBLEM STATEMENT

The objective of this project is to develop a consistent methodology for analyzing noise and vibration impacts on different terrestrial species. Develop standard metrics and procedures for the DOTs to conduct noise analyses of our highway projects on wildlife, terrestrial and aquatic, based on science and good practice.

Currently, state and federal wildlife regulatory agencies are implementing requirements for meeting certain noise thresholds for highway transportation projects. Yet, DOTs have little to no guidance from federal agencies on how to conduct noise analyses and estimate noise impacts on wildlife from federal agencies. This lack of guidance results in noise studies/analyses that may be inaccurate, non-comparative from state to state (or study to study), or completely unnecessary. DOTs have little to no guidance from federal agencies on how to estimate noise and vibration impacts on wildlife resulting from transportation projects during Section 7 consultation, or for other wildlife impact analysis during NEPA.

This lack of guidance can cause redirection and rework of efforts being conducted to address these impacts in an acceptable manner, often resulting in project delivery delay, and can result in noise studies/analyses that may be inaccurate, non-comparative from state to state (or study to study), or completely unnecessary. Collecting information on past acceptable noise impact assessment practices could help direct future work, or refine past methodologies as necessary, to make future noise impact assessment methodologies clear and easy to follow. Standardizing this noise and vibration assessment guidance could be the precursor to developing an agreement between FHWA and FWS regarding noise analysis methodologies required, and may result in the discovery of possible mitigation methods that could be used prior to construction to attenuated destructive noise levels expected.

Noise impacts to wildlife vary by species and depend on what is considered a threat to that species. Noise impacts to species are also timing-dependent, based on breeding season, rearing, fledging, or migration. The following are examples of noise disturbance to various animals:

1. Some nesting species may be more disturbed by a nearby researcher than construction occurring 100 yards away.
2. If it is a sensitive birthing period, a species may go to great lengths to avoid an impact their offspring and possibly leave favored habitat to do so.
3. A raptor might be tolerant with a disturbance when the young are very small, but when they get close to fledging, disturbance could make the young leave the nest too soon and lower their chance of survival.
4. Noise can interfere when a species relies on their hearing to find mates or food, or for echolocation.
5. In aquatic species, amplification of sound in the water column can cause physical damage to the aquatic species’ organs through sound pressure waves.
6. Sound vibrations, or percussive sounds, may cause a species to abandon an area.
Certain animal species may be habituated to sound, so examining increases in noise levels over ambient might be a better measure of an impact than overall noise levels. Taking noise habituation into consideration when evaluating noise effects on wildlife may reduce the need for unnecessary mitigation on highway projects.

This research will help define the procedures and metrics for conducting noise analyses on wildlife and identify effective mitigation alternatives applicable in project construction and narrow the focus when assessing noise and vibration impacts to terrestrial wildlife. It then will inform projects when noise mitigation is needed.

This research task supports Goal 3 for both the full Standing Committee on Environment (SCOE) and the Natural Resources subcommittee to “create the knowledge foundation on which to base state of the art impact analysis and mitigation planning for current and future environmental issues.”

IV. LITERATURE SEARCH SUMMARY

A cursory search of TRID (http://trid.trb.org) and Research in Progress database (http://rip.trb.org/) under key words “terrestrial noise” did not provide any previous work specific to methodologies for analyzing noise and vibration impacts on different terrestrial species. However, Caltrans does have and is the only state that has available protocol for addressing noise impacts to birds and bats.

The research will include a more detailed search of TRID (http://trid.trb.org) and Research in Progress database (http://rip.trb.org/) regarding any previous work specific to methodologies for analyzing noise and vibration impacts on different terrestrial species.

The research will include a detailed literature review and survey of highway agencies and oil and gas companies. The literature review will focus on those species of concern and representative ecoregions regarding noise and vibration effects on wildlife in the transportation and energy industry. Focus on noise and vibration assessments of differing environments and species and the mitigation criteria being used to permit various projects (including restrictions, attenuation, monitoring). Identify data gaps in existing literature and practice. Be sure to reach out to the USFWS and state Game and Fish organizations to collect any direction or requirements that they have included during their consultations with stakeholders and find out if they are consistent among the various states. Evaluate findings from the interviews and literature review to determine (at a minimum) the different and similar methodologies required for noise and vibration analysis by species, if there are any unsupported restrictions or conservations measures required, what are existing mitigation strategies, what works and what doesn’t, what is the best available science used by the regulatory agencies, and what are the newest mitigation technologies being used relative to species and reducing noise. Develop a draft report, disseminate draft for review, incorporate comments, and prepare a final literature review report.

V. RESEARCH OBJECTIVE

The objective is to develop a consistent methodology for analyzing noise and vibration impacts on different terrestrial species. Develop standard metrics and procedures for the DOTs to conduct noise analyses of our highway projects on wildlife, terrestrial and aquatic, based on science and good practice.

Tasks and Deliverables

Task 1: Conduct Interviews of DOTs and of Oil and Gas Companies
Conduct interviews of DOTs in representative ecoregions for information on species consultations or for developed guidance. See what species DOTs are most concerned about and which species would benefit from developed noise and vibration assessment guidance, to narrow the
species, or even guilds, focus of this study going forward to those that would benefit the DOTs the most. Among the choices of DOTs, include CA because of their available protocol for addressing noise impacts to birds and bats. Other states that have expressed an interest in noise analyses include MT, CO, UT, NV, AZ, ND, OK, IL, KY, OH, WY, WV, ME, and NH and may be possible states to reach out to during this process.

Task 2: Literature Review
Conduct a literature review focusing on those species of concern and ecoregions as identified in Task 1 regarding noise and vibration effects on wildlife in the transportation and energy industry with a focus on noise and vibration assessments of differing environments and species and the mitigation criteria being used to permit various projects (including restrictions, attenuation, monitoring). Identify data gaps in existing literature and practice. Be sure to reach out to the USFWS and state Game and Fish organizations to collect any direction or requirements that they have included during their consultations with stakeholders and find out if they are consistent among the various states. Evaluate findings from the interviews and literature review to determine (at a minimum) the different and similar methodologies required for noise and vibration analysis by species, if there are any unsupported restrictions or conservations measures required, what are existing mitigation strategies, what works and what doesn’t, what is the best available science used by the regulatory agencies, and what are the newest mitigation technologies being used relative to species and reducing noise. Develop a draft report, disseminate draft for review, incorporate comments, and prepare a final literature review report.

Task 3: Develop Guidance for Methodologies Used for Analyzing Noise and Vibration Impacts on Various Wildlife Species
Develop standard metrics and procedures for the DOTs to conduct noise and vibration analyses of our highway projects on terrestrial wildlife identified in Task 1 and 2, based on science and good practice. Bring stakeholders together from State Highway Agencies (SHAs), FHWA and Regional/State USFWS offices to create these strategies and standards.

Develop options for mitigation with and without monitoring that will be acceptable to regulatory agencies, such as a list of tested and viable construction methods to reduce impacts in a variety of environments. Bring stakeholders together from State Highway Agencies (SHAs), FHWA and Regional/State USFWS offices to create these strategies and standards. Make recommendations on where further research is needed.

Develop guidance and document in an agreement, understanding, or other method that documents the acceptance by these stakeholders of the methodologies developed in Task 3 and 4, with support from Tasks 1 and 2. Get signatures of these Governing Regulatory Agencies, and FHWA on the final agreement, understanding, or other document as determined appropriate by these stakeholders.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $249,000

Research Period:

24 months

(Note: This estimate may be changed by the Project Panel.)
VII. URGENCY AND POTENTIAL BENEFITS

Currently, state and federal wildlife regulatory agencies are implementing requirements for meeting certain noise thresholds for highway transportation projects. Yet, DOTs have little to no guidance from federal agencies on how to conduct noise analyses and estimate noise impacts on wildlife from federal agencies. This lack of guidance results in noise studies/analyses that may be inaccurate, non-comparable from state to state (or study to study), or completely unnecessary. New guidance would allow DOTs to expedite noise impact analyses; saving substantial time and money by addressing this issue in the impact assessment phase. It could also prevent or lower mitigation costs while increasing effective protections for sensitive species. There is also a benefit from consistency among methodologies so that studies can be comparable and so that the level of effort needed for this analysis can be predicted during project planning.

VIII. IMPLEMENTATION PLANNING

The target audience for this project is state highway agencies that are looking for consistent methodology for analyzing noise and vibration impacts on different terrestrial species and the development of standard metrics and procedures for the DOTs to conduct noise analyses of our highway projects on wildlife, terrestrial and aquatic, based on science and good practice. Champions of the project will include state highway agency environmental program managers, the AASHTO Committee on Environment Noise Working Group, and the AASHTO Terrestrial Noise Work Group.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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AASHTO Terrestrial Noise Work Group comprised of MEDOT, OHDOT, CODOT, WYDOT, ALDOT, IDDOT, VTDOT, OKDOT, VADOT, MDT, NDDOT, and KYTC

X. AASHTO MONITOR

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XI. SUBMITTED BY

This project statement is supported by the TRB Committee on Transportation-Related Noise and Vibration (ADC40) and the AASHTO Terrestrial Noise Work Group.

Tim Hill, Ohio DOT, SCOE Vice Chair
Office of Environmental Services Administrator, Ohio DOT
1980 West Broad Street, Mail Stop 4170
(Note: While anyone can write or contribute to preparing a problem statement, only state DOTs, AASHTO committees or councils, or the Federal Highway Administration can submit a problem statement to NCHRP.)

NCHRP Review of B-16

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:

The problem statement is somewhat unclear, with inconsistencies in types of species to be addressed (terrestrial only per the title; terrestrial, aquatic, and avian in the background; terrestrial and aquatic in the objective).

The objective is narrowly focused on a method for analyzing noise and vibration impacts for terrestrial species, which could have broad applicability if the research also investigates differences among states and their highly varied ecosystems. However, the tasks and deliverables outlined dilute this focus. For example, it is unclear why interviews with oil and gas companies are included given the topic is purported to be highway-related noise. Securing agreement from regulatory agencies on the analysis methods, mitigation, and monitoring is outside the scope of an NCHRP research project.

Review Date:
11/21/2017

FHWA Evaluation of B-16

Adam Alexander/HEPN-10; Damaris Santiago/Dan Buford/HEPE-30 - States have raised concerns about the effects of highway operations and construction activities on terrestrial species for many years. Specific issues relate to how they need to address comments from resource agencies in biological opinions and in NEPA documentation.

AASHTO Committee Evaluation for B-16

Methodology for Analyzing Noise and Vibration Impacts on Different Terrestrial Species

Submitted By:
Samantha Hoilett
AASHTO Liaison on behalf of CES Leadership
Committee on Environment and Sustainability

Comments:
Submitted by Committee on Environment and Sustainability Natural Resources Subcommittee. This project will develop standard metrics and methods for evaluating noise and vibration effects of highway projects on terrestrial wildlife. USFWS has already told us we need to analyze noise better and has refused at least two consultations based on it. Other states are having the same issue and I think it needs to be resolved quickly before more projects get held up with no guidance from the FWS on how to resolve it. The benefits would also extend to other, non-listed species.

Submitter Response for 2019-B-16
Methodology for Analyzing Noise and Vibration Impacts on Different Terrestrial Species

From: [email: Tim.Hill@dot.ohio.gov; shoilett@aashto.org]

Comments:
For the Noise/Vibration Study for wildlife - We absolutely can refine which species should be addressed. I believe it was discussed that we will limit this round to terrestrial species - so the others that are discussed, as made in the comment, are simply background on the importance of noise impacts on wildlife. A recommendation for approach to the regulatory agencies can be the product of this research, not resolving or negotiating this change - that's an easy change. But regarding who we interview, I think we need to keep it as broad as we want because I do not believe we have had a ton of information on this kind of comment from the regulatory agencies and we need as much data as we can find. And some work that the oil and gas do are relevant to transportation work - for example, they drill, and transportation sometimes drills when putting in bridge casions, especially when pile driving is too disruptive. I don't see this as being inappropriate to collect.

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Review Date: 12/19/2017
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-B-17

II. PROBLEM TITLE


III. RESEARCH PROBLEM STATEMENT

The rapid expansion of commercial development in the U.S. from the end of World War II through the 1970s created vast numbers of commercial properties along state and federal transportation routes in urban, suburban and rural areas. An overwhelming number of these properties are already 50 years of age or older, with more reaching that age every year. This presents an enormous challenge for state DOTs and other agencies to evaluate for National Register of Historic Places (NRHP) eligibility as required by Section 106 of the National Historic Preservation Act which mandates agencies to consider the effects of their projects on historic properties. Section 4(f) requires all possible planning to minimize harm to historic properties. Post-World War II commercial properties, including gas stations, shopping centers, drug stores, office buildings, restaurants and other businesses, that are more than 50 years of age may be considered historic properties if they possess architectural or historic significance and are considered eligible for the NRHP.

This problem statement complements NCHRP Project 08-77, Report 723: Model for Identifying and Evaluating the Historic Significance of Post-World War II Housing, which successfully addressed the need for a national historic context and National Register eligibility guidelines for post-war houses and residential subdivisions. The resulting report has proven extremely beneficial to state DOTs; and is one of the most downloaded reports among the Transportation Research Board’s online publications. Similar to residential construction, post-war commercial properties were closely intertwined with transportation improvements, including the expansion of state highways after World War II and the construction of the Interstate Highway System beginning in 1956. Commercial properties frequently stand in close proximity to highways because they took advantage of undeveloped land close to new interstates and housing developments to attract customers. Like housing, commercial properties were built in staggering numbers after 1945, but very little information exists on how to consistently evaluate the potential significance of these properties. First, this research is intended to provide to the state departments of transportation (DOTs) a proper historic context, supplying a better understanding of the historic and architectural significance of the plethora of commercial properties. Second, the research will give guidance on how to evaluate the integrity and NRHP criteria. Third, this research will provide state DOTs, the Federal Highway Administration (FHWA), State Historic Preservation Officers (SHPOs) and Tribal Historic Preservation Officers (THPOs) guidance on how to avoid disputes that drive up project costs and delay project delivery. Aside from the greatly needed guidance on this property type, this research could form the basis of a regulatory “Program Comment” from the Advisory Council on Historic Preservation (ACHP) to exempt certain common property types and designs from Section 106 consideration.

As improvements to existing transportation infrastructure are planned along routes that were commercially developed after 1945, the incidence of encountering Post-World War II commercial properties will continue to increase. Failure to systematically address these properties and provide consistent guidance in terms of NRHP eligibility will result in a piecemeal approach that will threaten to overwhelm state DOTs, FHWA divisions and SHPOs as they follow the Section 106 process. One of the goals of the AASHTO Standing Committee on the Environment is to implement methods to streamline the
environmental process where possible. The proposed research would provide timely guidance to DOTs and FHWA divisions on how to evaluate this extremely relevant property type.

IV. LITERATURE SEARCH SUMMARY

No research projects were found in the Research in Progress Database meeting the search criteria “Post World War II commercial properties”. The search did of course locate the TRB study on Post World War II Housing, mentioned elsewhere in this proposal (NCHRP Report 723). This report includes a guide to creating a context for Post-World War II neighborhoods which could be modified as a guide for creating a context for commercial buildings and developments of the same vintage. The report also provides a comprehensive presentation of building design styles and construction materials. A similar presentation should be developed for commercial structures.

A study of Denver’s Post World War II Suburbs was conducted and results published in the report Denver’s Post World War II Suburbs (Colorado Department of Transportation, Applied Research and Innovation Branch Report CDOT-2011-6) by Dawn Bunyak, Thomas H. and R. Laurie Simmons. The report presents a historical context of Post-World War II development in the Denver area, including discussions of commercial development as it related to the development of suburban neighborhoods, the true focus of the report. Though the report is geographically concentrated on the Denver area, the proposed study should draw examples from this report of context building recognizing the interrelation of both commercial and residential developments. This can be applied to other cities and regions of the U.S. and used to synthesize a national context of the commercial sector of Post-World War II development.

A small study conducted in 2014-15 as part of a Spring 2014 Pilot Project Competition was solicited by the University of Connecticut. The study, entitled The Suburbanization of American Cities Post World War II: Documenting, Visualizing and Analyzing the Impacts using Hartford, Connecticut as a Case Study by Norman Garrick, Ph.D. (UCNR24-32A), compared Pre- and Post-automobile cities by locating necessary historic data and converting it to a digital format and suggested more in depth analysis of neighborhoods and downtown areas to better understand the evolution of transportation and its relationship with the surrounding land. This small-scale study could offer some suggestions toward context building.


In 2008, Carol J. Dyson with the Illinois Historic Preservation Agency issued a guide entitled How to Work with Storefronts of the Mid-Twentieth Century: A Mid-Twentieth Century Storefront Components Guide, presenting common components of Post-World War II commercial storefronts. Though not necessarily comprehensive, it is a good example of an analysis of some of the most noticeable design elements of Mid-20th Century commercial storefronts. The proposed research should expand on such work.

V. RESEARCH OBJECTIVE

The research objective for the Post World War II commercial property plethora is to complement NCHRP Report 723 on Post-World War II Housing by providing an historic context that
synthesizes national Post-World War II commercial sector development, identification of elements, design styles and construction materials and techniques.

Nationwide, state DOTs and FHWA divisions are encountering Post-World War II commercial properties in transportation projects which must then be evaluated for NRHP eligibility. To help avoid delays in project delivery and increased project costs due to insufficient information regarding Post-World War II commercial properties, these properties should be addressed with guidelines that can streamline the Section 106 and Section 4(f) evaluation. As these property types have many similarities in their history, design, and architecture across the country, a national approach will be required to provide context and a consistent approach to evaluation of such Post-World War II properties as gas stations, shopping centers, drug stores, office buildings, restaurants and other businesses. Schools, churches, hospitals, industrial, and government buildings also proliferated during this time, but would not be included in the scope of this study since many such buildings are less uniform than commercial developments. This study would gather existing research, reduce duplicative efforts of state DOTs and other agencies, and establish consistent standards that can be applied to evaluation of NRHP eligibility.

Major Study Elements

- A nationwide study of Post-World War II commercial properties would identify which states have historic contexts in place for Post-World War II commercial development. The study would then create regional contexts and synthesize a national context for Post-World War II commercial property development.

- Post-World War II commercial designs were often completed by major architectural firms, and companies that produced innovative new materials and methods spread their products throughout the country. A national study of these designs and materials will help DOTs identify significant post-war examples of commercial properties and provide justification for identifying certain designs and common types do not rise to the level of significance to be considered eligible for the National Register. Additionally, vernacular commercial buildings that were constructed using more locally derived designs and methods (e.g. single story, cinder block small grocery stores) can be addressed as to common forms and their significance.

- The study would provide a lexicon of property types and characteristic elements and identify those building styles and characteristics that make a commercial property eligible for the NRHP. It would also identify those property types and styles that are not significant. As importantly, because many Post-World War II commercial properties have been modified over the years, the study would identify those alterations that would diminish a property’s integrity and therefore its NRHP eligibility. Establishing integrity thresholds would help distinguish properties eligible for the NRHP from the majority of properties that would not be NHRP eligible. Signs can either contribute to a structure’s historic character or even be eligible individually. Therefore, the study would include signs as a major component. The study would also address changes in the character of the area surrounding a commercial property (e.g. when a previously commercial area transitions to an area dominated by industrial properties).

- The study would provide case studies to explore and present common types and scenarios of Post-World War II commercial properties, their eligibility for the NRHP and common building styles and types that do not rise to the level of NRHP eligibility.

- The study would culminate in a report made available to the public, complementary to NCHRP Report 723: A Model for Identifying and Evaluating the Historic Significance of Post-World War II Housing.
VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

Anticipated Scope:

Historic Context Development: $125,000
This effort would identify the Post-World War II commercial property types most commonly impacted by transportation projects (such as gas stations, shopping centers, drug stores, movie theaters, office buildings, restaurants, etc.). States would be surveyed to determine if any states are currently using a context for Post-World War II commercial properties and/or applying a systematic approach to eligibility determinations for post-World War II commercial properties. The results of the survey would be used to develop a national historic context for Post-World War II commercial development. As part of context development efforts, at least three case studies from different areas of the U.S. would be identified. The case studies should include regions that exhibit a wide breadth of Post-World War II commercial development, such as would be commonly encountered by transportation projects. The case study areas also would possess a wide range of property types of high style as well as more modest examples. It might be useful if the regions differ in their historical and cultural origins, for example a region that was primarily developed post-1945 such as Nevada, and a region that initially developed before 1945 but also after 1945 into the 1970s. This might capture a contextual essence of regions that fully embraced Post-World War II development and design ideas and those regions in which those ideas were met with preexisting Pre-World War II concepts. This step would include identification of influential and prolific architectural design firms and the important material development. At least one case study should contain examples of vernacular commercial architecture. Design motives and ideas would be discussed.

National Register of Historic Places Evaluation Guidance: $125,000
This step would address the design elements, integrity thresholds and application of NRHP criteria for each key property type identified in the context. Design terminology will be provided. Typical modifications to such properties that affect integrity and eligibility also would be identified and discussed. Common property types or designs which might not have significance due to large numbers of examples would be defined. Actual listings of post-World War II commercial properties in the National Register of Historic Places will be reviewed to inform the guidance. The case studies will be used to demonstrate the application of the guidance to perform eligibility, integrity and significance determinations.

Report: $45,000
The report will present the results of the context and eligibility research with the case studies and will be made available to state DOTs through the Transportation Research Board publications and available to the public via online downloadable PDF available through TRB.

Total Cost: $295,000

Research Period:

Context: 12 Months
Eligibility: 12 Months
Draft Report: 6 Months
Review and Revision: 3 Months
Final Report Production: 2 Months
Total time: 35 months

VII. URGENCY AND POTENTIAL BENEFITS
As Post-World War II commercial properties and areas have already reached, or are fast approaching 50 years of age, they are being included in local surveys and are being evaluated according to NRHP criteria – often with little influence from the transportation community. The number of commercial properties eligible for listing in the NRHP is increasing dramatically which presents a major challenge to transportation project development in terms of time and cost. Post-World War II commercial properties are ubiquitous across the country, consisting of many thousands of properties. As a tremendous number of the properties occur along state and federal highways, the rate of exposure of transportation improvements to such properties will continue to rise drastically.

The potential value of this research is five-fold: 1) compilation of the existing research at the national level in one place; 2) compilation of the major architectural firms and standard designs at the national and regional levels in one place; 3) designation of characteristics and regional contexts; 4) “walk-through” (i.e. flow chart like) guidance on significance and integrity evaluation for eligibility; and 5) public facing report summarizing and detailing the above. The completed research project will bring together the existing information at both the national and regional levels, lay out how evaluation criteria and then build “walk-throughs” to operationalize these findings.

The current and future Section 106 and Section 4(f) administrative burden associated with these properties continues to grow. If state DOTs follow standard approaches for identifying and evaluating the National Register eligibility of these Post-World War II properties, state DOTs will be evaluating exponentially increasing numbers of these individual properties over the next several years, increasing current Section 106 and Section 4(f) administrative burdens, increasing project costs, and delaying project delivery. State DOT cultural resource management staff workloads could increase and SHPO staff will be similarly affected as evaluations are reviewed in Section 106 consultation.

Unless Post-World War II commercial properties are addressed in a programmatic fashion, each instance of a potentially NRHP eligible commercial property will be the subject of negotiation between every state’s DOT and FHWA staff and SHPO staff. In addition to providing a cost-effective and efficient means of addressing this property type a national approach will provide national consistency and predictability in the implementation of Section 106 and Section 4(f) requirements.

VIII. IMPLEMENTATION PLANNING

The target audience is two-fold. Primarily, the focus of the completed research will be to guide the Cultural Resources professional working in transportation, either within state DOTs or their consultants and FHWA divisions, carefully and consistently through the identification and evaluation process. Secondly, the report will convey to the public the Post-WWII commercial property building boom that occurred, and important designs and history about those properties. Key decision makers that likely will support the research and findings would be the cultural resources professionals at State DOTs, FHWA, ACHP, the National Council of State Historic Preservation Officers, TRB’s ADC50 and SCOE. A concerted push should be made to engage State DOT front offices to champion the implementation of the completed research for its ability to more effectively and efficiently contribute to project delivery. Early adopting state DOTs would be Louisiana, Nevada, and Virginia.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Carey Coxe, Louisiana Department of Transportation and Development, 225-242-4520, carey.coxe@la.gov
This statement builds on previous research that developed a highly relevant product for state DOTs, and describes a needed extension of existing research.

Note that NCHRP 25-25/Task 97, "Historic Roads: A Synthesis of Identification and Evaluation Practices" investigated historic contexts for roads. The project compiled a large bibliography of resources, many of which address commercial development adjoining historic (and potentially historic) corridors. Publication of the final report is anticipated in December 2017.

Review Date:
11/21/2017

FHWA Evaluation of B-17

Owen Lindauer/HEPE-10; David Clarke/HEPE-30 - This proposal complements an existing assessment of Post WWII residential properties and has much utility as roadways often impact historic commercial districts in towns and cities. The scope of this research notes the utility of its results to Section 4(f) analyses, which is true. But the task does not clearly call out the need to assess commercial districts as
well as the manner in which individual commercial properties may contribute to or not contribute to historic commercial districts.

AASHTO Committee Evaluation for B-17


Submitted By:
Samantha Hoilett
AASHTO Liaison on behalf of CES Leadership
Committee on Environment and Sustainability

Comments:
Committee on Environment and Sustainability #2 Priority. Like the main-NCHRP project on post-WWII residential properties referenced in the problem statement, the yearly exponential increase in commercial properties meeting the 50-year threshold for consideration as "historic" (i.e., eligible for the National Register of Historic Places) has the potential to overwhelm transportation project development by sheer numeric increase in survey, documentation, and inter-agency coordination. In addition, poor understanding of the history and context of post-WWII commercial properties likely will result in poor decisions concerning which properties are considered "important" and worthy of historic preservation consideration. Getting a better understanding of the national context of post-WWII commercial properties through a "transportation-lens" is a critical element to addressing how increasing numbers of resources are efficiently handled in project development and to support defining a likely small number of resources that have historic value. The post-WWII residential properties research document is one of the most downloaded and in-demand products of NCHRP, both from the transportation and historic preservation communities. The proposed research on post-WWII commercial properties likely will be of equally high value. The idea this could form a "program comment" makes it all the more valuable (essentially would exempt large swaths of resources). I would concur that by this point, the styles and designs were more national in style and type, and thus it would have appeal and use. It is also true these are a very common and typical resource that occur along all our corridors, and instead of "corridor studies" which can be costly, this might be the next best thing.
I. PROBLEM NUMBER

2019-B-18
To be assigned by NCHRP staff.

II. PROBLEM TITLE


III. RESEARCH PROBLEM STATEMENT

Pollinating insect populations are declining. As a result, there is increased interest in protecting pollinators along roadways. Several insect pollinators have been petitioned for listing, or listed, under state laws and the federal Endangered Species Act (ESA). Many of the species listed to date have had limited spatial distributions, but species with more widespread ranges are now being considered. State Departments of Transportation (DOTs) face uncertainty in practices to best design and maintain roadways to accomplish the legislative mandate of providing safe transportation while conserving species and, in cases of listed species, complying with state laws and the ESA. This project will compile information on current and previous conservation and compliance strategies and practices across the U.S. to inform state DOTs as they determine how best to conserve, maintain and improve roadside pollinator habitat.

This research aligns with the goals of the SCOE Natural Resources Subcommittee to increase the capacity of members to efficiently and reliably deliver environmentally sound transportation projects, programs and services, particularly Objectives 2.1: target emerging issues of particular importance to members and 2.2: disseminate successful strategies, lessons learned, techniques and technologies for addressing DOT Natural Resources issues, requirements and goals. This topic is of particular interest to the SCOE Subcommittee on Natural Resources.

IV. LITERATURE SEARCH SUMMARY

A search of the existing literature in TRID returns the literature review and best management practice guides for pollinator habitat developed by FHWA in conjunction with The Xerces Society and the U.S. Forest Service. It also shows that several states are undertaking local research on various aspects of roadside vegetation design and maintenance related to pollinators. There are other relevant resources which will be useful in developing the guidebook sections for design and management approaches; however, the currently available resources do not focus on complying with the ESA. This research project will leverage the existing and ongoing research and other resources by considering compliance with regulatory requirements for pollinator species that may be listed under the ESA or state laws and regulations while managing invasive species and maintaining safe roadways.

V. RESEARCH OBJECTIVE

Over 30 species of butterflies, skippers and moths are listed as threatened or endangered, as well as a fly, beetle, three bats and several birds (US Fish and Wildlife Service [USFWS] 2012 https://www.fws.gov/pollinators/Programs/Endangered.html). While most of these species are listed because they have limited remaining habitat areas, some of that habitat is on roadways and state DOTs have already worked out approaches to maintenance and conservation in those areas. The techniques developed and lessons learned by those DOTs can be transferred to
other DOTs and local transportation agencies to help as additional pollinating insects may become candidates for listing under the ESA, especially species that were historically more widely distributed. For example, the once widely occurring rusty-patched bumble bee was recently added to the list and the western bumble bee and Monarch butterfly are under consideration for listing, both of which are found across multiple states.

This project will build on the existing syntheses of best management practices for pollinator habitat in general by adding information on strategies for complying with regulatory requirements for currently listed, and preparing for future possible listing of additional, insect pollinators. The main synthesis of information will focus on best practices shared by transportation agencies, upcoming research, and approaches to conservation of pollinating insects listed under the Endangered Species Act. This information could be used to contribute to a template Candidate Conservation Agreement with Assurances, for development of best management practices (BMPs) for credits under Section 4 of the USFWS Director’s Order 218, Policy Regarding Voluntary Prelisting Conservation Actions (1/18/2017) or for development of a Habitat Conservation Plan for candidate or future-listed pollinators on roadsides.

Task 1: Conduct survey and collect information for synthesis.
- The synthesis would include collecting information from a survey of transportation agencies and non-government organizations (NGOs) involved with Section 7 consultations (gathering Biological Assessments, Biological Opinions, and related maintenance and monitoring plans) and Habitat Conservation Plans for pollinating insects under the Endangered Species Act as well as information on ongoing research from transportation agencies and NGOs. One aspect of particular interest would be whether implementing pollinator-friendly maintenance strategies has resulted in cost savings.

Task 2: Regional peer exchanges
- Hold a peer exchange in each of the four AASHTO regions with DOT maintenance, design and biology staff to discuss success and the challenges of approaches to pollinator habitat design and maintenance (policy, partnering, design strategy/guidelines, maintenance strategy/guidelines/training, and safety issues). Include USFWS, FHWA and other partners such as the Volpe Center for the purpose of developing a programmatic approach at the peer exchanges.

Task 3: Synthesize existing information and new information from Tasks 1 and 2
- Approaches to creating/restoring habitat for listed pollinators – within or outside the right of way (ROW), which parts of ROW, etc.
- Practices, such as changes in mowing schedules or techniques, that allow natural revegetation of pollinator habitat in locations where such habitat can be maintained without compromising transportation asset safety or operational concerns
- Maintenance practices to avoid take of listed pollinators in the ROW
- Communicating such practices to the public and within transportation agencies about mowing and spraying practices, effective signage and fencing
- Strategies for long-term management of, and habitat conservation within, the ROW
- Create a rating system for different approaches; rank by effectiveness
- Create BMP listing and descriptions needed for a programmatic agreement template
- Write draft and final reports

Task 4: Regional Guidebooks and Programmatic Template
- Develop a regional Guidebook of Current Practices for Roadside Pollinator Conservation and Endangered Species Act Compliance with sections targeted for environmental, design, construction and maintenance staff for each of the four AASHTO regions.
• Include a summary/matrix of regulatory tools DOTs can use to develop and maintain pollinator habitat and be in compliance with the ESA.
• Develop a template Programmatic Voluntary Prelisting Agreement for Roadside Pollinator Conservation and Endangered Species Act Compliance

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** Total: $500,000

**Research Period:** 30 months

VII. URGENCY AND POTENTIAL BENEFITS

State DOTs are being encouraged by—and proactively partnering with—many stakeholders to create pollinator habitat on their rights of way. This can be a significant change in the way of managing their roadsides for many states and will require new systems for selecting areas for habitat creation, designing and constructing it, planning maintenance and training staff to avoid damage to habitat once it is created—whether by new plantings or changes in vegetation practices that allow vegetation to naturally return to roadsides, as happens when mowing limits, frequencies, or herbicide applications are changed. In the future, as more widely distributed insects are undergoing general population declines and may be considered for listing under the Endangered Species Act, mistakes in roadside maintenance practices may have a greater potential for violations. As a result, many states are wary of creating or enhancing pollinator habitat without knowing of successful practices for managing it. However, if pollinator habitat continues to be lost and not replaced, the trajectory toward listing of more pollinators will continue. For this reason, it behooves state DOTs to share knowledge and successful practices learned from situations with already listed species and existing pollinator habitat areas. This project will result in information sharing through both peer exchanges and through the development of a guidebook with different sections aimed at designers, construction personnel, biologists and maintenance staff to increase the success of creating habitat for pollinators, whether they are listed under the Endangered Species Act or not.

VIII. IMPLEMENTATION PLANNING

The target audience for the research findings and products are state DOT design engineers, landscape architects, environmental planners, biologists, and maintenance staff. These are the key decision makers who will decide whether to implement the habitat guidelines at a project level with each DOT; the manager of each of these groups would be key in deciding whether to implement a pollinator habitat improvement approach within their discipline. AASHTO committees with likely responsibility for adoption of the results include the Standing Committee on Environment, Standing Committee on Maintenance and Standing Committee on Design.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Kris Gade, PhD, Roadside Resources Specialist, Arizona Department of Transportation, 602-292-0301, kgade@azdot.gov (SCOE Research Task Force Member/Vice Chair of SCOE Natural Resources Subcommittee)

X. AASHTO MONITOR

Kris Gade, PhD, Roadside Resources Specialist, Arizona Department of Transportation, 602-292-0301, kgade@azdot.gov

XI. SUBMITTED BY

Tim Hill, Ohio DOT, SCOE Vice Chair
References


Research in progress:

- Evaluating the Suitability of Roadway Corridors for Use by Monarch Butterflies (NCHRP, expected completion 3/13/2019)
- Establishment of Wildflower Islands to Enhance Roadsides for Pollinators Health and Aesthetics (Nebraska DOT, expected completion 12/31/2017)
- Evaluating Integrated Roadside Vegetation Management (IRVM) Techniques to Improve Pollinator Habitat (Maryland SHA, expected completion 12/31/2018)
- Storm Water Infiltration and Pollinator Habitat Zones Along Highways (North Carolina DOT, expected completion 8/15/2019)
- Monitoring and Habitat Assessment of Declining Bumble Bees in Twin Cities Metro Roadsides (Minnesota DOT, expected completion 8/31/2019)

Other relevant resources:

NCHRP Review of B-18

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:
NCHRP 20-119 is developing a method to determine if roadway corridors provide useful habitat for monarch butterflies and ways to manage roadside environment to benefit monarch populations; project completion scheduled for March 2019.

Review Date:
11/21/2017

FHWA Evaluation of B-18

Eric Weaver/HRDI-20 - This problem statement appears to be well developed and supported by references to previous practice, current research and changing conditions. Although there is significant amount of material existing, this would allow a consolidation to make things easier for State Highway Agencies (SHAs) to access and assist with their decision making. One aspect that may need to be addressed are potential institutional barriers at SHAs that may hinder their efforts to maximize the benefits of the product, such as competing budgets across departments and organizational "stovepipes" preventing effective coordination.

AASHTO Committee Evaluation for B-18


Submitted By:
Samantha Hoilett
AASHTO Liaison on behalf of CES Leadership
Committee on Environment and Sustainability

Comments:
Submitted by Committee on Environment and Sustainability Natural Resources Subcommittee. This project will compile information on compliance and conservation strategies and practices across the U.S. to inform state DOTs as they determine how best to conserve, maintain and improve roadside pollinator habitat. This is important because more insects are being considered for listing under the Endangered Species Act.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

**NCHRP Problem Statement Outline**

I. PROBLEM NUMBER

2019-B-19

II. PROBLEM TITLE

Streamlining Data Collection and Analysis for Project Level Air Quality Modeling

III. RESEARCH PROBLEM STATEMENT

State DOTs would benefit from guidance that goes beyond the norm on how to conduct modeling for project-level air quality analyses and addresses which modeling inputs are the most cost-effective and important to focus on in terms of improving accuracy and reducing uncertainty in modeling results. They would similarly benefit from an assessment of proportionality, that is, how accurate and precise the modeling inputs "need" to be in order to meet the specific regulatory requirements and, conversely, not require or involve demands for more accuracy, level of detail and precision in modeling inputs than are really needed to meet the specific regulatory objectives and application. The study would focus on emission and dispersion modeling (for which traffic would be an input) for particulate matter (PM) and emission modeling for mobile source air toxics (MSATs). It may, as funding permits, also address emission and screening-level dispersion modeling for carbon monoxide (CO).

Key tasks may include:

1) Document the modeling inputs needed to run EPA emission and dispersion models for project-level air quality analyses for both purposes of transportation conformity and NEPA. Also document the corresponding modeling outputs needed to show compliance for each pollutant with applicable regulatory requirements and guidance, i.e., the units and expected or typical number of significant digits.

2) Review and document common sources of data for each of the modeling inputs, and the typical time and cost for obtaining or generating those inputs. Depending on the budget available for this study, the cost-estimate may be quantitative (preferred) or qualitative (e.g., high, medium or low cost). Prepare an interim report for panel review.

3) Document or otherwise determine the sensitivity of the modeling chain for each pollutant, based on the results of a literature review for project-level sensitivity studies (the results of which may be limited) as well as sensitivity modeling conducted specifically for this study. For MSATs, the focus would be on emission modeling inputs and outputs. For PM and (if funding permits) CO analyses, the focus would be on modeling inputs and outputs for the emission-dispersion modeling chain. Rank the inputs according to sensitivity, from the most sensitive to the least sensitive. The modeling should be based on typical transportation project types. e.g., congested intersections, highway interchanges and links, etc. Prepare an interim report for panel review.

4) For each pollutant, use the results from the previous tasks to identify which modeling inputs and sources of data contribute most cost-effectively to reducing the noise (modeling uncertainty stemming from modeling inputs) in the modeling results (emissions for MSATs, and concentrations for PM and, if funding permits, CO). To the extent feasible, include consideration of default modeling inputs as a baseline.
5) Assess proportionality to the extent feasible, i.e., the concept of limiting the level of detail and number of significant digits to just that needed to meet the specified regulatory requirements. For each pollutant, using the results from the previous tasks and additional sensitivity tests as needed, identify limits to how precise the modeling inputs need to be (in terms of number of significant digits) to generate modeling output that would "just" meet the regulatory requirements in terms of number of significant digits for project-level analyses for each pollutant. Prepare an interim report for panel review.

6) Draft recommendations for best practices for data collection and analysis on the basis of costs and cost-effectiveness and (if funded) proportionality.

7) Prepare draft and final reports.

IV. LITERATURE SEARCH SUMMARY

Searches were conducted on TRID (http://trid.trb.org), which includes the Research in Progress database (http://rip.trb.org/). No studies were identified that had similar scopes to that proposed here. Generally, the studies identified address one or more (but not all) of the elements of the proposed study. The following results are representative of what was obtained:

Cambridge Systematics, "Enhanced Truck Data Collection and Analysis for Emissions Modeling", NCHRP 08-101, in progress (2017). See: http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3860. The final report serves as a "guide for transportation practitioners on methods, procedures, and data sets needed to capture commercial vehicle activity, vehicle characteristics, and operations to assist in estimating and forecasting criteria pollutants, air toxics, and greenhouse gas emissions from goods and services movement." As such, its scope is limited to: 1) heavy duty vehicles, and not the entire on-road fleet including both light and heavy duty vehicles as proposed for this study, and 2) emission modeling, and not as proposed for this study the overall traffic, emissions and dispersion modeling chain needed for project-level air quality analyses. It does however consider costs on a qualitative basis for developing inputs, showing awareness that state DOTs need even that limited cost information to make rational economic decisions in improving their modeling practices and procedures.

Jones Jr, S L, Cooper, D C, and Keely, D K, "Streamlining Air Quality Models in Alabama", University Transportation Center for Alabama (UTCA) Report 03412, 2004. See: http://utca.eng.ua.edu/research/projects/?id=03412. This research sought "to develop a user-friendly, Windows version of MOBILE6 and a Windows carbon monoxide (CO) screening model", using defaults inputs for example. It did not address streamlining of refined analyses, or models currently in use (MOVES and AERMOD) that would be addressed in this proposed research. It also does not present the type of rigorous and systematic testing and analysis of current models and associated data collection and analysis proposed in this study that would serve to guide state DOTs in streamlining the data collection and analysis process for the current suite of models (including CAL3QHC in addition to MOVES and AERMOD).

Patel, I., Kumar, A., and Manne, G., “Sensitivity Analysis of CAL3QHC Roadway Intersection Model”, Transportation Research Record, Issue 1842, 2003, p. 109-117. See: http://dx.doi.org/10.3141/1842-13. The study presents sensitivity results for one model (CAL3QHC), which is not the focus for the proposed study. Additionally, it does not take the additional and practical step of determining which of all inputs for the project-level modeling chain are the most important and cost-effective for state DOTs to address as proposed in this study. Other sensitivity studies (of which there are but few for current models) tend to have the same limitation.

The study investigates the sensitivity of MOVES model to changes in speed, temperature, seasons, time-of-day and year, and the sensitivity of predicted PM2.5 concentrations on an annual average basis to the choice of model (AERMOD versus CAL3QHCR) and difference in meteorological data set (urban versus rural). While the study is related in that it addresses model sensitivities for specific inputs (and not all inputs), it does not take the additional and practical step of determining which of all inputs for the project-level modeling chain are the most important and cost-effective for state DOTs to address as proposed in this study. Other sensitivity studies tend to have the same limitation. It also does not address MSAT analyses, which are a key component of project-level air quality analyses for purposes of NEPA.

Porter, Christopher, Kall, David, et al., “Input Guidelines for Motor Vehicle Emissions Simulator Model, Volume 2: Practitioners’ Handbook: Project Level Inputs”, NCHRP Web Document, Issue 210, 2014, 163p. See: http://www.trb.org/Main/Blurbs/172041.aspx. This study focuses on one model (the MOVES emission model) and “provides information on alternative sources of local input data and the advantages and disadvantages of each.” However, it does not address the entire project-level modeling chain including traffic, emissions and dispersion, as proposed in this study. Additionally, while it presents alternative sources of data, it also does not seek to provide guidance to state DOTs on the most important inputs to focus on based on rigorous and systematic sensitivity testing for model inputs and time and cost analyses for modeling inputs as proposed in this study.

V. RESEARCH OBJECTIVE

The objective is to develop practical guidance for state DOTs that goes beyond the norm on how to conduct modeling for project-level air quality analyses and identifies which modeling inputs are the most cost-effective and important to focus on in terms of improving accuracy and reducing uncertainty in modeling results. As a means to further improve the cost-effective of data collection and analysis processes and procedures, the guidance would to the extent feasible also address proportionality, that is, how accurate and precise the modeling inputs "need" to be in order to just meet (and not exceed) the specific regulatory requirements.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

The recommended funding for the project is $300 thousand, as it is expected to require the equivalent of one analyst for a period of one to one-and-a-half years for which an assumed rate of $200 thousand per year including overhead is assumed.

The work involves primarily computer modeling on standard personal computers. No special or expensive equipment is needed.

Research Period:

The research period is expected to be up to 24 months, including three months for review and revision of a draft final report and one month for review and revision of each of three interim reports.

VII. URGENCY AND POTENTIAL BENEFITS

State DOTs would benefit from guidance that identifies which emission and dispersion modeling inputs are the most important and cost-effective for modelers to focus on for project-level air
quality analyses conducted for purposes of NEPA (which applies to all states) and, where applicable, the EPA transportation conformity rule. State DOTs would also benefit from guidance on the level of detail or degree of accuracy needed in those inputs to just meet the regulatory need (number of significant digits). Overall, the results from this proposed study would allow modelers for state DOTs to best determine how to prioritize their limited resources for data collection and analysis, and so help optimize and streamline the modeling process for project-level air quality analyses.

Note: The proposed study was the top-ranked research topic by state DOTs in the 2017 review and ranking process conducted by the AASHTO Air Quality, Climate Change and Energy Subcommittee as part of the AASHTO Center for Environmental Excellence annual Call for Research Ideas. Additionally, the topic was identified as a research need by the TRB Transportation and Air Quality Committee (ADC20) Project-Level Analysis Subcommittee; see Research Topic ID#128, “Resource Allocation Among the Traffic, Emission and Dispersion Modeling Steps in Project-Level Analyses”, in: https://www.trbairquality.org/wp-content/uploads/2015/05/ADC201-Project-Level-Air-Q-Research-Ideas-2015.pdf.

VIII. IMPLEMENTATION PLANNING

Target audience: State DOT staff, their consultants, FHWA Divisions, EPA

Key decision makers who can champion implementation of products: AASHTO Subcommittee on Air Quality, Climate Change, and Energy

AASHTO committees and others responsible for adoption: AASHTO Subcommittee on Air Quality, Climate Change, and Energy; State DOT staff

Early adopters: States that voted for the project in the AASHTO Air Quality, Climate Change and Energy review and ranking process, including AZ, CA, CO, FL, MN, OR, TX, VA, WA, WI

Barriers to adoption: None expected.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

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XI. SUBMITTED BY

Tim Hill, Ohio DOT, SCOE Vice Chair
Office of Environmental Services Administrator, Ohio DOT
NCHRP Review of B-19

Reviewed By:
Ann M. Hartell
ahartell@nas.edu

Comments:

The proposed project seeks to reduce the analytic burden of AQ analyses for state DOTs by an exploratory approach to arrive at a more parsimonious model that will provide robust results, even if specified with lower quality data. The objective is to investigate what modeling inputs can be left out without affecting model results. The objective also suggests reducing the data quality required in order to "just meet" regulatory requirements; this might involve sensitivity testing on sample sizes (e.g. taking draws from complete datasets to test if less frequent sampling provides the same results) or comparing results using data from a subset of sampling locations (to test if the same results can be achieved using data from a reduced number of sampling sites). Other data reduction strategies could also be tested.

Such exploratory modeling can be useful in identifying those variables that drive a model, however the results are highly dependent on the specific datasets used, the specification choices of the analyst, and the sequence of those choices in specifying sequentially reduced models, presenting a challenge to national generalizability of the method and of the results. Usually, testing a model to find the most parsimonious specification is a relatively straightforward exercise that can be done by an analyst running an existing model.

In order for regulatory agencies to reduce the analytic requirements on state DOTs, the results the research project would need to be compelling. Further, a state DOT would need to be confident that the results from a reduced model and/or data are fully defensible.

Review Date:
11/21/2017

AASHTO Committee Evaluation for B-19

Streamlining Data Collection and Analysis for Project Level Air Quality Modeling

Submitted By:
Samantha Hoilett
AASHTO Liaison on behalf of CES Leadership
Committee on Environment and Sustainability

Comments:
Committee on Environment and Sustainability #3 Priority. B-19 is a high-value study that would help streamline the preparation of air quality analyses for projects for both NEPA and EPA air quality
conformity. The scope is clear and achievable. Additional funding if made available could address the related subject of uncertainty through the modeling chain, so that inputs that carry the greatest uncertainty (in addition to being ones to which the models are sensitive) can be targeted for improvement. It has well defined and achievable goals. It was the top ranked research topic by state DOTs in the 2017 review and identified as research need by TRB ADC20. At first glance some of this work looks like it overlaps with new proposal that just posted called "Quantifying the Contribution of Vehicle Emission to Local Air Quality". That project is looking at the uncertainty and proportionality of dispersion models. However, this project is looking at the streamlining data collection in the dispersion and emission models. This research would be very useful, especially in terms of doing MSAT emission analysis. FHWA created a guidance for doing MSAT quantitative analysis in October 2016 and it has created quite a few new data needs at the project level that our traffic folks do not usually provide. So, it would be good to know how detailed we need our inputs to be and how that would affect the outcome, so we can make better decisions. I think this research would benefit many DOTs that are struggling with their MSAT and PM analyses. It would be useful to know how MSAT concentrations can vary (or focus on the major MSAT emitters like diesel PM and benzene) and how the emissions could change based on the improve site specific data versus using MOVES national defaults.

Submitter Response for 2019-B-19
Streamlining Data Collection and Analysis for Project Level Air Quality Modeling

From: [email: shoilett@aashto.org;Tim.Hill@dot.ohio.gov]

Comments:
The AASHTO CES comments are overall very well-stated and supported. In particular, they reference a related NCHRP proposal on "Quantifying the Contribution of Vehicle Emission to Local Air Quality" for which this proposed work would complement perfectly. This proposed study would in essence identify the most important modeling inputs on which state DOTs should focus their efforts, considering both the sensitivity of the models and, if funding suffices (more would help), the uncertainty associated with those inputs. Though it seems an obvious way to improve the state of the art for regulatory project-level air quality analyses, it has not been done to date so this would be ground-breaking and important work.

A clarification is needed for the NCHRP comments. In theory, the results of this study could lead to models that require fewer inputs but only if the model developers choose to make those changes in response to the findings of this study. They may choose to not do so. However, that does not reduce the utility of the study to state DOTs, as merely identifying the most important modeling inputs on which to focus would clearly allow them to prioritize the allocation of their limited resources (time and funding) to improving those modeling inputs, and vice versa, to allocate the least resources needed to the modeling inputs that have the least influence on the results. The net benefit to state DOTs is improved modeling performance through more optimal allocation of resources to the most important inputs. It is neither using lower quality data nor reducing the number of modeling inputs per se, though the latter is a possible outcome in the long-term if the model developers choose to make those changes based on the new information to be obtained from this study.

Contact Info:
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Review Date: 12/19/2017
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-B-20

II. PROBLEM TITLE

Watershed Approach to Mitigating Hydrologic Impacts of Highway Projects

III. RESEARCH PROBLEM STATEMENT

Departments of Transportation are being put under pressure to address the adverse impacts of larger stormwater volume discharges from increasing impervious surface area (aka hydromodification.) Development and more impervious surfaces in a watershed results in a change to the storm hydrograph, increasing runoff volumes, heightening peak flows and shortening the duration of the runoff event. This change increases flooding, triggers stream channel change, accelerates stream bank and bed erosion, increases sediment loads and turbidity, harms aquatic habitat, and reduces low flow discharges. While the U.S. Environmental Protection Agency (EPA) has not promulgated federal rules to regulate stormwater volume directly as a pollutant, Endangered Species Act (ESA) compliance conditions, some state-issued NPDES MS4 permits, and some state regulations do have hydromodification requirements. For example, in Washington state projects must reestablish pre-development hydrology, and in Oregon conditions of ESA Biological Opinions for highway projects require maintaining pre-project hydrology for channel forming flows.

The traditional technique for addressing hydrologic impacts of highway projects is to construct detention and retention basins. While the basins are effective at reducing peak flows and flood issues, they are less well suited to maintaining or reestablishing relatively “natural” hydrology for streams, and may in fact lead to local degradation. They also require considerable right-of-way adjacent to highways, add to the maintenance burden, and can become attractive nuisances. Full infiltration of stormwater discharges on-site is frequently not feasible due to physical constraints. Other approaches, such as using compost amended vegetated filter strips for volume reduction, are promising, but still require right-of-way that may not be available.

Various elements of the landscape, primarily wetlands, forests and floodplains, reduce, delay and desynchronize peak flows from precipitation, and are important elements in establishing the natural hydrology of a watershed. While individually these elements have on occasion been used to mitigate for project impacts, there has not been a broader examination of, or methodology for, an integrated approach to mitigating for highway or development impacts on surface water hydrology at the watershed scale.

This project would investigate the capability of landscape modifications elsewhere within a watershed to off-set the hydrologic effects of the increase in impervious surface and changes in drainage associated with highway improvement projects. Examples include floodplain reconnection, use of strategically placed and designed created or restored wetlands, and reforestation. The goal of the research would be to identify effective actions, develop techniques for quantifying the benefits of the actions and assessing their ability to compensate for project and system impacts, and develop guidance for evaluating and selecting the appropriate approach for the affected watersheds. It would be useful for project mitigation, advance mitigation and watershed enhancement efforts. This research would be a companion to NCHRP 840 "A Watershed Approach to Mitigating Stormwater Impacts."

The final product would be aimed at DOT hydraulic engineers, environmental staff and planners, but would also be useful for city and counties responsible for watershed improvements.
The SCOE Strategic Plan and Research Plan identified water quality, which includes hydromodification, as the number two research priority. The proposed project addresses the SCOE Natural Resources Subcommittee Goal 2, increase the capacity of members to efficiently and reliably deliver environmentally sound transportation projects, programs and services relating to natural resources, and Goal 3, create the knowledge foundation on which to base state of the art impact analysis and mitigation planning. The Research Road Map for Stormwater specifically calls out looking at innovative practices such as stream restoration and leveraging wetlands to address volume and hydromodification mitigation, as well as evaluating regional BMPs for mitigation, issues directly addressed by this proposal.

IV. LITERATURE SEARCH SUMMARY

The TRB’s TRID and RIP databases, and Google were used to search for research and literature related to watershed approaches to stormwater management and the hydrologic functions of wetlands, trees and forests, floodplains and soil enhancement. Research on developing a watershed approach to stormwater management has been largely focused on stormwater quality, not compensating for hydromodification (NCHRP Report 840). The most relevant paper presents an approach for identifying natural water storage sites and discusses natural infrastructure, with a focus on increasing water storage to mitigate for floods and droughts. There is considerable reviewed and gray literature on the importance of various landscape elements, such as wetlands, forests and floodplains, to normal watershed hydrology and streams. This literature tends to be focused on individual elements and on the effect of impacts to them on watershed or local hydrology, and not on quantifying the beneficial results of creation or enhancement of the landscape elements. The main exception would be stormwater runoff reduction from trees, particularly in urban areas. Several cities and counties have methods for calculating the benefits of tree planting for runoff reduction. Wetlands are widely recognized as having an important flow moderation function, but little if anything on assessing the effectiveness of wetland creation or enhancement on watershed hydrology. At least one study examined the benefits of floodplain reconnection on a stream channel and its hydrology, but this was not put in a larger watershed context.

This project would identify hydrologic and engineering techniques that can be used to design landscape element enhancements to moderate runoff hydrology and to evaluate their effectiveness at offsetting the impacts from highway facilities within the watershed.

V. RESEARCH OBJECTIVE

The proposed project is intended to identify elements of the landscape in a watershed that can be enhanced or created to offset adverse hydromodification, assess the feasibility and effectiveness of creating or enhancing those elements, and develop a methodology for mitigating highway project and system impacts. The main product would be a practical methodology and guidance for:

• Identifying opportunities in a watershed to enhance or create landscape features that moderate runoff or storm flows and can be used to offset hydrologic impacts of highway facilities
• Designing created or enhanced landscape features for hydromodification mitigation
• Quantification of the hydrologic changes from creating or enhancing landscape features
• Analyzing the effectiveness of modification of specific landscape features, singly or in concert, to offset highway hydrologic impacts

Work on the project would include identifying and evaluating hydrologic models and techniques for their suitability for the project’s goals. Testing of the methodology would demonstrate the practicality and accuracy of the results.

Depending on the approach taken by the researcher, software or a model to support decision making and quantification of the hydrologic impacts of mitigation alternatives may be developed.

Dissemination of the results could include, besides the final report, a webinar and possibly professional or trade journal articles.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
**Recommended Funding:**

$500,000

**Research Period:**

36 months

An estimate of the number of months of research effort, including three months for review and revision of a draft final report, and one month for review and revision of each interim report.

**VII. URGENCY AND POTENTIAL BENEFITS**

With DOTs under more pressure to address impacts of hydromodification on stream ecosystems and quality, it is important to find alternatives to traditional on-site approaches to detention and flow modification. The traditional approaches may not be appropriate for specific locations, do not really establish "natural" hydrology, and do not address the larger issues of hydrologic degradation, which tend to be cumulative and extend both upstream and downstream of a project.

This project will provide DOT hydraulic engineers, environmental staff and planners an additional tool to mitigate hydrologic impacts. The resulting methodology and guidance will support the identification of mitigation opportunities, the design of landscape modifications and the quantification of the hydrologic effects of the modifications. By using the creation or enhancement of natural landscape elements there is the potential to combine hydrologic mitigation with mitigation for other protected resources, such as wetlands.

With technical guidance on a watershed approach, there would be more incentive and opportunity for collaborative efforts among DOTs, local jurisdictions and natural resource agencies which have greater responsibility and authority for the watershed as a whole. Collaborative projects, particularly if they lead to advance mitigation credit, can provide project level efficiencies for DOTs.

**VIII. IMPLEMENTATION PLANNING**

The primary target for the project's results are DOT staff involved in the planning, selection and design of hydromodification mitigation. A second important audience includes resource and regulatory agencies that are responsible for approving project mitigation, and local agencies that may be implementing watershed improvement plans.

Within DOTs implementation is most likely to be driven by environmental offices, since the project is aimed at environmental mitigation, with important support of hydraulic engineering, which would be responsible for technical analysis and design.

Appropriate AASHTO committees are the Natural Resources Subcommittee of SCOE and the Subcommittee on Design, Technical Committee on Hydrology and Hydraulics.

Initial users of this research are likely to be DOTs that are subject to permits or regulation that require mitigation of hydromodification impacts, and where ESA compliance for T&E fish species is a major factor in stormwater management programs.

**IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT**

William B. Fletcher
B-20/4

X. AASHTO MONITOR

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XI. SUBMITTED BY

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14 Centre for Hydrology University of Saskatchewan Saskatoon, Saskatchewan.

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**NCHRP Review of B-20**

**Reviewed By:**
Ann M. Hartell
ahartell@nas.edu

**Comments:**

This problem statement describes a project that will be a companion to NCHRP 840, extending that work by developing a suite of potential approaches for watershed-scale mitigation and quantified measures and design guidance for hydromodification mitigation. Although several potential research products are listed in the objective, these leave some ambiguity as to what is actually needed by state DOTs (e.g. decision support models, design guidance, metrics of mitigation strategies, and evaluation of landscape features for effectiveness in mitigation, all of the above). Note that scoping the project to include a model or software will require care to ensure the research products are accessible to all state DOTs.

**Review Date:**
11/21/2017

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**FHWA Evaluation of B-20**

Joe Krolak/HIBS-20 - Such "watershed” approaches neglect reality of highways constituting linear transportation networks. Every watershed has different characteristics that may require inconsistent approaches that are not commensurate to use of sound hydrologic practice nor the relatively small footprint of the network. Additionally, watershed issues involve larger discussions and issues of land use and water rights. State DOTs usually lack legal authority to get involvement in private land use. Evaluating watersheds will add additional requirements and require additional resources not available to projects and programs. This effort neglects other large scale hydrologic studies that currently exist under federal and other auspices (FEMA FIS, etc). This study will result in misplaced expectations by resource agencies and others.
AASHTO Committee Evaluation for B-20

Watershed Approach to Mitigating Hydrologic Impacts of Highway Projects

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – This research would be beneficial by providing an additional low maintenance tool to mitigate hydrologic impacts associated with highway improvement projects and aid in compliance with environmental permit requirements. While not formally ranked, this research is supported by the Committee on Design.

Submitted By:
Samantha Hoilett
AASHTO Liaison on behalf of CES Leadership
Committee on Environment and Sustainability

Comments:
Committee on Environment and Sustainability #1 Priority. Submitted by CES Natural Resources Subcommittee. This research would quantify the degree to which natural features (wetlands, floodplains) could mitigate increased flows from new impervious surfaces.

Submitter Response for 2019-B-20
Watershed Approach to Mitigating Hydrologic Impacts of Highway Projects

From: [email: Tim.Hill@dot.ohio.gov;shoilett@aashto.org]

Comments:

FHWA: Such "watershed" approaches neglect reality of highways constituting linear transportation networks. Every watershed has different characteristics that may require inconsistent approaches that are not commensurate to use of sound hydrologic practice nor the relatively small footprint of the network.
Response: It is true that highways are linear transportation networks. The traditional approach to hydromodification mitigation (i.e., mitigating increases in peak flow and duration), detention basins, is often not well suited to linear facilities. Detention can result in extensive right-of-way needs, multiple facilities along a highway that can be a hazard and maintenance burden, and are inefficient at mimicking a "natural" hydrology. Highways do have a relatively small footprint, but they do contribute to the cumulative effect that leads to stream channel degradation, and in any case regulators can and do require mitigation for hydromodification impacts from projects.

FHWA: Additionally, watershed issues involve larger discussions and issues of land use and water rights. State DOTs usually lack legal authority to get involvement in private land use.
Response: State DOTs can and do already acquire rights to use formerly private land for environmental mitigation and other highway uses. The watershed approach does not involve regulating private land use or infringing on water rights.
FHWA: Evaluating watersheds will add additional requirements and require additional resources not available to projects and programs.

Response: DOTs would not be expected to analyze watersheds, rather they would use existing resources to identify opportunities to provide hydromodification benefits within watersheds. This is essentially what DOTs do when looking for mitigation for other resources, and this approach could coordinate with and leverage those efforts. DOTs are already being required by regulation to mitigate for hydromodification impacts. Adding to the set of tools that DOTs can elect to use for dealing with flow control requirements can only make things easier for DOTs in the long run. A watershed approach to hydromodification mitigation is not aimed at making DOTs responsible for analyzing or managing watersheds.

FHWA: This effort neglects other large scale hydrologic studies that currently exist under federal and other auspices (FEMA FIS, etc).

Response: This research would draw on and integrate other studies, but such studies are not especially available or designed for use by DOTs. This comment assumes that the main focus of the research statement is flood control, which it is not. The research is intended to address those flows that are important for channel form and processes (and not incidentally, water quality).

FHWA: This study will result in misplaced expectations by resource agencies and others.

Response: This would be a problem only if a DOT oversells a watershed approach. The research would develop additional tools a DOT could use, when and where appropriate, to meet environmental regulatory requirements for mitigating hydromodification impacts.

Ann Hartell, NCHRP:
NCHRP: Although several potential research products are listed in the objective, these leave some ambiguity as to what is actually needed by state DOTs.

Response: The primary products of use for DOTs would be
* A guide to hydromodification mitigation options. This would include selection criteria, site identification, and what and how hydromodification benefits are provided.
* A tool box with techniques and methods for quantifying hydromodification benefits from each option, and for relating mitigation benefits to highway impacts.
* Supporting documentation for use by DOTs when presenting a watershed approach to hydromodification mitigation with regulatory agencies and other parties. It would describe the concepts, scientific background, advantages and limitations of the approach.

Contact Info:

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Review Date: 12/19/2017
Research Field C

DESIGN
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-C-01

II. PROBLEM TITLE

Managing Speed: Self-Enforcing Roadways for Two Lane Rural Highways

III. RESEARCH PROBLEM STATEMENT

Speeding is cited as a contributory factor in nearly one-third of all fatal crashes reported in the U.S. Thus, managing speeds is likely to be a tangible safety management strategy. Application of self-enforcing or self-explaining roadways is one possible approach to manage speeds. In this context, a Self-Enforcing Roadway is defined as one which encourages driver speed choice to be compliant with the regulatory speed limit. Based on existing operating speed models for two-lane rural highways, the use of minimum or near-minimum geometric design criteria appear to be associated with lower driving speeds, while conservatively applying the design criteria produces higher operating speeds. Current geometric design methods, such as those published in the AASHTO Green Book, are based on the design speed concept. Minimum values for many speed-based criteria exist (e.g., radius of horizontal curve, stopping sight distance), but no maximum values are published. Because the Green Book also recommends using larger than the minimum values for different design elements, resulting operating speeds often exceed designated design speeds. When larger than minimum values of geometric design criteria are applied in practice, it is possible that the geometric features of the roadway will have little influence on driver speed choice.

The application of larger-than-minimum design criteria can produce operating speeds that exceed design and posted speed limits. The purpose of the self-enforcing roadways (i.e., achieving a target speed) concept evaluation is to re-examine the design criteria in the Green Book to determine if ranges of geometric criteria may produce target speeds consistent with geometric design speeds. For this research project, the focus should be on two-lane rural highways with moderate to high design speeds (40 to 70 mph); however, it is anticipated that some of the concepts developed in this research may be extended to the low-speed operating environment.

IV. LITERATURE SEARCH SUMMARY

There are a few documents that discuss self-enforcing roadways. The most recent is the Self-Enforcing Roadways: An Informational Report (FHWA, 2017), which states that there are several geometric design procedures that have been developed to overcome some of the limitations associated with the design speed concept. It indicates that the application of minimum (or limiting) values of geometric design criteria in combination with larger-than-minimum (or less than limiting) values of criteria may produce design inconsistencies.

A paper published in Transportation Research Record: Journal of the Transportation Research Board, Number 2309, (paper is titled “Geometric design, Speed, and Safety”) states that, while the definition of design speed has changed twice, its basic application and assumed implications have not. Relationships between the design speed and operating speed, as well as between design speed and safety, that were assumed to exist more than 70 years ago still influence design guidance in current policies and practice. The paper reviewed AASHTO design policies and revealed different definitions of design speed. It concluded that safety on road segments with different design speed–operating speed relationships has not been thoroughly researched.
It is expected that a detailed literature review will be conducted in the development of this project. Any "gaps" in knowledge that require further research can be suggested to enhance the evaluation beyond those mentioned above.

V. RESEARCH OBJECTIVE

The objective of this research project is to re-examine the geometric design criteria in the AASHTO Green Book to determine the range of design values can be used as a speed management strategy. It is expected that the spacing between speed-influencing features will also be studied. This research would provide information that could be considered for inclusion in future editions of the AASHTO Green Book.

The research would include simulator studies, field studies and reliability analysis. Driving simulators offer the opportunity to better understand how drivers select their speed in a controlled roadway environment. A driving simulator experiment could be undertaken to assess varying geometric design criteria in the HDS. A series of roadway alignments, each with different geometric design features, could be displayed in the simulator. The focus of the simulator study would be on the horizontal alignment (e.g., curve radius and curve spacing) and cross-section elements (e.g., lane and shoulder widths as well as offset to roadside features). Further, the alignments should include sections with and without regulatory speed limit signs to isolate the effects of the roadway and roadside features on driver speed choice.

Field studies offer the opportunity to collect vehicle operating speeds on two-lane roadways, and to consider the range of roadway features present along these roadways. The roadway variables to be considered include the following: horizontal curve radius, superelevation, horizontal curve length, horizontal curve spacing, offset to roadside features, vertical grade, lane and shoulder width, design speed (designated and inferred), and the posted speed limit. Data should be collected on moderate-to-high speed roadways in several states.

Moreover, a reliability analysis should be undertaken to determine the probability of non-compliance (probability that a set of field conditions do not comply with minimum or limiting values of design criteria) of the following geometric design models/criteria: 1) Radius of curve from the point-mass model; 2) Stopping, intersection, and decision sight distance models; 3) Length of crest vertical curve design model; and 4) Horizontal sightline offset model.

These models should be assessed using field data from existing two-lane rural highways. Vehicle operating speed and geometric design data from a variety of two-lane rural highway segments in several states should be collected. Once the segments are identified, the existing geometric features should be included in the reliability models as “fixed” or deterministic values. Operating speed data along the study segments should be included in the reliability models as random variables. Random variables, such as driver eye heights, object heights, driver perception-reaction times, and driver deceleration rates, should be identified using published literature. The probability of non-compliance for the study sites should be computed using first- or second-order reliability methods.

In addition to the reliability analysis, crash data from the study segments should be compiled and appended to the geometric design and reliability data. Statistical models of crash frequency should be estimated and include the probability of non-compliance as an independent variable in the models. The model should then be interpreted to define the threshold in which the probability of non-compliance is associated with increased crash likelihood. Once this value is determined, this probability should then be used in the reliability models to determine ranges of geometric
design criteria that minimize crash frequency and the probability of non-compliance to design criteria.

Establishing an upper-limit to current geometric design criteria may help produce operating speeds that are consistent with designated design speeds and posted speed limits. The upper-limit for design criteria that are influenced by the designated design speed can be determined using operating speed model equations.

The self-enforcing roadway concepts may be applied to planned or existing roadways that are programmed for reconstruction. Self-enforcing roads aim to change driver behavior by using geometric elements resulting in operating speeds commensurate with the intended roadway purpose, including the adjacent land use.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

- **Recommended Funding:** $ 900,000
- **Research Period:** 36 months

VII. URGENCY AND POTENTIAL BENEFITS

There is an opportunity to develop a new strategy for speed management through geometric design, which would support the vision towards zero deaths initiatives by potentially reducing the total number of fatalities related to speeding across the country.

VIII. IMPLEMENTATION PLANNING

The intended research product would be used by design engineers that would like to better regulate operational speeds through modifying geometric design values.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

- Abdul Zineddin, Speed Management/Transportation Specialist, Federal Highway Administration, (202) 493-3288, Abdul.zineddin@dot.gov

X. AASHTO MONITOR

- To be assigned by AASHTO

XI. SUBMITTED BY

- Abdul Zineddin, Office of Safety R&D, FHWA
- Norah Ocel, Office of Safety R&D and Resource Center, FHWA
- Eric Donnell, Penn State University


NCHRP Review of C-01
Reviewed By: Camille Crichton-Sumners, ccrichton-sumners@nas.edu
Comments: The study will be helpful as it advances the state of practice from the use of the design speed concept and should help the Community of Practice (CoP) gain a better understanding of driver speed
choice which may aid in crash reduction. The research approach includes the use of simulator studies, field studies and reliability analysis so the timeframe and budget are appropriate. Potentially may be undertaken as an FHWA pooled fund study and/or at TFHRC since they have simulator study capability.

Review Date: 11/30/17

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AASHTO Committee Evaluation for C-01

Managing Speed: Self-Enforcing Roadways for Two Lane Rural Highways

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – The proposed research would be beneficial by providing guidance on how modifications to geometric design can help regulate operational speeds on two lane rural highways.

Submitted By:
Steven Buckley
Chair of Research Subcommittee
Committee on Safety

Comments:
4. Would be very controversial!
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-C-02

II. PROBLEM TITLE

Access Control Techniques to Reduce Wrong-Way Entries from Freeway Exit Ramps

III. RESEARCH PROBLEM STATEMENT

Over the past few decades, different engineering countermeasures have been proposed, implemented, and tested by various state and local agencies to mitigate WWD activities. The majority of these countermeasures are related to wrong-way-related traffic control devices (TCDs). The effectiveness of these TCDs is currently being studied by an ongoing NCHRP project. The current AASHTO Green Book Policy on Geometric Design of Highways and Streets (i.e. “Green Book”) provides some general guidelines on mitigating WWD at different types of interchanges by implementing proper geometric elements (raised medians, turning radius, channelizing islands, etc.). Some geometric design elements and access control techniques have been shown, based on case studies, to be capable of physically preventing and reducing the frequency of WWD vehicle entries. Some state DOTs also developed more specific guidelines for deterring WWD in their own design manuals. Very little research has been conducted to examine safety effects of these access control techniques and geometric elements at different types of interchanges.

Entering an exit ramp from the arterial has been identified as the most prevalent way to enter a controlled-access highway system in the wrong direction at almost all kinds of interchanges. The problem of making a wrong turn onto an exit ramp is compounded when there are exit and entrance ramps adjacent to each other, which is seen at partial cloverleaf (parclo) interchanges. These interchanges and their connection crossroads have one of the highest rates of WWD entries among all types of interchanges. The proximity of the exit and entrance ramps (making two-way ramps) of parclo interchanges make them particularly susceptible to WWD and the consequences. It is generally accepted that some geometric elements at the intersection of two-way ramps and crossroads or within their vicinity are capable of causing further confusion (if designed improperly) or physically preventing the WWD maneuver (if designed properly). For instance, a non-traversable median on the crossroad is believed to help alleviate WWD left-turn movements, whereas a side street or access driveway in proximity of a two-way ramp may confuse drivers. Although several factors relating to the driver (e.g., intoxication and age) as well as other conditions, such as lighting, have been found to contribute to more than half of WWD maneuvers, a considerable proportion of WWD crashes may be prevented with appropriate design of geometric elements. However, there are few research documents available on their level of effectiveness to guide decisions relating to strategies for reducing the WWD incidents.

Some access control techniques and minor geometric elements that can affect WWD entries at interchanges may be identified based on the past studies and existing geometric design manuals (AASHTO Green Book and other state DOT design manuals). Eight geometric design elements are recognized to affect the probability of WWD entries. These elements include intersection angle, control/corner radius from crossroad to exit ramp, control/corner radius from exit ramp to crossroad, width of the median between the exit and entrance ramps, intersection balance, distance to a nearby access point, type of median on crossroad, and the type of channelizing island at the exit ramp throat. Further research is needed to quantify the safety effects of these
variables and define minimum and optimal values for each variable to better guide interchange
design projects.

IV. LITERATURE SEARCH SUMMARY
See Research Problem Statement

V. RESEARCH OBJECTIVE
The objective of this NCHRP project is to develop specific guidelines that state DOTs as well as
local agencies may apply to reduce the incidents of WWD, what the effect of each treatment is,
and where they should be applied to best perform and deter this behavior. The focus would be
access control techniques and geometric design elements. This project would evaluate the
effectiveness of current practices and develop guidance for potential changes that can be
incorporated into the next editions of the AASHTO Green Book and the TRB Access
Management Manual to improve access control near interchanges and geometric design at ramp
terminals for different types of interchanges for physically deterring wrong-way entries onto
freeways.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:
It is estimated that this research would require $450,000 to complete.
(Note: This estimate may be changed by the AASHTO Standing Committee on Research.)

Research Period:
It is estimated that this research would take approximately 24 months to complete.
(Note: This estimate may be changed by the AASHTO Standing Committee on Research.)

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION
Driving the wrong way on high-speed, controlled-access highways, namely wrong-way driving
(WWD), has been a consistent issue in the United States since the introduction of the Interstate
highway system in the 1950s. This type of crash, which constitutes only about three percent of
crashes on these facilities (based on a study by the NTSB), tends to be more severe, increasing
the probability for fatalities or incapacitating injuries. A recently conducted inquiry of the Fatality
Analysis Reporting System (FARS) database revealed that an average of 355 people were killed
in WWD crashes each year over a ten-year period (2004 to 2013) in the nation.

VIII. PERSON(S) DEVELOPING THE PROBLEM
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IX. PROBLEM MONITOR
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X. DATE AND SUBMITTED BY

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NCHRP Review of C-02
Reviewed By: Camille Crichton-Sumners ccrichton-sumners@nas.edu
Comments: The problem statement was created by Huaguo Zhou of Auburn University, author of the following related studies:
http://www.sciencedirect.com/science/article/pii/S0001457517304037?showall%3Dtrue%26via%3Dihub#abs0005
https://www.ideals.illinois.edu/handle/2142/48998
https://www.researchgate.net/profile/Mahdi_Pour-Rouholamin/publication/271207232_Mitigating_Wrong-Way_Movements_near_Interchange_Areas_Using_Access_Management_Techniques/links/54c1ad5d0cf2d03405c5ba81.pdf
The problem statement appears to have some overlap with these studies. There is also be an opportunity to merge this with problem C-17 "Wrong-Way Driving (WWD) Solutions, Policy and Guidance".
Review Date: 11/30/17

AASHTO Committee Evaluation for C-02

Access Control Techniques to Reduce Wrong-Way Entries from Freeway Exit Ramps

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – The proposed research would be beneficial by developing guidance on geometric design elements and access control techniques to reduce wrong way entries.

Submitted By:
Steven Buckley

C-02/3
Comments:
5. Focus should remain on design.
I. PROBLEM NUMBER

2019-C-03

II. PROBLEM TITLE

"Design Specifications for the Static and Seismic Design of Piles for Downdrag"

III. RESEARCH PROBLEM STATEMENT

The AASHTO LRFD Bridge Design Specifications (2012) recognize that piles in settling soil experience downdrag forces from negative skin friction and that they may also move downward with the adjacent soil. Many bridges are constructed in areas where there is compressible soil or liquefiable soil which necessitates the consideration of downdrag forces and associated settlement. Downdrag for static conditions, as well as seismic conditions, has increasingly placed greater demands on existing and new foundations and also led to higher construction costs. The goal of this study is the development of design specifications for the static and seismic design of piles for downdrag after an evaluation of traditional and neutral plane methods with well-documented case histories. The development of these recommended procedures is related to the following AASHTO SCOBS global objectives:

- Enhance the AASHTO Specifications
- Model and manage information intelligently
- Accelerate bridge delivery and construction
- Extend bridge service life, and
- Contribute to national policy.

The research will consider the fundamental behavior of piles subject to downdrag and provide design specifications for the implementation of the neutral plane method for the evaluation of downdrag and the static and seismic design of piles. Experience has shown that there are significant cost advantages to the use of the neutral plane method due, in part, to differences with the approach that is currently explicitly described in the AASHTO Specifications.

IV. LITERATURE SEARCH SUMMARY

There is a great deal of published information on the design of piles for downdrag; however, some of the design methods lack a rational basis and/or are in conflict with the results of long term pile monitoring. TRB Research Record 1169 included the paper “Unified design of piles and pile groups” by Bengt H. Fellenius (1989) that explains the fundamental concepts of the neutral plane method. The recent FHWA publication “Design and Construction of Driven Pile Foundations” (2016) incorporates a modified design methodology proposed by Siegel et al. (2013) for application of the neutral plane method within the LRFD framework for static conditions. Case histories on seismically induced downdrag are more limited. Rollins and Strand (2006) published on downdrag forces due to liquefaction surrounding a driven test pile, while Rollins and Hollenbaugh (2015) reported on downdrag forces on auger-cast piles following blast-induced liquefaction. Fellenius and Siegel (2008) applied the concepts of the neutral plane to a pile during liquefaction but this has not been incorporated into a design guideline yet. Although there are a number of very useful publications that describe the fundamentals and concepts of the neutral plane method, there is no guideline for the design of piles using the neutral plane for considering downdrag for static and seismic conditions.
V. RESEARCH OBJECTIVE

The objective of the research is to develop design specifications for the Static and Seismic Design of Piles for Downdrag that will use the framework of the AASHTO specifications and incorporate the most up-to-date research on drag load. The neutral plane method will be explained in detail and its use will be illustrated by real world examples.

The specifications will address the following questions:

• What are the pile and ground conditions for which downdrag should be considered?
• Is there a threshold ground settlement when downdrag should be considered?
• Will new fill placed in an area of existing piles cause downdrag?
• Are coatings and sleeves effective methods for designing for downdrag?
• How should battered piles be designed for downdrag?
• Is it appropriate to include the downdrag force as a factored top load for LRFD design?
• What is the neutral plane method?
• When does a neutral plane develop for static conditions?
• How is the location of the neutral plane determined for static conditions?
• How is the neutral plane implemented in pile design for static conditions?
• When does a neutral plane develop for seismic/liquefied conditions?
• How is the location of the neutral plane determined for seismic/liquefied conditions?
• How is the neutral plane implemented into pile design for seismic/liquefied conditions?
• What skin friction should be used in liquefied layers to evaluate downdrag?
• How is the neutral plane method applied to groups of piles?

Specific tasks of the research to accomplish the main objective include:
Task 1 Identify and summarize available methods for analyzing downdrag. Methods should include traditional AASHTO LRFD methods and Neutral Plane methods (such as Fellenius’ Unified soil method (2004), Briaud and Tucker’s method (1997), MNDOT methods (2016), etc.)

Task 2 Review current AASHTO LRFD Bridge Design Specifications for provisions and commentary that are specific to the design of deep foundations including the effects of downdrag.

Task 3 Conduct a literature review to obtain a representative set of well-documented case histories involving downdrag for static loadings as well as liquefaction induced settlement. Ideally, case histories should be selected where measurements define (a) load vs. depth in the pile, (b) pile settlement, (c) ground settlement vs. depth, (d) ultimate side resistance, (e) end-bearing resistance vs. displacement, and other key parameters.

Task 4 Prepare an internet survey of AASHTO states regarding their design practices regarding the effects of downdrag on deep foundations.

Task 5 Identify knowledge gaps revealed by Tasks 1 through 4 and develop a field testing plan to produce supplemental downdrag case histories where there is insufficient data to evaluate available analysis procedures.

Task 6 Submit an interim report and proposed work plan, within 6 months of the start of contract, documenting the results of Tasks 1 and 6. Approval of the report will be required before proceeding with the remaining tasks.

Task 7 Execute the testing program and collect appropriate data over a sufficient time period to provide complete case histories.

Task 8 Use case history and experimental data to critically evaluate the various available methods and determine relative advantages and disadvantages for each method. Develop preliminary recommendations regarding the best practices for evaluating downdrag for deep foundations.

Task 9 Prepare an interim research report that describes the case history data set, the results of the field testing program, the results of the analysis evaluation procedure and the recommendations regarding neutral plane concepts.

Task 10 Prepare a draft design guidelines for analyzing downdrag which summarizes key aspects of pile behavior, presents downdrag design guidelines, and provides examples using actual data. Submit the guidelines to technical advisory committee for review and comment.

Task 11 Address review comments and publish final guidelines and a final research report that presents the complete results of the research.

Task 12 Develop a draft downdrag ballot item that provides recommended changes to the AASHTO LRFD Bridge Design Specification and AASHTO Guide Specifications for LRFD Seismic Bridge Design to address the design of deep foundations for static and seismic downdrag.

Task 13 Submit draft AASHTO ballot language for panel review.

Task 14 Incorporate review comments by panel into the ballot language and submit the downdrag ballot item for AASHTO SCOBS consideration.

The final products of this project will be (a) a guidelines on the design of deep foundations for static and seismic downdrag, (b) a research report with the complete results of the research, and (c) AASHTO SCOBS ballot ready code language for the adoption of design specifications for the Static and Seismic Design of Piles for Downdrag.
VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Type of research:** Full NCHRP project

**Recommended Funding:** $500,000

**Research Period:** The project will be completed in thirty-six (36) months.

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

According to transportation engineers from several states, experience with the explicit AASHTO approach for downdrag has shown that it can lead to unrealistic results and the use of longer piles, surcharging, and/or ground modification. The AASHTO Specifications allow the use of the “neutral plane method”; although it only briefly referenced. The absence of detailed guidelines for the neutral plane is a reason cited for the reluctance among designers and consultants to use the neutral plane method even though the neutral plane method represents a simple, more realistic model for piles subjected to a downdrag force and its associated effects.

Dan Brown, the current DFI President and one of the authors of the FHWA manuals on drilled shafts, driven piles, and continuous flight auger piles comments that, “There is a great need within the deep foundation industry for workable guidelines for designing piles and pile groups for downdrag within the LRFD framework that is based on fundamental pile behavior.”

There is great urgency to support the state transportation departments in an effort to save time and construction cost. Time can be saved by avoiding the adverse impacts of surcharging over time and ground modification at the beginning of projects. Time and money can also be saved by providing clear and concise design guidelines for downdrag. This is especially important for design-build projects where the basis of the design plays a vital role in evaluating the respective teams. Construction time and materials can be more efficiently expended using a rational design method based on the results of long term monitoring and load testing of piles.

The Guidelines would be immediately available for state transportation engineers and their consultants for design and ensure consistency in the design and review process throughout the U.S. Without the Guidelines, state highway departments will continue to implement costly, potentially unnecessary measures to address downdrag to make certain that their designs meet the requirements of the AASHTO Specifications.

The target audience for the Guidelines includes state transportation engineers and their consultants for design. Elmer Marx (Chair of TRB AFF50 Committee on Seismic Design and Performance of Bridges) with AKDOT and Ken Fishman (Chair of TRB AFS30 Committee on Foundations for Bridges and Other Structures) with MMCE have endorsed this Project. Jon Bishoff with UDOT and Sharid Amiri (Chair of the TRB AFF50(1) Subcommittee on Geoseismic Issues) with CALTRANS have also endorsed this Project.

VIII. PERSON(S) DEVELOPING THE PROBLEM

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IX. PROBLEM MONITOR

Potential technical panel members for this project include:

Sharid Amiri, California Department of Transportation  Gregory Sanders,
Missouri Department of Transportation
   David Hemstreet, Alaska Department of Transportation and Public Facilities
   Susan Ortiz, Oregon Department of Transportation
   Nicholas Harman, South Carolina Department of Transportation
   Don Anderson, CH2M
   Youssef Hashash, University of Illinois Urbana-Champaign
   Neven Matasovic, Geosyntec
   Thomas Cooling, AECOM
   Justice
   Maswoswe, FHWA

X. DATE AND SUBMITTED BY

May 5, 2017

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X. AASHTO SCOBS COMMITTEE ENDORSEMENTS

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NCHRP Review of C-03
The problem is suitable for funding in the FY 2019 NCHRP. The AASHTO SCOBS ranked this problem as the 1st in a group of 5 high-priority problems from the problem statements reviewed this year. The objective of this project is consistent with the 2013 SCOBS Strategic Plan.

FHWA Evaluation of C-03
Jennifer Nicks/HRDI-40 - The AASHTO LRFD Bridge Design Specifications state that the neutral plane method may be used to determine downdrag, but provide little guidance on its use in static and seismic conditions. Research in this area should be pursued to finalize design specifications for adoption by AASHTO. Silas Nichols/HIBS-20 - Recent research using instrumented piles has led to FHWA adopting a design methodology for downdrag applying the neutral plane method within an LRFD framework. Research to develop AASHTO guidance for both static and seismic application is a natural progression and should be pursued by NCHRP.

AASHTO Committee Evaluation for C-03

Design Specifications for the Static and Seismic Design of Piles for Downdrag

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Bridges and Structures

Comments:
Committee on Bridges and Structures – This proposal ranked #1 out of 5 submitted this year, and is supported by the Technical Committees on Seismic Design (T-3), Movable Bridges (T-8), and Substructures and Retaining Walls (T-15).
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-C-04

II. PROBLEM TITLE

Deceleration Rates for Design and Arterial Access Management

III. RESEARCH PROBLEM STATEMENT

Selection of a deceleration rate is integral to determining the deceleration component of upstream functional intersection distance, the length of left-turn and right-turn deceleration lanes, access connection spacing that permits drivers to consider one-access connection-at-a-time, and corner clearance which is a special case of connection spacing.

Research completed un NCHRP Project 3-91, Development of Left-Turn Lane Warrants for Unsignalized Intersections, indicates that auxiliary lane are warranted at low volumes. Implementation of this finding will result in more frequent use of auxiliary lanes. And, it is important that the design accommodate expected driver-vehicle operating characteristics.

Research relative to deceleration rates has been concerned with the approach to signalized intersections. This maneuver does not involve a lane change, or lateral movement, as is the case with movement into a left-turn or right-turn lane, however does provide a good baseline for comparison. Logic suggests that the deceleration rate while making the transition from a through traffic lane into a turn lane should be less than that while braking while "steering straight ahead" (no lane change). Additionally there are questions as to: 1) the deceleration characteristics of large trucks (an issue in the design of auxiliary lanes on truck routes); and 2) the relationship between deceleration rates and initial speed prior to braking.

IV. LITERATURE SEARCH SUMMARY


4. Williams, W. L., "Driver Behavior During the Yellow Interval," Transportation Research Record 644, National Research Council, 1977 pp. 75-78.

Several researchers [1, 2, 3, 4, 5] reported deceleration rates based on the observation of numerous drivers' deceleration to a stop at stop-controlled and signal controlled intersections. Others [6, 7] reported driver performance of selected individuals.

Research in New Zealand [1] indicates that: 1) the deceleration used by drivers increases as the initial speed (speed prior to braking) increases, 2) the deceleration rate increases as the driver decelerates, and 3) drivers on open roads on urban streets drive slower (implying that deceleration rate is related to initial speed).

Research by Gates, et al [2] collected data on approach speed, distance upstream of stop line at the beginning of the yellow phase, travel time to stop line at the beginning of yellow, and deceleration rate. The 15th, 50th, and 85th percentile average deceleration rates of the first-to-stop were 7.2, 9.9, and 12.9 $\text{fps}^2$, respectively. Gates, et al also found that deceleration rate increased with speed as illustrated. Exhibit 1.

<table>
<thead>
<tr>
<th>Exhibit 1: Deceleration Rate ($\text{fps}^2$) Related to Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach Speed (mph)</td>
</tr>
<tr>
<td>Perfentile*</td>
</tr>
<tr>
<td>15th</td>
</tr>
<tr>
<td>50th</td>
</tr>
<tr>
<td>85th</td>
</tr>
</tbody>
</table>

*Percent of drivers utilizing a deceleration rate equal to, or less than, the rate indicated.

They found that drivers who were closer to the intersection at the beginning of yellow utilized a higher deceleration rate than those further away as shown in Exhibit 2.

<table>
<thead>
<tr>
<th>Exhibit 2: Deceleration Rate ($\text{fps}^2$) Related to Estimated Travel Time to Intersection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Travel Time to Intersection</td>
</tr>
</tbody>
</table>

C-04/2
Fambro, et al. [6] observed braking performance of 26 individuals driving a vehicle provided by the research agency and an additional 12 individuals using their personal vehicles. Each driver made repeated braking maneuvers on a closed-course. The researchers concluded that "Approximately 90 percent of all drivers choose decelerations greater than 3.4 m/sec²" (This statement is repeated on page 111 of the AASHTO Greenbook.)

This deceleration rate is equivalent to 11.2 fps². It is to be noted that 11.2 fps² exceeds the 50th percentile average deceleration rate reported by Gates, et al [2]. It also exceeds the 85th percentile deceleration of 10.4 fps for an approach speed of ≤ 40 mph. (Only 15 percent of the observed drivers were observed to utilize a higher deceleration rate). It also exceeds the 50th percentile deceleration rate for approach speeds greater than 40 mph (see Exhibit 1). Additionally, 11.2 fps² is close to the 85th percentile rate when the travel time is more than 4.0 seconds to the intersection and the 50th percentile when the travel time is equal to or less than 4.0 seconds (see Exhibit 2).

Exhibit 3 shows the frequency distribution of the deceleration rates reported by various sources together with the approximate 11.2 fps² deceleration rate recommended by Fambro, et al [6].

The observed deceleration rates [2, 3, 4, 5] and the information shown in Exhibits 1, 2, and 3, also call into question the 10 fps² as a "comfortable rate" recommended by ITE.
The following serious issues arise with the deceleration rate recommended by Fambro, et al [6]: 1) Extremely small number of individuals, 2) Extremely limited geographical distribution (one urban area), and 3) Data collected by repeated trials by the extremely small number of different individuals on a closed-course (not observation of individual drivers decelerating to a stop at an intersection).

Wang, et al [7] reported on the use of in-vehicle GPS to obtain deceleration data. The observed average deceleration rates were higher than Gates and others [1, 2, 3, 4, 5]. However, this research focused on in-vehicle GPS for data collection and involved only a few individuals in a limited geographical setting (Atlanta).

Warren et al. [8] recorded speeds of vehicles decelerating in a through lane prior to turning right into a driveway. They found that three deceleration regimes existed: a slow deceleration rate well in advance of the driveway; an increased rate as the vehicle got closer to the driveway; and a higher rate immediately at the driveway.

No information relative to deceleration characteristics of large trucks was found.

V. RESEARCH OBJECTIVE

The principal objective of this research is to collect and analyze deceleration characteristic data-of 1) passenger vehicles and 2) large trucks when transitioning from a through traffic lane into a left-turn or right-turn lane and then decelerating to a stop, or very slow speed turn, at an access connection. The findings will
provide designers with a much improved basis for determining the length of turn lanes. Questions to be addressed include:

1. The distance upstream of an access connection that drivers of: a) passenger vehicles, and b) large trucks begin deceleration as a function of speed.

2. The deceleration profile (cumulative graph of deceleration rates of a) passenger vehicles and b) large trucks while transitioning from a through lane into a turn lane. And, the deceleration profile of b) passenger vehicles and c) large trucks begin deceleration as a function of speed.

The research is expected to include:

- Developing the work program
- A critique of the available literature
- Proposed data collection locations
- Study design for data collection and analysis
- Data collection
- Data analysis and documentation
- Recommended practice (deceleration/maneuver distances) for the design of left turn and right-turn lanes
- Project report

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** Recommended Funding: It is estimated that the cost of the research envisioned herein will be approximately $750,000.

**Research Period:** The time needed to complete the research described herein is estimated to be 30 months.

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

See Problem Statement.

VIII. PERSON(S) DEVELOPING THE PROBLEM

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X. DATE AND SUBMITTED BY
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NCHRP Review of C-04
Reviewed By: Camille Crichton-Sumners ccrichton-sumners@nas.edu
Comments: Better estimation of required turning lane lengths will likely reduce to reduce the potential for rear-end and side-swipe crashes involving vehicles changing from thru-lanes to turning-lanes. One outcome of this research will be recommendations for changes in geometric design (deceleration/maneuver distances) of left turn and right-turn lanes and will require suggested language for updates to the "Green Book".- A Policy on Geometric Design of Highways and Streets with concurrence by FHWA. The objectives are achievable through research and if field measurements are used the budget and schedule seem reasonable.
Review Date: 11/30/17

FHWA Evaluation of C-04

Bob Ferlis/HRDO - Both driver behavior and vehicle performance have continued to change and the need to update or confirm key performance factors such as deceleration rate, and particularly the differences between drivers, is apparent. This study provides an opportunity to provide foundational data useful to researchers and practitioners.
I. PROBLEM NUMBER

2019-C-05

II. PROBLEM TITLE

Highway Capacity Manual Methodologies for Analyzing Freeway Merging and Diverging Bottlenecks Considering Different Geometric Characteristics and Mitigation Strategies

III. RESEARCH PROBLEM STATEMENT

Freeway congestion typically generates at freeway merge and diverge segments, which have the potential to serve as bottlenecks. To alleviate or mitigate the impacts of congestion at these segments, a number of active management operational strategies such as ramp metering, hard shoulder running, etc. have been implemented. The current freeway merge and diverge methodologies in Chapter 14 of the 6th edition of the Highway Capacity Manual (HCM) were developed over 25 years ago using limited field collected data. In addition to limited data, the methodology does not conform to the fundamental relationship of traffic flow, namely that flow is the product of speed and density. Also, contrary to literature findings, the methodology overestimates the capacity values at both merge and diverge segments. In addition, the HCM does not offer any methodology for lane drops or additions, which often occur in the vicinity of freeway merge/diverge segments. The HCM identifies the following limitations of the current methodology:

- Special lanes, such as high-occupancy vehicle (HOV) lanes, as ramp entrance lanes
- Ramp metering
- Active traffic management operational strategies
- Inconsistency with basic segment approach
- The effect of adjacent upstream/downstream ramps if different from single-lane right-side ramps.

In the past decade, the data available to traffic engineers have expanded exponentially with ubiquitous sensor coverage of urban freeways and probe vehicle coverage of entire roadway networks. These new datasets provide a wealth of information to support the development of updates or changes to the merge and diverge methodologies, and potentially complement traditional data sources.

IV. LITERATURE SEARCH SUMMARY

The original basis of the current merge and diverge methodologies date back to the 1970s, with a major update in 1993 in NCHRP 03-37. Since then, no major changes to the methodology have been incorporated into the HCM though there has been ongoing research in the area. Work with the weaving methodology should build upon the work completed in NCHRP 03-75 “Analysis of Freeway Weaving Sections”. Listed are a few recent studies that address key issues in capacity and level of service analysis at merge and diverge sections. The list also includes literature on the impact of managed lanes or other operational strategies on highway capacity.


https://active-traffic.tti.tamu.edu/

V. RESEARCH OBJECTIVE

This research is focused on three major objectives: (1) evaluate the current HCM freeway merge and diverge methodologies and propose methodology improvements or changes, (2) consider the effects of commonly implemented freeway management tools and strategies on capacity and quality of service, and (3) evaluate different geometric configurations that have not been adequately described in the HCM, such as lane drops/additions or long acceleration/deceleration lanes for multilane ramps, and recommend modifications to the proposed methodologies accordingly. The research will evaluate the use of emerging data sources for model development and provide guidance on incorporating such datasets for validation of analysis results. The new methodologies should be developed with close consideration to the HCM weaving and basic segment methodologies to ensure compatibility.

Research Proposed
Potential Tasks:

1. Analyze, describe, and critique pertinent domestic and international literature on analysis of freeway merge and diverge sections. Summarize information on the effectiveness of existing analytical methodologies for freeway merges and diverges, emphasizing any available information on their compatibility with basic freeway and weaving segment methodologies. The literature review should also include freeway operational strategies that are typically implemented at these segments, such as ramp metering, hard shoulder running, HOV lanes, etc., at either permanent or temporary basis.

2. Describe alternative frameworks for new merge and diverge methodologies. The methodologies should ideally utilize the free flow speed and capacity adjustment factors used in the basic segment methodology, but may include new approaches such as lane-by-lane analysis. Analytical frameworks for treating various geometric configurations (e.g., lane add/drops merging or diverging from/to single lane mainline such as single-lane managed lane merge/diverge segments, CD roads or ramps that are splitting or converging) should also be developed. The frameworks should also address how specific operational strategies will affect capacity and quality of service based on geometry and configurations.

3. Identify existing field-data sets at freeway merges and diverges with and without operational strategies, and lane add/drops, and assess their usability for this project. Include guidance on how to utilize data from emerging technology for capacity and quality of service analysis and for validation of results. Supplement the datasets with design configurations and any additional parameters required in the current or proposed methodologies.

4. Develop an improved set of methodologies to macroscopically assess the freeway merges, diverges, and lane add/drops that predicts capacity, speed, and density (as well as any other proposed performance measures). Validate the proposed methodologies and demonstrate their
advantages in predicting speed and level of service using field data. The methodologies should be clear and rational and the input data should be reasonably accessible to practitioners.

5. Evaluate the ability of the proposed framework to replace the current weaving analysis methodology by analyzing previously collected weaving datasets from NCHRP 03-75 and configurations on the boundary between weaving and merge/diverge segments (e.g., long auxiliary lanes, closely spaced on- and off-ramp segments).

6. Propose updates to Chapter 14 and other relevant chapters (basic and weaving segments) of the 6th Edition of the HCM and develop a computational engine that can implement the proposed methodologies. Develop example problems illustrating the proposed framework and methodologies.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: 500,000

Sponsors:
AHB40 – Highway Capacity and Quality of Service Committee. Chair: Tom Creasey, Tom.Creasey@stantec.com, 859-422-1861.
AHB20 – Freeway Operations Committee. Chair: Jon Obenberger, Jon.Obenberger@dot.gov, 202-493-3265.

Research Period:
30 months

VII. URGENCY AND POTENTIAL BENEFITS

This research will produce new analytical methodologies and tools for improving the Highway Capacity Manual merge and diverge segments existing procedures. The proposed research will address several limitations of the current methodologies, which include different geometric configurations and implementation of active traffic management operational strategies. Failure to fund this problem statement will result in cost-prohibitive use of microsimulation.

VIII. IMPLEMENTATION PLANNING

As this research will result in new and/or improved Highway Capacity Manual methodologies, the target audience includes transportation engineers and planner, freeway management personnel, and educators. Ultimately, the new and improved methods will lead to more accurate analyses of freeway systems and improved decision making with regard to limited transportation resources.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

- R. Thomas Chase, Institute for Transportation Research and Education (ITRE), North Carolina State University, 919-515-8625, rtechase@ncsu.edu
- Alexandra Kondyli, Ph.D., University of Kansas, 785-864-6521, akondyli@ku.edu
- James Colyar, Federal Highway Administration, 360-753-9408, james.colyar@dot.gov

X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of
the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. SUBMITTED BY

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NCHRP Review of C-05

Reviewed By:
B. Ray Derr
rderr@nas.edu

Comments:

The proposed research is appropriate for the NCHRP and the expected benefit is high.

As noted in the problem statement, the current methodology was developed 25 years ago. The proposed research can take advantage of new availability of data to develop improved techniques for these fundamental freeway features.

The Highway Capacity Manual continues to be the primary analysis tool for planning and design and new techniques would find immediate use. It is also the only practical analysis tool for predicting travel time reliability. Improved techniques for metered ramps could be incorporated into ramp meter system control algorithms.

In addition to being consistent with the new weaving methodologies, the research should support the corridor analysis work being done in NCHRP 15-57, Highway Capacity Manual Methodologies for Corridors Involving Freeways and Surface Streets.
Submitter Response for 2019-C-05
Highway Capacity Manual Methodologies for Analyzing Freeway Merging and Diverging Bottlenecks Considering Different Geometric Characteristics and Mitigation Strategies

From: bill.knowles@txdot.gov
Comments: Concur with reviewer comments
Contact Info: bill.knowles@txdot.gov
Mobile: 512.517.6404

Review Date: December 18, 2017

Bill Knowles, P.E.
State Traffic Analysis Engineer
Transportation Planning and Programming Division
Texas Department of Transportation
Mobile: 512.517.6404
I. PROBLEM NUMBER

2019-C-06

II. PROBLEM TITLE

Strategic Plan Development for Improvement of Roadside Safety Computer Simulation

III. RESEARCH PROBLEM STATEMENT

Computer modeling has made significant progress in helping transportation agencies cost-effectively develop crashworthy hardware. However, there are knowledge gaps that limit the usefulness of computer model.

It is difficult for transportation agencies to decide what improvements are needed for computer modeling of roadside safety. It is also difficult for transportation agencies to decide what research into computer modeling of roadside safety has the highest priority. This is because most computer modeling is done by third parties (e.g., crash test facilities, researchers, hardware developers…) and not within the transportation agency.

Developing a strategic plan for computer modeling of roadside design issues could help transportation agencies prioritize research efforts to improve computer modeling abilities. A strategic plan would lead to faster and more cost-effective improvement of roadside safety hardware and practices.

IV. LITERATURE SEARCH SUMMARY

Some of the known areas for improvement of computer simulation related to roadside safety include:

- Lack of MASH vehicle models that correlate directly with primary test vehicles because of age of vehicle models make and model of available vehicle models;
- Modeling suspension, wheel, and tire behavior under crash loading and part failure is critical for predicting accurate interaction between vehicles and roadside hardware;
- Improvements to soil-post interaction would help properly model guardrail, thrie beam, and other similar systems;
- Improvements to soil-post interaction would help simulation of barriers on slopes and the influence of soil variation on barrier behavior;
- Improvements to modeling of steel fracture will improve modeling of guardrail, thrie beam, and similar systems;

V. RESEARCH OBJECTIVE

The research team will collect a list of known areas where computer modeling can be improved. This list will then get prioritized by the research team, panel members, Technical Committee on Roadside Safety, and AFB20(1) Computation Mechanics Subcommittee. Priority will be given to projects that will likely generate the most improvement to roadside safety.

The final step of the research is to develop a strategic plan to complete this work. The strategic plan is to include project priorities, problem statement, literature search, estimated schedule, estimated costs, benefits to highway agencies, and how research would be implemented.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$200,000
VII. URGENCY AND POTENTIAL BENEFITS
Every year transportation agencies are asked to do more with less. They are also asked to do work faster. Improvements to computer modeling will help transportation agencies improve roadside safety, and develop hardware faster. A strategic plan will prioritize what improvements to computer modeling are needed.

VIII. IMPLEMENTATION PLANNING
Target groups for this research are AASHTO Technical Committee on Roadside Design, AFB20(1) Computation Mechanics Subcommittee, and researchers in the field of roadside design. Improvement to computer modeling will aid in developing roadside hardware, and other improvements in roadside design.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. SUBMITTED BY

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NCHRP Review of C-06
Comments:

The problem statement is potentially solvable through research and has a reasonable clear objective. The scope of the research and research period is reasonable; however, I am concerned the budget may be too low, given all of the simulation scenarios and varying computer modeling tools. A budget of $300,000 may be more adequate under the research objective considering additional potential coordinated enhancements to the Roadside Safety Analysis Program also, that many states use or their consultants. The research results may also potentially address ongoing updates for AASHTO MASH and RDG publications in consideration of the various task force and committee strategic plans.

Review Date:
11/30/2017

FHWA Evaluation of C-06

FHWA RwD Team - Good problem statement.

Submitter Response for 2019-C-06
Strategic Plan Development for Improvement of Roadside Safety Computer Simulation

From: [email: erik.emerson@wi.gov]

Comments:

The proposed research does not include the actual modeling. It is the development of the strategic plan. The subsequent rounds of research based on the strategy will likely need to do computer work.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-C-07

II. PROBLEM TITLE

Developing Endurance Characterization Curves for GFRP Reinforcing Bars

III. RESEARCH PROBLEM STATEMENT

Expanding the AASHTO LRFD Bridge Design Guide Specifications for GFRP-Reinforced Concrete Bridge Decks and Traffic Railings (BDGS for GFRP) to include all reinforced concrete members will require developing endurance limits that meets the AASHTO design needs. Also, BDGS for GFRP identifies areas where further work is needed. These areas include the creep rupture due to sustained tension load. This project should identify the appropriate endurance limits that would match the AASHTO LRFD Bridge Design Specifications reliability.

The currently proposed ASTM specification prepared under Subcommittee D30.10 does not provide tests methods or acceptance criteria for creep rupture or cyclic loading (fatigue). While there are standard test methods (ASTM D3479 for Fatigue properties; ASTM D7337 for Creep properties), the need for updated acceptance criteria remains outstanding. Also, ACI 440.1R-15 Guide for the Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer (FRP) Bars recommends maximum sustained tension limits and maximum fatigue stress of 0.2f_{tu} for GFRP reinforcement. This ACI limit was developed based on limited experience and early-generation GFRP bars. The new endurance design limit should be linked to a maximum time for creep and number of cycles for fatigue (e.g., a 125-year service life and 3 million cycles).

The current AASHTO LRFD Bridge Design Specifications is calibrated for a 75-year service life and a 2-million cycle fatigue threshold. However, GFRP is expected to lengthen and extend the service life, so a 125-year service life and 3 million cycles are more appropriate for GFRP specifications.

As part of the GFRP specifications, it is necessary for owners to require the manufacturers to certify, based on testing, that their product meets certain endurance limits. However, it is impractical to require each manufacturer to develop their own endurance curves. Therefore, new industrywide endurance limit characterization curves would allow manufacturers to assure that a product meets the endurance limits through simple short duration verification testing.

This research project meets the AASHTO SCOBS Strategic Plan objectives:

1- Extend Bridge Service Life,
3- Maintain and Enhance the AASHTO Specifications, and
6- Optimize Structural Systems.

IV. LITERATURE SEARCH SUMMARY

The literature search did not provide sufficient information to indicate definite endurance limits for GFRP bars. Existing research points toward fatigue and creep rupture information specific to materials and environmental conditions and largely related to aerospace and marine applications.

V. RESEARCH OBJECTIVE
The objective of this research is to develop endurance limits that would meet the AASHTO LRFD Bridge Design Specifications reliability requirements. This work should include developing the applicable resistance factors. This work would involve the following tasks:

1. Literature search of test methods and accelerated testing.
2. Develop testing procedures for both the creep rupture and fatigue.
3. Develop testing program to produce the endurance characterization curves.
4. Perform the testing.
5. Review and analyze test results.

The testing and recommended results should cover products from multiple manufacturers.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Type of Research

This work involves research, analytical work, and physical testing.

Recommended Funding:
$400,000

(Note: This estimate may be changed by the AASHTO Standing Committee on Research.)

Research Period:
36 months

(Note: This estimate may be changed by the AASHTO Standing Committee on Research.)

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

Developing endurance limits would facilitate the development and implementation of more efficient and effective GFRP reinforced concrete specifications. This research statement is supported by numerous states DOT but was late to AASHTO SCOBS.

VIII. IMPLEMENTATION PLANNING

This research will result in enhancement to the specifications that will be implemented in the AASHTO LRFD Bridge Design Guide Specifications for GFRP-Reinforced Concrete Bridge Decks and Traffic Railings -2009. This specification is being updated to include other reinforced concrete members.

IX. PERSON(S) DEVELOPING THE PROBLEM

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Jim Gutierrez, PhD, P.E.
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X. PROBLEM MONITOR

TBD

XI. SUBMITTED BY

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NCHRP Review of C-07
The problem statement is well written, and the research objective is well-defined. GFRP is expected to lengthen and extend the service life of bridge decks. Therefore, the return on investment of this research is expected to be very high. The problem is suitable for funding in the FY 2019 NCHRP.

__________________________

FHWA Evaluation of C-07

Ben Graybeal/HRDI-40 - The greater use of non-corrosive reinforcements including GFRP in concrete structures would be advantageous, but this would require better understanding of the bar limit states. This study could begin to address the issue; however, it is not clear that the all GFRP bars would perform the same and thus is it not clear that a study assessing a suite of proprietary bars would actually provide a fully useful solution.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

Rank 4 (Committee on Materials)

I. PROBLEM NUMBER

2019-C-08

II. PROBLEM TITLE

“Defining Geotechnical Test and Performance Data for Asset Management and Accelerated Design Benefits”

III. RESEARCH PROBLEM STATEMENT

Geotechnical design, construction and performance monitoring are intimately tied to the collection, interpretation and delivery of geotechnical data. Unfortunately, data is often provided in an informational format that limits operational efficiencies and its future usefulness. Examples of "informational" include reports in PDF or Excel, etc. formats that cannot be readily transferred or applied for new interpretation without manual manipulation (cut and paste). In addition, little to no metadata is conveyed to identify the type, source and reliability of the data.

Access to historic data saves money and time for agencies by reducing the amount of new data required. Time and money is also saved when operational efficiencies are optimized through automation using standardized data structure. Further, the collation of consistently formatted and comparable data across regions will improve design efforts and establish performance expectations, practical measures and aid overall asset management.

Clear definition of data structures for transfer and storage is necessary for consistent, complete data independent of interpretation.

IV. LITERATURE SEARCH SUMMARY

In 2006, a consortium of organizations, including Ohio DOT and FHWA, initiated the Data Interchange for Geotechnical and Geoenvironmental Specialists (DIGGS) standardized schema, which was later revised as DIGGS V2.0 through Ohio DOT funding and in coordination with the Geo-Institute of ASCE. With these efforts complete, the Geo-Institute of ASCE now begins to administer an open-source data structure ready for practice. Currently, geotechnical and geologic test elements have been defined. As a result of limited resources, elements such as geoenvironmental, foundation installation and load testing have been provisionally removed from this system to expedite proof of function. Completion of the existing system and defining elements for subsequent development of the system to meet the needs of transportation agencies will require this funded effort.

V. RESEARCH OBJECTIVE
The research will develop industry consensus to expand the data dictionary for soil mechanics, structure installation, ground improvement, instrumentation, and potentially performance data sets based on industry needs. Further, this effort will ensure data structures are consistent with existing standards including ASTM, AASHTO testing procedures. Engaging industry interest groups will further ensure a complete and robust object structure for the benefit of transportation assets. The extent of the dictionary test features will be dependent on resources available but may include additional items described in the tasks.

Tasks:

1. **Soil Properties**: Density, moisture content and gradation to shear strength, unsaturated behavior, cyclic performance, compressibility, etc. There are approximately 45 tests included in the DIGGS Schema that require final vetting.

2. **Structure Installation**: Pile, drilled shaft installation, shallow foundation construction, grouting and ground improvement beneath structures and embankments, wall construction. Recent work on large diameter pipe piles, DTFH61-14-C-00036, reviewed and update the schema for pile load tests and demonstrates the value of data compilation and would serve as a baseline for this effort related to deep foundation load testing.

3. **Performance**: Long term management of assets will be dictated by their performance indicators. There is ongoing research to define key metrics of performance. As these indicators are defined (by others), they will be incorporated into the same data structure so that inter related evaluation of an asset can consider the full lifecycle of the structure and its components.

The deliverable for this work would be the online data dictionary. Although the goal will be to have a robust dictionary defined, the open source system would allow future expansion if required.

VI. **ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD**

**Recommended Funding**: $200,000-$300,000

(Note: The level of funded provided may be raised or lowered by the AASHTO Standing Committee on Research if and when the problem statement is selected)

**Research Period**:

The project will be completed in twenty-four (24) months.

VII. **URGENCY AND POTENTIAL BENEFITS**

Availability of usable data is critical to our ability to make future interpretations, manage existing features or assets, and accelerate future project delivery. Efficient collection, transfer, storage
and retrieval of data for design, construction and asset management will save substantial time and money.

Without clear definition of data structure needs, ongoing and future geotechnical and asset management research may produce incomplete data sets and require repeated effort on subsequent projects or be of limited value to DOTs.

This study is supported and relevant to • Minnesota DOT • Ohio DOT • Missouri DOT • Louisiana DOTD • Louisiana Transportation Research Center • North Carolina DOT • New Hampshire DOT • Colorado DOT

VIII. IMPLEMENTATION PLANNING

Implementation simply requires the data standardized structure to be used as standard practice, and can be achieved through requirements within guidance manuals and standards developed by FHWA and AASHTO, respectively. Maintenance and updating these data structures as required would be managed by the Geo-Institute of ASCE and vetted as needed by AASHTO subcommittees for adoption.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

Ohio DOT, A and North Carolina DOT

Sponsoring Committees:
AFP10, Engineering Geology; AFP20, Exploration and Classification of Earth Materials; AFS30, Foundations of Bridges and Other Structures

XI. SUBMITTED BY

Christopher Merklin, P.E.,
Geotechnical Engineer
Ohio Department of Transportation
(614) 275-1361
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NCHRP Review of C-08
Reviewed By:
Andrew C. Lemer
alemer@nas.edu

Comments: The management and retrieval of geotechnical data is an important part of the larger issue of storing and providing access to project development information to inform transportation system management decision-making. The subject matter of this problem statement is in that sense appropriate for NCHRP and, with a well framed research objective, likely to yield useful results. However, developing industry consensus cannot be achieved within the context of the research project. Even if substantial efforts to engage industry interest groups are excluded, the recommended funding may not be adequate to deliver a well-designed online geotechnical data dictionary likely to meet the needs of multimodal transportation agencies.

Review Date:
11/22/2017

FHWA Evaluation of C-08

Mike Adams/HRDI-10 - The proposed project aims to expand upon DIGGS V2.0 to include additional information on geotechnical structural features and their associated performance metrics. This would help promote the consistent collection of data for geotechnical applications and ensure complete files for a project for repeated data use. It's a worthy effort, but the implementation planning in the problem statement should be further developed to justify the project considering DIGGS still needs to take roots. Silas Nichols/HIBS-20 - The development of DIGGS has been widely supported by FHWA, industry, and a DOT pooled fund study. The management and communication of data as an asset is a necessary step for more cost effective and safer engineering solutions. The development of broad data dictionarys to standardize how data will be stored and communicated is essential. This effort supports that and should be pursued by NCHRP.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

“This problem statement is the 3rd ranked design priority by the AASHTO Subcommittee on Design”

I. PROBLEM NUMBER

2019-C-09

II. PROBLEM TITLE

An update of the Green Book design vehicles and minimum turning paths.

III. RESEARCH PROBLEM STATEMENT

The current Green Book design vehicle classifications have been developed over a 40+ year period. These design vehicle dimensions and minimum turning radii, while providing full coverage of the general vehicle fleet, are difficult to support and verify. This difficulty is a result of the limited or nonexistent supporting data and research for these vehicles.

Questions have been raised about the steering angles for some of the Green Book design vehicles which appear small for the modern vehicle e.g., 13 degree steering angle for the WB-92D and WB-109D. This can result in overly conservative or large geometric layouts and striping plans. Further, with the increased usage of modern roundabout designs, accurate vehicle steering angles and swept paths are of utmost importance.

The Technical Committee on Geometric Design (TCGD) recently received pre-ballot review comments on the Green Book, 7th Edition, from members of the AASHTO Subcommittee on Design. Comments related to the Green Book Design vehicles include:

- Minimum Inside Radius for WB-67 (WB-20 Metric) is not consistent with older versions of Green Book; please verify.
- Why is the CTR of the WB-92D design vehicle so much larger than the WB-109D? The different radii make a huge difference when laying out turn templates. Is one more common than the other?
- Why is the CTR of the WB-109D vehicle so much shorter than the WB-92D? The WB109D has longer trailers but can turn much tighter than the WB-92D? The different radii make a huge difference when laying out turn templates. Is one more common than the other?

The TCGD response to each of these questions was that further research would be needed on these issues and that the need for future revisions will be taken under advisement for the 8th edition of the Green Book.

The Green Book turning path templates provide insufficient data for software developers, such as AutoTURN, to incorporate the turning paths in CAD programs without making assumptions such as the kingpin and hitch locations. As such, the CAD programs provide similar but different turning paths than the Green Book templates. Further, with industry movement towards 3D design, ground clearances or heights of the various design vehicles are needed but not provided by the Green Book.
The proposed research directly supports the Standing Committee on Highways (SCOH) Resolution, passed May 25, 2016 in Des Moines, Iowa, regarding the direction on Flexibility in Design Standards. Specifically, the **SCOH resolution** included the following elements:

**RESOLVED**, AASHTO should provide guidance to state DOTs and other users of the Green Book regarding flexibility in design; and be it further

**RESOLVED**, This guidance should follow the AASHTO model of being research-based and peer-reviewed; and be it further

**RESOLVED**, This guidance should address designing in and for a multi-modal transportation system; and be it further

**RESOLVED**, SCOD should identify gaps in necessary research and develop a plan to fill those gaps.

### IV. LITERATURE SEARCH SUMMARY

Some similar research in this area is as follows:


- **Effects of Turns by Larger Trucks at Urban Intersections**, Transportation Research Record 1195, Joseph Hummer, Charles Zeeger, and Fred Hanscom for the FHWA office of Safety and Traffic Operations Research and Development, 1988  

- **Austroads Design Vehicles and Turning Path Templates**  

- **NAASRA Design Vehicles and Turning Templates**  
  [http://114.111.144.247/Presto/content/Detail.aspx?ctID=NmQ5ZmY0YWQtNTc4NS00YzZiLTk3MTItNjEzYWQxZTgyMTRl&rID=MTM2Mw==&qcf=&ph=VHJ1ZQ==&bckToL=VHJ1ZQ==&](http://114.111.144.247/Presto/content/Detail.aspx?ctID=NmQ5ZmY0YWQtNTc4NS00YzZiLTk3MTItNjEzYWQxZTgyMTRl&rID=MTM2Mw==&qcf=&ph=VHJ1ZQ==&bckToL=VHJ1ZQ==&)

### V. RESEARCH OBJECTIVE

This research will ensure the design vehicle classes represent the vehicles on our roads including the elimination of any inconsistent and unrealistic vehicle characteristics. The research should provide guidance of the use, application or general conservativeness of the templates.

The research will provide missing design vehicle information required for 3D design applications.

### VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**
Total funds requested is $400,000.

**Research Period:**

The research deliverables shall be within 30 months of the NCHRP Project panel kickoff meeting.

**VII. URGENCY AND POTENTIAL BENEFITS**

The research is needed immediately to fill a gap in current design vehicle data.

**VIII. IMPLEMENTATION PLANNING**

The research recommendations are needed by the AASHTO Technical Committee on Geometric Design for the 8th edition of the Green Book. An update of the design vehicles will be used in the design of rural and urban intersections nationwide.

**IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT**

Provide name, title, organization, telephone number, and email address.

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**X. AASHTO MONITOR**

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement.

**XI. SUBMITTED BY**

Submitted By:

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**NCHRP Review of C-09**

Reviewed By:
B. Ray Derr
rderr@nas.edu

Comments:
The proposed research is appropriate for the NCHRP, addresses questions raised by state DOTs during recent balloting of the Green Book, and the expected value is high. The products of the research are clear and would help designers using the Green Book and AutoTURN. The proposed research has a high probability of success.

Review Date: 11/17/2017

FHWA Evaluation of C-09

John McAvoy/HIPA-20 - Will this study also research the turning radii of any proposed new autonomous vehicles? FHWA Intersections Team - Some Software vendors have done a lot of work in this area as a result of deployment of innovative intersection designs. This research should somehow try to incorporate that good work from industry. Would like to see more information shared about the nuances of using tools. Any thoughts on vehicles other than the "design" vehicle in terms of language in the GB? Accommodation of certain types of vehicles that may not be the "design" vehicles often are just as important for a successful design (i.e. school bus, fire truck, OSOW)? The vertical clearance of the design vehicles can be just as critical as we look at intersection grades, cross slopes, curbing (mountable and non-mountable).

AASHTO Committee Evaluation for C-09

An update of the Green Book Design Vehicles and Minimum Turning Paths

Submitted By: Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments: Committee on Design – This proposal ranked #3 out of 6 submitted this year. The research will update 40+ year old turning templates to today's fleet, and provide additional information for consistent 3D modeling of the vehicles and turning paths. Concerns were noted late during review of the AASHTO Green Book 7th Edition. It is vital that this research begin now to be included in the 8th Edition.
I. PROBLEM NUMBER
2019-C-10

II. PROBLEM TITLE
Determination of Encroachment Conditions in Work Zones

III. STATEMENT OF THE RESEARCH PROBLEM

There were 96,626 crashes in work zones in 2015. This equates to one work zone crash every 5.4 minutes. Every day, 70 work zone crashes occurred that resulted in at least one injury, and every week, 12 work zone crashes occurred that resulted in at least one fatality. Previous research regarding work zone encroachments has also indicated that there is a higher frequency of fatalities in work zone crashes than non-work zone crashes. Thus, work zones may be an area where significant safety improvements can be made.

NCHRP Report No. 350 and AASHTO MASH recommend that work zone hardware be tested under the same criteria as permanent barrier systems. Therefore, in order to be used on high speed facilities, work zone barriers are tested under the Test Level 3 (TL-3) criteria which involve a pickup truck vehicle impacting the barrier at a speed of 62.1 mph and at an angle of 25 degrees. When subjected to such an extreme impact, most work zone barrier systems have produced large lateral deflections, high vehicle climb, and high roll angles. Most pin and loop portable concrete barrier systems have deflected more than 1200 mm (4 ft) when subjected to the TL-3 testing criteria. However, it is generally accepted that the TL-3 strength test with a pickup truck represents an extreme impact severity that is infrequently encountered in real world crashes. The use of these theoretically extreme impact conditions forces designers to accommodate large barrier deflections and use potentially over-robust barrier systems that increase cost and complexity in the work zone.

The impact conditions specified in NCHRP Report No. 350 and MASH were derived from encroachment data collected on freeways. However, it has been suggested that the reduced speeds and narrow lane and shoulder widths typically found in work zones may reduce the speed and angle distribution for work zone crashes. If the severity of impact conditions in work zones was found to be lower than that non-work zone crashes, the potential exists to utilize that data to develop more efficient work zone areas and barrier designs. Conversely, if work zone encroachments could be shown to occur at very different impact conditions than previously assumed, work zone and barrier design could be adjusted to address those conditions. Thus, a need exists to determine vehicle encroachment data specific to work zones in order improve safety in work zones.

IV. LITERATURE SEARCH SUMMARY

Encroachment characteristics describe “real-world” impact conditions from vehicle crash data. This data is useful for many reasons. It provides a better understanding of actual impact conditions and allows designs to better select and apply roadside safety hardware, it helps hardware practitioners better design the hardware to meet the majority of the crashes, and it provides for selection of representative testing guidelines for road hardware. Selection of testing guidelines has traditionally followed a philosophy of the worst practical case impact which has been defined as the 85 percentile impact speed and angle.
As noted previously, impact conditions for the design and evaluation of safety barriers and other hardware have been developed based on encroachment data taken from freeways through reconstruction of crashes or analysis of vehicle departures from the roadway. While these methods likely yield a valid picture of vehicle behavior on freeways, it is unclear if that data is valid for work zone areas where traffic speeds and road geometries are more restricted.

There have been many studies of work zone encroachments in the past. These include the studies by CALTRANS (1972), Hargroves (1982), Nemeth and Migletz (Ohio, 1978), Hall and Lorenz (New Mexico, 1998), Garber and Zhou (Virginia, 2002), and Daniel, Dixon, and Jared (Georgia, 2000). The study performed by CALTRANS recorded crashes before work zone placement and during work zone placement for 10 random projects. The results of the study found that the crash rate increased 21.4 percent, the injury rate increased 21.1 percent, and fatal crashes increased 132 percent. The other studies conducted similar analyses and found similar increases in the crash rate and noted that the proportion of fatal crashes stayed nearly the same or increased.

However, none of the work zone encroachment studies involved crash reconstruction in order to determine the speed and angle of the encroachments. Thus, the studies assumed crash speed and angle data were similar to general roadway crash data. This assumption goes against conventional wisdom of the roadside safety community where it has been generally believed that the speed and angle of work zone crashes are lower than non-work zone crashes. This is based on the idea that work zones have lower speeds and a narrower roadway than the typical highway they are installed on. However, no statistical evidence of this has even been demonstrated. Thus, we observe a higher frequency of fatalities in work zone crashes, but we do not fully understand the characteristics of these crashes. A need exists to further study work zone encroachment characteristics in order to better design the work zone to improve safety for the travelling public and workers.

V. RESEARCH OBJECTIVE

The objective of this research program will be to determine encroachment conditions associated with work zone crashes, including speed, angle, and vehicle mass, and determine if they are consistent with those previously determined for freeways. It is anticipated that the research effort to meet this objective would encompass the following tasks.

1. Review existing literature on encroachments and work zones crashes.
2. Review states practices in work zones and include speed reductions, separation of traffic, barrier use, temporary geometrics, etc. through work zones that could correlate to the encroachments.
3. Analyze encroachment data collected.
4. Review methods to collect encroachment data or if engineering analysis could be used to analyze data collection.
5. Develop a data collection plan for work zone encroachments taking into account that most work zones are reset as soon as possible by field staff after a crash event.
6. Provide analysis of work zone encroachment conditions and recommendations for future research.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $500,000

**Research Period:** 36 months
VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

Current data on work zone crashes suggests that work zones are higher risk for crashes and fatal injuries, but accurate data on the impact conditions associated with work zone crashes does not exist. Development of accurate encroachment data for work zones would indicate areas for improvement in the design of work zone and the safety barriers used therein and raise the level of safety in work zones for the travelling public and workers. Furthermore, if encroachments for work zones are significantly different than non-work zones, designers could balance temporary features and cost in work zones against use of higher cost features to provide the best use of state funds.

The AASHTO Technical Committee on Roadside Safety, under the Committee on Design, rates this research need 5 out of 5 submitted for consideration for Fiscal Year 2019 funding. The Committee on Design rates this 6 of 6 research problem statements submitted.

VIII. PERSON(S) DEVELOPING THE PROBLEM

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IX. PROBLEM MONITOR

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X. DATE AND SUBMITTED BY

September 14, 2017
NCHRP Review of C-10

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:
The problem statement is potentially solvable through research and has a clear objective; and is also ranked 5th of TCRS’ five top priorities. The scope of the research and research period is reasonable. The research results may also address ongoing updates for AASHTO MASH and RDG publications in consideration of the various task force and committee strategic plans.

Review Date:
11/30/2017

AASHTO Committee Evaluation for C-10

Determination of Encroachment Conditions in Work Zones

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – This proposal ranked #6 out of 6 submitted this year. The research will evaluate encroachment conditions in Work Zones to include roadway system, speed, angle, and vehicle mass. Current data on work zone crashes suggests that work zones are higher risk for crashes and fatal injuries, but accurate data on the impact conditions associated with work zone crashes does not exist. Development of accurate encroachment data for work zones would identify areas for improvement in the design of work zone, layout of work zone safety barriers, and improve work zones for the travelling public and workers.
Determination of Encroachment Conditions in Work Zones

From: [email: Keith.Cota@dot.nh.gov]

Comments: TCRS appreciates the opportunity to submit comments on its fifth priority for research proposal in 2019. As within non-work zones, encroachment data is critical in determination of worst case run-of-road events and aids in the development of worst case crash test criteria's as outlined in MASH. In work zones, this provides a unique operational condition different than non-work zones due to reduced shoulders, narrower lane widths, lower operating speeds and other restrictions that can affect work zone encroachments. With this understanding, TCRS will be able to determine whether updates to MASH crash performance criteria should be considered for work zones or whether current criteria remain valid in MASH. The knowledge gained under this study will allow for a comparison of encroachments of work zones and non-work zones, and allow for improved understanding of operational performance for work zones within the RDG. TCRS looks forward to a favorable acceptance for the evaluation of work zone encroachments.

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Review Date: December 19, 2017
II. PROBLEM TITLE

Development of a Barrier Design to Accommodate Vehicles, Pedestrians, and Cyclists

III. RESEARCH PROBLEM STATEMENT

There is an urgent need to foster the development, operation and maintenance of an integrated national transportation system, which gives consideration to the presence and safety of non-motorized users. As the number of non-motorized users continues to grow within the US, crashes between motorists and non-motorized users continue to grow as well. Based on National Highway Traffic Safety Administration (NHTSA) data from 2015, 5,376 pedestrians and 818 bicyclists were killed in crashes with motor vehicles. These two modes accounted for 17.7 percent of the nation’s 35,092 total fatalities in 2015. Unfortunately, a large percentage of our nation’s roadways are not designed to safely accommodate non-motorized users. Thus, non-motorized users such as pedestrians and bicyclists are expected to jointly use facilities that have inadequate lateral offsets between the travel lanes and the non-motorized transportation facilities such as sidewalks and multi-use paths. On many of these facilities, ROW, fiscal, and/or geographical constraints prohibit transportation agencies from increasing this offset distance, which leaves agencies with the option of doing nothing or trying to fit some type of positive protection device in between the travel lanes and the non-motorized transportation facility. Currently, there are no positive barrier systems that have been designed specifically for the purpose of providing positive protection between non-motorized transportation facilities and motorized facilities.

There is a critical need to develop a new multi-functional barrier system complying with the specific requirements needed for the accommodation of vehicles, pedestrians and cyclists; one that is affordable from a constructability and installation standpoint; one that is appealing from an aesthetic perspective; one that takes into consideration adequate and proper sight distance, and one that is designed to safely contain and redirect direct hits from non-motorized users. The ultimate objective of this proposed research is to develop a barrier system that considers the safety of motorists, pedestrians, and bicycles while satisfying the Proposed Right-of-Way Accessibility Guidelines (PROWAG) and the American Association of State Highway Transportation Officials (AASHTO) Manual for Assessing Safety Hardware (MASH) Test Level 3 requirements.

IV. LITERATURE SEARCH SUMMARY
Back in late 1990s, with the passing of the Transportation Equity Act for the 21st Century (TEA-21), the Federal Highway Administration (FHWA) adopted a policy to create an integrated, intermodal transportation system that improves safety and accessibility for bicyclists and pedestrians and provides travelers with a real choice of transportation modes (Lewendon et al., 2004). According to the policy, all new and improved transportation facilities should be planned, designed, and constructed giving consideration to the presence and safety of non-motorized users.

Over the last few decades, AASHTO has worked towards accomplishing this goal by establishing committees that are looking at the safety from the perspective of non-motorized road users. Unfortunately, a discrepancy in recommended rail height originated from the different perspectives between bicycle facility designers and bridge designers. The AASHTO “Bridge Specifications” and “Guide for the Development of Bicycle Facilities” require a 54-inch and a 42-inch bicycle railing height on bridges, respectively (AASHTO, 1999; AASHTO, 1989). Later studies determined that there was no existing empirical data to support the selection of either height for bicycle railing and that structures constructed with 42-inch pedestrian railing height did not affect non-motorized user’s safety. The AASHTO Bridges and Structures Subcommittee, however, preferred maintaining the 54-inch railing height specification for railing placed on shared path bridge facilities to adequately protect the public.

Existing guidelines for the design of railing for bicyclists were reviewed as part of NCHRP 20-7 (168) project (Lewendon et. al., 2004). Within this project, the authors reported of known guidelines at the federal, international, state and local levels. The 1989 AASHTO “Standard Specifications for Highway Bridges” serves to help the designer with the proper bridge railing selection based on the type of traffic that is anticipated on the bridge (AASHTO, 1989). The guideline, however, does not include criteria outlining the choice of a specific railing type. It only recommends the installation of a combination railing when the need arises for protecting pedestrians and bicyclists. With the 2002 AASHTO “Standard Specifications for Highway Bridges”, specific requirements for railing height started being imposed (AASHTO, 2002). With this document, the AASHTO guidelines for 54-inch and 42-inch railing height became requirements when selecting barriers to protect non-motorized users. This document also required specific size limits in the openings between horizontal and vertical elements of a combination bridge rail system to prevent objects from falling or being pushed through the railing (AASHTO, 2002). Specific geometric requirements for design of guardrails and handrails are also reported by the American with Disability Act (ADA), which ensures access to the built environment for people with disabilities.

The NCHRP 20-7 (168) project also reviewed European and foreign guidelines for the adoption of bicycle railing heights (Lewendon et al., 2004). As a result of this review, it was reported that foreign Countries have different guidelines for bicycle railing heights, which span from 47 inches in Denmark to 59 inches for bridge locations in England.

Based on their extensive literature review and outreach results, the NCHRP 20-7 (168) study recommended a minimum bicycle railing height of 48 inches in locations where bicyclists need to be protected from severe hazards. This bicycle railing height has been recommended in other instances when the edge of the travel lane is laterally offset less than 5 feet from the edge of the non-motorized facility in order to prevent bicyclists from falling over the railing and into the path of oncoming traffic.
There are a variety of research studies currently in development to address unresolved questions regarding geometric and safety requirements for multi-modal facilities. These studies, however, are more targeted to either propose updates on existing AASHTO guidelines from a geometric perspective, or to investigate planning, design, and operational issues when considering pedestrian and bicyclists. No known research or testing studies currently involve the investigation of pedestrians and bicyclists’ safety through a much needed development of a roadside barrier design that safely accommodates vehicles and non-motorized users on a multi-modal facility.

V. RESEARCH OBJECTIVE

This project would seek to investigate the geometric and design requirements needed to develop and appropriately evaluate a multi-functional barrier system that safely accommodates motorists, pedestrians and cyclists on roadways that serve multiple modes of transportation. The following tasks are proposed:

a. Conduct a literature review of documented national and international research regarding the investigation and adoption of bicycle and pedestrian rail heights;
b. Survey State Department of Transportation personnel and international transportation agencies to determine current practices, as well as related needs and concerns regarding combination railing systems;
c. Determine available relevant crash data sources to complement needed information;
d. Develop a guardrail system design to accommodate motorists, pedestrians, and cyclists;
e. Construct, full-scale crash test and evaluate the proposed system to MASH Test Level 3 requirements;
f. Develop criteria for placement and use of an appropriate combination traffic-pedestrian - bicycle railing height;
g. Suggest proper aesthetically pleasant system terminal option(s) for design and evaluation in future study.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $500,000

Research Period: 2 years

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

At locations where proper lateral offset cannot be provided due to Right-of-Way limitations or other constraints, a positive protection device is needed to protect bicyclists and pedestrians from motorized vehicles. A combination traffic-pedestrian-bicycle concrete barrier rail is currently the only option available for this purpose. From a cost-benefit perspective, however, a concrete combination barrier does not represent a viable solution, given the high construction and installation costs.

There is an urgent need to design a new multi-functional guardrail system complying with the specific requirements needed for the accommodation of vehicles, pedestrians and cyclists, while satisfying PROWAG and MASH Test Level 3 requirements. This project will provide the opportunity to investigate the needed geometric and design requirements necessary in the
development and evaluation of a barrier system that accommodates multimodal accessibility. The intended result of this research project would be to deliver a new cost-effective roadside barrier system that is designed to safely accommodate motorized and non-motorized users.

The AASHTO Technical Committee on Roadside Safety, under the Committee on Design, rates this research need 4 out of 5 submitted for consideration for Fiscal Year 2019 funding. The Committee on Design rates this 5 of 6 research problem statements submitted.

VIII. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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IX. PROBLEM MONITOR

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X. DATE AND SUBMITTED BY

September 15, 2017

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REFERENCES


NCHRP Review of C-11

Reviewed By:  
Mark S. Bush  
mbush@nas.edu

Comments:  
The problem statement is potentially solvable through research and has a reasonable clear objective; and is also ranked 4th of AASHTO Technical Cmte on Roadside Safety five top priorities. The scope of the research and research period is reasonable. The research results may also address ongoing updates for AASHTO MASH and RDG publications in consideration of the various task force and committee strategic plans.

Review Date:  
11/30/2017
FHWA Evaluation of C-11

FHWA RwD Team - This seems more like a project for one of the pooled fund studies. Ped-Bike Team - $500,000 seems like a lot of money to conduct the mentioned research. One of the goals of the project should be a revision of the AASHTO/ITE standards. Gary Jensen/HEPH-30; Dan Goodman/HEPH-10 - We recommend incorporating security considerations into the discussion of barrier design issues/context given recent events. Note that barriers are one element of connected pedestrian and bicycle networks; however, the underlying issue may be motor vehicle speed, and it will never be possible to fully separate all interactions. The problem statement seems overly focused on bridge rail research and the establishment of a singular guardrail approach. The final result of the study shouldn't be to "develop and appropriately evaluate a [singular] multi-functional barrier system," and the need to "construct, full-scale crash test and evaluate the proposed system to MASH Test Level 3 requirements" should not be predetermined. Rather, it would be preferable to evaluate literature and crash data, reconcile what various documents - including the updated AASHTO Bike Guide - say about barrier height/design, assess existing options for barriers, and ultimately develop criteria and a decision support tool to help practitioners select the best barrier design given project context.

AASHTO Committee Evaluation for C-11

Development of a Barrier Design to Accommodate Vehicles, Pedestrians, and Cyclists

Submitted By:
Pamela Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – This proposal ranked #5 out of 6 submitted this year. The objectives of the research project would be to deliver a new cost-effective roadside barrier system that is designed to safely accommodate motorized and non-motorized users for incorporation into a future update of the Roadside Design Guide. This will increase safety for vehicles, pedestrians, and bicyclists in some multimodal environments.

Submitter Response for 2019-C-11

Development of a Barrier Design to Accommodate Vehicles, Pedestrians, and Cyclists

From: [email: Keith.Cota@dot.nh.gov]

Comments: TCRS appreciates the opportunity to submit comments on its fourth priority for research proposal in 2019. The need to evaluated cost-effective barrier systems to accommodate non-motorized users continues to be need for the RDG practitioners. As noted by FHWA through their review of the problem statement, the emphasis on past evaluation for pedestrian and bicycles has been on bridge railing (with focus on barrier height). While this application on bridges are critical due to potential vertical drop offs, the application and needs along the longitudinal roadway remains unanswered. In accordance with FHWA guidance, any modifications made to MASH crash tested longitudinal roadside barriers (which
may be recommended under this study) will required crash performance evaluation to ensure the modified system will continue to meet crash performance under MASH. The end result of this research will extend the knowledge beyond bridge rails, provide RDG users the opportunity to address priority facilities with high non-motorized users, and allow for updates to other AASHTO guides for non-motorized users. TCRS looks forward to a favorable acceptance for the development of applications non-motorized users with longitudinal roadside barriers.

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Review Date: December 19, 2017
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline


I. PROBLEM NUMBER

2019-C-12

II. PROBLEM TITLE

Development of MASH TL-3 Deflection Reduction Guidance for 31-inch Guardrail

III. RESEARCH PROBLEM STATEMENT

With the design and installation of guardrail systems, there routinely exist needs to provide a stiffening mechanism to reduce the lateral deflection distance behind these systems, for example when concrete bridge piers are located near roadway shoulders. Various means of providing reduced deflections have been made with past systems that have included nesting of guardrail and the reduction of guardrail post spacing. With the recent adoption of the American Association of State Highway and Transportation Officials (AASHTO) Manual for Assessing Safety Hardware (MASH), there is currently little to no guidance on the use of MASH compliant guardrail installations that reduce these types of deflections within Midwest Guardrail Systems (MGS) and their necessary transitions. Thus, a need exists to provide guidance for the use of MASH compliant guardrail installations that provide a safe transition to a stiffening mechanism which will reduce the deflection distances behind guardrail while maintaining the integrity and safety performance of the MGS. This research will continue the development of guidance for the design and installation of reduced deflection guardrail systems which are MASH compliant.

IV. LITERATURE SEARCH SUMMARY

A similar project, Research Report No. TRP-03-139-04, evaluated guardrail stiffening and provided guidance for guardrail placement for W-beam guardrail using full, half and quarter post spacing designs for shielding rigid obstacles. This project evaluated and developed guardrail systems according to the TL-3 safety performance criteria in National Cooperative Highway Research Program (NCHRP) Report No. 350. Although this project may have been similar in nature, the tests were performed using the NCHRP testing criteria and not MASH criteria, which has been adopted by the Federal Highway Administration as the industry standard. Another main difference is that the study that documented reducing deflection behind a guardrail system was limited to the minimizing post spacing and did not discuss other options such as the use of double nesting and the necessary guardrail transitions for these applications.

V. RESEARCH OBJECTIVE

The objective of this research is to develop guidance for the use of MASH TL-3 compliant guardrail installations that provide a safe transition to a stiffening mechanism which will reduce the deflection distances behind guardrail while maintaining the integrity and safety performance of the MGS.

Proposed scope of project:

1) Determine potential stiffening mechanisms to reduce barrier deflection to desired levels.
2) Perform an analysis of those mechanisms to determine their performance and safety.

3) Perform full-scale testing of the proposed reduced deflection designs.

4) Research on the need for providing a transition to the mechanism within the guardrail system.

5) Provide a design of the transition.

6) Evaluate the transition through MASH TL-3 full-scale crash testing.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

It is recommended that $500,000 in funding is needed for this research.

Research Period:

It is estimated a 24 month research period be used for this project.

VII. URGENCY AND POTENTIAL BENEFITS

The proposed research was selected by the AASHTO Technical Committee for Roadside Safety (TCRS) as one of its top priority research projects in 2017 by its voting members. The potential value is to provide guidance on MASH compliant guardrail installations that is used by State DOT’s when minimum deflection is needed along guardrail systems. Use of reduced deflection guardrail may significantly reduce costs by preventing the need to garner additional space or move hazards within the working width of current guardrail designs.

The AASHTO Technical Committee on Roadside Safety, under the Committee on Design, rates this research need 2 out of 5 submitted for consideration for Fiscal Year 2019 funding. The Committee on Design rates this 2 of 6 research problem statements submitted.

VIII. IMPLEMENTATION PLANNING

The appropriate target for the research findings is the State DOT’s and localities (towns, cities, etc.). Design details and testing results will be distributed to roadside designers through journal papers, test reports and presentations given to AASHTO Task Force 13, the AASHTO Technical Committee on Roadside Design and the Transportation Research Board standing committee on Roadside Safety Design. Personnel within the various transportation agencies responsible for the development of roadside standards will be encouraged to adopt the new guidance and included in their own and the AASHTO Roadside Design Guide.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT
NCHRP Review of C-12

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:
The problem statement is potentially solvable through research and has a reasonable clear objective; and is also ranked 2nd of AASHTO Technical Cmte on Roadside Safety five top priorities. The scope of
the research, research period and budget is reasonable. The research results may also address ongoing updates for AASHTO MASH and RDG publications in consideration of the various task force and committee strategic plans. The priority objective is the development of updating MASH TL-3 compliant guardrail installations to reduce deflections. The focus is on 31 inch MGS and potentially improve AASHTO RDG guidance for practitioners.

Review Date: 11/30/2017

FHWA Evaluation of C-12

FHWA RwD Team - Good problem statement.

AASHTO Committee Evaluation for C-12

Development of MASH TL-3 Deflection Reduction Guidance for 31-inch Guardrail

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – This proposal ranked #2 out of 6 submitted this year. This research will develop approaches to stiffen MASH TL-3 compliant guardrail installations to reduce deflections. The focus of this research would address the 31 inch Midwest Guardrail Systems (MGS) and will improve guidance in the Roadside Design Guide for the practitioners.

Submitter Response for 2019-C-12

Development of MASH TL-3 Deflection Reduction Guidance for 31-inch Guardrail

From: [email: Keith.Cota@dot.nh.gov]

Comments: TCRS appreciates the opportunity to submit comments on its second priority for research in 2019. The intent of this research is to provide the RDG practitioner tools to consider means for reducing the deflection of MASH TL-3 guardrail with a focus on toward the new standard W-Beam Midwest Guardrail System (MGS). As a designer, there is a defined need to address real world applications that results in hazards being placed behind guardrail within close proximity roadside safety hardware. This project will provide critical guidance within the future update of the RDG. TCRS looks forward to a favorable acceptance for the development of applications for reducing deflections with the standard W-Beam guardrail.

Contact Info:
Keith A. Cota, Chairman
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

Comments: TCRS rating: 1 of 5. Committee on Design rating: 1 of 6

I. PROBLEM NUMBER
2019-C-13

II. PROBLEM TITLE
Guardrail Performance at Various Offsets from Curb for MASH TL-3 Applications

III. RESEARCH PROBLEM STATEMENT
Curb is used to control drainage, separate pedestrian facilities, limit right-of-way, provide access control, and limit erosion. However, the need for curbs often competes with guardrail installation. For example, a steep slope needs curb to control drainage and erosion. This steep slope may need shielding. If a pedestrian facility is near curb, guardrail will have to be further offset from the face of curb.

Typical solutions for curb placed near a guardrail, like using a sloped curb or reducing curb height can be difficult to use. Some examples of problems that can occur dropping the curb height or a sloping a curb may cause ADA problems (sight impaired pedestrian may unexpectedly enter a roadway). Shorter curbs may not have the hydraulic capacity needed

Most of the research on curb and guardrail used the older National Cooperative Highway Research Program (NCHRP) Report 350 testing criteria. AASHTO and FHWA’s joint MASH agreement requires the use of MASH evaluated hardware.

There has been some crash tests with a curb placed near guardrail. Many of these tests have failed due to guardrail rupture, barrier override, or vehicle instability. Traditionally crash testing has focused on the performance of pickup trucks striking guardrail with a nearby curb. Some recent crash testing has indicated that more research is needed on small cars hitting a guardrail near a curb.

Crash testing guardrail installed near a curb with pickup trucks has shown the difficulties in using just computer modeling to set beam guard placement recommendations.

IV. LITERATURE SEARCH SUMMARY
NCHRP Report 537: Recommended Guidelines for Curb and Curb–Barrier Installations, has a comprehensive summary of crash testing and computer modeling research up to 2005 [1]. The summary shows that guardrail has had problems when a curb is near. Computer modeling within NCHRP Report 537 suggested that curbs could be to guardrail under certain criteria. No crash testing was used to verify the report’s recommendations. NCHRP Report 537 did not examine how newer 31-inch tall beam guard designs would perform when curb was near or MASH testing criteria.

In 2009, the Midwest States Pooled Fund Crash Test Program researched MGS performance near 6-in. high curbs. The research began by conducting MASH 2009, TL-3 impacts into a 6-in. high AASHTO Type B curb to assess the vehicle’s trajectory [4-5]. The vehicle’s trajectory and computer modeling were used to create offset guidelines for MGS placed behind curb for TL-3 conditions.

The pooled fund also funded a pickup, TL-3, MASH crash test [6]. The truck was contained by the guardrail, but the truck rolled over soon after being redirected. The test was considered a failure.
The rollover was caused by front truck tire falling off the truck and wedging under the truck. This type of vehicle part failure is difficult to implement in computer modeling.

As a final phase of this study, a MASH, TL-2 crash test was performed with MGS installed 6 ft behind a 6-in. high, AASHTO Type B curb [16]. This test passed the crash test criteria.

MGS guardrail was successfully tested to NCHRP 350 TL-3 criteria with a pickup truck when a curb is adjacent to beam guard. No NCHRP 350 small car test were performed with MGS guardrail. No MASH crash testing has been conducted with MGS.

More recent research conducted with thrie beam approach guardrail transitions with curb [7] and testing of MGS with curb and a single omitted post (report in progress) were unsuccessful with a MASH TL-3 small car. In these tests, the small car wedged under the rail and caused rail rupture.

V. RESEARCH OBJECTIVE

This research will be to develop guidelines for the use of the 31-in. MGS adjacent to curbs under MASH TL-3 impact conditions. The research will consider the effect of curb geometry, barrier offset from the curb, and barrier height relative to the roadway on the performance of the guardrail. Guidance will be developed for placement of 31-in. guardrail adjacent to curbs based on these parameters. It is anticipated that a combination of previous research, computer simulation modeling, and full-scale crash testing will be required to develop and verify the guidance.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Estimated Recommended Funding: $600,000
Estimated Research Period: 36 months

VII. URGENCY AND POTENTIAL BENEFITS

Development of guidance for safe placement of guardrail offset from curb and gutter will prevent conflicts with drainage features, guardrail, and pedestrian facilities. This research should allow more improved flexibility in roadway design and drainage, fewer concerns regarding ADA requirements. Development of increased barrier offsets from curbs should also provide lower maintenance cost for the guardrail.

More recent crash testing results, use of a different beam guard design, and change in crash test criteria calls into question how well guardrail performs near a curb. Previous recommendations from computer modeling on guardrail placement near curb need to be reevaluated.

The AASHTO Technical Committee on Roadside Safety, under the Committee on Design, rates this research need its top priority, of 5 submitted for consideration for Fiscal Year 2019 funding. The Committee on Design rates this its top priority of six research problem statements submitted.

VIII. IMPLEMENTATION PLANNING

Research may be implemented into the AASHTO Roadside Design Guide. Individual states may implement this research as part of their own state standards.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Erik Emerson
Standards Development Engineer - Roadside Design
Wisconsin Dept. of Transportation
X. **AASHTO MONITOR**

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XI. **SUBMITTED BY**

September 15, 2017  
Keith A. Cota, P.E.  
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XI. **REFERENCES**


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**NCHRP Review of C-13**

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:

The problem statement is potentially solvable through research and has a reasonable clear objective; and is also ranked 1st of AASHTO Technical Cmte on Roadside Safety five top priorities, and first priority of AASHTO Design Committee. The scope of the research and research period is reasonable. The research results may also address ongoing updates for AASHTO MASH and RDG publications in consideration of the various task force and committee strategic plans. Guideline development for the use of the 31 inch MGS system adjacent to curbs and geometric conditions under MASH TL-3 impact conditions will offer improved guidance for a future update to AASHTO RDG.

Review Date:
11/30/2017

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**FHWA Evaluation of C-13**
FHWA RwD Team - Good problem statement.

AASHTO Committee Evaluation for C-13

Guardrail Performance at Various Offsets from Curb for MASH TL-3 Applications

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – This proposal ranked #1 out of 6 submitted this year. This research will develop guidelines for the use of the 31-in. Midwest Guardrail Systems (MGS) adjacent to curbs under MASH TL-3 impact conditions. The research will consider the effect of curb geometry, barrier offset from the curb, and barrier height relative to the roadway on the performance of the guardrail. This research will offer improved guidance for future updates to the Roadside Design Guide.

Submitter Response for 2019-C-13

Guardrail Performance at Various Offsets from Curb for MASH TL-3 Applications

From: [email: Keith.Cota@dot.nh.gov]

Comments: TCRS appreciates the opportunity to submit comments on its top priority for research in 2019. The interaction of curbing in front of guardrail has and continues to be a critical application of designers. The focus of this research is to advance our knowledge on guidance for the RDG on the use of curbs in front of guardrail and identify geometric limitations for its offset and vertical heights. This research will benefit the end user of the RDG. TCRS looks forward to a favorable acceptance for evaluation of interaction of curbing with roadside safety hardware.

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Review Date: December 19, 2017
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline


I. PROBLEM NUMBER

2019-C-14

II. PROBLEM TITLE

Validation of Roadside Crash Injury Metrics in Real World Crashes (Correlation of Actual Injury Outcomes to Those Predicted During Crash Testing)

III. RESEARCH PROBLEM STATEMENT

The methods used to evaluate injury risk in roadside hardware crashes were developed in the 1980s and very likely outdated. The advancement of vehicle designs (i.e.: vehicle crumple zones, seatbelts, frontal and side airbags, etc.) have resulted in significant changes over the last three decades. In frontal crashes, the flail-space crash injury metric is now too conservative considering that occupants are now required to wear seat belts, airbags are used as supplementary restraint systems, and vehicles have crumple zones, all specifically designed to provide controlled ride down decelerations. In contrast in side crashes, the flail space model, which does not account for intrusion, may have the opposite problem and not be sufficiently conservative.

The simplified point mass, flail-space model (FSM) was introduced in 1981 by Michie and is currently used in the United States (U.S.) Manual for Assessing Safety Hardware (MASH) crash test procedures to assess vehicle occupant injury risk in roadside hardware crash tests. Similar Canadian, Australian and New Zealand crash test standards also use the FSM. The European procedures (CEN, 1998) use a variation of the FSM in conjunction with the Acceleration Severity Index (ASI) to gauge occupant injury risk. Both metrics are used in roadside crash tests as a substitute for an instrumented anthropometric crash test dummy (ATD). Using an ATD in MASH certification compliance testing would significantly increase the cost of crash testing of the order of around 40 percent if not more, increasing the cost of safety hardware.

Despite long-term usage to evaluate occupant risk in full-scale crash tests of roadside safety hardware, there is little information correlating either FSM or ASI to occupant injury. In addition, FSM was developed in an era when few drivers wore seat belts airbags were still a rarity and crumple zones in vehicles had yet not been developed. FSM predictions are hence unrepresentative of the injury risk experienced by drivers in 2017. ASI is newer, and was designed for belted occupants, but has not been validated against U.S. occupants in the current fleet. In addition, both FSM and ASI are acceleration-based measures which are better suited to head and chest impacts. They are less than ideal for predicting the risk of leg injuries, such as those injuries observed in some end terminal collisions. Also, neither metric is suited for predicting injury in crashes where the occupant compartment is compromised, including broken side windows in rigid and semi-rigid barrier impacts and A-pillar cutting that can occur in crashes with cable barrier.
This project would seek to compare the current MASH occupant risk procedure predictions with real world crash events where longitudinal and lateral decelerations have been measured and with results from instrumented ATD’s placed in current barrier impacts. Alternative vehicle-based methods of determining occupant injury risk will also be evaluated. The anticipated result would be revised MASH occupant risk tolerance values and/or an improved method of determining occupant injury risk in roadside hardware crash tests. This research is supported by the Technical Committee on Roadside Safety’s (TCRS) Strategic Plan. The objective of the Strategic Plan is to lead roadside policy development, support safety innovations, and to identify standards that are outdated, lacking, or not supported by recent evidence within the current MASH that should be addressed in upcoming revisions and support research to satisfy those needs.

IV. LITERATURE SEARCH SUMMARY

The flail-space model (FSM) assumes each front seat unbelted occupant is a point mass that moves similar to a “free-missile” within the vehicle compartment. The model provides preferred and maximum longitudinal and lateral occupant impact velocity (OIV) and “ridedown” deceleration values compared to those determined experimentally from the roadside safety hardware crash test, using a tri-axial accelerometer placed at the vehicle’s center of gravity (CG). A list of references is listed below.

Despite long-term usage to evaluate occupant risk in full-scale crash tests of roadside safety hardware, there is little information correlating the FSM to occupant injury. Ray et al. (1986) investigated the occupant injury mechanisms in longitudinal barrier collisions, focusing mainly on the lateral OIV. Council and Stewart (1993) attempted to link occupant risk (calculated from crash tests) to actual injury attained in similar real-world collisions but limited data prevented any conclusions. Gabauer and Gabler (2004) evaluated OIV (a component of the flail space model) in frontal crashes using 58 Event Data Recorder (EDR) downloads from real world data, and found the OIV was reasonable predictor of maximum occupant injury in frontal crashes. However, more recently, Tana, Grzebieta and McIntosh (2016) reviewed the flail space’s side impact criteria for thoracic injuries and found the recommended values too high.

Similarly, there has been little research relating the ASI to actual occupant injury. Shojaati (2003) attempted to correlate the ASI to risk of occupant injury via the Head Injury Criterion (HIC), a metric used by the National Highway Traffic Safety Administration (NHTSA) to assess head injury potential. For nine lateral sled tests, the HIC determined from a Hybrid III dummy was plotted against the ASI as determined from the measured vehicle acceleration. The available data suggested an exponential relation between HIC and the ASI but did not provide a direct correlation to occupant injury. Gabauer and Gabler (2005) examined the ASI threshold values in EDR data from 120 real-world frontal collisions, and found that the current ASI thresholds were a reasonable marker of “light injury, if any” for belted and airbag-restrained occupants.

Since the implementation of FSM and ASI, several other vehicle-based injury metrics have been developed which should be considered for as possible candidates for MASH. Gabauer and Gabler (2006) found, for example, that FSM offered no statistically significant advantage over the traditional and simpler metric of crash severity, delta-V. All of these metrics, i.e., FSM, ASI, and delta-V, are acceleration based, and have little correlation with lower leg injury mechanisms – which are primarily intrusion based.
REFERENCES

- Shojaati, M., Correlation between injury risk and impact severity index ASI, 3rd Swiss Transport Research Conference, Monte Verità / Ascona, March 20-22, 2003

V. RESEARCH OBJECTIVE

This project would seek to compare the current MASH occupant risk procedure predictions with real world crash events where longitudinal and lateral decelerations have been measured and with results from instrumented ATD’s placed in current barrier impacts. The anticipated result would be revised MASH occupant risk tolerance values and/or an improved method of determining occupant injury risk in roadside hardware crash tests. The following tasks are proposed:

a. Synthesis of engineering rationale for FSM, ASI, and other Vehicle-Based Injury Criteria to include injury biomechanics basis, computational effort, and practicality.
b. Determine data sources for validation of roadside crash injury metrics.
c. Correlation of real-world injury outcomes to those predicted by the FSM, including correlation by body region, and performance of FSM in frontal vs. side crashes.
d. Correlation of real-world injury outcomes to those predicted by other vehicle-based injury criteria. Potential candidates would include ASI, Delta-V, Occupant Load Criterion, and the Vehicle Pulse Index. For each potential alternative criterion, determine correlation by body region as well as the performance of each in frontal vs. side crashes.
e. Ranking of FSM and other vehicle-based injury criteria by correlation to real-world injuries.
f. Recommended MASH injury criteria and limits for incorporation in an updated MASH.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
VII. **URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION**

Key to certification of roadside hardware in MASH is the evaluation of motorist injury risk. The current injury model, the Flail Space model (FSM), is largely outdated. FSM was developed in the 1980’s when few drivers wore belts, airbags and crumple zones were still a rarity. FSM predictions are largely unrepresentative of the injury risk experienced by drivers in 2017. The belief is that FSM predictions are overly conservative, but this conjecture has not been proven through analysis. In addition, both FSM and ASI are acceleration-based measures which are better suited to head and chest impacts. They are less than ideal for predicting the risk of leg injuries, such as those injuries observed in some end terminal collisions. Also, neither metric is suited for predicting injury in crashes where the occupant compartment is compromised, including broken side windows in rigid and semi-rigid barrier impacts and A-pillar cutting that can occur in crashes with cable barrier.

From a cost-benefit perspective, both FSM and other metrics, e.g. ASI, may lead to hardware which is overly conservative. Occupants are now required to wear seat belts, airbags are used as supplementary restraint systems and vehicles have crumple zones, all specifically designed to provide controlled ride down decelerations. But similarly, the failure of FSM to accurately predict lower leg injury, may lead to designs which inadvertently put motorists’ legs at risk in a roadside hardware collision.

There is an urgent need to evaluate and potentially update the injury risk metric in MASH. This project will construct the technical foundation to upgrade this key evaluation criterion for roadside safety hardware testing.

The AASHTO Technical Committee on Roadside Safety, under the Committee on Design, rates this research need 2 out of 5 submitted for consideration for Fiscal Year 2019 funding. The Committee on Design rates this 4 of 6 research problem statements submitted.

VIII. **PERSON(S) DEVELOPING THE PROBLEM**

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NCHRP Review of C-14
Reviewed By:
Mark S. Bush
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Comments:
The problem statement is potentially solvable through research and has a reasonable clear objective; and is also ranked 3rd of AASHTO Technical Cmte on Roadside Safety five top priorities. The scope of the research and research period is reasonable. The research results may also address ongoing updates for AASHTO MASH and RDG publications in consideration of the various task force and committee strategic plans.

Review Date:
11/30/2017

FHWA Evaluation of C-14

FHWA RwD Team - We suggest getting NHTSA input regarding use of Anthropomorphic Test Devices (crash test dummy).

AASHTO Committee Evaluation for C-14

Validation of Roadside Crash Injury Metrics in Real World Crashes (Correlation of Actual Injury Outcomes to Those Predicted During Crash Testing)

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – This proposal was #4 out of 6 submitted this year. The intent of this research is to establish direct correlation of actual injury outcomes to those predicted during crash testing. The advancement of vehicle designs (i.e.: vehicle crumple zones, seatbelts, frontal and side airbags, etc.) have resulted in significant changes over the last three decades. Our understanding for MASH occupant risk procedure predictions with real world crash events is critical to assure the predicted limits remain valid or should be adjusted in MASH crash test criteria.

Submitter Response for 2019-C-14

Validation of Roadside Crash Injury Metrics in Real World Crashes (Correlation of Actual Injury Outcomes to Those Predicted During Crash Testing)

From: [email: Keith.Cota@dot.nh.gov]
Comments: TCRS appreciates the opportunity to submit critical research needs for consideration of limited funding. The objective of this research proposal is to confirm the MASH occupant risk procedure predictions with real world crash events. This model has not been updated with real world experiences for several decades in which we have seen advancement of improved vehicle designs. An evaluation of the real world injuries for crashes will allow for improved prediction models and adjustments within the future update of MASH and RDG. Incorporating NHTSA into the study for the potential development of MASH procedures for the incorporation of crash test dummy is a good suggestion. TCRS looks forward to a favorable acceptance of this real world crash study.

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Review Date: December 19, 2017
Highway Network Alternatives to Determining High Stress Pavement Safety Hotspots

Description: Some state agencies use a locked wheel friction tester to collect network-level friction data for safety issues on their roadway system and have for the last several decades, while others have abandoned this practice since it is no longer federally required. This process is time-consuming and expensive to collect on the entire state system. The data has to be collected on such a large interval because it uses tires, water, and fuel, which results in states not having the detail to determine where an unsafe pavement section is located. The costs to collect can be in the hundreds of thousands of dollars for a smaller state or more for a larger state. It is imperative that we find a cheaper and more efficient alternative(s) to this device for finding hot spots on the roadway.

Most DOTs collect 2-D laser based macrotexture (MPD) and/or 3-D downward surface imaging with their profilers on their entire system of roadways. Macrotexture data is collected at very small intervals at highway speeds and could be used to determine if there are sections of a roadway on the network that have deficient friction on the surface. This research would provide a more proactive approach to friction problems for the traveling public. DOTs could collect 3D surface imaging and macrotexture data and send their locked wheel friction tester to the specific sites that were determined to be deficient.

Objective: The objective of this research is to develop a means to collect data Pavement Management System or road inventory database and use the data to determine friction “hot spots” on the roadway. Means of locating areas with higher rutting levels, bleeding, flushing poor geometrics (bad cross slope, curves or supers with incorrect speed limit) could possibly also be developed.

Benefits: A proactive approach to friction issues on our roadway system would provide the following:
- Decrease the number of accidents and fatalities.
- Save DOTs the expense of extra data collection with locked wheel and use the money where the best return can be realized.

Related Research: The following are active projects:
- Protocols for Network-Level Macrotexture Measurement, NCHRP 10-98
- Evaluation of Pavement Surface Micro- and Macro-Texture, Texas Department of Transportation
- A Demonstration Pilot for a Pavement Friction-Management Program, Virginia Department of Transportation
- Safety Evaluation of Pavement Surface characteristics with 1mm 3D Laser Imaging, Oklahoma State University, Oklahoma Department of Transportation, and Research and Innovative Technology Administration

The following are completed projects:
- Guide for Pavement Friction, NCHRP 01-43

Tasks: The following is a list of tasks for this project:

Phase I
1. Perform literature review and survey of approaches for analyzing and interpreting the data for determination of high stress safety hot spots.
2. Determine what technologies are suitable for this purpose. Consider the findings of NCHRP 10-98, Protocols for Network-Level Macrotexture Measurement, when performing this step.
3. Determine the interval of the selected technology(s) collection to determine hot spots.
4. Collect data using the selected technology(s) on a network. Determine where the hot spots are located.
5. Perform friction evaluation on the hot spots using the ASTM E-274 test method with both the E-524 (smooth) and E-501 (ribbed) test tires or other approved evaluation alternative to see if pavement is friction deficient.

6. Interim Report and Phase II plan

**Phase II**

7. Analyze data collected from selected technology(s) Phase I. Determine best technology for finding hotspots on the pavement from the selected technology(s). Explain pros and cons of each technology studied and reasons why the one chosen is best.

8. Develop guidelines for collection of the network-level data hot spot safety location identification including thresholds for each method (texture, rutting, geometry, etc.) employed.


**Implementation:** The results of this research will be made available to safety and pavement management professionals and state and local agencies.

**Sponsoring Committee:** AFD 90, Surface Properties – Vehicle Interactions

**Funding:** More than $350,000

**Research Period:** 24-36 months

**Research Priority:** High

**RNS Developer:** Brian Schleppi

**Date Posted:**

**Date Modified:** March 21, 2016

**Index Terms:** Friction, Safety, Pavement Management, Pavements, Data Collection, Macrotexture

**Cosponsoring Committee:**

**Subjects:** Highways, Data and Information Technology, Maintenance and Preservation, Pavements

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**NCHRP Review of C-15**

**Reviewed By:**
Edward T. Harrigan
eharriga@nas.edu

**Comments:**

A. Is the problem potentially solvable through research?

The objective is potentially solvable through research; the proposed tasks provide a reasonable approach to achieving the objective.

B. Is it likely of interest to at least 2/3s of the DOTS?

This is a problem of national interest and is

C. If not, can you suggest a brief improvement?

Not applicable.
D. Is the scope of the research reasonable?

The proposed scope is reasonable.

E. Can the research be done in 2-3 years at the most?

The research can be accomplished with 2 years.

F. Is the budget adequate?

Due to the substantial field work proposed in the problem statement, staff strongly recommends an increased budget of $500,000.

G. Comments on current or past research on the topic.

This research should be closely coordinated with and make use of the results of active Project 10-98, Protocols for Network-Level Macrotexture Measurement. The project panel may consider delaying the start of the project until substantial results are available from Project 10-98.

I recommend revising the title to "Highway Network Alternatives to Determining Pavement Friction Safety Hotspots."

Review Date:
11/21/2017

FHWA Evaluation of C-15

Katherine Petros/HRDI-20 - FHWA has ongoing research to demonstrate Continuous Friction Measurement Equipment for network applications and this work includes relating friction and macrotexture thresholds that are linked to key safety performance measures. To date, over 3700 miles of data have been collected in five States. If funded, this NCHRP project should also coordinate with the FHWA effort. Gina Ahlstrom/HiAP-10 - Worthwhile project as it addresses safety and looks at various issues with friction data collection.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

Problem No: 2019-C-16
TRB AFD90 RNS
Surface Property Data Requirements for AASHTO’s Highway Safety Manual

Description:

Safety is a top priority at every level of the transportation hierarchy (local, state, and federal). Highway safety is clearly a multidisciplinary problem that has three interacting components: the vehicle, the driver, and the roadway infrastructure. Therefore, to achieve significant safety improvements, it is necessary to improve in all three areas and their interactions.

With the recently released AASHTO Highway Safety Manual (HSM), safety practitioners now have access to sophisticated and statistically valid models for determining the substantive safety of proposed or in-service roadways. However, implementing these new models poses a challenge for State Departments of Transportation (DOTs) as they are very “data hungry” in their application.

Modern mobile multifunctional data collection systems utilized for pavement management data collection provide a possible existing data source which DOTs may be able to “mine” in order to obtain needed data inputs. In particular, automated systems can provide a great deal of information related to pavement surface properties (Roughness, Faulting, Rutting, Raveling, Bleeding, Cracking, Texture, Crossfall, Grade, Curvature, Digital imagery, etc.).

The proposed project would be to examine the surface property data elements which are required by the HSM models, as well as their required resolution and accuracy. Capabilities of automated data collection systems would also be reviewed with an eye toward connecting data needs to potential data sources.

Objective:

The objective of this work would be a review of the HSM crash prediction and crash modification models in order to identify the specific data elements which are required for analysis. Details regarding the required resolution and accuracy will be obtained.

These findings will be mapped against the capabilities of a range of automated data collection systems available in the marketplace in order to identify opportunities for data sharing.

Benefits: A proactive approach to friction issues on our roadway system would provide the following:

- Decrease the number of accidents and fatalities
- Save DOTs the expense of extra data collection since pavement management and HPMS groups are already collecting most of this data
- Use safety money where the best return can be realized

Related Research:

- Safety Evaluation of Pavement Surface characteristics with 1mm 3D Laser Imaging, Oklahoma State University, Oklahoma Department of Transportation
- AASHTO Strategic Highway Safety Plan (SHSP)
- State-of-the-practice (AASHTO Guide for Pavement Friction, FHWA Tech Advisories T5040.36 & T5040.38)
- TPF-5(099) Low-Cost Safety Countermeasures
- TPF-5(141) Pavement Surface Consortium
NCHRP 1-46 (Handbook on Pavement Design, Construction, and Management)

AASHTO Develop National Strategic Highway Safety Plan

Tasks:
Phase I
1. Perform literature review and survey of approaches for analyzing and interpreting the crash prediction and crash modification models.
2. Determine the details for the required resolution and accuracy that the different pieces of data will be required, an example would be rutting.
3. Collect data using the selected data elements on a network. Determine, which the can be used in the models.
4. Interim Report and Phase II plan

Phase II
5. Analyze data collected from selected data elements in Phase I. Determine best data elements for inclusion in the models. Explain pros and cons of each data element studied and reasons why the one chosen is best.
6. Develop guidelines for collection of data elements including thresholds for each method (texture, rutting, geometry, etc.) employed in the models.
7. Final Report

Implementation: The results of this research will be made available to safety and pavement management professionals and state and local agencies.

Sponsoring Committee: AFD90, Surface Properties - Vehicle Interaction

Funding: More than $250,000
Research Period: 12-18 months
Research Priority: High
RNS Developer: Richard Fox-Ivey
Date Posted: TBD
Date Modified: March 28, 2016

NCHRP Review of C-16

Reviewed By: Mark S. Bush
mbush@nas.edu

Comments:

There are currently multiple NCHRP research projects underway addressing existing or varying components of this problem statement's objective of HSM crash prediction and crash modification models. Specifically, NCHRP 17-62, "Improved Prediction Models for Crash Types and Crash Severities," and NCHRP 17-63, "Guidance for the Development and Application of Crash Modification Factors." In addition, other NCHRP research is underway addressing components of this problem statement for a new proposed HSM 2nd edition. Also two major capstone NCHRP research efforts are
underway: NCHRP 17-72, "Update of Crash Modification Factors for the HSM," as well as the major comprehensive research, NCHRP 17-71, "Proposed AASHTO Highway Safety Manual, Second Edition" is a significant comprehensive project that will eventually result in the publication of the brand new HSM, scheduled under AASHTO's projected publication of 2020 or 2021. Also, two new NCHRP projects, approved under FY18 funding, (RFPs already released at the time of this review) NCHRP 17-85, "Development and Application of Crash Severity Models for the HSM," and NCHRP 17-86, "Estimating Effectiveness of Safety Treatments in the Absence of Crash Data," may also feed in to the 2nd edition HSM at the time of its anticipated new release. It is likely best until the new 2nd edition AASHTO HSM is released, then this research problem statement should then be considered and its research would then be more affective and applicable.

Review Date:
11/30/2017

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FHWA Evaluation of C-16

FHWA RwD Team - This project is timely because FHWA Safety and Pavement Teams are just beginning an effort to promote the need for continuous pavement friction management. Also, it will coordinate well with FHWA's on-going study to evaluate the ability of laser imaging to predict friction (1st on on list of related research in problem statement). Perhaps part of the project could be to collect additional years of data on that study. Friction is a countermeasure that will continue to be needed even when CV and AV become prevalent. We recommend the funding amount be estimated and specified, rather than the currently ambiguous "More than $250,000".

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AASHTO Committee Evaluation for C-16

Surface Property Data Requirements for AASHTO's Highway Safety Manual

Submitted By:
Steven Buckley
Chair of Research Subcommittee
Committee on Safety

Comments:
This appears to have been submitted by a TRB committee rather than a state, AASHTO committee, or FHWA. This does not follow the NCHRP format. The Committee on Safety and Highway Safety Manual steering group have not discussed a need for this research, and to our knowledge this has not been discussed with the TRB ANB25 committee, which deals with the HSM.
I. PROBLEM NUMBER

2019-C-17

II. PROBLEM TITLE

Wrong-Way Driving (WWD) Solutions, Policy and Guidance

III. RESEARCH PROBLEM STATEMENT

The proposed research seeks to build upon research currently being conducted under National Cooperative Highway Research Program (NCHRP) Project 03-117 by:

- Developing practical guidance for retrofitting existing interchanges and design of new interchanges to reduce the likelihood of wrong-way driving (WWD) incidents and crashes; and
- Evaluating the potential for active WWD warning systems that are commercially available or in development to reduce WWD incidents and crashes.

NCHRP Project 03-117, which is expected to be completed in the Spring of 2018, is focusing on 1) reviewing different design configurations to see how the characteristics of the interchange effect WWD and 2) developing recommendation to clean-up inconsistencies in passive sign and pavement marking requirements in the Manual of Uniform Traffic Control Devices (MUTCD) related to freeway exit ramps.

Since the beginning of the interstate highway system in the 1950s, crashes related to driving the wrong way on freeways have posed a problem for transportation officials. To this day, even though wrong way collisions are infrequent (only about 3 percent of all crashes on high-speed, divided highways) WWD remains a serious problem because the resulting crashes almost always result in death or serious injury to the persons involved.

According to the National Highway Transportation Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS) database, nationally 1,566 fatal WWD crashes occurred on divided highways over a six-year period from 2004 to 2009, resulting in 2,139 fatalities. On average, about 360 people are killed each year as a result of WWD.

There are two overarching areas of research that should be addressed. The first area is the more traditional geometric design and static signing and striping. The second area is the emerging field of active warning systems. We would define an active system as one that would reliably detect WWD entries and trigger devices to issue warnings to responders and active devices such as lighted signs, lighted pavement markings, and audible and tactile devices.

IV. LITERATURE SEARCH SUMMARY

There has been a fair amount of research related to WWD, but not much on active warning systems or methods to retrofit problem interchanges. To date, there have been relatively few studies of the performance of active WWD warning systems. The limited research identified in this area is listed in Subsection C of the Literature Search Summary.

A. Treatments/Static Systems
1. Wrong Way Driving, Special Investigative Report, National Transportation Safety Board Year: 2012

B. Geometrics/Access Management


V. RESEARCH OBJECTIVE

The goals of this proposed research are to:

1. **Develop practical guidance for retrofitting existing interchanges and design of new interchanges to reduce the likelihood of wrong-way driving (WWD) incidents and crashes.**

   It is envisioned that the study would compile effective mitigation approaches from past research into a single document. This document would serve as a comprehensive “one stop shop” for agencies interested in retrofitting existing locations and designing new facilities. It would contain example plan sheets, specifications, operational strategies and application approaches.

   It would include and showcase many of the most common interchanges and intersections. It should also address how to apply it to those less common and new emerging interchanges and intersections, providing guidance on when reconstruction is necessary or problems can be addressed through augmentation with upgraded signs and striping.

   Since all interchanges and intersections are not the same and they all can’t or maybe even don’t need to be changed to reduce WWD there should be a recommended process to analyze and prioritize large numbers of locations.
Lastly, the research should include guidance on the subsystems to monitor the performance of the improvements in terms of WWD reductions. This would also include reporting on the status and performance of any active warning subsystems that are installed. This may be an important tool for system maintenance but also to report to the public the effectiveness of these systems.

These monitoring systems could also be used to study potential problems if performance degrades over time. It could provide information on when restriping is needed or sign reflectivity has diminished. But it could also signal the impacts of other changes in the vicinity of these locations not directly related to the initial installation and study location. This could include new signals or roadways adjacent to or nearby the ramp.

Also important will be definitions of overall system performance. For example, in an active system what would be an acceptable definition of detection performance possibly in terms of allowable number of missed or false calls. For the overall system, how much down time to communications failures or field device failures would be acceptable.

2. Evaluate the potential for active WWD warning technologies that are now becoming commercially available or in development to reduce WWD incidents and crashes.

Advances in technology are allowing the development of more active WWD warning systems. They are beginning to show promise but have been tested primarily as singular standalone implementations. More commonly tested active technologies include signs with flashing LED borders, blank out or LED matrix signs. Newer active technologies could include flashing color changing lighted markers in the pavement or on adjacent structures such as guardrails or similar structures. These may be solar powered and radio controlled to communicate with detection equipment. Little research has been done on possible shape, configuration, flash patterns and locations. This project should include a more systematic view of the configuration, applicability, and implementation of these devices.

The research should also address the mechanisms to control these systems and relay status to traffic management, safety and law enforcement systems and operators. Key to this would be defining the messages delivered and posted then implementing a commonly accepted set of responses by all stakeholders involved.

The research should also include assessment of the performance of total packages at various roadway configurations in operational settings. There are several new alignments being developed that could serve this purpose. There are also locations identified in previous research that would be good candidates for trial applications of the guidance.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

Total Budget $600,000

**Research Period:**

An estimate of the number of months of research effort, including three months for review and revision of a draft final report, and one month for review and revision of each interim report: 36 month research contract period. Timing and duration of activities are indicated above.

VII. URGENCY AND POTENTIAL BENEFITS
WWD events continue to occur due to many factors. Many of the approaches so far have accomplished some reductions. New more advanced technologies are forthcoming in the market place and need to be evaluated an included in an overall approach to the problem.

The development and compilation of clear guidance into a single document that could be included in DOT design manuals would foster a more systematic and uniform installation of roadway geometries, signs, striping and technology.

A more uniform method for monitoring, measuring and reporting the effectiveness of these installations would also help in demonstrating the results of the overall program.

VIII. IMPLEMENTATION PLANNING

The intent of this research concept is to implement as fully as possible a single comprehensive guide to the implementation of improvements to roadway geometries and alignments including geometric alternations, signing, striping and other active warning systems to minimize WWD events. The guide will include:

- Example plan sheets for roadways that includes WW and right way treatment options.
- Example language to add to Design Manuals to guide Designers on how to use geometric designs to reduce WWD events.
- Measures to monitor and report performance of WW and right way implementations.
- Example guidance on how Traffic Investigators should investigate WWD event locations to develop countermeasures, example plans and specification. The guide then will be used by State DOT’s.
- Guidance on connection of new active systems to Traffic Management and Operations centers including adjacent traffic signal systems. Recommended interfaces to the National ITS Architecture and NTCIP protocols.
- Guidance on the prioritization of sites for installation WW and right way solutions.
- This guidance then can be shared through meetings and training.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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Paul R. Olson, P.E,  
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The following state DOT CEOs are sponsoring this request:
- Mike Dew, Secretary, Florida Department of Transportation
- Malcolm Dougherty, Director, California Department of Transportation and Chair, TRB Executive Committee and AASHTO Committee on Construction
- Rudy Malfabon, P.E., Director, Nevada Department of Transportation and Chair, AASHTO Committee on Highway Traffic Safety
- Brian Ness, Director, Idaho Transportation Department and Chair, AASHTO Special Committee on Research and Innovation
- James Barna, Chief Engineer/Assistant Director, Ohio Transportation Department

The problem statement is also being sponsored by North Carolina Department of Transportation Research, Mobility and Safety and the NC Turnpike Authority.
A number of the sponsoring states have expressed a willingness to help identify field testing locations and provide support as needed.

X. **AASHTO MONITOR**

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. **SUBMITTED BY**

Contact information for individuals submitting or supporting this problem statement.

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**NCHRP Review of C-17**

Reviewed By:  
B. Ray Derr  
r ierr@nas.edu

Comments:

The proposed research is appropriate for the NCHRP and it is likely to produce usable results.

The problem statement reference NCHRP 03-117 which is primarily looking at wrong-way movements on divided highways. It has also done some analysis of wrong-way movements on freeway exit ramps which is the focus of the proposed research. The manager of that project does think that additional study will be beneficial.

The first part of the proposed research is to update guidance on interchange design to reduce wrong-way drivers. My understanding is that the likelihood of these maneuvers varies by interchange configuration and that partial cloverleafs are the most problematic. The problem statement includes a large number of issues and many of them would likely be assessed through synthesis-level efforts.

The second part of the problem statement is to look at active warning systems, including assessments of field installations. As written, this would be an expensive undertaking to get enough sites for statistically valid data.

If selected, the panel will have to decide how to allocate the budget between the two parts of the problem statement.
The problem statement is similar to Problem Statement C-02. If funded, consideration should be given to incorporating aspects of that problem statement.

Review Date:
11/16/2017

FHWA Evaluation of C-17

FHWA Intersections Team - This should be merged with C-02.

AASHTO Committee Evaluation for C-17

Wrong-Way Driving (WWD) Solutions, Policy and Guidance

Submitted By:
Steven Buckley
Chair of Research Subcommittee
Committee on Safety

Comments:
5. ARDOT has a project under construction to enhance wrong-way traffic control devices (signs and pavement markings). While this will be helpful, further guidance on additional measures to prevent wrong-way crashes will be beneficial.
I. PROBLEM NUMBER

2019-C-18

II. PROBLEM TITLE

Submittal and Review Process of Roadside Safety Products for Inclusion on State DOT Qualified Products Lists (QPL)

III. RESEARCH PROBLEM STATEMENT

Roadside safety products are installed to provide crash protection to occupants of errant vehicles that leave the travelway. Impact performance criteria for these products are provided in MASH, based on full scale crash testing. FHWA issues Hardware Eligibility Letters for these products and FHWA procedures and regulations require that these products that are installed on federal-aid highway projects must meet MASH. The AASHTO Roadside Design Guide provides additional guidance on selection, placement, and installation of these products based on systems that comply with the MASH criteria and the system’s performance characteristics. These products include:

- Longitudinal Barriers and Bridge Rails (FHWA “B” Letters)
- Barrier Terminals and Crash Cushions (FHWA “CC” Letters)
- Work Zone Devices (FHWA “WZ” Letters)
- Sign Supports, Mailboxes, and Delineator Posts (FHWA “SS” Letters)
- Luminaire Supports (FHWA “LS” Letters)

States rely on FHWA eligibility letters as part of their reviews for these products. Once crash testing is completed and an FHWA eligibility letter has been issued, the final step in getting these products installed is submitting them to each individual State DOT for evaluation and inclusion on what is most commonly known as a Qualified Products List (QPL). Although this process has been in place for many decades, it varies from State to State. In addition, through the years DOT’s have reduced resources and staff. The increasing complexity of crash testing and interpreting results as well as in-service evaluation makes make the review and approval process for roadside safety devices challenging and lengthy.

Owners or manufacturers of these roadside safety products experience a lengthy review process with FHWA. This is further compounded by the review process of States. With the MASH implementation dates approaching, streamlining the submittal, review and approval process of roadside safety products for State DOTs QPL is important to State DOTs as well as industry. This can help support State DOTs’ in-service evaluation of these roadside safety products.

Finally, according to FHWA Open Letter dated May 26, 2017, once these MASH products eventually make their way to the States QPL, the responsibility and final decisions on selection and modifications to devices will be at the State and local level. FHWA will no longer review modifications to tested MASH products unless all crash tests are repeated incorporating that modification. Manufacturers will not rerun tests and State DOTs are reluctant to approve modifications without FHWA’s review. A resolution is needed to allow the introduction of these manufacturers' innovative modifications into the field.

The need to nationally identify best practices and streamline the submittal and review process of roadside safety products for Inclusion on State DOT QPL is long overdue.
Some States have simplified the submittal requirements and are regularly successful in reviewing MASH tested products in a timely manner; however, many States have requirements that are taxing to the state agencies themselves as well as the manufacturers, and may take excessive time and resources to review before placing them on their QPLs. Variations in processes include:

- Different submittal forms and approvals for different departments within the same State, including unique supporting documentation that is State specific.
- States with new product committees meeting schedules vary and some may not regularly meet or have difficulty getting products on the agenda causing further delay.
- Some states charge fees to review a product while others do not.
- State specific drawings stamped by a P.E. registered in that State.
- Some states may limit interaction with manufacturers for a variety of reasons.
- On-line submittals by manufacturers can present challenges such as file size limitations, State agency firewalls, etc.
- Some states may require the manufacturer to install 2 or 3 “demonstration project” units around the State, at the manufacturers cost, to be reviewed for a year.
- Requesting unique State specific labeling/markings on the product.
- Variations by state on acceptance of proprietary products. This may be due to concerns about competitive bids.
- States that participate within the pooled fund programs that conduct research at MwRSF and/or TTI may want to use only the generic products that come from testing performed at those facilities. Some State DOTs may not accept other or proprietary products that do not come from these test facilities.
- Some DOT’s limit the amount of products they will accept when they already have two or more other products approved.

IV. LITERATURE SEARCH SUMMARY

Research has not been performed on this topic to date.

V. RESEARCH OBJECTIVE

The objective of this research is to:

- Research, document, and evaluate the submittal and review processes of roadside safety products throughout DOT’s across the United States.
- Identify forms, policies, practices, and procedures that have demonstrated as being effective and efficient in the submittal, review, and approval processes for roadside safety products.
- Develop a draft step-by-step process that States can use to help guide a State in the evaluation of roadside safety products within the proper context of that product and how it was tested.
- Develop a roadmap of proven successful policies, practices, and procedures that have demonstrated to be effective and efficient in the way roadside safety products are submitted and reviewed.
- Develop guidelines for State DOTs to understand which modifications to MASH tested products are acceptable without re-testing and have the ability to approve. This would include developing a method to have the DOT approvals shared by all States.
- Develop a method for states to share their evaluations of roadside safety products amongst other states to further streamline the process.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
Recommended Funding:

It is estimated that the proposed research will require approximately $150,000 in funding.

Research Period:

It is estimated that the proposed research will require approximately 24 months to complete.

VII. URGENCY AND POTENTIAL BENEFITS

Urgency – MASH was published in 2009 and updated in 2016. The AASHTO/FHWA joint implementation plan calls for sunset dates of MASH tested products beginning December 31, 2017 and continuing through December 31, 2019. There will soon be an inundation of submittals going to State DOT offices. Without improvements to the submittal, evaluation, and approval process, it will be difficult for States to have approved devices on their QPL.

Potential Payoff – The primary payoff is improved and streamlined processes, policies and practices that can be used in establishing standards for MASH tested roadside safety products and permit enhancements or improved maintenance to these products. The cost of this research is a small fraction of what would be saved through improved policies and practices.

Implementation – the results of this research can be used as a basis for states to re-evaluate and improve their processes to streamline and ensure more consistency nationally which would result in significant efficiency and improvements to the submittal, review, and approval process of MASH tested products. In addition it would establish options for manufacturers to be able to offer State DOTs modifications and improvements to MASH tested products. It would also likely provide valuable information for the FHWA and the States in developing up-grade, retrofit, and replacement policies regarding roadside safety products.

VIII. IMPLEMENTATION PLANNING

AASHTO and State DOTs will be able to take the results of the research and utilize to coordinate and determine changes to State policies and processes. This could be integrated into the State DOTs’ in-service evaluation processes.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

To be determined.

XI. SUBMITTED BY

Submitted 10/15/2017 by:
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NCHRP Review of C-18

Reviewed By:
Mark S. Bush
mbush@nas.edu

Comments:

The problem statement is potentially solvable through research and has a reasonable clear objective. The scope of the research and research period is reasonable; however, the budget may be too low given the full variety of safety hardware in use across the entire United States and all the varying 52 state DOTs considering also DC and Puerto Rico under AASHTO. I would suggest a budget of at least $250,000 under this problem statement's objective versus the $150,000 proposed which also may provide opportunities for implementation of the anticipated research results. The research results may also address ongoing updates for AASHTO MASH and RDG publications in consideration of the various task force and committee strategic plans. This problem statement was discussed and also received endorsement under Task Force 13 (www.aashtoTF13.org) which is comprised of members from State and local DOTs, academia and the safety hardware industry.

Review Date:
11/30/2017

FHWA Evaluation of C-18

FHWA RwD Team - This does not seem appropriate as an NCHRP project - should be a Synthesis. The method for State's deciding to include a product on their QPL is specific to each state that has one. They may already have processes, and some states do not have QPLs. So it might make sense to develop a process that many states agree with and some will use, but we recommend removing the reference to QPLs from the problem statement. If the problem statement remains in those to be ranked, we recommend that Part III include the role of functional or performance specifications for certain installations where multiple products may satisfy the roadside safety requirement.
AASHTO Committee Evaluation for C-18

Submittal and Review Process of Roadside Safety Products for Inclusion on State DOT Qualified Products Lists (QPL)

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
The Committee on Design has concerns about the scope and viability of this research proposal. The objectives are qualitative, not quantitative, and involve policy issues beyond the scope of NCHRP research. It would be more appropriate for the first step in addressing these concerns to be a synthesis of the various QPL submittal and review processes.
Comments: The AASHTO Standing Committee on Highway Traffic Safety (Committee on Safety) rated this its top research problem statement out of four being submitted for consideration

I. PROBLEM NUMBER
2019-C-19

II. PROBLEM TITLE
Assessing the impacts of connected, automated and autonomous vehicles on the future of transportation safety

III. RESEARCH PROBLEM STATEMENT
Transportation agencies are charged with an increasingly complex task of balancing the needs to preserve and maintain assets while introducing new assets into an already overwhelmed transportation system. Gradually, organizations are recognizing that past practices of designing what is considered a safe traveling environment is changing as the vehicle fleet evolves to more connected, autonomous and automated driving. While it is understood that impacts are relatively minor today, the implications on the design and operational criteria of tomorrow will be substantial.

Research is needed to understand and plan for these impacts, and to consider how these impacts could change the way we plan, design and operate our facilities. Transportation agencies are constrained within the existing footprints available to reduce the increasingly burdensome impacts to the environment and right of way, as well as the economic impacts to surrounding businesses. DOTs also recognize that they are unable to maintain the state of good repair on many assets, and failure to do so adequately creates significant safety, mobility and maintenance risks. DOTs need to understand how best to deal with these challenges to reduce burdens on deteriorating asset conditions (e.g., bridges, pavements, electrical, environmental) while maintaining safety and mobility.

In the past, design and operational criteria were developed in a manner that could be argued by some as “overdesign”. This type of design occurred as a means to increase safety for the vehicle and traveler because few systems existed within vehicle fleet to account for driver errors, risky behavior and human factors.

Since vehicles are increasingly being designed and operated to account for these factors, how we plan for, develop, and operate facilities will also need to change. With this in mind, preparing for a new design framework is critical and needs consideration. The new design framework will allow for targeting resources to those infrastructure aspects that are least impacted by the connected, autonomous and automated driving systems. In this sense, practical design and operations should incorporate how future changes will benefit safety performance and should consider necessary design criteria modifications to maximize the potential benefits of this technology.

It is important to consider these vehicle fleet changes that can be used to prioritize investment decisions in the future. This research will evaluate potential vehicle system modifications and potential focus areas in design and operational criteria.

IV. LITERATURE SEARCH SUMMARY
The value of automated, autonomous and connected vehicles, and the need for changes of our roadway infrastructure, is extant in literature. Most research efforts discuss what infrastructure is needed to provide for a well operating system, not what will change in terms of providing safe infrastructure. To this end, little research has been completed related to the potential impacts on design and operational criteria, beyond just a few brief discussions. These include: Litman T, (2017) Autonomous Vehicle Implementation Predictions Implications for Transport Planning, Victoria Transport Policy Institute


V. RESEARCH OBJECTIVE
The objective of this research is to review and document existing and anticipated future changes to the vehicle fleet. With this information, develop an outline of how these changes will likely affect safety performance over time and what potential changes to design and operational criteria could be developed to maximize the potential benefits. The research will then be used to develop a framework and strategic approach for the safety profession to consider in developing and implementing new design criteria and operational approaches that consider these technological advances.

Potential Tasks:
• Evaluate existing literature on connected, autonomous and automated vehicles to determine the particular crash types and contributing factors that will most likely be impacted by this new technology.
• Evaluate current highway design, traffic control and operational criteria most often associated with the crash type and contributing factors identified in the literature review to determine potential design and operational focus areas.
• Develop a list of priority areas to be addressed that would provide the maximum benefits to transportation agencies.
• Develop methods to assess the risks and opportunities to changes in design criteria.
• Develop a framework and strategic plan to incorporate vehicle fleet changes into modification of design and operational criteria including:
  o Planning activities necessary to implement the change.
  o Methods and manuals that would need to be modified to enable the change.
  o Potential timing of the fleet, design and operational changes.
  o And an outline of risk and opportunities related to the changes.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
Recommended Funding:
$450,000
Research Period:
18 months

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION
This research is needed to reduce unnecessary expenditure of resources and to reduce deterioration on existing assets. The payoff will provide changes in: 1) How we design in the future is planned for today, rather than allowing continued overdesign, 2) Creating a better understanding of how new vehicle technology can reduce impacts to the environment, right of way, and economics as vehicle fleets change over time, 3) Allowing agencies to make better design and operational decisions, and 4) Providing a framework for change that leads to the greatest reduction in fatal and serious crashes.

The AASHTO Standing Committee on Highway Traffic Safety (Committee on Safety) rated this its top research problem statement out of four being submitted for consideration. This research will support the SCOHTS Strategic Plan goals related to strategic highway safety planning to help reach a goal of zero traffic fatalities and to promote and support data-driven safety performance analysis and planning.

VIII. PERSON(S) DEVELOPING THE PROBLEM
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IX. PROBLEM MONITOR
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X. DATE AND SUBMITTED BY
The AASHTO Standing Committee on Highway Traffic Safety in cooperation with the TRB
Highway Safety Performance Committee.

NCHRP Review of C-19

Reviewed By:
William C. Rogers
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Comments:

NCHRP 20-102(15), Impacts of Connected and Automated Vehicle Technologies on the Highway
Infrastructure, will begin in March 2018. This $650,000 research project should address most of the
issues proposed in C-19.

Review Date:
11/16/2017

FHWA Evaluation of C-19

FHWA Intersections Team - This should be merged with C-02.
AASHTO Committee Evaluation for C-19

Assessing the Impacts of Connected, Automated and Autonomous Vehicles on the Future of Transportation Safety

Submitted By:
Sharon Edgar
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel
Council on Public Transportation

Comments:
#3 priority for Council on Public Transportation. Include consideration of mobility as a service using CV/AV and the impacts on safety
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

Comments: The AASHTO Standing Committee on Highway Traffic Safety (Committee on Safety) rated this its fourth priority research problem statement out of four being submitted for consideration.

I. PROBLEM NUMBER
2019-C-20

II. PROBLEM TITLE
Assessing the impacts of turn lanes in different contexts and modal considerations to increase safety performance.

III. RESEARCH PROBLEM STATEMENT
Developing a better understanding of the role a turn lane has on reducing crashes is becoming increasingly important as small changes to the roadway can result in significant costs to agencies. Current design and operational philosophies are commonly focused on whether a lane is needed, and how will the installation of that lane affect operations, yet limited understanding exists regarding key factors in the safety decision making process to quantifying the turn lane safety performance characteristics (such as length of storage, deceleration length area, taper treatment, offset, etc.).

For some locations, the turn-lane crash modification factors are quite significant, and at other locations and context, the factors are quite low. While much research exists on turn lanes both from a safety and operational perspective, data is typically aggregated in a manner that does not allow for the fine tuning of safety considerations. The intent of this research would be to understand the impacts of turn lane design on the safety of a facility given different modal priorities, context and traffic mix (e.g., freight, pedestrians, and bicyclists) under different levels of traffic. Consideration of left and right turns is often a benefit to the vehicle but a disadvantage to the bicyclist and pedestrian because of increased exposure, speeds and crossing distances.

IV. LITERATURE SEARCH SUMMARY
Much research exists on the impacts of traffic operations and safety, but this research has substantially focused on conditions from the point of view of the vehicle within a single functional class or system of road facilities. This proposed research differs in that it investigates different contexts, volume threshold, design parameters and mixes of motorized versus non-motorized considerations.

V. RESEARCH OBJECTIVE
The objective of this research is to take a microscopic view of design and operations of turn lanes and their impacts on safety to both the vehicles and vulnerable road users. In this effort the intent is to recognize that design and operational criteria must be set in a manner that not only creates high mobility but also impacts safety for all road users. In the past, research has been macroscopic and data was aggregated in such a way that close consideration of the specific design aspects were not possible. To this extent designs are conservative and often at the expense of other modes of travel.

The safety aspects of turn lane design and location also should consider the implications of the “do nothing” option. As an example, left turn lanes at rural four-lane highways may only be constructed if the turning volume exceeds a minimum threshold, yet the absence of the turn lane for even one or two vehicles may result in severe rear-end, angle, or sideswipe crashes at isolated locations. Alternative turn lane designs options, such as constructing a short turn lane so as to provide limited storage, can be expected to directly influence safety performance at these locations. There is a need to evaluate the safety performance of various designs on differing facilities, modal mixes, and contexts to better allow for categorization of new design approaches.

The intent of this research is therefore to review and document existing design approaches to develop a better understanding of the current basis for the design of turn lanes at intersections, and to provide updated criteria to enhance design and operational performance of future designs based on the data-driven analysis.

Potential Tasks

C-20/1
• Task 1 – *Literature review* of the existing studies on the safety and operational implications of turn lanes in different context, modal mixes and lane configurations.

• Task 2 – *Review the current practice* by evaluating current design and operational criteria to identify key operational and safety characteristics most often identified in decision making. The goal of this task is two-fold:
  - Identify potential design and operational considerations that will reduce the impacts of turn lanes in multiple context and traffic flow/mix considerations.
  - Identify specific impacts to all modes as turn lanes are provided (e.g., increased crossing distance for pedestrians).

• Task 3 – *Prepare a work plan* for the development of safety models for evaluating turn lane impacts on safety for all modes.

• Task 4 – *Prepare an interim report* documenting the literature review, the review of practice, and the list of potential design and operational considerations for reducing the impacts of turn lanes.

• Task 5 – *Execute the work plan* described in Task 3 by developing safety models either through statistical or risk based considerations.

• Task 6 – *Develop the crash modification factors* that will account for the greater flexibility in design and operation (e.g., allow for different design based on traffic volume and model mix).

• Task 7 – *Prepare final deliverables* that will state the results and the recommendations for changes to guidance and standards documents.

**VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD**

Recommended Funding:
$650,000
Research Period:
24 months

**VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION**

This research provides major benefits: 1) The critical components to the design of turn lanes are better understood and optimized based on performance and user needs; 2) Under different contexts and modal operations, design modifications would consider all modes, not just vehicles; 3) Because designs may vary based on different characteristics, expenditures will support safety performance needs, rather than rely on applying pre-determined design criteria that are not optimized for differing conditions.

The AASHTO Standing Committee on Highway Traffic Safety (Committee on Safety) rated this its fourth priority research problem statement out of four being submitted for consideration. This research will support the SCOHTS Strategic Plan goal related to strategic highway safety planning to help reach a goal of zero traffic fatalities and to promote and support data-driven safety performance analysis and planning, and the goal related to institutionalizing the Highway Safety Manual by developing additional crash modification factors.

**VIII. PERSON(S) DEVELOPING THE PROBLEM**

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IX. PROBLEM MONITOR
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X. DATE AND SUBMITTED BY
The AASHTO Standing Committee on Highway Traffic Safety in cooperation with the TRB
Highway Safety Performance Committee.

NCHRP Review of C-20

Reviewed By:
William C. Rogers
wrogers@nas.edu

Comments:
For vulnerable road users, this project is a logical follow-on to NCHRP 07-25, Guide for Pedestrian and
Bicycle Safety at Alternative Intersections and Interchanges, NCHRP 15-63, Guidance to Improve
Pedestrian and Bicycle Safety at Intersections, and NCHRP 17-84, Pedestrian and Bicycle Safety
Performance Functions for the Highway Safety Manual, which are underway, as well as NCHRP 17-87,
Enhancing Pedestrian Volume Estimation and Developing HCM Pedestrian Methodologies for Safe
and Sustainable Communities, which is expected to start in April 2018.

Review Date:
11/16/2017

FHWA Evaluation of C-20

FHWA Intersections Team - The multimodal (transit, bike and ped) aspect likely has not been addressed
well in the literature. Possible existing research on this. For example Mn/DOT study (rural) and NCHRP
457 Evaluating Intersection Improvements: An Engineering Study Guide and maybe even the NCHRP 500 series intersection guidance. Possible Synthesis topic looking at how state DOT's are designing turn lanes and what volume and crash thresholds might be driving the addition and design of the turn lanes? Not sure $650k is needed based on the available research and scope presented.

AASHTO Committee Evaluation for C-20

Assessing the Impacts of Turn Lanes in Different Contexts and Modal Considerations to Increase Safety Performance

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design - The proposed research could be beneficial by providing new guidance/design criteria to enhance the operational and safety performance of future turning lane designs given differing facilities, modal mixes and contexts.

Submitted By:
Elizabeth Robbins
Chair
Committee on Planning

Comments:
Not in COP's top three, but recognize that this research would be of high interest to DOT's and local governments.

Submitted By:
Sharon Edgar
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel
Council on Public Transportation

Comments:
#2 priority for Council on Public Transportation. Include impact on transit operations, including but not limited to BRT and transit riders (as peds)
Comments: The AASHTO Standing Committee on Highway Traffic Safety (Committee on Safety) rated this is second priority out of four being submitted for consideration.

I. PROBLEM NUMBER
2019-C-21

II. PROBLEM TITLE
Developing Safety Performance Functions for Rural Two-Lane Highways that Incorporate Speed Measures

III. RESEARCH PROBLEM STATEMENT
The Highway Safety Manual (HSM) currently provides Safety Performance Functions (SPFs) for several roadway types and intersection types, which highway agencies can calibrate to local conditions for use in predicting expected safety outcomes for given roadway designs and safety features. These SPFs, and others developed in-house by highway agencies, are a function of AADT, since the number of vehicles on a facility is directly related to the likelihood of crashes. However, speed is also an important predictor of roadway safety. The severity of the crash is particularly sensitive to vehicle speeds, since the crash energy increases by the square of the vehicle velocity. Speed may also have an impact on the probability of crash occurrence, although this is less well-understood. Despite the importance of speed on safety, speed measures are, however, generally not included in most SPFs.

Highway agencies have little guidance for understanding the impact their speed policies have on safety outcomes. The measures used to assess safety in most crash data are usually determined subjectively after the crash and do not provide clear information about the safety effects of vehicle operating speeds for a road section or other location type by time, weather, etc. Rural two-lane roads are a priority for understanding the speed-safety relationship, because more than half of all fatal crashes occur on rural roads. Nearly 40 percent of those are deemed to be speeding-related (i.e. racing, exceeding speed limits, or too fast for conditions) [FARS]. It is not well-understood which speed measures (such as average speed, 85th percentile speed, speed variance, speed limit violation rate, etc.) are the best predictors of crash likelihood and severity. The objectives of this research are to 1) identify the speed measures available to (or obtainable by) highway agencies that are the best predictors of safety, and 2) develop Safety Performance Functions (SPF) for rural two-lane, two-way highways that incorporate one or more speed measures.

IV. LITERATURE SUMMARY
Various speed measures have been used to estimate the relationship between speed and safety. The power models developed by Elvik (2009) quantify the relationship between the changes in average speed and several safety measures. The HSM also uses average operating speed of a road to estimate crash modification factors for changes in speed (using data from Elvik and others), but there remains significant uncertainty about the factors influencing the relationship. Another more frequently used speed measure is the 85th percentile operating speed. However, depending on the posted speed limits and other geometric design factors, the percentiles might change considerably; the NCHRP Report 504 lists the speed percentiles for the rural highways with various posted speed-limits. In addition, some researchers argue that speed variance should also be considered in the analysis of safety. Additional experience may be gained from the field of speed consistency research, where speed is studied in relation to road alignment and safety.

V. RESEARCH OBJECTIVE
The main objectives of this research are 1) to identify the most relevant speed measures for predicting safety, and 2) evaluate the potential of including speed measures in SPFs for rural two-lane facilities. The results of this study will help to improve the performance and accuracy of the HSM predictive methods and help agencies in deciding about appropriate speed limits.

The following tasks are suggested for performing the research:

- **Task 1 – Literature review** of the existing studies on the estimated impact of various speed measures on crash likelihood and severity, such as average or 85th percentile, speed variance, speed compliance and other identified measures. Report the estimates, sample sizes, and the speed measures being evaluated.

- **Task 2 – Survey of Practice** of highway agencies to determine what speed data they collect or have available, available roadway inventory data, and other potential data types. This survey may also seek to identify how State agencies consider the impact of speed on safety when setting speed limits and choosing safety treatments. The literature review, survey and other means can also be used to identify sources of data, data types and roadway segments for inclusion in the study, potentially including those where agencies have changed the speed limit or have observed a change in operating speed (if a before-after analysis approach is being considered).

- **Task 3 – Prepare a detailed work plan** for the development of an SPF or SPFs for rural two-lane roads that incorporates one or more speed measures. Present work plans to the panel for approval.

- **Task 4 – Prepare an interim report** documenting the literature review, the survey of practice, potential data sources, and proposed work plans.

- **Task 5 – Execute Work Plan** developed in Task 3 and approved by NCHRP panel.

- **Task 6 – Develop SPFs** for rural two-lane facilities that incorporate a speed measure.

- **Task 7 – Evaluate CMFs** to determine if existing CMFs available for rural two-lane roads should be a function of one or more speed measures. Recommend new CMFs where appropriate.

- **Task 7 – Prepare final deliverables.** The research team will develop a final project report that documents the research and provides the speed measures, SPFs and CMFs that would assist highway agencies in estimating the safety impacts of speed measures. The research team will also prepare draft text for inclusion of a future edition of the HSM that incorporates the new SPF(s) and CMF(s).

### VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $500,000  
**Research Period:** 36 months

### VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

The results of this research project will help to improve the existing SPF for rural two-lane highway facilities by accounting for vehicle operating speeds. It will also serve as a reference for improving the accuracy and the performance of the SPFs for the other facilities included in the HSM. The second edition of the HSM is currently underway and is expected to be ready for the publication by 2019. Thus, any potential changes and improvements to the existing predictive methods will have to be addressed in a later edition of the HSM.

The AASHTO Standing Committee on Highway Traffic Safety (Committee on Safety) rated this is second priority out of four being submitted for consideration. This research will support the SCOHTS Strategic Plan goal related to implementation and institutionalization of the Highway Safety Manual, by developing additional tools for making data-driven decisions on rural two-lane roads.
VIII. PERSON(S) DEVELOPING THE PROBLEM

John Milton
Ida van Schalkwyk
Bahar Dadashova
Jessica Hutton
Hillel Bar-Gera
Jiri Ambros
Libby Thomas

IX. PROBLEM MONITOR

Ida Van Schalkwyk

X. DATE AND SUBMITTED BY

December 15, 2017

AASHTO Standing Committee on Highway Traffic Safety
TRB ANB20(5): Traffic Speed and Safety—Cross-Cutting Issues
(Parent committee: Safety Data, Analysis, and Evaluation (ANB20))
TRB ANB25: Highway Safety Performance

Also submitted by Washington DOT

Ida van Schalkwyk
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XI. REFERENCED LITERATURE

NCHRP Review of C-21

Reviewed By:
William C. Rogers
wrogers@nas.edu

Comments:
Developing speed measures in Safety Performance Functions for rural two-lane roads would improve the safety on what are most dangerous roads.

Review Date:
11/16/2017

FHWA Evaluation of C-21

FHWA RwD Team - The timing is not ideal -- should wait for results from NCHRP project 17-85, where much of the concern may be addressed. We need to see what SHRP2 related projects will come up with in terms of correlating safety and speeding. Would prefer the focus be on urban/suburban arterials rather than rural two-lane. Our reasoning is that rural two-lane roads are typically consistent because they are typically consistent within a state, and therefore this can be adequately handled by state calibration. Even a state that has two or more cross-sections (varying shoulder widths) could handle this by breaking the roadways into two facility types with two calibration values. Urban/suburban arterials, where there is a large range of speed limits and cross sections, would be a better focus for an NCHRP study.

AASHTO Committee Evaluation for C-21

Developing Safety Performance Functions for Rural Two-Lane Highways that Incorporate Speed Measures

Submitted By:
Jameelah Hayes
liaison
Traffic Engineering

Comments:
3rd highest priority
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

Comments: The AASHTO Standing Committee on Highway Traffic Safety (Committee on Safety) rated this its third priority research problem statement out of four being submitted for consideration.

I. PROBLEM NUMBER

2019-C-22

II. PROBLEM TITLE

Updating Safety Performance Functions for Data-Driven Safety Analysis

III. RESEARCH PROBLEM STATEMENT

Data-driven safety analysis (DDSA) methods, including those presented in the AASHTO Highway Safety Manual (HSM), are becoming increasingly popular due to their ability to reliably and quantitatively assess the safety performance of existing and proposed roadways. Predictive safety analysis methods are implemented using the following types of statistical models:

- Safety performance functions (SPFs), which predict the crash frequency for a given set of geometric and operational conditions. SPFs can be simple (i.e., AADT-only models) for planning purposes or detailed (i.e., many input variables).
- Severity distribution functions (SDFs), which predict the severity distribution of crashes.
- Crash modification factors (CMFs), which predict the effectiveness of safety treatments.

Many SPFs and CMFs used in current tools were developed over the last 30 years as research created content for the HSM. For example, AASHTOWare Safety Analyst SPFs were developed using 1993-2001 data collected from the Highway Safety Information System (HSIS). Over time, the relationships represented by the models change due to improvements in vehicle design, changes in driver behavior, new legislation, and other trends. Millions of dollars have been allocated to research that develops these statistical models, and nearly as much funding is required to update models using current model development practices.

New research is needed to determine how best to regularly update outdated models in the HSM, AASHTOWare Safety Analyst, and Interactive Highway Safety Design Model (IHSDM). There is an urgent need to examine the immense amount of resources needed to continue to develop and maintain the knowledge base to support the implementation of DDSA methods as well as to plan an efficient path forward for the future.

IV. LITERATURE SEARCH SUMMARY

The value of the DDSA methods is well documented in literature, and the analysis approaches are being widely adopted by State and local agencies. Research to date has primarily developed new SPFs that increase the facility types that agencies can analyze with DDSA methods. Over the last 30 years, research has generated thousands of SPFs and CMFs, some of which are becoming potentially outdated.

Most individual research projects address no more than a handful of facility types or safety treatments. Each project typically costs hundreds of thousands of dollars (each of which may only apply to a few percent of roads or intersections). Often, roughly half the cost of these projects is
allocated to data collection and reduction. There are almost no efficiencies in updating models using current model development procedures; new data collection and explorative analysis is needed for each project. While the HSIS is a common data source, no existing database is sufficient for the needs of researchers conducting this research for all facility types.

Furthermore, prior research has not considered how models could be updated or maintained. Current research (e.g., NCHRP 17-62, Improved Prediction Models for Crash Types and Crash Seversities; and NCHRP 17-72, Update of Crash Modification Factors for the Highway Safety Manual) is developing new methods, even before older methods are fully institutionalized and practice-tested. In contrast to prior research, this proposed research will consider how to most efficiently and sustainably update the existing models to use newer data and new statistical methods, all while continuing to expand the library of SPFs available to analysts.

V. RESEARCH OBJECTIVE

The primary objective of this research is to plan for updates to SPFs, SDFs, and CMFs currently in use within AASHTOWare Safety Analyst, the HSM, and IHSDM. It is not feasible to update all models within one research project. Instead, this research should develop a plan to update existing outdated models as well as sustain current and future models through ongoing research.

The research team could consider exploring answers to some or all of the following questions, which help to describe the specific research problem:

- What potential efficiencies are available at various steps in the research process to make the development and updating of SPFs, SDFs, and CMFs less resource-intensive, considering the processes for data collection, model development, and implementation?
- How can future safety research balance the demands on resources to immediately fix critically-deficient models while waiting until other models are practice-proven before revisiting them in research? Too many revisions to research are costly and could be a detriment to implementation.
- How can we (i.e., the transportation safety community) maintain and update thousands of SPFs and CMFs with limited research funding? Justifying new model development is fairly straightforward, but it may be harder to justify regular updates in the future if it is not substantially cheaper than developing new models.
- How frequently should models be updated (i.e., how old is outdated)?
- How can we assure the various research products (e.g., spreadsheets, software tools, etc.) are updated in accordance with prediction model updates? What potential funding sources can support these needs for implementation?
- How can we assure future research continues to apply uniform SPF calibration (i.e., all models in the HSM are calibrated to California for consistent application without State-specific calibration) for new models prior to inclusion in the HSM? Is it possible to avoid this step in the future, for example by using consistent data sources?
- What new methods could make the process of developing and updating of SPFs, SDFs, CMFs, and other tools more sustainable?
- Is it reasonable to sacrifice some of the accuracy and comprehensiveness of models for efficiency and sustainability, understanding there are (and will be) resource limitations?
- Can we plan for more efficient databases, systems, or procedures that could develop, calibrate, and update SPFs automatically and comprehensively?
- Is there a need to move toward fewer models in the HSM for simplicity and sustainability, rather than producing more and more finite models?
- What framework presents the most resource-efficient, implementation-focused path forward in safety performance research?
- Should we consider a more stringent filter on the research transferred to recommended practice? In other words, which methods, tools, and models do we recommend for practice (e.g., include in the HSM) versus those otherwise available in literature (e.g., journals).
• Is there a need to prioritize research that first focuses on how to facilitate the implementation of existing DDSA methods, rather than developing new methods?
• What critical gaps and limitations remain in existing methods and models?

Furthermore, it is suggested that this effort be coordinated with NCHRP Project 17-73 and other major safety performance research projects, as applicable.

VI. ESTIMATED FUNDING AND RESEARCH PERIOD

Recommended Funding:
$500,000

Research Period:
24 months

VII. URGENCY, PAYOFF POTENTIAL AND IMPLEMENTATION

Many states have requested that the HSM and related tools undergo an update to use newer data and this research supports those requests. However, the cost to update models is currently nearly the same as developing new models, which makes updating all models in one project infeasible. This research will explore the most efficient and sustainable methods for updating existing HSM models now and in the future, all while continuing to expand the knowledge base with new research.

According to recent survey of all 50 States, Puerto Rico (PR), US Virgin Islands (VI), and FHWA Federal Lands Highway Division (FLHD) for FHWA’s Every Day Counts innovation implementation initiative, 49 of 50 States plus PR and FLHD plan to deploy DDSA methods on one or more projects. Of those, 38 have already incorporated or aspire to incorporate DDSA into their policies and procedures.(3)

Many resources present the benefits of using predictive safety analysis methods based on advanced statistics.(4)(5) However, the relative effectiveness of basic and advanced methods is unclear when the advanced methods and tools use data that is far more outdated than basic analytical tools. It is unknown how much potential safety benefit is being lost as a result of 1) out-of-date safety performance functions being used to identify, plan, and design projects, and 2) inefficient procedures to develop and update DDSA methods and models. This proposed research will plan for more efficient use of research resources, ultimately facilitating the implementation of research and expanding the tools available to agencies.

The AASHTO Standing Committee on Highway Traffic Safety (Committee on Safety) rated this its third priority research problem statement out of four being submitted for consideration. This research will support the SCOHTS Strategic Plan goal related to implementation and institutionalization of the Highway Safety Manual, by updating tools for making data-driven decisions.

VIII. PERSONS DEVELOPING THE PROBLEM

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IX. PROBLEM MONITOR

To be determined.

X. DATE AND SUBMITTED BY

The Standing Committee on Highway Traffic Safety in coordination with the TRB Highway Safety Performance Committee.

XI. REFERENCES

2. https://www.hsisinfo.org/  

barnett@dot.state.al.us

NCHRP Review of C-22

Reviewed By:  
William C. Rogers  
wrogers@nas.edu

Comments:

There are several current projects that will inform the next revision to the Highway Safety Manual, but the proposed project should be delayed until the 2nd Edition of the HSM is published in 2020.

Review Date:  
11/20/2017

FHWA Evaluation of C-22
Scurry, Karen/Traffic Operations and Safety - $500K seems a little high to develop a plan on how to best sustain or update the HSM models into the future.
Research Field D

MATERIALS AND CONSTRUCTION
I. PROBLEM NUMBER
2019-D-01

II. PROBLEM TITLE
2017-06: Corrosion Rates of Uncoated Weathering Steel Bridges

III. STATEMENT OF THE RESEARCH PROBLEM
Uncoated weathering steel (UWS) is an attractive corrosion protection system for steel bridges because, if implemented correctly, should be relatively maintenance-free. Weathering steel was first used for steel bridge fabrication in the mid-1960’s, however, the technology was oversold and it was applied in environments where it should not have been used. In the early 1980’s the Michigan DOT experienced unexpectedly fast corrosion rates in UWS bridges leading to a moratorium of UWS indicating their complete disillusionment of the material and this spurred a national dialogue regarding the applicability of UWS. At this point an NCHRP study was undertaken resulting in Report 272 Performance of Weathering Steel in Bridges that highlighted the known performance problems with uncoated weathering steel bridges. Later in that decade was a second NCHRP project resulting in Report 314 Guidelines for the Use of Weathering Steel in Bridges was completed and the finding were largely implemented through a FHWA Technical Advisory which provides guidance on environments to avoid using UWS.

Characterizing the corrosivity in and around a bridge is nontrivial and at best the FHWA Technical Advisory provides qualitative, not quantitative guidance regarding allowable under clearance for grade separations, distance from coastlines, allowable atmospheric chlorides, deicing chemical type and deposition rates, etc. It’s known that that weathering steel patina does stabilize to a slow, predictable corrosion rate depending on environment. Pedro Albrecht, one of the authors of the Report 272 and 314, has numerous publications reporting on the corrosion rate of uncoated weathering steel based on steel mill exposure studies conducted from the 1940’s through the 1960’s. While the work is technically sound, the exposure studies were based on 4” x 6” panel exposures in rural, industrial, and marine environments, and the longest exposure period was 22 years. While corrosion rates can be predicted based on this data, the small, flat panels do not represent real corrosion concentrators (e.g. weld toes, bolted connections, leaking joints) in real bridges. Additionally, extrapolating approximately 20 years of exposure data to predict a service life of a bridge likely around 100 years is also questionable.

The AASHTO LRFD Bridge Design Specifications state “sacrificial metal thickness shall be specified,” however no guidance is provided for how much, nor how to even determine it. Additionally, the applicability of UWS is largely based on qualitative statements like “avoid UWS in areas of high deicing chemical usage,” where a more quantitative statement like “do not use UWS along roadways with deicing application rates in excess of 1000 lbs/lane mile” would be more useful. Despite the wealth of information published regarding UWS, it still is still plagued by poor perception and quantitative design guidance still remains allusive.

IV. LITERATURE SEARCH SUMMARY
A bibliography is presented at the end of this RNS as numerous publications have reported upon the performance of UWS, but none have been able to synthesize the relevant data enough to define quantitative performance indicators. The most recent work has been funded by the
FHWA Long-Term Bridge Performance Program and reported by Righman et. al. that developed an inventory of UWS bridges in the US (using 2012 NBI data) and began to link environmental factors to National Bridge Inventory coding items. However, that study stopped well short of collecting enough data to define quantitative performance indicators and it’s recommended that similar work continue.

V. RESEARCH OBJECTIVE
The objective of this research is to provide quantitative performance data of UWS bridges to assist with updating guidance for proper selection of UWS as a corrosion protection scheme. The research should specifically link known corrosion loss rates of exposure coupons in various macroclimates, to the specific microclimates within a real bridge itself. It is not envisioned that exposure testing will be pursued; rather, the existing UWS inventory will serve as the pool of potential specimens for further evaluation, and linking in-situ performance to climate data, bridge geometry, and deicing usage.

This work supports AASHTO Subcommittee of Bridges and Structures 2013 Strategic Plan objectives of “Extend Bridge Service Life,” and “Assess Bridge Condition.”

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $1,000,000

Research Period: Three years

VII. PERSON(S) DEVELOPING THE PROBLEM

Norm McDonald  State Bridge Engineer
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Justin Ocel, PhD, PE
Structural Steel Research Program Manager  Federal Highway Administration
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VIII. PROBLEM MONITOR
To be assigned by NCHRP staff.

IX. DATE AND SUBMITTED BY
Submitted to TRB AFF20 on 30Jan2017.

Bibliography


NCHRP Review of D-01
The AASHTO SCOBS ranked this problem as the 5th in a group of 5 high-priority problems from the problem statements reviewed this year. However, the requested funding appears to be extremely high given that topic has been extensively researched over the past decades by NCHRP, FHWA, and State DOTs.

FHWA Evaluation of D-01

Donald Becker/HRDI-10 - This would be a worthwhile study to conduct. As the problem statement mentions, FHWA already offers a significant amount of guidance on the use of weathering steel. Unfortunately, the guidance is very general in nature, and would be much more useful for designers if there were specific instructions. The funding level seems appropriate, as a significant amount of study and data reduction will be required to make a comparison between bridges from all over the country in different environments. Additional analysis and inspections of existing structures may also be required. D. Wang/HIBS-10 - This topic has immediate value to engineering application. The problem and objective are clearly stated. However, the research approach left open is hard to imagine - quantitative data and guideline are expected, but without exposure testing, which could be a challenging goal to achieve. The statement needs editorial polish.
AASHTO Committee Evaluation for D-01

Corrosion Rates for Uncoated Weathering Steel Bridges

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Bridges and Structures

Comments:
Committee on Bridges and Structures – This proposal ranked #5 out of 5 submitted this year, and is supported by the Technical Committees on Structural Steel Design (T-14), and Timber Design (T-16).
I. PROBLEM NUMBER

2019-D-02

II. PROBLEM TITLE

Developing High Strength Corrosion Resistant Steel Strands for Prestressing

III. RESEARCH PROBLEM STATEMENT

Prestressed concrete elements such as beams, girders, piles, and decks are essential part of the vast majority of bridges built in the US. These bridges are Prestressed with black steel strands that are susceptible to corrosion leading to structures deterioration. Corrosion is the first mode of deterioration for all bridges and the 7-wire strands are the most sensitive steel to corrosion. Delaying the onset of corrosion will reduce maintenance needs, extend the bridge service life and enhance the safety overall.

There is a need to develop corrosion resistant metallic strand that reduces maintenance and extend bridges service life. Work in Georgia, Florida and Virginia to develop a stainless steel strand have produced a stainless strand meeting the requirement of ASTM A276, UNS S31803 or S32205 (Type 2205), however this strands have a lower strength and lower elongation or ductility.

The objective of this research is to develop a high strength stainless steel strand for prestressing concrete structures and components. This strand should be usable in all bridge structures applications such as pre-tensioning, post-tensioning and cable stay applications.

This research statement meets the strategic plan of the AASHTO subcommittee on Bridges and Structures Items:
1- Extend Bridge Service Life,
4- Maintain and Enhance the AASHTO Specifications,
6- Optimize Structural Systems,

IV. LITERATURE SEARCH SUMMARY

The literature search produced numerous research in Florida, Georgia and Virginia that developed a stainless steel strand. However, this national effort is to cast a wider search for more suitable alloys. At the same time this research will consider the available strands.

V. RESEARCH OBJECTIVE

The objective of this research is to develop a high strength stainless steel strand for prestressing concrete structures and components. This strand should usable in all bridge structures applications such as pretensioning, post-tensioning and cable stay applications.

The research may involve at least the following tasks:
1- Literature review: Review of national and international literature for available metallic prestressing strands and alloys that have been used and may have the potential.

2- Based on the review, select few alloys that have the highest potential.

3- Develop small coupon samples of the selected alloys and test these coupons for potential corrosion, strength, ductility, and etc..

4- Based on coupon testing, narrow the selection down and develop full scale productions and testing.

5- Develop material specifications for the new strand.

6- Develop a final report.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Type of Research
This work involves literature search, metallurgical research, developing strands and testing. This research statement qualifies as a full NCHRP project.

Recommended Funding:
$600,000

(Note: This estimate may be changed by the AASHTO Standing Committee on Research.)

Research Period:
36 months

(Note: This estimate may be changed by the AASHTO Standing Committee on Research.)

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

Developing a stainless steel strand for all prestressed concrete applications will extend the service life and reduce maintenance needs for these applications.

VIII. PERSON(S) DEVELOPING THE PROBLEM

Sam Fallaha, P. E.
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IX. PROBLEM MONITOR

X. DATE AND SUBMITTED BY

October 2016.
XI. AASHTO SCOBS committee endorsements. Most research prioritized high by SCOBS will have one of more of the Technical committee endorsements and high prioritization. Technical Committee contacts are available at the following link. http://bridges.transportation.org/Pages/default.aspx

NCHRP Review of D-02

The problem is suitable for funding in the FY 2019 NCHRP. The AASHTO SCOBS ranked this problem as the 3rd in a group of 5 high-priority problems from the problem statements reviewed this year. The objective of this project is consistent with the 2013 SCOBS Strategic Plan.

FHWA Evaluation of D-02

Justin Ocel/HRDI-40 - This statement addresses a critical need to transition toward more corrosion-resistant alloys for use in the infrastructure. However, the problem statement is focused on identifying/developing stainless alloys and research conducted by VA, FL, and GA have already worked with a good variety of stainless alloys, and there are metallurgical constraints such that stainless alloys cannot attain the strengths of plain steel. Suggest the project be refocused towards developing design criteria to used existing stainless alloys that have been made into strands, rather than trying to find an alloy panacea. R.Holt/HIBS-10 - We agree that CR strand can provide bridge owners with a viable service life extention detail and this research would be beneficial.

AASHTO Committee Evaluation for D-02

Developing High Strength Corrosion Resistant Steel Strands for Prestressing

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Bridges and Structures

Comments:
Committee on Bridges and Structures – This proposal ranked #3 out of 5 submitted this year, and is supported by the Technical Committees on Bridge Preservation (T-9) and Tunnels (T-20).

Submitter Response for 2019-D-02

Developing High Strength Corrosion Resistant Steel Strands for Prestressing

From: [email: bruce.v.johnson@odot.state.or.us;sam.fallaha@dot.state.fl.us]

Comments: Comments accepted.

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http://www.fdot.gov/structures/

**Review Date:** 12/15/2017
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

Comments: SCOBS No 2 Priority

PROBLEM NUMBER 2019-D-03

I. PROBLEM TITLE

Effective Use of Duplex Coating Systems to improve Steel Bridge Structure Durability

II. RESEARCH PROBLEM STATEMENT

Steel bridge coatings greatly contribute to the longevity of a bridge structure and reduce the total life-cycle cost by protecting steel bridge members from corrosion. For most steel bridges across the nation, the most popular practice is to provide a 3-coat, zinc-rich primer system. The 3-coat system generally requires regular maintenance (touchup) and may have to be completely overcoated or repainted after as little as 15 years. This approach has proven to be a maintenance challenge for bridge owners. While efforts are on-going to improve the service life of traditional paint systems another approach would be the use of duplex systems (hot dip galvanized or metallized with a traditional finish coat) to provide long-term protection against corrosion. The combination of a metallic coating and a traditional finish coat is often referred to as a “duplex coating.” Van Eijnsbergen1 suggests that the synergetic life of duplex coatings is 1.5 to 2.3 times the sum of the individual lives – this means that may result in service lives in excess of 75 years. Unfortunately, bridge owners have had mixed experience with duplex coatings (including the galvanizing and metalizing process and/or finish coat application). Some DOTs have had great success with the approach while others have had issues with galvanizing and metalizing quality, experienced adhesion problems with the finish coating, or have had to perform maintenance painting of the duplex system sooner than anticipated. The processes are currently reliant on the experience of the galvanizers, metalizers, and coating applicators and as such, may be considered more of an art than science. The proposed project will close the gap between art and science by developing design guidelines, guide specifications, and a state of the art report.

III. LITERATURE RESEARCH SUMMARY

The TRID database was searched using terms such as “galvanizing,” “metallizing,” and “duplex coatings.” About half of the database hits related to concrete bridges (either using galvanized rebar, or thermal zinc treatments). The other half predominately addressed comparison studies on the relative performance of traditional coatings and metallic coatings, the benefits of metallic coatings, or adhesion of paints to galvanizing. Much of the directly relevant work was anecdotal. No comprehensive study was identified that covered the design considerations, proper specifications, or performance of duplex coating systems.

IV. RESEARCH OBJECTIVE

The objective of this research is to collect technical data and develop practical guidelines that allow bridge engineers to position duplex coating systems among alternative corrosion control options for steel bridge structures. The researcher shall use a combination of laboratory testing and field studies to accomplish the project objectives. The objective will be accomplished by developing three documents for the bridge design, maintenance, and construction community:

11 Design guideline for the use of duplex coatings. This document will provide the designer guidance on technical and economic issues relating to duplex coating systems and alternative systems. Issues to be addressed will include considerations for new construction and maintenance painting and considerations when selecting among galvanizing and metallizing.

11 Guide specifications for duplex coatings. These guide specifications will be developed in AASHTO format and will address the proper procedures for quality application of both the metallic and the...
They will also address testing procedures for qualification of duplex coating systems.

11 State of the art report. This report will document laboratory testing and field performance of duplex coating versus other systems on bridges. The report will identify state-of-the-art training and qualifications for applicators and inspectors. The report will also identify gaps in technology, training and other resources which, if filled would improve the state-of-the-art.

V. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
Recommended Funding: $500,000
Research Period: 36 months

VI. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION SCOB\$S global focus:
Foster innovation

SCOB\$S prioritized objective:
1 Extend Bridge Service Life

Duplex coating systems could be an option for improved durability for a large percentage of the nation’s bridge population. While economic considerations vary, duplex systems are available for shop and/or field application for new bridges, maintenance coating for existing bridges, and to protect steel components replaced during major rehabilitation. Effective use of duplex coating systems should make steel bridge designs more competitive by reducing service life cost through increased performance. The use of duplex systems should more than offset any increased application costs through the elimination costs associated with additional recoating cycles, such as: mobilization, maintenance and protection of traffic, user costs, surface preparation containment and disposal, as well as additional application costs. This project directly addresses the 2013 SCOB\$S strategic vision objective to “Extend Bridge Service Life.” SCOB\$S T-9, T-14, T-18; SCOM; the AASHTO National Bridge Preservation Partnership’s (NBPP) Coatings Group; TRB AHD 30, Standing Committee on Structures Maintenance, and TRB AHD30(2), Steel Bridge Coating Subcommittee have expressed support for this project.

VII. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

TRB AHD30(2), Steel Bridge Coating Subcommittee Chair
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SCOBS T-9 Vice Chair and NBPP Coatings Group Chair
Jeffrey A. Pouliotte, P.E.
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VIII. ENDORSEMENTS

SCOB\$S T-9 Chair
Bruce Johnson, P.E.
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SCOB\$S T-14 Chair
Effective Use of Duplex Coating Systems to improve Steel Bridge Structure Durability

Chip Becker, HRDI-10 and Brian Kozy, HIBS This topic shows merit, and is worth investigating further. We are already aware of at least one state (Florida) who is doing research on metalized coatings. We can see the benefit of a highly durable top/sealer coating over a metalized/galvanized coating, if the long-term durability can be predicted. Our main concern is that for a three-year study, some assumptions will need to be made, both in terms of expected durability, and in what will be considered a proper application procedure. Additional long-term studies may be needed to follow on from this work, and then be used to re-evaluate the conclusions from this three-year study.
Effective Use of Duplex Coating Systems to improve Steel Bridge Structure Durability

The problem is suitable for funding in the FY 2018 NCHRP. The AASHTO HSCOBS ranked this problem as the 3rd in a group of 5 high-priority problems from the problem statements reviewed this year. The objective of this project is consistent with the 2013 SCOBS Strategic Plan.

NCHRP Review of D-03

The problem is suitable for funding in the FY 2019 NCHRP. The AASHTO SCOBS ranked this problem as the 2nd in a group of 5 high-priority problems from the problem statements reviewed this year. The objective of this project is consistent with the 2013 SCOBS Strategic Plan.

FHWA Evaluation of D-03

Donald Becker/HRDI-10 - There seems to be renewed interest in metalizing or galvanizing as a corrosion protective measure. The use of a top-coat to seal the metalizing coating is recommended due to the potential porosity of the coating, as well as for aesthetics of a colored top coat. A proposal to follow this study with a long-term durability study would be recommended. We would also like to see some recommendations for applicator/inspector certification requirements. This seems to be likely covered under the State of the Art Report section. D. Wang/HIBS-10 - Recommend reducing research scope to focus on unbonded external tendons and combination of unbonded external and bonded internal tendons. The topic of unbonded internal PT needs significant research and is better suited as a separate research project.

AASHTO Committee Evaluation for D-03

Effective Use of Duplex Coating Systems to improve Steel Bridge Structure Durability

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Bridges and Structures

Comments:
Committee on Bridges and Structures – This proposal ranked #2 out of 5 submitted this year, and is supported by the Technical Committees on Bridge Preservation (T-9), Structural Steel Design (T-14), and Bridge Evaluation and Management (T-18). Support for this proposal has also been expressed by the Committee on Maintenance Bridge Working Group, and TRB AHD 30 Standing Committee on Structures Maintenance.
I. PROBLEM NUMBER

2019-D-04

II. PROBLEM TITLE

Updating Load and Resistance factors for the AASHTO LRFD Bridge Design Specifications

III. RESEARCH PROBLEM STATEMENT

The AASHTO LRFD Bridge Design Specifications was adopted in the 1990s. The load and resistance factors in the original code, which for the most part have remained unchanged, were determined using statistical parameters from the 1970’s and early 1980’s and is documented in NCHRP Report 368 (1999). There has also been considerable progress in the reliability-based code development procedures. Therefore there is a need to update the statistical database as well as the reliability analysis procedures for the load and resistance factors.

Recently, ACI performed a recalibration of the materials used in reinforced and prestressed concrete design. Their analysis showed that material quality has improved and this allowed for increasing the resistance factor in new editions of ACI 318 by 5-10%.

Since 1970’s, steel technology and associated regulations have changed considerably. For structural steel the original calibration used grade A36. Nowadays, the most common steel grade is ASTM A992 which meets or exceeds the A36 and A572 grade. Newer data is now available and can and should be used to update the statistical database for the development of the new resistance factors.

Similarly, to the load and resistance factors, the design live load, HL-93, in the AASHTO LRFD Code was developed based on a truck survey from Ontario (Canada) in 1978, which consisted of 9,250 selected trucks, since U.S. data was not available. In the meantime, an extensive weigh-in-motion (WIM) database has been collected by State DOTs, FHWA and as part of other NCHRP studies. As of 2011, WIM systems have been in operation for more than 20 years in most states in the U.S. Over 700 portable and permanent WIM stations are currently in operation around the Country. This provides an opportunity for a rational basis for verification of the live load model.

A preliminary analysis of the WIM data indicates that live loads have changed with respect to traffic volume, mix, and weight. It also shows that the expected live load may be 5-10% larger than that used in the original calibration of the AASHTO LRFD Bridge Design Specifications. Therefore, there is a need to update the statistical data base and if needed to make adjustments in the live load factor.

IV. LITERATURE SEARCH SUMMARY

The literature search will focus on collecting available information on statistical parameters of resistance (test results for materials and components), loads (WIM data) and efficient reliability analysis procedures.

V. RESEARCH OBJECTIVE
The objectives of this project are to (1) re-calibrate the strength limit states of the AASHTO LRFD Specifications based on modern statistical data for steel and concrete bridge construction materials to achieve the originally intended reliability index, and reflecting actual truck data. (2) submit the recommended load and resistance factors for adoption in the AASHTO Specifications for Highway Bridges.

The following tasks are proposed to accomplish this objective:

**Task 1** – Identify and select representative components and structures to be considered in the development of code provisions. Develop a database of structures to be used for the calibration. Include data for structures already inventoried in NCHRP Report 368 and augment the database with new ones.

**Task 2** – Develop a load model that accounts for statistical parameters for loads for various time periods and various traffic parameters. Include truck database from NCHRP Report 368 and recent WIM data.

**Task 3** – Collect recent statistical data for structural steel and concrete bridges, including data gathered in PCA Report SN2849. Develop resistance models that account for modern statistical data for steel and concrete bridges.

**Task 4** – Perform reliability analysis to determine load and resistance factors yielding a reliability index comparable to that achieved in the current AASHTO LRFD Specifications for Highway Bridges.

**Task 5** – Draft specifications and commentary for enhanced load and resistance factors for panel review and comment. Assess the changes in the statistical parameters of live load compared to the original code calibration in the 1990s. If needed, develop a revised live load and/or live load factor for the service, strength, fatigue and extreme event limit states.

**Task 6** – Revise specifications and commentary for adoption in the AASHTO Specifications for Highway Bridges.

**Task 7** – Prepare a final report documenting the entire research effort.

**VI. ESTIMATE OF FUNDING AND RESEARCH PERIOD**

**Type of Research:** Full NCHRP Project

**Recommended Funding:** $425,000

**Research Period:** 36 months

**VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION**

Initiation of this work is urgent. The load and resistance factors in the AASHTO LRFD Specifications were determined to achieve uniform levels of reliability. However, the statistical basis for code calibration has changed since the 1970s or even the 1980s. There is a need to revise the statistical parameters of live load, assess the effect on the design, and make sure that safety of bridges is not compromised.

If needed, the results of the proposed work will result in recommended revisions to the LRFD Specifications for design for possible adoption by the Highway Subcommittee on Bridges and Structures (HSCOBS) of AASHTO. The proposed project also addresses a strategic objective...
of the HSCOBS to fully implement LRFD through enhanced specifications for improved structural performance.

VIII. PERSON(S) DEVELOPING THE PROBLEM
Dr. Andrzej S. Nowak
Auburn University
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IX. PROBLEM MONITOR
Jeffrey Robert
AASHTO SCOBS T-5 Loads Committee Chair

X. DATE AND SUBMITTED BY
May 31, 2017
T-5 by
Jeffrey Robert,
Maryland State Highway Administration Office of Structures
707 N. Calvert Street, MS-203 Baltimore, MD
21202
410 545 8327, jrobert@sha.state.md.us

X. This research proposal has been reviewed and has the endorsement of the T-5 Loads Committee.

NCHRP Review of D-04

The AASHTO SCOBS ranked this problem as the 4th in a group of 5 high-priority problems from the problem statements reviewed this year. However, the return on investment appears very low as the current AASHTO LRFD Design Specifications is perfectly sound.

FHWA Evaluation of D-04

Ben Graybeal/HRDI-40 - Periodic updating of the load model and the resistance factors in the LRFD Bridge Design Specifications is warranted. However, it is not clear that the shortcomings in the current models are significant enough to warrant the major disruption that integrating the proposed study's results would cause. The lack of support from key AASHTO SCOBS technical committees (aside from T-5) raises questions. L. Gao/HIBS-10 - As articulated in the problem statement, the current AASHTO LRFD Specs are based on material data in 1970s and early 1980s and a truck survey from Ontario in 1978. Some States (having heavy legal loads such as Michigan and Pennsylvania or lacking strict enforcement) have identified urgent needs of revisiting the load/resistance factors and the design live load model. In addition, in last 30-40 years, huge amount of WIM and material data has been accumulated. These new material and WIM information makes the recalibration possible for improved design specifications. In general, this is an important research with urgency that may result in optimized design and positive economic impacts. However, the current LRFD design specifications still work for most States and this research is not a high priority in terms of improved system safety.
AASHTO Committee Evaluation for D-04

Updating Load and Resistance Factors for the AASHTO LRFD Bridge Design Specifications

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Bridges and Structures

Comments:
Committee on Bridges and Structures – This proposal ranked #4 out of 5 submitted this year, and is supported by the Technical Committees on Loads and Load Distribution (T-5), Movable Bridges (T-8), Bridge Preservation (T-9), and Substructures and Retaining Walls (T-15).

Submitter Response for 2019-D-04
Updating Load and Resistance Factors for the AASHTO LRFD Bridge Design Specifications

From: [email: bruce.v.johnson@odot.state.or.us; jrobert@sha.state.md.us]

Comments:
Live load estimated from the available recent WIM data is 10-20% larger than what was used in calibration of AASHTO Specifications in 1990’s. This can require either an increase of live load factor or increase of live load. This applies in particular to short span bridges. There is a need for consideration of multiple presence in adjacent lanes and comparison of the live load per girder with HL-93.

The load carrying capacity depends on mechanical properties of materials such as steel, concrete and wood. Recent material test data shows that since 1980's there is a significant change in the variability of mechanical properties. It was observed that the coefficient of variation is much smaller than 30 years ago. There is a need to assess the effect of the reduced variability on the resistance factors. Based on the calibration of ACI-318 for reinforced concrete components, the reduced coefficient of variation can allow for 5-10% increase of resistance factors. Similar effect can be expected for structural steel components, i.e. 5-10% increase of resistance factors. However, there is a need to assess the effect of new mechanical properties of materials on bridge components and expected results will be different than for buildings (size effect, quality of workmanship).

An important challenge of the proposed project is to consider a combined and simultaneous effect of growing live load and reduced variation of resistance.

Contact Info:
Jeffrey Robert - Maryland Department of Transportation
T-5 Chair
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Review Date: 12/18/17
I. PROBLEM NUMBER

2019-D-05

II. PROBLEM TITLE


III. RESEARCH PROBLEM STATEMENT

Performance-based pavement management calls for detailed pavement condition data for each segment of the national highway system as short as 0.1 mile according to the requirements of Moving Ahead for Progress in the 21 Century (MAP-21). Automated Pavement Condition Survey (APCS) becomes a necessity to collect such pavement condition data at 0.1 mile level using video images. Non-automated systems will be too laborious and too time-consuming to collect at such a detailed level. The market is filled with a variety of image-processing based APCS systems. However, when the time comes for a public agency to select one vendor, it becomes challenging because every vendor may claim their system is the best, due to the lacking of a consistent evaluation platform for these systems.

In this research, we propose to develop a set of standardized pavement surface images that are capable to test, calibrate, and validate the performance of an APCS system. We call this set of standardized pavement surface images a pavement surface image library. Images contained in this library are selected based on the testing needs of video image processing algorithms. For example, both asphalt and concrete pavement images will be built into the library with different type, severity, and extent of surface distresses.

IV. LITERATURE SEARCH SUMMARY

According to wiki.com (https://en.wikipedia.org/wiki/Standard_test_image), standard test images have long been developed and used across the world to test and evaluate image processing algorithms. Using standard test images, we can easily compare different system vendors both visually and quantitatively. The standard images are chosen to represent typical situations that a class of processing techniques would need to deal with. Other test images are chosen as challenges to algorithm performances, such as the reproduction of fine detail and textures.

Standard testing image library is commonplace in many areas of image processing applications, such as facial and finger print image processing. Huge and free collection of sample images designed for analysis and quality assessment of image processing techniques. Implementation of APCS systems offered a fantastic opportunity to construct standard test images for pavement distress recognition and processing.

V. RESEARCH OBJECTIVE

The research objective is to develop a pavement surface image library for the evaluation of image processing algorithms used in automated pavement condition survey.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
Recommended Funding:

$400,000.

Research Period:

24 months.

VII. URGENCY AND POTENTIAL BENEFITS

No consistent video image library exists to help benchmark the performance of different commercially available systems. The public sectors are challenged which system to select to implement; while the private sectors are similarly challenged because they need a consistent certification to set their system apart. A standard video image library will offer a consistent platform for the evaluation of video image processing algorithms used in automated pavement distress survey. It also makes a complete and comprehensive evaluation possible given the engineered composition of desired testing cases. The library will facilitate the development of commercial systems, and improve the automated pavement condition survey.

VIII. IMPLEMENTATION PLANNING

(a) The appropriate target audience for the research findings and products: State agencies
(b) Key decision-makers who can approve, influence, or champion implementation of the research products: State agencies and academia
(c) AASHTO committees and other individuals and organizations with likely responsibility for adoption of the results, and (d) “early adopters” – state DOTs that would be willing to evaluate the research products in their agency:

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Zhongren Wang, Supervising Transportation Engineer, California Department of Transportation, 916-274-6023, zhongren.wang@dot.ca.gov

X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. SUBMITTED BY

Contact information for individuals submitting or supporting this problem statement.

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DRISI
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NCHRP Review of D-05

Reviewed By:
Edward T. Harrigan
eharriga@nas.edu

Comments:

A. Is the problem potentially solvable through research?
The problem is of high priority and is potentially solvable through NCHRP research.

B. Is it likely of interest to at least 2/3s of the DOTS?
This is a problem of national interest.

C. Is there a reasonably clear objective?
The objective is clear and straightforward.

D. Is the scope of the research reasonable?
The scope is implicit but not stated in the problem statement. In addition, the statement does not provide any specific tasks or outcomes.

E. Can the research be done in 2-3 years at the most?
The research likely can be completed in 2 years.

F. Is the budget adequate?
The budget appears adequate.

G. Comments on current or past research on the topic.
A search of Google Scholar and the TRB website did not find any current research on this specific topic, though there are many publications dealing with automated pavement condition surveys.

FHWA Evaluation of D-05

Jack Springer/HRDI-30 - The project is needed but not yet. There is a current project NCHRP 01-57(A) that should be completed prior to this project. Also another issue is that each automated condition survey equipment only can process the data collected from its cameras. A FHWA pool fund project was looking
at coming up with a common file naming format for the equipment that would allow image to be used from one system to another. This should be resolved. Gina Ahlstrom/HIAP-10 - Unclear on the application of the library and how it will be used.

AASHTO Committee Evaluation for D-05


Submitted By:
Troy Suing
AASHTO Staff
Committee on Maintenance

Comments:
Committee on Maintenance rank as #4 priority
PROBLEM NUMBER
2019-D-06

PROBLEM TITLE
Guidelines for using sacrificial coatings to protect equipment assets from corrosion

RESEARCH PROBLEM STATEMENT
Vehicle and equipment corrosion is a major problem for transportation agencies. The service life of snow fighting vehicles and maintenance vehicles located in marine areas is usually shortened due to the effects of corrosion caused by salt – either through salt placement or working in a marine environment. This corrosion leads to larger maintenance expenditures and shorter vehicle life. This is a multi-million dollar problem that is nationwide in scope. The idea of using sacrificial coating is an innovative idea and may reduce the effects of corrosion and reduce maintenance costs.

Many transportation agencies used magnesium chloride (MgCl₂) and salt products extensively to help maintain safe mobility on winter highways. Relative to solid salt and salt brine, MgCl₂ products tend to migrate more into hidden areas and are more difficult to be cleaned from the equipment and vehicles. The exposure to these products poses a significant cost to DOT maintenance equipment and vehicles. For example, the Oregon DOT’s estimated Fleet Equipment replacement cost is $400 million, in which deicer exposure contributes a significant portion. In a recent study (Shi et al., 2013), for roadway agencies that report deicer corrosion to equipment as a significant issue, the total cost of current corrosion management and deicer corrosion was estimated to average $1 million and $14 million per year, respectively. In addition to corrosion due to anti icing chemicals, there is climatic corrosion in coastal states. The combination of anti-icing and marine environment make corrosion a significant national issue.

Preliminary field trials in Oregon have demonstrated the benefits of using sacrificial anodes to mitigate the corrosion of deicer tanks, even though the mitigation was isolated to a small area. In bridge protection and other applications, sacrificial coatings have been proven to work by the same principles as sacrificial anodes, i.e., protecting the metals of interest via supply of electrons. Applying a sacrificial coating to specific high-deicer-exposure areas on vehicles may be more cost-effective than the normal practice of frequent washing. In this context, there is an urgent need to identify various sacrificial coating options and evaluate their performance and cost benefits as a function of typical equipment and exposure scenarios of interest to equipment managers.

LITERATURE SEARCH SUMMARY
The literature search located studies on the effects of magnesium chloride on automotive components. Articles were found relating sacrificial coatings and corrosion of steel and aluminum alloys. There are articles and research papers that provide a list of best practices and guidelines to prevent corrosion on DOT equipment in the presence of chemical deicers. The current available guidelines cover a large subject area which covers material selection, paint/coatings selection and application, application of corrosion inhibitors, and vehicle washing practices. Not found were articles or studies that provide detail guidelines or a list of best practices for the implementation of sacrificial coatings onto DOT equipment that contact chemical deicers. Research is needed to identify cost effective sacrificial coating treatments to reduce corrosion effects of deicers to DOT equipment assets and extend their service life.

Literature Search Summary:
Corrosion Inhibitors Available for Preserving the Value of Equipment Asset in Chloride-laden Environments: State of the Knowledge
This paper was sponsored by TRB committee AHD60 Maintenance Equipment. Transportation Research Board 93rd Annual Meeting Location: Washington DC Date: 2014-1-12 to 2014-1-16
Corrosion by Chloride Deicers on Highway Maintenance Equipment Renewed Perspective and Laboratory Investigation
Transportation Research Record: Journal of the Transportation Research Board
Issue Number: 2361
Publisher: Transportation Research Board
ISSN: 0361-1981
Author: Yongxin Li, Yida Fang, Nicholas Seeley, Scott Jungwirth, Emily Jackson, and Xianming Shi
Date: 2013

Proactive Approaches to Protecting Maintenance Equipment against Chloride Roadway Deicers
American Society of Civil Engineers.
Author: Scott Jungwirth, Graduate Research Assistant, Western Transportation Institute, Montana State University; Xianming Shi, Ph.D., P.E., M. ASCE, Nicholas Seeley, and Yida Fang
Date: 2016
http://ascelibrary.org/doi/10.1061/%28ASCE%29CR.1943-5495.0000085

Best Practices for the Prevention of Corrosion of Department of Transportation Equipment
Clear Roads Research for Winter Highway Maintenance
Western Transportation Institute
Project 9906/CR13-04
Author: Mehdi Honarvar Nazari, Xianming Shi, and Laura Fay, and Dave Bergner
Date: March 2015

Identification and Laboratory Assessment of Best Practices to Protect DOT Equipment from the Corrosive Effect of Chemical Deicers
Western Transportation Institute, Alaska University Transportation Center, Washington State Department of Transportation, Federal Highway Administration, Research and Innovative Technology Administration
Author: Xianming Shi, Yongxin Li, Scott Jungwirth, Yida Fang, Nicholas Seeley, and Emily Jackson
Date: March 2013

Sol–gel coatings on metals for corrosion protection
Department of Coatings and Polymeric Materials, North Dakota State University
Author: Duhua Wang Gordon, P. Bierwagen
Date: Online 23 September 2008

Winter Highway Maintenance Operations: Connecticut
Connecticut Academy of Science and Engineering, Connecticut Transportation Institute, Connecticut Department of Transportation, Federal Highway Administration
Report No. CT-2289-F-15-1
Authors: James Mahoney, Eric Jackson, Donald Larsen, Timothy Vadas, Kay Wille, and Scott Zinke
Date: June 2014–July 2015

Magnesium-Based Sacrificial Anode Cathodic Protection Coatings (Mg-Rich Primers) for Aluminum Alloys
School of Polymers and High Performance Materials, the University of Southern Mississippi
V. RESEARCH OBJECTIVE

Identify cost-effective sacrificial coating treatments to reduce the corrosion effects of deicers to DOT equipment assets and extend their service life.

Task 1. Assessing current DOT practices
The research team will work with a minimum of 4 state agencies of which at least 1 will represent a marine environment to assess the current deicer corrosion cost impact to their fleet assets, and also identify typical equipment (e.g., plow trucks, slip-in deicer tanks, liquid deicer applicators, hoppers, and front end loaders), corrosion-prone parts, and assembly and exposure scenarios. The parts of interest may include electrical wiring/connections, plated and un-plated lines and fittings on hydraulic and brake systems; fasteners and components; plates and brackets bolted to the truck frame or top of the truck deck; and tank saddle and spray apparatus. They will also document metal types, current protection measures (e.g., Rhino-Shield), deicer loading & exposure time, climatic conditions (humidity & temperature), washing frequencies, and other factors (e.g., abrasives and debris) that affect the corrosion rates of the fleets. A digital, handheld refractometer will be used to measure the deicer concentration on the selected exposed parts, which will be used to create “splatter” diagrams showing most exposed areas of typical equipment/vehicles to MgCl₂ and salt deicer’s. It is known that deicer exposure exacerbates the risk of crevice corrosion and poultice corrosion “between adjacent pieces of metal, under gaskets and at fasteners, or on the surface of motor vehicle components” (NCHRP, 2007). A visual inspection for corrosion damage will be conducted by state agency forces and submitted to the research team.

Task 2. Identifying promising sacrificial coatings
Past and ongoing research will be reviewed and a national survey of fleet managers/engineers will be conducted to identify the various sacrificial coatings that may hold promise for protecting various metallic substrata from deicer corrosion. These may include long-lasting Zn-, Mg- or Al-based coatings that can form a stable, adherent oxide layer on the metallic substratum, or Zn-rich primer with a top coat.

Task 3. Accelerated laboratory testing
In light of findings from Tasks 1 and 2, the research team will conduct a statistical design of experiments to assess the anti-corrosion performance of the identified coatings through accelerated laboratory testing. The metallic substrata will be tested both in bare and coated conditions. The tests will consider the common types of corrosion seen in DOT fleet, such as crevice corrosion, pitting corrosion, galvanic corrosion, and cosmetic corrosion. The simulation of service conditions (e.g., annual rainfall and temperature cycles in various regions will be incorporated into the testing program. Other variables to simulate will include: the type and condition of metal to be protected (aluminum alloys, low-carbon formable steels, high-strength steels, etc.), the assembly and mechanical stress (e.g., vibration in HALT/HASS), the level and frequency of MgCl₂ exposure (with salt as control), climatic conditions (time of wetness, temperature, etc. via a modified SAE J2334 test), washing frequencies, and exposure to abrasives. The anti-corrosion performance of select coatings will be compared against a coating currently used, such as a rubberized coating. A service life model of various vehicle parts will be developed to link the results of accelerated laboratory tests to predict field performance of selected coating treatments. Subsequently, the model will be used to establish acceptance tests for selected
sacrificial coatings and to predict the beneficial life of selected coatings and their life cycle cost. For various selected scenarios, the most cost-effective coating treatment will be identified, considering the costs to apply/maintain the coating and the corrosion cost avoidance.

Task 4. Field validation

With the assistance of agency Fleets, the key findings from the lab will be validated on selected maintenance trucks in the field over 12 months. At least two agencies will be used in the validation. A key task is the development and deployment of vehicle-based sensors that on-line assess the condition of key metallic components and their applied coatings, using surface resistivity and electrochemical measurements or other suitable and reliable measures. Field investigation will confirm the most suitable areas to apply the coatings and validate the effectiveness of existing washing practices. All the project findings will be leveraged to develop guidelines for protecting new/old ODOT equipment and vehicles from deicers.

Task 5. Final report and presentation

The final report will provide final assessment of the identified coatings and develop guidelines for implementation. The guidelines should be written in a format suitable for AASHTO adoption.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

$400,000 and 36 months

VII. URGENCY AND POTENTIAL BENEFITS

This research will reduce agency inspection, maintenance and repair costs, while minimizing the risk of premature equipment failure and maximizing equipment service life, readiness and performance.

VIII. IMPLEMENTATION PLANNING

This research will modify state agency approaches to equipment preservation and enable them to make better decisions on preserving the quality and life of equipment assets. The findings will help agencies revise the requirements for coatings products in the QPL and in the Equipment Management Manual.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. SUBMITTED BY

Joe Horton
California Department of Transportation
NCHRP Review of D-06

Reviewed By:
Amir N. Hanna
ahanna@nas.edu

Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem is solvable through the proposed research. However, because corrosion development is a slow process, accelerated laboratory testing will be necessary but field validation is likely to require more than the proposed 12 months.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

Considering that the research focuses on the corrosion of deicer tanks and equipment used for snow and ice control, some state DOTs will have limited interest in the topic. Nevertheless, at least 2/3 of the DOTs should be concerned with this issue.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research.

D. Is the scope of the research reasonable?

The scope is reasonable, although there is a concern about the ability to produce adequate field validation within the proposed 12-month period.

E. Can the research be done in 2-3 years at the most?

Recognizing the duration required for corrosion tests and proposed field validation, the research would require 3 years; possibly more.

F. Is the budget adequate?

A higher budget of $500,000 would be necessary to execute the comprehensive laboratory investigation and associated validation effort needed to produce well-supported findings.

G. Comments on current or past research on the topic.

Research performed on the topic, as noted in the problem statement, will serve as the basis for developing a good research plan to accomplish the project objective.
Review Date:
11/28/2017

FHWA Evaluation of D-06

Donald Becker/HRDI-10 - This appears to be a comprehensive study of a costly problem. Numerous aspects are to be investigated. Concerned the time/cost allowed will be considerably underfunded for the level of effort and investigation being suggested. This might need to be broken into several different studies. From a technical perspective, it is a well thought out effort. Suggest some work/comparison done on application to new equipment vs. already fielded equipment.
I. PROBLEM NUMBER
2019-D-07

II. PROBLEM TITLE
Rubberized Hot Mix Asphalt vs Hot Mix Asphalt Lifespan study - A mechanistic-empirical study

III. RESEARCH PROBLEM STATEMENT
Asphalt rubber binder contains crumb rubber modifier manufactured from waste tires. So, there are significant environmental benefits for using Hot Mix Asphalt - Rubberized HMA-G in pavement construction. Every year, the State of California, uses about 2.45 million tons of HMA and 1.72 million tons of Rubberized Hot Mix Asphalt (RHMA-G). As per Caltrans Standard specifications Section 630, RHMA-G is used over HMA to retard reflection cracking, resist thermal stresses created by wide temperature variation and add flexibility to a structural overlay. Based on empirical evidence, it was determined that the life expectancy of RHMA-G overlay is equal to HMA (for the same thickness) when the pavement was designed for structural adequacy. The life expectancy of RHMA-G overlay is twice to that of HMA overlay (for the same thickness) when the pavement was designed for reflection cracking and/or ride quality.

Caltrans-Pavement Program uses nine climatic regions and three traffic levels. A preliminary in-house study was performed on historical data indicated that the performance of the RHMA-G was superior to HMA in some of those traffic and climatic combinations and inferior in others. From a life cycle point of view, it is important to further study this problem and objectively determine the suitable traffic and climatic combination conditions where we benefit the maximum from using RHMA-G over HMA.

IV. LITERATURE SEARCH SUMMARY

A number of studies were performed related to the performance of RHMA-G and HMA and compared for LCCA. The reference mentioned above is one study that was performed by CalRecycle to compare the LCCA between RHMA-G and HMA. Based on my literature review, none of the studies addressed the effect of traffic, climate and structural condition and section (existing) combinations on the performance of RHMA-G and HMA.

V. RESEARCH OBJECTIVE
To determine the pavement life improvement/deterioration of RHMA-G when used in place of HMA under different combinations of Traffic levels, Climatic conditions, existing pavement condition, etc. Different thicknesses shall also be evaluated in this study. A new specification shall be developed related to the application of RHMA-G in place of HMA under different combinations of traffic, climate, and structural section conditions. State agencies would benefit from this research because most or all of the states use RHMA-G for environmental, structural and functional benefits. They also have different climatic conditions and experience multiple traffic levels. The research results will be published and presented through reputed journals and conferences around the Country.
VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$400,000.

Research Period:

24 months.

VII. URGENCY AND POTENTIAL BENEFITS

1) Asphalt rubber binder contains crumb rubber modifier manufactured from waste tires. So, there are significant environmental benefits for using Rubberized HMA-G in pavement construction.

2) Only in State of California, 1.72 million tons of Rubberized Hot Mix Asphalt (RHMA-G) and 2.45 million tons of Hot Mix Asphalt are used for pavement projects each year.

Considering the magnitude of the RHMA-G that is being used in California, it is essential to study the impacts of traffic, climate and structural sections on the performance of RHMA-G and HMA and use those materials appropriately for the best return on investment. If this project is not funded, the RHMA-G used in the combination areas of inferior performance would lead to its premature failure and cause to waste millions of state and federal tax payers’ money.

VIII. IMPLEMENTATION PLANNING

(a) The appropriate target audience for the research findings and products: State agencies

(b) Key decision-makers who can approve, influence, or champion implementation of the research products: State agencies and academia

(c) AASHTO committees and other individuals and organizations with likely responsibility for adoption of the results, and (d) “early adopters” – state DOTs that would be willing to evaluate the research products in their agency:

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Venkata Mandapaka, Pavement Management Engineer, California Department of Transportation, 916-274-6072, venkata_mandapaka@dot.ca.gov

X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).
XI. SUBMITTED BY

Contact information for individuals submitting or supporting this problem statement.

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NCHRP Review of D-07

Reviewed By:
Amir N. Hanna
ahanna@nas.edu

Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem is solvable through the proposed research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

A least 2/3 of the DOTs should be interested in this topic.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, seems to suggest a research effort to show the benefits resulting from the use of rubberized hot-mix asphalt (RHMA) rather than the performance achieved by using RHMA and how it compares to that of HMA. The objective should focus on the performance of or relative performance of RHMA versus HMA.

D. Is the scope of the research reasonable?

The problem statement does not describe the scope but it appears to suggest a research effort to show that using RHMA provides advantages over HMA—a perceived conclusion. An objective scope that focuses on the use of the AASHTOWare Pavement ME Design procedures to predict the performance of pavement structures with RHMA layers and compare it to that of pavement structures with HMA layers should be considered. The results can then be presented in a manner that highlights the conditions under which RHMA is beneficial.

E. Can the research be done in 2-3 years at the most?

The proposed duration of 24 months is adequate.

F. Is the budget adequate?
The proposed budget of $400,000 is adequate.

G. Comments on current or past research on the topic.

Limited literature is cited. A literature review should be conducted as part of the project to identify and consider relevant research.

Review Date:
11/28/2017

FHWA Evaluation of D-07

Jane Jiang/HRDI-30 - The problem statement did not discuss what data source is available to achieve the project objectives. Lack of relevant pavement performance data will hinder this study. Dave Mensching HIAP-20 - Does the introduction of a material into pavement as a recycled material guarantee "significant environmental benefits". Please clarify. Rubber mixes in CA are different than elsewhere - this would need to be a study that investigates various types of rubber applications and proportioning. What is the rationale behind selecting projects to analyze? Which ME platforms are being evaluated? Is the contractor expected to determine material properties in the lab for ME analysis? If the contractor needed to do lab work as well, the funding amount may be too low.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-D-08

II. PROBLEM TITLE

Update to AASHTO M180 and Associated Material Specifications

III. RESEARCH PROBLEM STATEMENT

Many states use AASHTO and ASTM specifications for their guardrail components. A number of changes to the state of practice and material standards have generated a need to update AASHTO M180 as well as some associated materials specifications.

A lack of a consistent standard can increase fabrication costs for hardware suppliers and ultimately transportation agencies. A manufacturer can spend a significant amount of resources matching one state’s standards only to start completely over to match another state’s standards. Consistency will also help to increase competition; allowing for the possibility for lower hardware costs for transportation agencies.

In recent years, there has been an increased focus on roadside hardware. Making sure that transportation agencies are using the correct materials in a barrier system has become more important.

IV. LITERATURE SEARCH SUMMARY

Some examples of changes in the state of practice and material that are not currently addressed are:

- Asymmetrical W-Beam to Thrie-Beam Transition section in use for a number of years but not currently in ASTM M180;
- Inconsistency in steel grade for thrie beam terminal connectors;
- Use of high-strength steel bolts connecting thrie beam terminal connectors to rigid barrier;
- Different slot patterns for thrie beam terminal connectors, thrie beam, and W-beam rails;
- Lack of consistent marking on manufacturers’ hardware;
- Changes in ASTM bolt standards;
- Steel industry is moving away from A36 steel;
- No guidance for shop bent beam guard or thrie beam (e.g., radius marking, radius tolerances, etc.);
- Tolerances for holes in steel posts;
- Cable breaking strength for most roadside applications exceeds the standards that currently available; and
- Lack of a standard for swage fittings.

V. RESEARCH OBJECTIVE

Research objective is to review existing material requirements for guardrail. To do this effort, a research team will need to review existing state specifications, standard drawings, crash test reports, and material standards (e.g. AASHTO, ASTM, etc.). Research team is then to identify gaps in material standards, inconsistencies in material standards, and updates to material standards.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$200,000
Research Period:

24 months

VII. URGENCY AND POTENTIAL BENEFITS

Roadside hardware has been under increased scrutiny nationally. Lack of referencing the proper standard, using an outdated standard, and/or no existing standard may exist; material issues can expose an agency to additional risk. Many transportation agencies are pressed for funds and staff time to determine what is the proper material standard.

Having updated national guidance or standards will help researchers, manufacturers, and transportation agencies reduce time and overall costs.

A number of transportation agencies directly reference AASTHO M180 in their specifications or standard drawings. Changes to this document will directly lead to implementation of the research.

Individual states can adopt the recommendation of this research in their standards and drawings. This will save the states the time in reviewing multiple sources of information.

Crash Testing facilities will be able to reference the correct materials information in crash testing documentation. This will lead to states adopting the correct materials when new devices are developed.

VIII. IMPLEMENTATION PLANNING

Target groups for this research are AASHTO Technical Committee on Roadside Design, Highway Subcommittee on Materials, individual state standard development engineers, individual state specification engineers, individual state materials engineers, crash test facilities, researchers, and material manufacturers.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. SUBMITTED BY

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NCHRP Review of D-08

Reviewed By:
Edward T. Harrigan
eharriga@nas.edu

Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem is definitely solvable through the proposed research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

Considering that guardrail is used by the majority of states, at least in limited situations, the problem statement is likely of national interest.

C. Is there a reasonably clear objective?

I suggest a revision of the objective to the following: "Propose revisions to AASHTO M180 and associated materials specifications to address changes in the state of practice and materials that are not considered in the current specification."

D. Is the scope of the research reasonable?

The scope is reasonable.

E. Can the research be done in 2-3 years at the most?

The research can be done in 2 years.

F. Is the budget adequate?

No. Staff recommends a budget of $300,000.

G. Comments on current or past research on the topic.

A search on Google Scholar from 2014 to present did not identify research on this topic.

Review Date:
11/21/2017

FHWA Evaluation of D-08

D-08/3
FHWA RwD Team - Good problem statement. We have heard of some concerns about hardware components supplied not being what is tested because of dated specifications.

Submitter Response for 2019-D-08
Update to AASHTO M180 and Associated Material Specifications

From: [email: erik.emerson@wi.gov]

Comments:
I have no issues changing the name or budget
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-D-09

II. PROBLEM TITLE

A Guidebook for Risk-Based Construction Inspection

III. RESEARCH PROBLEM STATEMENT

State Transportation Agencies (STAs) are currently facing the critical challenge of supporting an increased demand for highway system rehabilitation and construction work with reduced funding and staff. NCHRP Synthesis 450: Forecasting Highway Construction Staffing Requirements found that “STAs are managing larger roadway systems with fewer in-house staff than they were 10 years ago.” The high retirement rates affecting public owners during the last few years and the migration of experienced STA staff to the private sector are not only challenging these agencies’ ability to meet required staffing levels, but also their capacity to retain critical knowledge. Experienced employees have developed skills to make effective decisions and address specific risks during the performance of their duties, and usually, those skills are lost when they retire and/or are replaced by less seasoned staff. NCHRP Synthesis 450 found that staff constraints and the lack of needed skills are affecting virtually all STA functions, with the major impact on construction inspection (CI) capabilities. This situation has motivated STAs to seek out effective strategies to facilitate CI activities and optimize the use of limited available staff, allowing for personnel to “do more with less.”

The need for this research aligns with the objectives of the Contract Administration and the Integrated Construction and Technologies Sections within the AASHTO Subcommittee on Construction. An in-depth discussion took place on the topic of risk-based construction inspections at the AASHTO Subcommittee on Construction Annual Meeting in August 2017 with the result the development of this problem statement.

IV. LITERATURE SEARCH SUMMARY

A study conducted by the Texas Department of Transportation (TxDOT) investigated over 100 CI workload reduction strategies used by STAs across the country. The different types of strategies evaluated in this study include the incorporation of effective decision-making tools, changes in current CI outsourcing practices, the redistribution of available in-house staff, modifications of standard specifications, the implementation of streamlined/paperless procedures, adjustments to QA/QC programs, and leveraging today's technology to facilitate CI activities. The top 31 strategies were further studied and ranked based on their potential effectiveness in reducing CI efforts for TxDOT. The most effective CI workload reduction strategy identified in this study was the use of lists of prioritized inspection activities. As a prioritization criterion, subject matter experts have proposed to borrow a concept widely used for the inspection of pipe systems in the oil and gas industry: risk-based inspections. A risk-based inspection approach prioritizes inspection activities according to the estimated risk of not performing or postponing each activity. It allows inspectors to pay greater attention to the most critical activities, which is particularly useful when multiple activities that should be inspected occur concurrently. The total risk associated with each activity is usually quantified by multiplying the consequences of reduced inspection (in terms of dollars) by the probability of occurrence of the risk consequences.

Previous studies have found that some transportation agencies are prioritizing CI activities; however, it is occurring without formal implementation guidance, forcing STAs to implement these practices through trial and error. Likewise, most current CI prioritization protocols are based on inspectors'
experience and judgment, making these protocols less efficient when used by inexperienced inspectors. This study is aimed to developing a Risk-Based Construction Inspection (RBCI) guidebook to assist STAs with the effective implementation of these techniques. The guidebook is expected to improve the inspection process and reduce the knowledge gap between experienced and less seasoned inspectors through the transformation of expert knowledge into standardized risk management processes.

The proposed research should address the following questions:

- What are the appropriate procedures to assess/quantify risk and prioritize CI activities in effective RBCI systems?
- What factors should be considered to assess/quantify risk on CI activities? (e.g. potential cost consequences of reduced inspections; past performance of general contractor and subcontractors; staffing requirements; known issues usually found by inspectors in similar projects)
- What is the appropriate procedure to assess/quantify risk associated with inspection and work zone or job site safety? To what degree do certification/training programs already address this risk?
- What is the magnitude of the expected benefits of implementing risk-based inspections? (e.g. reduction of staffing requirements; improvement of workmanship; reduction of rework; critical knowledge retention; project performance improvement – cost, time, and quality)
- What are the limitations of RBCI systems? To what extent can inspectors relay on these systems?
- How could the risk assessment of CI activities help STAs to effectively allocate available in-house CI staff across active and upcoming projects?
- How could the risk assessment of CI activities be factored into the decision of whether or not to outsource CI services for a given project?
- What are the appropriate procedures to incorporate critical knowledge from experienced inspectors into the risk assessment process? (as a means to reduce the knowledge gap between experienced and inexperienced inspectors).
- How could today's technologies (e.g. mobile devices; online apps; remote-controlled devices) and streamlined/paperless procedures help to improve the performance of RBCI systems?

V. RESEARCH OBJECTIVE

The main research objective of this project is to develop a RBCI implementation guidebook for STAs. The guidebook should compile effective practices identified through a comprehensive review of the existing relevant research and a critical analysis of the state-of-the-practice in using RBCI systems in transportation construction/maintenance projects as well as in other industries. Data should be collected through an online survey directed to STAs and 4-6 case studies strategically selected based on the maturity of their CI programs. The guidebook should include a methodology to factor the perceived risk of CI activities into the decision-making process associated with the outsourcing of CI services.

Specific Tasks of the research to accomplish the main objective include:
- **Task 1** – Benchmark the state-of-the-practice by public and private owners in the use of RBCI practices for both horizontal and vertical projects. Survey STAs to identify the different RBCI approaches, as well as other CI prioritization methods, currently used in transportation construction and maintenance projects.
- **Task 2** – Based on the information collected during Tasks 1, prepare a research work plan describing the methodology for identifying potential effective practices and developing authoritative conclusions that will lead to the accomplishment of the research objectives and the
The plan shall include a detailed description of any statistical analysis methods and qualitative research instruments. Provide a list of 4-6 potential case studies for approval by the NCHRP project panel.

- Task 3 – Execute the research work plan and prepare an interim report describing the collection and analysis of survey and case study data as well as emerging conclusions, effective practices, lessons learned, and a proposed outline for the guidebook. The interim report shall include appendices that contain the details of the case study analysis written in a form that permits it to be published separately as a stand-alone report should the NCHRP panel decide that would be appropriate.

- Task 6 - Prepare the draft guidebook for implementing RBCI on transportation construction and maintenance projects. Submit the draft guidebook to the NCHRP panel for their review and comments. Incorporate review comments as required and validate the guidebook’s efficacy with a case study DOT.

- Task 7 - Publish the final guidebook and a final research report that details the full results of the research.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:
Recommended funding for the project is $400,000 to $500,000

Research Period:
It is estimated that 30 months will be required to perform the research.

The anticipated budget and schedule are based on assumptions for required resources to support on-site collection of agency case study project data, the assembly of the contents of the guidebook, and the validation of the guidebook in the field directly with a case study DOT.

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

The RBCI implementation guidebook to be produced by this project is intended to address two different issues currently affecting the CI capabilities of STAs. The first issue is the increasing gap between available and needed staffing levels to effectively oversee active construction and maintenance projects. During the last couple of decades, STAs have been dealing with an increasing shortage of needed in-house staff, a situation exacerbated by growing construction programs. RNCI practices facilitate the CI process and minimize the risk of reduced inspections, helping STAs to deal with the fact that it is not possible to fully inspect all project activities with their current staffing levels. The second issue is the increasing knowledge gap created by the high retirement rates and the migration of experienced CI inspectors to the private sector. An effective RBCI system should be able to capture critical knowledge from experienced inspectors to incorporate it into the risk assessment process, so that this knowledge can be used by less seasoned inspectors and will not be lost when the person who has the knowledge leaves the agency.

Besides improving the efficiency in the use limited CI resources and reducing the knowledge gap between experienced and inexperienced inspectors, RBCI systems also improve the overall quality and performance of the transportation infrastructure by ensuring a satisfactory performance of construction contractors in performing their duties.

VIII. RELATED RESEARCH

NCHRP Synthesis 450: Forecasting Highway Construction Staffing Requirements.

NCHRP Synthesis 313: State DOT Outsourcing and Private-Sector Utilization.

Project 0-5799: Synthesis of the Construction Inspection Workload Reduction Strategies. Texas Department of Transportation
IX. PERSON(S) DEVELOPING THE PROBLEM

Jorge A. Rueda, PhD – Auburn University
Keith Molenaar, PhD, PE – University of Colorado Boulder
Daniel D’Angelo, PE – Applied Research Associates

X. PROBLEM MONITOR

The TRB Standing Committee on Construction Management (AFH10) is submitting this problem statement through the sponsorship of the AASHTO Subcommittee on Construction.

XI. SUBMITTED BY

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NCHRP Review of D-09

Reviewed By:
Amir N. Hanna
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Comments:

A. Is the problem potentially solvable through research? If not, why?
The problem appears to be solvable through the proposed research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?
The topic of research is likely to be of interest to at least 2/3 of the DOTs.
C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research.

D. Is the scope of the research reasonable?

The scope is reasonable but need more clarity and specifics. Also, the task descriptions have omitted 2 of the tasks (Tasks 4 and 5).

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 30 months appears adequate.

F. Is the budget adequate?

The proposed budget of $400,000 appears adequate.

G. Comments on current or past research on the topic.

One study has been cited. Further literature review should be performed as part of the research.

Review Date:
11/28/2017

FHWA Evaluation of D-09

Chris Schneider, HIAP-30 - Conducted in 2012-2013, the Construction Peer Network's (see: https://www.fhwa.dot.gov/construction/cpn/) most selected peer exchange topic was "Assessing inspection levels of effort with risk-based processes," where peer exchanges addressed formal inspection checklists and processes for what to inspect and how often based on the potential impact to quality, schedule, and cost. Individual states such as Arizona, CalTrans, Florida, Nevada, Utah, and others, have developed processes to address the issue. The proposed project to develop a Risk-Based Construction Inspection guidebook to capture best practices to assist STAs with this increasing problem is a progression to efforts already made by individual states. A timely project.

AASHTO Committee Evaluation for D-09

A Guidebook for Risk-Based Construction Inspection

Submitted By:
Evan Rothblatt
Liaison
COC

Comments:
AASHTO Construction Committee number 1 (top ranked) RPS
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-D-10

II. PROBLEM TITLE

Structural Design and Analysis of Post-Tensioned Concrete Structures with Flexible Fillers.

III. RESEARCH PROBLEM STATEMENT

Grouted and bonded post-tensioning tendons are the predominant post-tensioning systems used in bridges in the United States. However, recent durability issues of grouted tendons have prompted state’s Departments of Transportation (DOT’s) to move toward unbonded tendons using flexible fillers to facilitate future replacement of potentially corroded tendons. Structural members can be prestressed utilizing unbonded internal tendons (UIT), unbonded external tendons (UET), combined unbonded internal and external tendons (CUT), bonded tendons (BT) or combinations of bonded and unbonded tendons (CBUT). While flexible fillers have been used in Europe for decades, this new direction in post-tensioning requires reevaluation of the current AASHTO LRFD Bridge Design Specifications (AASHTO LRFD) for post-tensioned structures with UIT, CUT and CBUT.

This proposed study consists of three parts. The analysis and experimental evaluation of shear in structures with internally unbonded tendons in the webs of structural members. An analytical study to evaluate the flexural behavior of structures with UIT, CUT and CBUT. Finally, the evaluation of the resistance factors for structures with UIT, CUT and CBUT.

The applicability of the Modified Compression Field Theory (MCFT) for shear design of bridges utilizing unbonded tendons is somewhat ambiguous because the theory is formulated based on membrane elements with well-distributed, bonded reinforcement. In unbonded segmental construction, there is no continuous bonded longitudinal reinforcement at the match-cast joints to resist in-plane axial tension stress at the local level. External or internal unbonded tendons can only resist global elongation between anchorage points. Therefore, this study is critical to determine the applicability of MCFT in shear and torsion design for structures with UIT, CUT and CBUT.

The current edition of AASHTO LRFD addresses both unbonded and bonded tendons separately and includes a section that addresses components with both bonded and unbonded tendons. The unbonded tendon approach is based on grouted external tendons resulting from research performed by MacGregor (1989). In addressing the mixed condition (CUT or CBUT), it refers to a more rigorous detailed analysis or a conservative simplified analysis. This mixed condition, however, has not been adequately evaluated and recent limited research (UF/FDOT) has revealed the need to further explore this condition. While grouted external tendons are common practice, the new design philosophy could utilize internal unbonded tendons as well as combinations of unbonded and bonded tendons where the majority of the prestressing steel is unbonded.

Internal unbonded tendons introduce voided ducts in the webs and flanges of I- and Box girders. Voided ducts reduce the structural capacity of a web to resist shear. Concerns have been raised whether it is sufficient to deduct the duct diameter from the web thickness in determining the concrete contribution.
AASHTO LRFD currently differentiates resistance factors for bonded and unbonded state, however, does not address a combined state.

The shear and flexure design procedures should account for combining bonded and unbonded tendons in the same structural member.

This research statement meets the AASHTO Subcommittee on Bridges and Structures’ Strategic Plan items:
1- Extend Bridge Service Life,
4- Maintain and Enhance the AASHTO Specifications,
5- Accelerate Bridge Delivery and Construction,
6- Optimize Structural Systems.

IV. LITERATURE SEARCH SUMMARY

Significant research has been done on the flexure of external unbonded tendons some of which may be applicable to internally unbonded tendon. However, little or no research has been done on shear in the webs with stacked unbonded tendons. No work was found on the resistance factors for internal unbonded tendons or the combination of bonded and unbonded tendons.

V. RESEARCH OBJECTIVE

The objective of this research is to update the AASHTO LRFD Bridge Design Specifications design procedures for bridges with unbonded tendons or a combination of bonded and unbonded tendons. The research should include the shear provisions for webs with multiple unbonded tendons (duct voids). This research should also update the associated resistance factors. Tasks involved in this research:
1- Literature Search
2- Develop analytical and experimental work plan. This should include full scale testing of structural members with stacked unbonded tendons in the webs.
3- Conduct the experimental testing.
4- Conduct analysis based on experimentally calibrated models.
5- Develop design and analysis procedures.
6- Propose revisions to AASHTO LRFD Bridge Design Specifications.
7- Develop final report.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

Estimated cost $600,000.

(Note: The level of funding provided may be raised or lowered by the AASHTO Standing Committee on Research if and when the problem statement is selected)

Research Period:

36 months.

VII. URGENCY AND POTENTIAL BENEFITS

Post-tensioned bridges are an economical cost effective solution where applicable. This research fills an existing gap in the current specification for bridges with replaceable unbonded tendons using flexible filler. This type of system will enhance the safety, durability and maintainability of these bridges. This research will be welcome by many state DOT’s.
VIII. IMPLEMENTATION PLANNING

This research will result in specifications that will be implemented in the AASHTO LRFD Bridge Design Specification.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

<table>
<thead>
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X. AASHTO MONITOR

To Be Assigned.

XI. SUBMITTED BY

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NCHRP Review of D-10
Reviewed By:
Edward T. Harrigan
eharriga@nas.edu

Comments:

A. Is the problem potentially solvable through research?

This problem is of high priority and is potentially solvable through NCHRP research.

B. Is it likely of interest to at least 2/3s of the DOTS?

Yes, this is a problem of national interest.

C. Is there a reasonably clear objective?

The objective is clear and straightforward.

D. Is the scope of the research reasonable?

The scope is reasonable and is supported by an outline of proposed tasks.

E. Can the research be done in 2-3 years at the most?

Whether the research can be completed within 2-3 years depends on the requirements for full-scale testing of structural members with stacked unbonded tendons in the webs. It is probable that a 48-month project would be required.

F. Is the budget adequate?

Again, the adequacy of the proposed budget is dependent on the requirements for full-scale testing. Because of this uncertainty and the inherent costs of full-scale testing, staff suggests a budget of $800,000.

G. Comments on current or past research on the topic.

Based on a quick subject-matter search of Google Scholar and the TRB databases, staff agrees with the conclusions of the literature review provided in the problem statement.

Review Date:
11/22/2017

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FHWA Evaluation of D-10

Ben Graybeal/HRDI-40 - Important study whose results are needed in order to ensure appropriate reliability of post-tensioned structures as owners consider the use of unbonded internal tendons. Current LRFD shear provisions are semi-empirical and their formulation does not account for this new structural configuration. R. Holt/HIBS-10 - Recommend reducing research scope to focus on unbonded external
tendons and combination of unbonded external and bonded internal tendons. The topic of unbonded internal PT needs significant research and is better suited as a separate research project.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

Rank 2 (AASHTO Committee on Materials)

I. PROBLEM NUMBER

2019-D-11

II. PROBLEM TITLE

Benchmarking Accelerated Laboratory Tests for ASR to Field Performance: Consideration of Cement and Alkali Contents and Influence of SCMs

III. RESEARCH PROBLEM STATEMENT

Developing new test methods and benchmarking existing laboratory test methods aimed at assessing alkali-aggregate reactivity and preventive measures remain central challenges to the concrete and aggregate industry. The so-called perfect test method to assess the potential for alkali-silica reaction (ASR) would be capable of assessing actual job concrete mixtures, in a relatively short period of time (e.g. 1-6 months or less) and would accurately predict true field performance. Unfortunately, we do not have such a test method. The recently developed AASHTO R 80-17 Practice (previously AASHTO PP 65) and ASTM C 1778-16 Guide have significantly improved the way the concrete industry assesses aggregates for potential alkali-silica reactivity and, subsequently, selects appropriate mitigation methods to use potentially alkali-silica reactive aggregates in new concrete construction. These documents were a result of several FHWA- and DOT-funded research projects on evaluating the potential for and the prevention of alkali-silica reaction\(^1\),\(^2\),\(^3\) together with consideration of the existing approach by the Canadian Standards Association (CSA).\(^4\) A unique feature of these projects was the use of long-term outdoor exposure sites to benchmark accelerated laboratory tests to concrete exposed to actual environmental fluctuations. The concrete mixtures that were investigated primarily followed mixture proportions specified in ASTM C 1293 including cement contents and alkali contents. This is often considered our most reliable test method for assessing aggregate reactivity. As a result, the current guidance documents (AASHTO PP 65 and ASTM C 1778) are based on mixtures that have high cement contents (708 lb/yd\(^3\) (420 kg/m\(^3\))) and high alkali contents (0.95% or 1.25% Na\(_2\)O\(_{eq}\)). These have been criticized as not properly capturing concrete mixtures with lower cement contents (e.g. < 708 lb/yd\(^3\) (420 kg/m\(^3\))) and/or lower alkali loadings. Furthermore, recent results from long-term exposure sites have indicated that the amount of SCM required to control ASR expansion in the concrete prism test (ASTM C 1293) or that required when following the AASHTO R 80-17 practice or ASTM C 1778 guide may not be sufficient to control expansion in outdoor exposure blocks with high contents of high-alkali cements.\(^5\),\(^6\) Testing SCM mixtures in exposure blocks with more moderate (and realistic) alkali levels is required to determine if this is merely an artifact of the severe alkali loadings used in previous exposure-block studies.

The goal of this research is to cast concrete exposure blocks that will be exposed to real environmental exposure conditions with moderate alkali loadings and lower cement contents to provide the crucial long-term benchmarking for the development of ASR test methods for job mixtures and to validate and/or calibrate the prescriptive measures in AASHTO R 80-17 and ASTM C 1778. Several modified accelerated test methods that show promise to assess aggregate reactivity and potential mitigation options will also be investigated. While this represents an important long-term investment, the results from the exposure blocks cast in this research are the ONLY way to build confidence within the concrete and aggregate industry for modifications to the current guidelines in regard to assessing alkali-aggregate reactivity. The researchers on this proposal are intimately involved in the key committees at ASTM and AASHTO responsible for ASR standards development and were the
key players in getting the current AASHTO R 80-17 and ASTM 1778 standards adopted. They are ideally positioned to further modifications to these methods and to directly implement results of this research effort into such documents.

IV. LITERATURE SEARCH SUMMARY

Data from long-term exposure blocks located in Austin, Texas; Ottawa, Ontario, Canada; Fredericton, New Brunswick, Canada; Treat Island, Maine and most recently Corvallis, Oregon provide the most representative samples for bench-marking ASR in field concrete to accelerated laboratory tests within North America. In fact, the current prescriptive approach for assessing and determining preventive measures for ASR in AASHTO R 80-17 and ASTM C 1778 is based on results of laboratory and field investigations at these sites. A significant challenge however is that the cement content and concrete alkali loading (total alkalis in kg/m^3) in these evaluation methods are higher than what would be found in most concrete elements in the field. The reason behind this is due to the alkali leaching that occurs in the ASTM C 1293 method. In this test method the high relative humidity (95-100%) and elevated temperature (38°C) produced around the specimens promotes leaching of ions, namely alkali ions (Na and K) and calcium from the prisms. Over the course of the test, this essentially reduces the “fuel for the fire” of ASR. As a result the ASTM C 1293 method requires a high cement and high alkali content to combat this issue and to ensure the test method is capable of evaluating a full range of potentially reactive aggregates from slow and low expanding aggregates to fast and high expanding aggregates. This of course is a critical departure from concrete in service where typically larger elements will only suffer leaching in the outer skin of the concrete element.

Our collective data shows that ASTM C 1293 provides the best correlation for determining aggregate reactivity while the ultra-accelerated ASTM C 1260 is marginal at best for aggregate reactivity. In the past few years, these test methods have been shown to have shortcomings with regards to properly assessing mitigation measures, specifically in predicting the dosage required to control reactivity below expansion limits of 0.04% in field blocks. A large number of exposure blocks are failing in the field, despite showing passing ASTM C 1293 two-year prism results or 2-week ASTM C 1567 results. The main issue with the C 1293 test is the leaching of alkalis. One of the problems with ASTM C 1567 is the supply of an inexhaustible reservoir of alkalis throughout the test which tends to mask the influence that SCMs may have on the availability of alkalis. Also with ASTM C 1567 the need to process aggregate (crushing and grading) may alter the outcome. Further, in the ASTM C 1293 test method with SCMs, a lower initial alkali loading may be used since only the Portland cement portion is augmented to 1.25% Na_2O_{eq}. These are three key features to address in new test methods. New methods that are currently under investigation include:

- the miniature concrete prism test (MCPT)
- the concrete cylinder test (CCT)

Establishing correlations between the accelerated tests and actual field exposure remain a critical research need.

V. RESEARCH OBJECTIVE

The main research objectives are twofold; these are:

- To extend the current database from field-exposure blocks produced with cement contents and alkali loadings that are representative of highway pavements and structures for the purpose of validating and/or calibrating the prescriptive (preventive) measures in AASHTO R 80-17 and ASTM C 1778.
• To extend the current database from field-exposure blocks better able benchmarking of the various "performance tests" or "job-mixture tests" that have been or are being developed currently.

It is anticipated that the principal outcomes/products from this research program will include the following:

• Draft revisions to the prescriptive measures that are currently in ASTM R 80-17 and ASTM C 1778.

• Recommendations for improving ASTM performance tests and a draft standard(s) for the most promising test(s)

• An extensive database from field-exposure blocks in three different climates with a wide-range of concrete materials which will be made available to other researchers active in ASR research. Beyond the duration of the proposed study, the performance of the blocks will continued to be monitored indefinitely and the data made available to AASHTO, FHWA and other researchers. Note: that it is anticipated that additional blocks evaluating a wide range of materials will continue to be produced beyond the proposed program and these data will also be made available on a continuing basis.

It is anticipated that at least 150 additional mixtures will be cast to supplement the existing database from outdoor exposure sites; the variables to be considered will include:

• A wide range of reactive aggregates with an emphasis on low to moderately reactive aggregates as much of the existing data has been gathered from highly or extremely reactive aggregates

• Cement contents in the range used in pavements and highway structures (300 – 400 kg/m³)

• Various cement alkali levels especially cements of low (0.4 to 0.6% Na₂Oeq) and moderate (0.6 to 0.8% Na₂Oeq) alkali content

• A wide range of SCM types and contents with focus on moderate levels typically used in pavements (e.g. 15 to 25% fly ash, 25 to 35% slag)

• Environmental exposure - blocks from each mixture will be placed in three locations to represent various temperature/humidity ranges; these are: Austin (TX), Corvallis (OR) and Fredericton (NB, Canada).

In addition to blocks, samples will also be cast from each mixture for laboratory testing using the currently most-promising performance tests.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

The recommended level of funding for the proposed research is $650,000 over a 39 month period, with the last three months for review and revision of the draft final report.

VII. URGENCY AND POTENTIAL BENEFITS

Currently, there is a great deal of excitement surrounding the now unified approach in dealing with alkali-aggregate reactivity in North America. Some of that excitement is positive and some of it is skeptical. One of the biggest challenges that aggregate, cement and concrete producers are raising questions about is the aggressive nature of the laboratory testing and field exposure sites in regard to high cement contents and high alkali contents. As outlined in this proposal there is a significant need to increase the breadth of our laboratory and especially exposure block repository from which modifications to the requisite standards will be made. There is a call from the industry to provide critical benchmarking data from exposure sites on moderate
alkali content and moderate cement contents in regard to impacts on alkali-silica reactivity. This proposed research will provide this crucial missing data and represents an important and needed effort to increase the reliability of our methods for determining susceptibility to ASR and appropriate mitigation techniques to avoid the reaction. It is also clear that modifications to our laboratory tests are needed to capture the performance of SCMs in regard to controlling ASR. Certainly, a logical question is “why were these types of mixtures not investigated initially”? Producing large-scale exposure blocks is an incredibly time- and labor-intensive task and it took great effort to convince funding agencies to invest in large-scale and long-term investigations such as this. As a result, not every possible scenario could be realized. In addition, what we have learned from the existing exposure sites is that there is a disconnect between our laboratory and field testing. This justifies the need for continued study as outlined in this proposal. From an urgency standpoint, it is critical to start the exposure outdoors as soon as possible, as time is working against us. It is common that we say, “we should do this, or we should start this” and then five years or ten years in the future nothing was started and we have the same questions. The time to initiate this work is now so that we can start realizing the beneficial knowledge it will provide as soon as we possibly can. If the work is not started now (e.g. the project is not funded) the industry will continue to have these same questions and we will be further and further from answering this critical questions that will ultimately improve the AASHTO R80-17 and ASTM C1778 guidance documents.

VIII. IMPLEMENTATION PLANNING

The target audience for the findings of this research are incredibly broad as ASR can affect nearly every structure that is exposed to the elements. In particular the audience would include: FHWA, AASHTO Subcommittee on Materials (SOM), ASTM Subcommittees C09.26 Chemical Reactions and C09.50 Risk Management for Alkali Aggregate Reactions, all State DOTs, concrete, aggregate, cement and ready-mix producers and owners of transportation structures (e.g. pavements, bridges, ports, airports) and other important concrete structures including dams, foundations, mass concrete, nuclear power structures, etc. The key decision-makers who can approve, influence or champion implementation of the research products would be:

- Collin Lobo – NRMCA
- Gina Ahlstrom – FHWA

The AASHTO committees and other individuals/organizations with responsibly of adoption of the results would include:

- Chair of AASHTO SOM
- Chair of ASTM C 09.26
- Chair of ASTM C09.50
- Chair of ACI 201 – Guide to Durable Concrete

Several State DOTs that would be willing to evaluate the research products in their agency would include:

- Texas
- Maryland
- Pennsylvania
- Wyoming
- California
- Massachusetts
- South Dakota

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT
X. AASHTO MONITOR

Andy Naranjo, Rigid Pavements and Concrete Materials Branch Manager, Construction Division, TxDOT, T-512-506-5858, andy.naranjo@txdot.gov

XI. SUBMITTED BY

Andy Naranjo, Rigid Pavements and Concrete Materials Branch Manager, Construction Division, TxDOT, T-512-506-5858, andy.naranjo@txdot.gov and the Subcommittee on Materials

REFERENCES


12 AASHTO TP 110-14 (2016), Standard Method of Test for Potential Alkali Reactivity of Aggregates and Effectiveness of ASR Mitigation Measures (Miniature Concrete Prism Test, MCPT).

NCHRP Review of D-11

Reviewed By:
Edward T. Harrigan
eharriga@nas.edu

Comments

A. Is the problem potentially solvable through research?

The problem is potentially solvable through NCHRP research.

B. Is it likely of interest to at least 2/3s of the DOTS?

According to 2013 FHWA report on alkali-aggregate reactions (AAR), incidents of ASR are found in all 48 continental states.

C. Is there a reasonably clear objective?

The proposed objectives are clear and straightforward.

D. Is the scope of the research reasonable?

The scope of the research is ambitious but reasonable.

E. Can the research be done in 2-3 years at the most?

It is feasible to complete the research in 3 years

F. Is the budget adequate?

Staff recommends a budget of $800,000 due the extensive program of specimen preparation, long-term monitoring, and laboratory testing required.

G. Comments on current or past research on the topic.

The literature review in the problem statement appears comprehensive. A search of recent literature on ASR in Google Scholar found one additional paper that may be relevant to the topic;

FHWA Evaluation of D-11

Ahmad Ardani/HRDI-10 - This is a very timely research proposal - Many exposure blocks in Texas and across north America are failing in the field, despite passing the two-year prism test, ASTM C1293 and the 2-week mortar bar test, ASTM C1567. It is the consensus there are two main issues with these ASTM tests: leaching of alkalis is said to be one reason; furthermore, when SCMs are used as mitigating measures, an under-alkali loading occurs since only the alkali in the cement portion is augmented to 1.25% Na2Oeq. Examining the use of Concrete Prism Test (CCT) and miniature concrete prism test (MCPT) as an accurate and accelerated test methods in evaluating ASR mitigation measures looks very promising as they don’t promote leaching of the alkalis. Gina Ahlstrom- HIAP-10 - This project will help further refine lab tests with actual field performance. Further, this project builds off previous ASR research and deployment activities funded by FHWA. A number of States are interested in this work.
I. PROBLEM NUMBER 2019-D-12

II. PROBLEM TITLE
DESIGN GUIDELINES FOR ALTERNATIVE LIGHTWEIGHT BACKFILL FOR MECHANICALLY STABILIZED EARTH WALLS

III. RESEARCH TITLE
Alternative lightweight backfill for MSE walls include but are not limited to cellular (foamed) concrete, foamed glass aggregate, geotechnical polyurethanes, expanded lightweight aggregate concrete and expanded polystyrene (EPS), which are alternative to lightweight aggregate. The use of alternative lightweight fill for Mechanically Stabilized Earth (MSE) walls has grown in popularity in recent years due to its effectiveness in reducing fill weight on soft soils and limited availability of lightweight aggregate. They have also become increasing popular alternatives for lightweight embankment backfill (Ruttanaporamakul et al., in review), due to their relatively low density when compared to traditional backfill (Anderson et al. 2012; Miller et al. 2004; Saride et al 2010).

The advantages of alternative lightweight fill include reduced vertical and lateral load, minimizing settlement, accelerated installation rate and fill uniformity with no compaction required, and may reduce cost by circumventing conventional ground improvement techniques. Some alternative lightweight fills are pervious and free draining while some are impervious and most of them provide thermal insulation. Successful case studies have shown that alternative backfill can be used as MSE backfill. Anderson et al. (2012) described the use of lightweight cellular concrete for an MSE railway embankment with steel reinforcement. An additional advantage of cellular concrete in this case study was its ability to be pumped long distances, which was critical in the tight construction. Although alternative backfill has been used successfully in MSE wall construction, its application is currently limited due to relatively high cost, lack of knowledge among owners and practitioners in the suitability and selection of alternative backfill material, interaction of the backfill with MSE reinforcement, and design and installation of those materials. Therefore, there is a need for design guidelines for the increased use of alternative backfill in MSE walls in practice.

IV. LITERATURE RESEARCH SUMMARY
Stark et al. (2004) provided design guidelines and material/construction standards for EPS block geofoam as a lightweight fill alternative in roadway embankments. This RNS calls for a similar document for alternative backfill for MSE walls. Several studies have been conducted to evaluate the advantages of alternative backfill for MSE walls. For example, Hatami and Witthoeft (2007) evaluated the potential of EPS inclusions in MSE walls, showing a 75% reduction in lateral earth pressure compared to traditional backfill material using numerical simulations.

V. RESEARCH OBJECTIVES
The main objective of the proposed research is to develop design guidelines for the use of alternative lightweight backfill in MSE walls with extensible and inextensible reinforcements. The design guidelines will cover suitability and material selection criteria, engineering properties for various alternative backfills, critical design considerations, interaction of alternative backfill with reinforcements, and installation considerations.

Tasks
The proposed research consists of the following tasks:

**Task 1: Review Literature and Assess Current Practices**
This task includes a comprehensive review of national and international practices for use of alternative lightweight backfill in MSE applications and transportation earthworks.

**Task 2: Identify Gaps in Current Practices and Perform Appropriate Studies**
After the literature review and the assessment of current practices, identify and list gaps in material properties, design, and construction/installation of current practices. Perform appropriate studies to bridge the gaps for development of design guidelines.

**Task 3: Develop Design Guidelines for Use of Alternative Lightweight Backfill in MSE Walls**
Develop comprehensive design guidelines for use of alternative lightweight backfill in MSE applications. The design guidelines should include but are not limited to material selection, engineering design properties, required material characteristics for use as alternative lightweight backfill, lab and field testing requirements, design with extensible and inextensible reinforcements, installation guidance and environmental suitability of the materials.

**VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD**
$300,000, an experimental field phase may be required estimated to cost additional $300,000 depending on the results of the first study. The research period is estimated to be 24 months.

**VII. URGENCY AND POTENTIAL BENEFITS**
The benefits of developing the design guidelines for use of alternative backfill in MSE applications are.
- Providing an alternate to potentially costly ground improvement techniques to support embankment or structures
- Differentiating the mechanical behavior between lightweight aggregates (which fit in with conventional MSE design) and alternative lightweight fill such as cellular foam concrete
- Improving safety through comprehensive and consistent design considerations using alternative lightweight backfill

**VIII. IMPLEMENTATION PLANNING**
This research will serve as a basis for development of an implementation plan to be included in FHWA GEC-11 Design and Construction of MSE wall and Reinforced Soil Slopes.

**IX. PERSON DEVELOPING THE PROBLEM**
Willie Liew, P.E. M.ASCE,
Tensar International;
404-209-0431 (PHONE)
Relevance

Federal and State DOTs, Researchers; the following DOT’s have expressed strong interest in supporting this research: Nebraska Department of Roads, Louisiana Department of Transportation and Development, Idaho Transportation Department, and the Oregon Department of Transportation. In addition, the AASHTO Subcommittee on Materials has indicated they consider this a critical research need and we anticipate it being supported at the next annual committee meeting.

Sponsoring Committee
AFS10 – Transportation Earthworks

Research Priority
High

Source Info

Date Posted
03/01/2017

Date Modified

Index Terms
Transportation, Earthwork, Alternative lightweight backfill, Mechanically Stabilized Earth (MSE)
Cosponsoring Committees
AFS70 – Geosynthetics

Subjects
Highways, Materials, Construction, Bridge and other Structures

References


NCHRP Review of D-12
Reviewed By:
Amir N. Hanna
ahanna@nas.edu
Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem appears to be solvable through the proposed research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

The topic of research is likely to be of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research.

D. Is the scope of the research reasonable?

The proposed scope involves 2 phases of work; the scope of the first phase is clearly described. The second phase will include experimental field work, if supported by the findings of the first phase. Details of the anticipated field work are not provided. It is suggested that the scope be limited to the work proposed for the first phase.

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 24 months appears adequate.

F. Is the budget adequate?

The proposed budget of $300,000 for the first phase appears adequate.

G. Comments on current or past research on the topic.

Only a few studies have been cited. Further literature review should be performed as part of the research.

Review Date:
11/28/2017

FHWA Evaluation of D-12

Jennifer Nicks/HRDI-40 - There is currently a lack of design guidance for MSE walls constructed with alternative backfill materials. This problem statement looks to address this need for a variety of lightweight backfills. This proposed research has merit, but the funding and research period estimates seem low for the development of truly comprehensive design guidelines considering the amount of backfills available and the various limit states. S. Nichols/HIBS-20 - Currently, there is no guidance for alternative fills in MSE construction, and this research would address that. While the idea is good and the research would advance the use of MSE, there are other more pertinent needs for MSE design.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

Rank 3 (AASHTO Committee on Materials)

I. PROBLEM NUMBER

2019-D-13

II. PROBLEM TITLE

Evaluating Use of Unconventional Fly Ash Sources in Highway Concrete

III. RESEARCH PROBLEM STATEMENT

Supplementary cementitious materials (SCM) are a key ingredient of today's concrete and can vastly improve the durability (e.g., ASR mitigation) and sustainability of concrete mixtures. While demand for fly ash (the highest used SCM) and other suitable pozzolans continues to escalate, the supply of high quality and economically available fly ash has been shrinking or at least become unpredictable. This is in part due to shifting of fuel sources (e.g., coal to natural gas) at power plants and partly due to tightening environmental and air pollution regulations, which affect fly ash quality by increasing its carbon, calcium, sulfur, and ammonia contents.

Currently, less than 50% of produced fly ash meets M 295 (ASTM C618) requirements, and as such is usable in concrete. The imbalance between the supply and demand for quality fly ash has already resulted in regional and seasonal shortages, which is anticipated to significantly worsen in future. In a recent AASHTO survey 80% of respondents indicated issues with the fly ash supply. For example, based on today's practices and standards, it is estimated that by year 2030, supply of M 295 (ASTM C618) fly ash in the U.S. will be approximately 14 million tons, while the demand will exceed 35 million tons. A vast, largely untapped resource, is the fly ash that has been stockpiled over the years in dry storage monofills. Another option is application of fly ash benefication technologies that are easy to implement and do not require high capital investment.

Obviously, transportation agencies and the concrete industry need to evaluate and identify new and unconventional fly ash resources that will maintain the quality and performance of concrete.

This research falls directly in line with AASHTO's Vision Statement to 'the development of transportation solutions that create economic prosperity, enhance quality of life, and improve safety.' The increased usage of fly ash, which has shown to be beneficial in concrete, will help make concrete better, less costly, and longer lasting, and reduce the need for landfill.

IV. LITERATURE SEARCH SUMMARY

A literature search was done on the problem statement of non-standard fly ash in concrete. Twenty-two projects were described but none were of the nature of this research, to utilize non-standard fly ash in mixtures. The closest ones referenced using an increased amount. A recent completed study NCHRP 749 – Methods for Evaluating Fly Ash for Use in Highway Concrete has looked into this. This study will use the results of that study and expand on it.

The topic of increased need for fly ash and the lowering supply has prompted the Subcommittee on Materials (ASOM) to convene a Task Force which produced a SOM 2016 Fly Ash Task Force Report in November 2016.
V. RESEARCH OBJECTIVE

The objective of this research is to update AASHTO M 295 (ASTM C618) standard to consider new and unconventional fly ash sources that are appropriate for use in highway concrete.

Accomplishment of this objective will require at least the following tasks.

Task 1. Literature review
The review should include previous studies on the use of recovered stockpile and lagoon fly ash, performance of non-M 295 (ASTM C618) fly ashes in concrete, as well as various fly ash beneficiation and mineral processing technologies that are available at industrial or laboratory scale. Evaluation of the economic viability, effectiveness and ease of implementation of each beneficiation technology should be included. Also, standard and recently developed test methods to characterize the properties and performance of fly ash should be reviewed. The review should identify the most promising unconventional fly ash resources and beneficiation technologies that will be experimentally evaluated in the remaining project tasks.

Task 2. Acquiring recovered fly ash and high loss-on-ignition (LOI) fly ash samples
Samples of sources of stockpiled fly ash identified in Tsk 1 should be obtained and evaluated to determine the degree of heterogeneity in the properties considering the different locations and depths of each stockpile. In addition, several samples of marginal or high LOI fly ashes should be acquired for benefication and testing.

Task 3. Characterizing and beneficiating fly ash samples
Each obtained fly ash sample should be characterized to determine its bulk chemistry and mineralogy, unburned carbon content, and physical properties. The results should be compared with M 295 (ASTM C618) requirements to determine areas of non-conformance, and to identify the necessary benefication. The most promising and feasible benefication methods identified in Task 1 will be applied to fly ash samples.

Task 4. Evaluating the performance of raw and beneficiated fly ashes in concrete
A well-designed experimental plan should be developed and executed to evaluate the fresh and hardened properties of concrete mixtures containing raw or beneficiated fly ash. Consideration should be given to the consistency of the entrained air content and structure and other relevant properties. The results allow numerical evaluation and ranking of the effectiveness of various benefication methods. For stockpiled fly ash, this task will identify critical benefication processes and those having marginal impact on the performance of concrete. Guidelines for evaluating stockpiled fly ashes and recommendations on new tests or modifications of existing test methods should be presented.

Task 5. Preparing a Proposed Revised/Updated AASHTO M 295 Standard
Based on the findings of the evaluations performed in Task 4, a proposed revised version of AASHTO M 295 that considers the new and unconventional fly ash sources that are appropriate for use in highway concrete should be prepared.

Task 6. Draft project report
A draft project report that documents the entire research effort should be prepared and submitted for NCHRP review.

Task 7. Final project report
A revised final deliverable should be prepared that addresses the comments on the draft project report together with a response to comments.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

$ 400,000

**Research Period:**

30 months

VII. URGENCY AND POTENTIAL BENEFITS

This is a very urgent issue since the use of Fly Ash and other Supplementary Cementitious Material (SCM) has been shown to not only increase the durability of concrete and is less costly but reduce the negative effects of alkali-silica reactivity (ASR), a reaction that almost all 50 states experience.

The potential benefits would be increased concrete durability, less expensive concrete and less landfilled material. Not funding this project will have the opposite effect.

This research parallels the needs of the SOM Task Force on Fly Ash that in the short term alternate sources are reviewed and shared, and that AASHTO rewrite the standard for its use. In the long term to look at further testing of this material and look at blending of ashes.

VIII. IMPLEMENTATION PLANNING

The target audience for this would be the SOM and all DOT’s which use concrete. Optimization of processing technologies and/or modification to expand the fly ash standard to allow different types to be used could be adopted rather quickly. States would not have to change any specification since they already reference the AASHTO or ASTM specification. Because this has been a major issue within the US highway community there would be many states willing to utilize rather quickly.

IX. PERSONS DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

Mick Syslo (NE DOT) or his designee. Mr. Syslo is the Chair of the AASHTO Technical Section for this standard.
XI. SUBMITTED BY

TRB Concrete Committees AFN10, AFN20 AFN30 and AFN40 through the AASHTO Committee on Materials and Pavements

NCHRP Review of D-13

Reviewed By:
Edward T. Harrigan
eharriga@nas.edu

Comments:

A. Is the problem potentially solvable through research?

The problem is of high priority and is potentially solvable through NCHRP research.

B. Is it likely of interest to at least 2/3s of the DOTS?

The problem statement is of national interest as PCC is widely used in the construction of highway structure.

C. Is there a reasonably clear objective?

The objective is clear and straightforward, to revise AASHTO M 295 to encompass specification of beneficiated or otherwise unconventional fly ashes.

D. Is the scope of the research reasonable?

The research scope, as described by the tasks, is well defined and reasonable.

E. Can the research be done in 2-3 years at the most?

Staff estimates that the research will required 3 years.

F. Is the budget adequate?

Considering the uncertainty inherent in the potential experiment design for evaluating beneficiation technologies and validating the results, staff recommends a budget of $600,000.

G. Comments on current or past research on the topic.

A search on Google Scholar from 2014 to present did not identify research directly related to the research objective.

Review Date:
11/21/2017
FHWA Evaluation of D-13

Rick Meininger/HRDI-10 - This is an important and urgent topic for both transportation agencies and industry "in part due to shifting of fuel sources (e.g., coal to natural gas) at power plants and partly due to tightening environmental and air pollution regulations, which affect fly ash quality by increasing its carbon, calcium, sulfur, and ammonia contents." Fly Ash will continue to be available, but its properties have and will be changing, and DOTs need to know how to best use currently "non-standard" fly ashes in concrete as SCMs from both a sustainability and ASR mitigation standpoint. Several avenues of potential research: how can recovered fly ash from landfills and impoundments best be processed and used in concrete; various blends of cementitious materials might be used in concrete -- blended either at the concrete plant and/or blended as a component in blended cement or in a performance-graded cement; research on how to overcome the problem of controlling the entrained air content in fly ash concrete in those cases of high LOI fly ashes and fly ashes that adsorb much of the air-entraining agent preventing the necessary stabilization of air bubbles. "This research parallels the needs of the SOM Task Force on Fly Ash ... that AASHTO rewrite the standard for its use." Revisions to AASHTO M 295 are needed to broaden the sources and blends of fly ash used to make quality, long-lasting concrete. Gina Ahlstrom/HIAP-10 and Sam Tyson/HIAP-20 - There has been a need to update existing fly ash specification for years. The project would help States deal with reduced fly ash supply. Additional minor comments include the following: could be clearer in the title that they are researching coal fly ash, include American Coal Ash Association, should emphasize research on finding unconventional sources of coal fly ash that can be beneficiated through processes that result in coal fly ash that meets current standards rather than modifying AASHTO M295 (ASTM C618). Modification of the AASHTO & ASTM procedures would require many years of developing performance data and discussion and debate in the relevant committees. May be worth investigating the pecimum and optimum limits of both class F and c coal fly ash.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

Rank 1 (AASHTO Committee on Materials)

I. PROBLEM NUMBER

2019-D-14

II. PROBLEM TITLE

Rating Concrete Permeability Based on Resistivity Measurements

III. RESEARCH PROBLEM STATEMENT

The AASHTO T 277/ASTM C 1202, Electrical Indication of Concrete Ability to Resist Chloride Ion Penetration, has been widely accepted for assessing durability of concrete. The test provides an indication of the concrete’s ability to resist chloride ion penetration but it has many shortcomings: it is slow and time consuming, destructive, prone to errors caused by sample heating, and fails to adequately capture features associated with supplementary cementitious materials (SCMs). Electrical resistivity measurements (AASHTO T 358, Standard Method of Test for Surface Resistivity Indication of Concrete’s Ability to Resist Chloride Ion Penetration) have the potential of providing performance-based evaluation of concrete although they may not always yield accurate results. However, the data obtained from these measurements do not relate to concrete water permeability. It is suggested that a formation factor that incorporates the ratio of the resistivity (ρ) of the bulk concrete to the resistivity (ρ₀) of the pore solution or other approaches can be used to provide a better assessment of transport properties. There is need to evaluate the feasibility of using this or other approaches as a tool for rating concrete permeability based on resistivity measurements.

IV. LITERATURE SEARCH SUMMARY

Literature search revealed numerous publications related to concrete air and water permeability but none that explicitly relate concrete water permeability to resistivity properties.

V. RESEARCH OBJECTIVE

The objective of this project is to develop recommendations for rating concrete water permeability based on electrical resistivity measurements.

Tasks: Accomplishment of the project objective will require at least the following tasks.

Phase I:

Task 1. Review literature, ongoing research findings, and current practices relevant to the characterization and measurement of concrete water permeability and its relationship to electrical resistivity. This information may be assembled from published and unpublished reports, contacts with academia, transportation agencies, industry organization, and other sources.

Task 2. Identify and evaluate concrete mixture and test parameters that influence concrete water permeability (e.g., aggregate sources, including lightweight aggregates, cementitious materials, water to cementitious materials ratios, age of concrete, and curing regimen) and the methods currently used in the United States and other countries for measuring concrete water permeability and relating it to resistivity measurements. Discuss the merits and deficiencies of these methods,
and recommend potential methods for use in laboratory evaluations, for further evaluation in Phase II.

Task 3. Develop a research plan for an experimental investigation, to be executed in Phase II, for (1) developing and demonstrating test methods for measuring water permeability, (2) evaluating the effects of a range of the concrete mixture parameters (aggregate source, combinations of portland cement and different supplementary cementitious materials, water/cementitious materials ratios, age of concrete, etc.) identified in Task 2 on concrete water permeability and consider the range of CaO/(Al₂O₃+SiO₂) ratios obtained for mixtures made with 100% portland cement to those made with commonly used SCM types and proportions, and (3) relating concrete water permeability to electrical resistivity measurements.

Note: The research plan must provide detail on the work proposed for Phase II. The work proposed for Task 5 must be divided into subtasks, and the work proposed in each subtask (e.g., details of the experimental investigation, including proposed test procedures, test variables, specimen details and materials, replication; the rationale for proposed experimental plan; data analysis procedures; and other information to illustrate relevance of the proposed work to achieving project objective) must be described in detail. The proposed research plan must be free from any aspects that could be perceived as jeopardizing the objectivity of the research.

Task 4. Prepare an interim report that documents the research performed in Tasks 1 through 3. Following review of the interim report by the NCHRP, the research team will be required to make a presentation to the project panel. Work on Phase II of the project will not begin until the interim report is approved and the Phase II work plan is authorized by the NCHRP. The decision on proceeding with Phase II will be based on the contractor’s documented justification of the updated work plan.

Phase II:

Task 5. Execute the plan approved in Task 4. Based on the results of this work recommend (1) a test method for measuring concrete water permeability, and (2) a means for rating concrete as very low, low, moderate, and high permeability based on resistivity values. If a protocol for the recommended test method is not currently available, it should be developed and presented in AASHTO format. The recommendations for rating concrete permeability based on resistivity measurements shall be prepared in the form of a recommended practice in AASHTO format.

Task 6. Prepare a draft final deliverable that documents the entire research effort, and submit for NCHRP review. The test protocol and recommended practice shall be prepared as stand-alone documents appropriate for incorporation into the AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $500,000

**Research Period:** 30 months

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

Concrete durability and service life is greatly influenced by its water permeability. However, measuring water permeability of concrete is difficult. By relating water permeability to electrical resistance that can be easily measured, durability can be easily assessed and if necessary and adjustment be made to achieve the level of permeability required for the desired service life. The developed test protocol and recommended practice will be prepared for incorporation into the
AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing.

Limited work on this topic was approved under NCHRP Project 20-07/Task 381. However, the Advisory Panel agreed on the need for a more comprehensive research effort to consider the relevant mixture parameters and test conditions needed for producing well-supported findings. The panel prepared a draft research problem statement and provided it to the AASHTO Highway Subcommittee on Materials (SOM) Tech Sections 3a, 3b, and 3c to seek endorsement and SOM approval and submittal to the NCHRP for funding from NCHRP FY 2019 Program.

VIII. PERSON(S) DEVELOPING THE PROBLEM

Advisory Panel for NCHRP Project 20-07(381) in cooperation with SOM Tech Sections 3a, 3b, and 3c (John Stanton, Mick Syslo, and Brian Eagan, Chairs)

IX. PROBLEM MONITOR

X. DATE AND SUBMITTED BY

Date: Submitted by the AASHTO Highway Subcommittee on Materials

NCHRP Review of D-14

Reviewed By: Edward T. Harrigan eharriga@nas.edu

Comments:

A. Is the problem potentially solvable through research?

The problem is potentially solvable through an NCHRP research project.

B. Is it likely of interest to at least 2/3s of the DOTS?

The problem is of national interest.

C. Is there a reasonably clear objective?

Staff recommends restating the objective as "Develop proposed AASHTO standard methodology and criteria for measuring and rating concrete water permeability by electrical resistivity testing."

D. Is the scope of the research reasonable?

The scope as defined by the proposed tasks is reasonable.

E. Can the research be done in 2-3 years at the most?
The research can be accomplished in 3 years.

F. Is the budget adequate?

Considering the complexity of the topic and the range of test and material variables of interest, staff recommends a budget of $650,000.

G. Comments on current or past research on the topic.

A search on Google Scholar from 2014 to present did not identify research directly related to resistivity test method development.

The problem statement was proposed to replace NCHRP Project 20-07/Task 381 after the panel established the need for a substantially larger research effort to adequately address the issue and produce well-supported and reliable findings. This problem statement was prepared by the panel in cooperation with the three Technical Sections of the AASHTO Committee on Materials and Pavements that deal with concrete and cementitious materials. The problem statement was endorsed and submitted by the Committee, and was ranked as their highest priority of the 6 problem statements submitted by the Committee.

Review Date:
11/21/2017

FHWA Evaluation of D-14

Ahmad Ardani/HRDI-10 - The ASTM 1202 provides an indication of the concrete’s ability to resist chloride ion penetration, which in turn can be used to assess concrete permeability; however, the test is time consuming and can be affected by heat. The formation factor, which is a new concept for permeability is gaining momentum as an accurate and accelerated test method for concrete durability and is measured by the ratio of surface resistivity of the concrete over its pore solution resistivity. It is believed that this new test method can evolved to a point that can be used as a concrete durability spec, i.e. it can be used as a quality assurance (QA) for durability. Gina Ahlstrom/HIAP-10 - This project will further aid in the development of the Formation factor, which is a critical component of the Provisional Standard for Performance Engineered Concrete Mixes, PP 84-17.

AASHTO Committee Evaluation for D-14

Rating Concrete Permeability Based on Resistivity Measurements

Submitted By:
Evan Rothblatt
Liaison
COMP

Comments:
AASHTO Committee on Materials and Pavements number 1 (top ranked) RPS
I. PROBLEM NUMBER

2019-D-15

II. PROBLEM TITLE

Thermal cracking resistance of asphalt binders

III. RESEARCH PROBLEM STATEMENT

The Performance Grading (PG) system assigns an operational temperature range to a given asphalt binder within which the binder demonstrates adequate resistance to rutting, fatigue cracking, and thermal cracking. The PG system, or some variation thereof is commonly used in the United States to: (i) select the grade of the asphalt binder appropriate for use in different climatic and project conditions, (ii) serve as a purchase specification, and (iii) evaluate the potential impact of changes in binder properties and composition on mixture performance.

Over the past few years, there have been several new trends in binder and mixture production technologies, which ultimately influence binder properties, such as (i) increased emphasis on the use of recycled asphalt, (ii) increased use of industrial by products as an asphalt binder extender / modifier, (iii) introduction of a variety of new chemical additives to promote recycling, (iv) additives used to facilitate mixture production and placement, and (v) chemical and polymer modifiers to alter the properties of the straight-run binder to meet current specifications. All of these factors have a significant influence on the inherent distress resistance of asphalt binders, which is not accurately captured by the current tests and parameters in the PG framework.

Significant work has been done or is in progress to address this gap with regards to rutting, intermediate temperature fatigue cracking, and aging. For example, the Multiple Stress Creep Recovery (MSCR) test and concomitant parameters were introduced to better predict the inherent resistance of asphalt binders to rutting. Ongoing NCHRP Projects 9-59, 9-60, and 9-61 are focused on evaluating the fatigue cracking resistance of asphalt binders using the fatigue performance of asphalt mixtures as a benchmark, addressing the issue of variations in the chemical composition of the binder that may result in poor performance of asphalt mixtures but are not captured by the existing test methods, and addressing the issue of appropriate short- and long-term aging methods that are to be used for binder evaluation. However, there is still a need to better understand and improve the current tests, parameters and specification limits to evaluate the inherent resistance of asphalt binders to low-temperature cracking or more broadly thermal cracking.

Special note to AASHTO Committees and Subcommittees: Please indicate the relationship between the suggested problem and the committee’s strategic plan and/or its overall research agenda.

Advice to State Departments of Transportation and the Federal Highway Administration: Submitters are encouraged, but not required, to vet or submit problem statements through an appropriate AASHTO committee or subcommittee.
IV. LITERATURE SEARCH SUMMARY

The current AASHTO M320 asphalt specification is primarily based on the use of the Bending Beam Rheometer (BBR). The BBR is an excellent tool to measure the low temperature stiffness (S) and rate of relaxation (m-value) of the asphalt binder. In rare cases when the stiffness value fails to meet the requirements, the specification allows for a strength test (DT or direct tension test). Higher stiffness or lower m-value are indicators of higher thermal stresses. However, failure only occurs when the thermal stresses in combination with external load related stresses, exceed the tensile strength of the material. The BBR does not provide a measure for the strength of the material and unfortunately despite substantial development work during SHRP, the DT test has not gained widespread usage.

Several studies have tried to overcome the limitations of the BBR and develop a simple and easy to use method for testing low temperature cracking resistance of asphalt binders. These tests focus on the fracture resistance of the binder. For example, the Asphalt Binder Cracking Device (ABCD) (Kim et al. 2006, AASHTO TP92), the Double Edge Notched Test (DENT) (Hesp 2004, Andriescu et al. 2004), Single Edge Notched Beam (SENB) (Hesp 2004, Velasquez et al. 2012), and BBR-Pro are all methods that can be used to evaluate the fracture resistance of the binder. While most of the aforementioned methods require the use of additional accessories or capital equipment, studies have also shown that the performance of the binder can be more accurately predicted by using different parameters from the current BBR test method. For example, difference in continuous grade based on stiffness and m-value can serve not only as an indicator of performance for low temperature cracking, but also as an indicator for fatigue cracking resistance at intermediate temperatures (Rowe 2014).

In addition to the actual test method itself, there are constraints and gaps in knowledge that need to be addressed. Thermal cracking is a predominant form of distress that is strongly tied to the aging of asphalt binders and concomitant changes in ductility. As such, a better understanding of the differences between oxidation and physical understanding is needed to develop appropriate methods and interpret results accurately. Also, since this distress is of particular concern with the use of recycled asphalt, certain test methods that require large binder samples are not ideal on account of the recovery process from the recycled material.

V. RESEARCH OBJECTIVE

The research study is intended to investigate the material properties and mechanisms that dictate the thermal cracking resistance of asphalt binders with emphasis on low temperature cracking, and to use this information to improve the test methods, parameters, and specifications (as needed) in the current PG framework. Specifically, this study must consider, but not be limited to, the following aspects:

1. Review the literature to better understand the mechanisms of thermal cracking including emphasis on the role of aging, the role of physical hardening, the material properties that dictate the thermal cracking resistance of the binder in the field, and the methods that can be used to assess such properties.
2. Review the work being done in ongoing NCHRP Projects 9-59, 60, and 61 to ensure synergy between the proposed work and other ongoing projects.
3. Use the above information to design and execute a work plan to identify the most suitable test method(s) and parameter(s) that can be used to identify the inherent thermal cracking resistance of asphalt binders. Selection of test method(s) should be based on considerations that include but are not limited to: accuracy in predicting performance, repeatability of the method, and requirements for sample size and preparation. Accuracy of the method must be validated using a variety of different materials with laboratory and/or field performance of asphalt mixtures.
4. Recommend an implementation plan for the use of the proposed method and parameters so that it can be (i) phased into the existing framework of binder specifications and (ii) used as an independent method to evaluate the thermal cracking resistance of asphalt binders.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

The recommended funding is $600,000 for a duration of three years.

**Research Period:**

The project is estimated to be completed in 30 months including three months for review and revision of a draft final report, and one month for review and revision of each interim report.

VII. URGENCY AND POTENTIAL BENEFITS

Thermal cracking of asphalt binders is a critical form of distress in asphalt mixtures. The current PG framework for low-temperature cracking is based on either the stiffness or rate of relaxation of the binder. This approach, while it has served well for unmodified binders, does not adequately screen for premature failures, particularly in light of an increased use of a variety of different additives, modifiers and extenders during the asphalt binder and mixture production processes. A more accurate method to screen binders for their low temperature and thermal cracking resistance is required to prevent such false positives and associated expensive failures. Such a method should be capable of being incorporated into the current PG framework as well for use as a binder performance evaluation tool.

VIII. IMPLEMENTATION PLANNING

The products of this research will directly benefit state highway agencies and should result in better characterization of low temperature binder properties. Better characterizing low temperature properties and specifying those binders will result in binders better to resist low temperature cracking for a longer period of time, thus prolonging pavement life. This impacts life cycle cost and optimizing state DOT funds. Every DOT is interested in longer pavement life and lower lifecycle cost. Asphalt binder suppliers will be greatly interested in these products as the binders they produce may be specified with these properties.

Key decision makers and early adopters would be state DOTs that are particularly interested in resisting thermal cracking. These would likely be more norther states where extreme low temperatures are encountered.

The project is expected to deliver test methods in AASHTO format and tentative specification limits for binder manufacturers to follow and state highway agencies to specify. AASHTO Subcommittee on Materials, Technical Section 2b would be responsible for reviewing and balloting these research products for approval and AASHTO member state’s use.

In order to maximize timely deployment of the research results, problem statement submitters should identify (a) the appropriate target audience for the research findings and products, (b) key decision-makers who can approve, influence, or champion implementation of the research products, and (c) AASHTO committees and other individuals and organizations with likely
IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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Amit Bhasin, Ph.D., P.E., The University of Texas at Austin, 512-471-3667, a-bhasin@mail.utexas.edu

X. AASHTO MONITOR
TBD

XI. SUBMITTED BY
Darren G. Hazlett, P.E., Texas Department of Transportation, Deputy Director, Construction Division, 512-416-2456, darren.hazlett@txdot.gov

NCHRP Review of D-15

Reviewed By:
Edward T. Harrigan
eharriga@nas.edu

Comments:

A. Is the problem potentially solvable through research?
The problem is potentially solvable through an NCHRP research Project.

B. Is it likely of interest to at least 2/3s of the DOTS?
The one or more of the various types of thermal cracking found in asphalt pavements can occur in a majority of the states.

C. Is there a reasonably clear objective?
The objective statement is clear. This research would address a recognized need to better specify asphalt binders in terms of their resistance to (a) single abrupt low-temperature changes, (b) cyclic temperature changes around the freezing point, and (c) the effects of physical hardening. In particular, physical hardening was considered during the original SHRP research but not definitively addressed in the performance-grading system.

D. Is the scope of the research reasonable?
The scope, as expressed by the proposed tasks, is reasonable.

E. Can the research be done in 2-3 years at the most?

A 3-year project is suitable.

F. Is the budget adequate?

Based on the cost of previous projects of this type, staff recommends a budget of $800,000.

G. Current or recent research

Much work has been done in the last 20 years on this topic, most notably by Hesp in Canada and Marasteanu in the United States. However, their research has not yet led to significant changes in the asphalt binder performance-grading system. As noted in the problem statement, the proposed research should coordinate with ongoing Project 9-59, 9-60, and 9-61. However, none of these projects are duplicative of the objectives of this problem statement.

FHWA Evaluation of D-15

Jack Youtcheff/HRDI-10 - The proposed project addresses a current shortcoming in the binder specification that has arisen from the present diversity of binder sources and formulations. This project would expand on NCHRP Projects 9-59, 60 and 61 and address a distress mechanism (thermal cracking) only tangentially addressed by this ongoing research. The proposal would be well served in also considering the effect of chemical compatibility on performance. Dave Mensching/HIAP-20 - Very timely study. Is the timing of 9-59, 9-60, and 9-61 conducive to Research Objective 2? Describe synergy? Would this require a contractor to alter their workplan if not in certain alignment with existing projects? Recommend elaborating or removing.

AASHTO Committee Evaluation for D-15

Thermal Cracking Resistance of Asphalt Binders

Submitted By:
Evan Rothblatt
Liaison
COMP

Comments:
AASHTO Committee on Materials and Pavements number 3 ranked RPS
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-D-16

II. PROBLEM TITLE


III. RESEARCH PROBLEM STATEMENT

Connected and Automated Vehicles (CAV) are growing in popularity for the traveling public and the trucking industry. There are many advantages to using CAV, but they present challenges as well. The existing physical and digital infrastructures for transportation owners are not equipped to support these vehicles without major financial investments from public and/or private institutions. The changes in travel patterns, vehicle spacing, wheel wander and other aspects may accelerate the deterioration and performance of pavements. Additionally, recognizing the slow pace of adoption of new design standards and coupled with the fact that pavement assets are typically designed for 20 plus years, it’s imperative that this research on the impacts of CAV on pavements design, rehabilitation and materials be undertaken now to facilitate adoption and implementation by pavement asset owners.

IV. LITERATURE SEARCH SUMMARY

A search through TRID did not find anything related to the direct impact on infrastructure which is why this research is needed. Everything related to CAV is generally about safety, capacity, interactions, and freight. The closest research so far is the ongoing NCHRP 20-102(15) work.

To date, much of the research and funds have focused on digital infrastructure to connect CAV with communications systems. As an example, some work is currently underway through NCHRP 20-102(15) “Understanding the Impacts of the Physical Highway Infrastructure Caused by the Increased Prevalence of Advanced Vehicle Technologies”. However, the focus of this work is on traffic control devices. While that work is vitally important, very little investigation has been done on the potential impacts on transportation owners’ largest asset – pavements.

V. RESEARCH OBJECTIVE

1. Provide an estimate of the uptake and impact CAV on the performance of pavements and materials.
2. Develop a guideline document for pavement practitioners on how to initially consider these impacts in their pavement design policies and practices.

Tasks anticipated in this project include:

1. Perform a literature review of on-going/completed research related to the anticipated uptake of CAV. This task would extend the efforts undertaken under NCHRP 20-102.
2. Perform a literature review of on-going/completed research related to the changes in vehicle behavior that may impact pavement performance (i.e., structural and functional), design, rehabilitation and materials policies for transportation agencies.
3. Identify potential pavement design/performance impacts of CAV on new or existing structures through various stakeholders such as owners, car manufacturers, systems developers, industry, and material vendors.
4. Review and identify sections in the AASHTO 1993/98 Guide for the Design of Pavement Structures that will be impacted by CAV.
5. Summarize the expected impacts based on the level of uptake.
6. Determine gaps in current design methodologies based on tasks 1 through 5.
7. Develop research plan (i.e., Roadmap) to evaluate the gaps and propose further research needs statements to address the gaps.
8. Provide a guideline document including the results of the above task to include initial guidelines for addressing the potential impacts.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

$400,000

**Research Period:**

24 months

VII. URGENCY AND POTENTIAL BENEFITS

This research will provide practitioners with appropriate guidance on how to account for the impact of CAV in their pavement design policies and practices. Pavements are designed with service lives generally ranging from 15 to 50 years. However, significant uptake of CAV is anticipated to occur within the next decade. Therefore, without this research, there is substantial risk that the impacts of CAV will be considered too late in the lifecycle of many pavements.

VIII. IMPLEMENTATION PLANNING

The intent of this research is to provide practical guidance that could be used by all local, state and federal agencies that own pavements. No institutional or political barriers to implementation are anticipated.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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Trenton Clark, P.E., Executive Vice President, Virginia Asphalt Pavement Association, 804-929-2331; tclark@vaasphalt.com

Dr. David H. Timm, P.E., Brasfield & Gorrie Professor, Auburn University, 334-844-6282, timmdav@auburn.edu

Lyndi D. Blackburn, P.E.; Asst. State Materials & Tests Engineer, Alabama Department of Transportation; 334-206-2203; blackburnl@dot.state.al.us

Catherine McGhee, P.E.; Director of Research; Virginia Transportation Research Council; Virginia Department of Transportation; Cathy.McGhee@VDOT.Virginia.gov

X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you
wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. SUBMITTED BY

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Supported by: AFD 30 and AFD 60

NCHRP Review of D-16

Reviewed By:
Edward T. Harrigan
eharriga@nas.edu

Comments:

A. Is the problem potentially solvable through research?
This is a timely statement of a problem that is potentially solvable through NCHRP research.

B. Is it likely of interest to at least 2/3s of the DOTs?
Considering the apparent inevitability of CAV adoption in the next decades, this problem statement is likely of national interest.

C. Is there a reasonably clear objective?
While clear, the objectives appear to overlap those of current NCHRP Project, Impacts of Connected and Automated Vehicle Technologies on the Highway Infrastructure. Although this current project is mentioned in the problem statement, the statement in IV. Literature Search Summary that the "... the focus of this work [Project 20-102(15)] is on traffic control devices" appears incorrect.

D. Is the scope of the research reasonable?
The scope of the research as described by the proposed tasks appears reasonable.

E. Can the research be done in 2-3 years at the most?
The research can be accomplished in 2 years. However, staff recommends that deferment of this problem statement to a future fiscal year when the results of 20-102(15) are available.

F. Is the budget adequate?
The proposed budget is adequate.

G. Comments on current or past research on the topic.
On its surface, this problem statement appears duplicative of work already funded in NCHRP Project 20-102(15), Impacts of Connected and Automated Vehicle Technologies on the Highway Infrastructure. A search with Google Scholar and TRID did not identify any other similar research.
FHWA Evaluation of D-16

Nadarajah Sivaneswaran/HRDI-20 - The need to address this emerging topic from pavements point has been discussed in the last few meetings of TRB AFD 30 Standing Committee on General and Emerging Pavement Design. A timely topic and findings from this effort will help inform agencies to be strategic and proactive in pavement design, rehab and construction decisions moving forward as CAV share gradually increases in the network of pavements. Heather Dylla/HIAP-10 and Dave Mensching/HIAP-20 - High research need and was a topic of a GAO audit this year. This is a valuable project that addresses serious implications concerning potential future needs for revised guidelines for designing and assessing performance of pavements. However, how does mechanistic-empirical (M-E) design factor into this problem statement? Would NCHRP be receiving a guidance document related only to empirical pavement design? Perhaps a task be included to provide guidance on the implications to states who are or already have adopted M-E design? Sources of projected growth in truck traffic associated with CAV would be the U.S. DOT Intelligent Transportation Systems Joint Program Office; the American Trucking Associations; and, the Department of Mechanical Engineering at Auburn University.

AASHTO Committee Evaluation for D-16

Determination of the Impacts of Connected and Automated Vehicles (CAV) on Pavement Design, Rehabilitation, and Materials Selection

Submitted By:
Evan Rothblatt
Liaison
COMP

Comments:
AASHTO Committee on Materials and Pavements number 2 ranked RPS
I. PROBLEM NUMBER

2019-D-17

II. PROBLEM TITLE

Practitioners Handbook for Noise Wall Inspection Procedures During and Post Construction

III. RESEARCH PROBLEM STATEMENT

There are hundreds of miles of noise walls along the nation’s highways. However, unlike bridges, pavements, and retaining walls, noise walls in general are often overlooked assets. There is no comprehensive guidance or system addressing the inspection of new and existing noise walls. The long term performance of noise walls depends on many factors, and unfortunately, there have been instances of poor performance. Like every important class of assets, noise walls need initial and periodic inspection, assessment, and management. States are looking for guidance, tools, and funding regarding an initial and post inspection noise wall program.

IV. LITERATURE SEARCH SUMMARY

There does not appear to be any previous work with specific focus on Noise Wall Inspection Procedures During and Post Construction.

Below are projects from TRID (http://trid.trb.org) and Research in Progress database (http://rip.trb.org/) relating to structural walls but not specific to noise walls.

Road structures inspection manual (Accession Number: 01381210)

Inspection Guidelines for Construction and Post-Construction of Mechanically Stabilized Earth Wall (Accession Number: 01459903)

V. RESEARCH OBJECTIVE

The objective of this research is development of a Practitioners Handbook for Noise Wall Inspection Procedures During and Post Construction.

The completed handbook will provide state highway agency staff and supporting consultants with information necessary to effectively inspect new noise wall projects as well as existing noise walls to avoid issues during and post construction.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $150,000
Research Period:

24 months

(Note: This estimate may be changed by the Project Panel.)

VII. URGENCY AND POTENTIAL BENEFITS

This project has high urgency for states that have a high square footage (SF) of noise walls and continue to build new noise walls. Lack of funding for the project will result in a continued state of risk for states when trying to ensure new noise walls are constructed properly and existing noise walls are performing properly.

VIII. IMPLEMENTATION PLANNING

The target audience for this project is state highway agencies that have a high SF of noise walls and continue to build new noise walls. Champions of the project will include state highway agency environmental program managers and the AASHTO Committee on Environment Noise Working Group.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you
If you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. SUBMITTED BY

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NCHRP Review of D-17

Reviewed By:
William C. Rogers
wrogers@nas.edu

Comments:
This should be a synthesis project. A quick search showed that in 2016 Colorado published a 300-page manual entitled, Colorado Retaining and Noise Walls Inspection and Asset Management Manual, and in 2017, Wisconsin published the WisDOT Structure Inspection Manual, with Chapter 5 -- Noise Walls, containing recommended inspection procedures.

Review Date:
11/16/2017

FHWA Evaluation of D-17

Richard Duval/HRDI-20 - Research with quick hit, simplicity, and costs. There is the obvious performance of the wall structures to assess, but also have to consider as the wall deteriorates does this reduce the sound and air abatement also. Adam Alexander/HEPN-10 - States may be able to address this need by coordinating with states that already have acceptance and inspection methodologies. This could be an issue for states that do not build many noise barriers.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-D-18

II. PROBLEM TITLE

Statistical Inspection Procedures for Transportation Projects

III. RESEARCH PROBLEM STATEMENT

Many transportation agencies use statistical sampling and testing procedures for evaluating the quality of construction materials. Contractor quality control requirements, Lot-by-Lot acceptance using random sampling, and use of quality measures such as percent-within-limits (with associated pay adjustments) have been used successfully for years. However, these are typically applied to material properties such as strength, density, asphalt content, permeability and grain size; application of statistical sampling techniques and analytical analysis and trending of data for inspection of workmanship is not as widespread.

Inspection procedures with statistical based sampling would offer several positive benefits. Agencies would have the ability to apply rational acceptance decisions based upon the positive assessment of work completed correctly and reduce reliance on subjective assessments of construction workmanship quality. Inspection data on observed performance rate for a sampling of workmanship could be analyzed to identify work items with acceptable rates of observed performance; this information could be used by contractors in their process improvement efforts and by agencies to assist with determining required levels of inspection effort. Use of these procedures would provide inspection documentation that is consistent and objective, leading to improved information for long-term facility preservation and maintenance. Overall construction quality would be improved by accurately determining the observed performance rate through a systematic and statistical approach to inspection, eliminating the acceptance of work items that fail to meet the minimum performance rate.

This project is aligned with the AASHTO Subcommittee on Construction’s 2016-2017 work plan, which includes gathering data to support risk-based inspection, as well as with the mission of the Subcommittee on Materials Quality Assurance and Environmental technical section.

IV. LITERATURE SEARCH SUMMARY


- This report evaluated inspection practices at INDOT and developed a risk-based inspection protocol.


- Describes materials testing and workmanship inspection programs that evaluate independent data that can be used to help manage project and program quality.
The proposed research would expand on these works by providing statistically-sound methods for accepting construction work items and improving contractor construction processes and agency and inspection procedures. The information would also be used to develop true risk-based inspection protocols to optimize inspection resources.

V. RESEARCH OBJECTIVE

The objective of this project is to produce guidelines for transportation agencies to use in developing statistical procedures for construction inspection.

Possible tasks include:

1) Literature search.
2) Survey of state agencies.
3) Identification of key inspection attributes for various work items. Include earthwork, pavement, and structures.
4) Develop a proposed statistical sampling inspection method. Include guidance on both attributes and variables acceptance plans.
5) Develop inspection guidance for major work items including earthwork, pavements and structures.
6) Produce a PowerPoint slideshow for presentation as a TRB Webinar.
7) Prepare a technical brief describing the research project and resulting guidelines.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$350,000.00

Research Period:

24 months

VII. URGENCY AND POTENTIAL BENEFITS

According to a 2010 report published by the American Society of Civil Engineers’ Construction Management and Inspection Committee, approximately two-thirds of construction project failures are related to sub-standard workmanship. Successful deployment of statistical inspection procedures has the potential to improve project quality and reduce occurrences of failures caused by substandard construction practices. Improved quality will lead to lower costs through reduced rework and improved facility life. Agencies and contractors will benefit from having access to inspection data that can be used to improve processes, quantify risk, and optimize inspection efforts.

VIII. IMPLEMENTATION PLANNING

The target audience for this product will be public transportation agency leaders responsible for project delivery, including Chief Engineers, construction engineers, project managers, quality assurance engineers, contracts engineers, and construction oversight staff. FHWA construction and quality assurance specialists in the various divisions and Resource Centers will be critical in assisting with implantation of these procedures, as will the AASHTO Subcommittees on Construction and Materials. Contractor and consultant engineering associations, including the
Associated General Contractors, the American Road and Transportation Builders Association, and the American Council of Engineering Companies will be important partners.

Potential barriers include resistance to change by some agencies, lack of training for both agency and contractor personnel, and lack of appropriate data collection and management tools.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

XI. SUBMITTED BY

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Richard.bradbury@maine.gov

NCHRP Review of D-18

Reviewed By:
Amir N. Hanna
ahanna@nas.edu

Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem appears to be solvable through the proposed research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

The topic of research is expected to be of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?
The objective, as stated in the problem statement, provides a clear intent of the research.

D. Is the scope of the research reasonable?

The scope is reasonable and appropriately addresses the intent of the research.

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 24 months appears adequate.

F. Is the budget adequate?

The proposed budget of $350,000 appears adequate.

G. Comments on current or past research on the topic.

A few relevant studies have been cited; further literature review should be performed as part of the research.

Review Date:
11/29/2017

FHWA Evaluation of D-18

Richard Duval/HRDI-20 - Important study if strictly focused on statistical inspection only. However, there is a lot of research/education that may be able to capture this already in the pipeline or could be redundant. At some level we need to coordinate with other RNS. This would include Above RNS D-09 - A Guidebook for Risk-Based Construction Inspection; Currently FHWA is conducting research on QA essentials for Accelerated Bridge Construction which includes inspection; FHWA NHI working to improve Bridge Construction Inspection course; NCHRP 10-92 Optimizing the Risk and Cost of Materials QA Programs; and, FHWA Construction Digital Inspection research. Chris Schneider/HIAP - 30 - A statistical approach to inspecting workmanship cannot substitute for the needs and reality of construction, its operations, activities and items of work. Observation (inspection) of workmanship is a real-time action performed by one’s eyes, knowledge and experience, and the decision to inspect and frequency to inspect is based on requirements and the unique conditions that affect a particular project. It is the intuition of the inspector (construction manager, resident engineer) to determine what operations and work items are high risk and low risk in terms of inspection needs and what items need no inspection, spot inspection or continuous inspection based on the unique conditions of the project. Statistical inspection cannot replace the proper or actual inspection needs of the project.

AASHTO Committee Evaluation for D-18

Statistical Inspection Procedures for Transportation Projects

Submitted By:
Evan Rothblatt
Liaison
COC

Comments:
AASHTO Construction Committee number 2 ranked RPS
I. PROBLEM NUMBER

2019-D-19

II. PROBLEM TITLE

Provide a suggested title, in as few words as possible.
Roadside Safety Analysis Program (RSAP): Accident Data Verification and Update

III. RESEARCH PROBLEM STATEMENT

A description of the problem or need—one or more paragraphs explaining the reason for research. Be explicit about how the intended research product will be used and by whom.

The current Roadside Safety Analysis Program (RSAPv3), is a MS Excel macro-enabled workbook rewritten from a Monte Carlo method as updated in NCHRP 22-27. The intent of this proposed research is to extend and validate the accident data used for the severity models in RSAPv3. While some accident data was used to develop the initial severity models in RSAPv3, NCHRP 22-27 was not intended to be a comprehensive review of roadside crash data. This proposed project would add new types of roadside hazards using a wider range of accident data as well as validate the existing hazard models. Additionally, we would request the creation of a visual component to the program where the user can see a plan view illustration of the information they entered to verify obstacle locations correctly.

Special note to AASHTO Committees and Subcommittees: Please indicate the relationship between the suggested problem and the committee’s strategic plan and/or its overall research agenda.

Advice to State Departments of Transportation and the Federal Highway Administration: Submitters are encouraged, but not required, to vet or submit problem statements through an appropriate AASHTO committee or subcommittee.

IV. LITERATURE SEARCH SUMMARY


This proposed research builds on the framework established by NCHRP 22-27 to further extend and refine the severity models in RSAPv3. Providing a wider range of hazard severities and validating the severity models will make RSAPv3 an even more useful and reliable tool for roadside designers. Some recent NCHRP projects have validated and extended RSAPv3 severity models based on the narrow scope of each project. NCHRP 22-12(03), for example, added some rigid concrete bridge railings, NCHRP 12-90 added bridge piers and NCHRP 22-31 is adding some median barrier data. What is needed, however, is a more comprehensive review and update of the crash data for the severity models in RSAPv3. The severity models are easily modified in RSAPv3 but the underlying accident data needs to be collected and analyzed.
To avoid duplication with other current or past research, the problem submitter must provide a summary of the results of a literature search. At a minimum, searches should be conducted on TRID (http://trid.trb.org), which includes the Research in Progress database (http://rip.trb.org/).

Please describe how your proposed research differs from, and will build upon, the existing body of research found in the literature review. An excellent resource on conducting literature searches is Transportation Research Circular E-C194, “Literature Searches and Literature Reviews for Transportation Research Projects,” available at http://www.trb.org/Publications/Blurbs/172271.aspx. If you are not comfortable conducting the search yourself, you can contact your local transportation library or the TRB Library (202/334-2990 or hcohen@nas.edu) and ask them to conduct the search for you. If no search is performed, please justify why it was not needed.

V. RESEARCH OBJECTIVE

The last update for the Roadside Safety Analysis Program (RSAP) was to update the program from a Monte Carlo method into a MS Excel macro-enabled workbook that was easy to update and receive results. This proposed project would extend the range of hazards represented by the RSAPv3 severity models and validate them with the best accident data available. A second objective is to add the capability for the user to check the input data visually through the creation of a plan view generated from the user inputs.

Provide a succinct statement of the desired research outcomes and expected final products (e.g. guidelines, software, test method, equipment, methodology, specifications, manual, or process). A description of proposed tasks is not required, but the anticipated scope and breadth of the research should be described in sufficient detail to demonstrate that the objective can be achieved and that the estimated funding is justified. Also consider including supplementary activities that will help facilitate implementation of the research products, such as brochures, summaries, presentations, workshops, or peer exchanges aimed at specific target audiences.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

Unknown.

Submitters should provide an estimate of funds necessary to accomplish the stated objectives and some initial implementation facilitation activities. Adequate funding level depends on the hourly rates of the PI and research team members and the proposed research methodology. Costs must also include other estimated expenses required for the research such as purchase of materials, extensive physical testing, or computer modelling. Beyond the research itself, it can be valuable to provide funding for implementation activities beyond the completion of the work. Submitters are encouraged to submit budgets that are adequate for the proposed topic. Underfunded research is much less likely to produce implementable products.

As a general guideline, the present cost for research usually averages about $200,000 for 100 percent of a professional employee’s time per year. This figure represents a fully loaded, professional rate that would include an individual’s direct salary and benefits and an agency’s overhead or indirect costs. Average rates for supporting staff might be approximately one-half those of professionals.

(Note: The level of funded provided may be raised or lowered by the AASHTO Standing Committee on Research if and when the problem statement is selected.)
Research Period:

An estimate of the number of months of research effort, including three months for review and revision of a draft final report, and one month for review and revision of each interim report.

We would assume 2-year research effort in generating this update as well as some outstanding period of time that would gather user reports to assess the update and address the quality of the update. Thus, gathering future information for future possible improvement opportunities.

(Note: This estimate may be changed by the Project Panel.)

VII. URGENCY AND POTENTIAL BENEFITS

With the limited highway funding around the nation, highway agencies seek practical design measures for highway improvements. RSAP provides a cost-effective analysis that aids researchers and highway engineers evaluate practical roadside options. The next generation Roadside Design Guide anticipates more discussion on cost effective evaluations.

The AASHTO Standing Committee on Research – NCHRP’s governing body – will select projects based on two key factors: the potential value of the research results and the likelihood of implementation-ready products. This section should describe the anticipated product and the potential benefits if the research is completed successfully and the products deployed. It should also discuss the potential negative impacts if this problem statement is not funded.

VIII. IMPLEMENTATION PLANNING

Additional information may be needed…

(a) Engineers, researchers and other RSAP Users

(b) Highway agencies, Cities, counties, universities, and consultants.

(c) AASHTO tech committee on Roadside safety, Committee on Design, etc

(d) User evaluate updated version

In order to maximize timely deployment of the research results, problem statement submitters should identify (a) the appropriate target audience for the research findings and products, (b) key decision-makers who can approve, influence, or champion implementation of the research products, and (c) AASHTO committees and other individuals and organizations with likely responsibility for adoption of the results, and (d) “early adopters” – state DOTs that would be willing to evaluate the research products in their agency. Any institutional or political barriers to implementation of the anticipated research products should also be identified.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Provide name, title, organization, telephone number, and email address.

Tom Rhoads, P.E.
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X. AASHTO MONITOR
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XI. SUBMITTED BY

Contact information for individuals submitting or supporting this problem statement.

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(Note: While anyone can write or contribute to preparing a problem statement, only state DOTs, AASHTO committees or councils, or the Federal Highway Administration can submit a problem statement to NCHRP.)

NCHRP Review of D-19

Reviewed By:
William C. Rogers
wrogers@nas.edu

Comments:
The objective of this proposal is unclear and no cost estimate was provided.

Review Date:
11/20/2017

FHWA Evaluation of D-19

FHWA RwD Team - This is a very worthwhile effort, and could be very useful to designers, particularly in PBPD. However, most states are not using RSAP because of the lack of training. FHWA is interested in developing a training component that could be made available through NHI. We recommend a training component be added to this problem statement.
AASHTO Committee Evaluation for D-19

RSAP Update

Submitted By:
Steven Buckley
Chair of Research Subcommittee
Committee on Safety

Comments:
4
ARSHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-D-20

II. PROBLEM TITLE

Use of Fibers in Asphalt Concrete to Enhance Material Performance

III. RESEARCH PROBLEM STATEMENT

Cracking and rutting are the two predominant distresses in asphalt concrete mixtures that lead to resurfacing. Rutting or deformation of the pavement has been largely addressed through the adoption of the Superpave™ mix design approach and the use of modified asphalt binders, although issues still occur. However, the cracking durability of asphalt mixtures continues to be a significant problem nationwide. In many locations asphalt mixtures are now deemed “dry” and crack prematurely due to load- and/or climate-related factors. In addition to premature cracking in flexible pavements, reflective cracking is a long standing problem with asphalt mixtures placed over jointed concrete pavement. The age at which these asphalt pavements are resurfaced is controlled by the deterioration of the asphalt mixture over the joints. The life of a surface mixture placed over jointed concrete pavement is typically 50 to 70 percent of the life of a similar mixture placed over continuously reinforced concrete pavement.

Fiber reinforcement in asphalt mixtures is a promising strategy to address cracking durability, enhance deformation resistance, and delay reflective cracking. In the case of fiber-reinforced asphalt mixtures, two broad applications exist: 1) synthetic fibers that provide mechanical reinforcement to dense and gap graded mixtures (referred to here as mechanical reinforcement systems) and 2) synthetic or natural fibers used in SMA and open graded/porous mixtures to increase the viscosity of the binding system and prevent drain-down (referred to here as binder reinforcement systems). The focus of the proposed study is on mechanical reinforcement systems. Asphalt mixtures modified with mechanically-reinforcing fibers should provide a cost effective mitigation strategy for the problem of reduced service life caused by both durability and reflective cracking, while enhancing rutting resistance. Research is needed to identify practices and procedures for specifying, designing, producing, and constructing cost effective mixtures that incorporate mechanical reinforcement fibers.

The outcomes of this project are anticipated to include guidance and specifications for the design and construction of fiber-reinforced asphalt mixtures. These products will be directly applicable for use by agencies in implementing the use of fiber-reinforced asphalt mixtures for improving cracking durability and enhancing rutting resistance.

IV. LITERATURE SEARCH SUMMARY

Asphalt mixtures modified with fibers have seen little use because of the higher cost compared to non-fiber modified mixtures. However, with increasing concerns about cracking resistance, a number of studies have sought to address fiber-modification. A literature search of “fiber-reinforced asphalt mixtures” and “fiber modified asphalt mixtures” returns a number of applicable studies since 2005, including both domestic and international work. However, most of the studies have been laboratory evaluations, with some domestic field-related work being conducted in Idaho (Muftah, A., Bahadori, A., Bayomy, F., and Kassem, E. Fiber-Reinforced Hot-Mix Asphalt: Idaho Case Study. Transportation Research Board 96th Annual Meeting, Transportation Research Board, 2017, 20p.) and Pennsylvania (Gibson, N. and Li, X. Characterizing Cracking of Asphalt Mixtures with Fiber Reinforcement: Use of Cyclic Fatigue
and Direct Tension Strength Tests. Transportation Research Record: Journal of the Transportation Research Board, Issue 2507, 2015, pp. 57–66). Other aspects of fiber-modification include cost-effectiveness. The market price of common fiber reinforcement is $0.10 per square foot, and the cost increase of adding fibers to asphalt mixtures is approximately 11% (Stempihar, J.J., Souliman, M.I., and Kaloush, K.E. Fiber-Reinforced Asphalt Concrete as Sustainable Paving Material for Airfields. Transportation Research Record: Journal of the Transportation Research Board, Issue 2266, 2012, pp 60-68). Fiber reinforcement could be cost-effective if it can extend the service life of pavement more than 11%, which has been validated in laboratory testing (Wu, S., Ye, Q., Li, N. and Yue, H. Effects of Fibers of the Dynamic Properties of Asphalt Mixtures. Journal of Wuhan University – Materials Science, Vol. 22, Issue 4, 2007, pp. 733-736). These studies show promise in both performance and cost-effectiveness for the use of fiber-reinforced mixtures, but there is still agency and industry uncertainty due to a need for field validation of laboratory concepts, as well as the lack of uniform guidance and specifications. In addition, NCHRP Synthesis 475 (McDaniel, R.S. Fiber Additives in Asphalt Mixtures. Synthesis 475, National Cooperative Highway Research Program, Transportation Research Board of the National Academies, Washington, DC, 2015, 55p.) reviewed approximately 100 documents and performed a survey all states with a response rate of 96%; this report found significant gaps in the state of knowledge regarding fiber modified mixtures and specifically recommended the development of standardized guidance on the production and construction of fiber modified mixtures.

V. RESEARCH OBJECTIVE

The objective of this research is to provide guidance and specifications for the use of mechanical reinforcement fibers in asphalt mixtures for the specific purpose of improving the resistance to cracking (i.e., durability, fatigue, and reflective). Specific tasks include: 1) Review historical research and current information on fiber-reinforced asphalt mixtures to identify appropriate types of fibers for consideration; 2) Evaluate the effects of the mechanical fiber reinforcement components to determine their impact on mixture properties as well as virgin and aged asphalt binder/mastic properties; 3) Evaluate selected pavement structures constructed using fiber-modified asphalt mixtures to determine the influence of fiber reinforcement on pavement resistance to cracking and rutting (methodology may include accelerated loading); (4) Assess the pertinent factors influencing the selection of materials, design, production, and construction of mixtures, and performance to determine appropriate guidance for these aspects; (5) Develop specifications and guidelines for agency use of fiber-reinforced asphalt mixtures.

The expected products include: 1) a guide for fiber applications in asphalt mixtures including suitable types of promising fibers, optimum fiber content, mixing methods, and disadvantages or cautions that should be considered; 2) specifications for the design and construction of fiber-modified asphalt mixtures; and 3) a report to document the results of this study on fiber modified asphalt mixtures including the assessment of cracking and rutting performance and service life. The use of publications, webinars, and workshops should be anticipated to facilitate implementation.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$500,000

Research Period:

36 months

VII. URGENCY AND POTENTIAL BENEFITS
The issue of cracking has begun to dominate national conversations about the durability of asphalt mixtures. Adoption of the products anticipated from this research has the potential to address the millions of miles of pavements that prematurely deteriorate due to cracking. One agency alone, VDOT, spends approximately $500,000,000 on asphalt resurfacing each year. The average life for an asphalt surface mix is 12 years. An extension in service life by 1.5 years would offset the initial material cost and provide additional benefits from reduced travel delays with fewer lane closures for resurfacing. Likewise the savings to agencies over time will allow departments to focus limited funds on other infrastructure needs. Nationally, the cost savings and benefits could be billions of dollars per year in direct agency costs and ten-fold that amount when user delay costs are considered.

VIII. IMPLEMENTATION PLANNING

Implementation efforts for this work should target two specific audiences – agency/owners and the asphalt contracting industry. Successful implementation will require the adoption and use of the product specifications by owner/agencies in order to specify the use of fiber-modified asphalt mixtures. It will also require educational efforts focused on both the agency/owner and contracting industry on appropriate practices and procedures to design, produce, and construct these mixtures. In some cases, production may require an industry investment of modifications to asphalt production plants. In addition, outreach will be required through the AASHTO Committee on Materials and Pavements for the adoption of specifications, as well as other groups to assist with outreach and education.

Barriers to implementation may include institutional barriers such as prior negative experiences with fibers of any type, disinterest in adopting “new” products and procedures, and other typical hurdles. Care will need to be taken to prevent proprietary product specifications such that implementation can be made smoother, as many agencies cannot specify proprietary products.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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Rebecca McDaniel
Technical Director
NCHRP Review of D-20
Reviewed By:
Edward T. Harrigan
eharriga@nas.edu
Comments:
A. Is the problem potentially solvable through research?

The problem is potentially solvable through a combination of laboratory and field experiments.

B. Is it likely of interest to at least 2/3s of the DOTS?

This question is difficult to answer. As the submitters note, dense- and gap-graded asphalt mixtures "... modified with fibers have seen little use because of the higher cost compared to non-fiber modified mixtures." But cracking is now considered the prevalent distress type in asphalt pavements and the cause of much premature failure. While first costs will be higher, states might adopt the use of fiber-modified asphalt mixtures if research can demonstrate that their use provides a substantial reduction in maintenance and rehabilitation costs.
C. Is there a reasonably clear objective?

The objectives and expected deliverables are clearly and concisely stated.

D. Is the scope of the research reasonable?

The scope is reasonable.

E. Can the research be done in 2-3 years at the most?

Realistically, due to the implied need for field or full-scale APT evaluation of fiber-reinforced mixtures, a 4-year period of performance is more reasonable.

F. Is the budget adequate?

Again, due to the implied need for field or full-scale APT evaluation of test mixtures, staff recommends a budget of $1.00-1.25 million.

G. Comments on current or past research on the topic.

A search in Google Scholar for literature between 2012 and 2017 turned up many references to laboratory research with fibers such as steel, nylon, and basalt among others. Recent research has been almost exclusively conducted in Asia. However, there was no information on field testing of such mixtures.

Some relevant citations follow:

**Hybrid Reinforcement of Asphalt-Concrete Mixtures Using Glass and Polypropylene Fibers.**
SM Abtahi, S Esfandiarpour, M Kunt… - … Fabrics & Fibers …, 2013 - jeffjournal.org

ABSTRACT There is a constant effort to improve the performance of asphalt-concrete (AC) mixtures. Among various modifiers for asphalt, fibers have received much attention for their improving effects. This paper introduces the novel concept of hybrid reinforcement of AC.

**Investigation of usability of steel fibers in asphalt concrete mixtures**
S Serin, N Morova, M Saltan, S Terzi - Construction and Building Materials, 2012 - Elsevier

… fiber and mineral fiber additives to the asphalt mixture as fiber-reinforced asphalt binder in … Experimentally obtained results indicated that fiber-reinforcement increased the viscosity of asphalt binder until 0.5 … study it is implied that the strengthening effects of these fibers are more …

**Investigation of usability of basalt fibers in hot mix asphalt concrete**
N Morova - Construction and Building Materials, 2013 - Elsevier

… increasing economic and environmental requirements for reinforcements in polymer composites, the reinforcement potential of … But, there is less research to study the basalt fiber reinforced asphalt mixture. In this study, the usability of basalt fibers in hot mix asphalt concrete was …

**Uniformity and mechanical properties of dense asphalt concrete with steel wool fibers**

… tensile strength relative to asphalts, they may improve the cohesive and tensile strength of bituminous mixtures [9]. Besides, fiber-reinforced asphalt concrete may have a good resistance to ageing, moisture damage and reflection cracking [10]. Finally, fibers may also …

**Cracking resistance of fiber reinforced asphalt concrete at– 20° C**
Impact of Short-cut Basalt Fiber on Asphalt Concrete Performance [J]
Y Zhao, H Li - Journal of Highway and Transportation Research ..., 2012 - en.cnki.com.cn
... Corrosion resistance characteristic of continuous basalt fiber and its reinforcing composites[J ... 710064,China];A Study on High Temperature Stability of Fiber Asphalt Mixtures[J ... of Tibet Autonomous Region, Lhasa 850001,China];Application of Fibers-Reinforced Asphalt Mixture ...

Using ESEM to Analyze the Microscopic Property of Basalt Fiber Reinforced Asphalt Concrete
GAO Chunmei, WU Weijie - International Journal of Pavement Research ..., 2017 - Elsevier
67 days ago - Abstract The basalt fiber staggered distribution in the asphalt concrete matrix and the bonding situation between asphalt are analyzed by images collected using field emission environmental scanning electron microscope (ESEM) test equipment. The results

Modelling Marshall Stability of fiber reinforced asphalt mixtures with ANFIS
N Morova, E Eriskin, S Terzi - ... (INISTA), 2017 IEEE ..., 2017 - ieeexplore.ieee.org
111 days ago - Abstract—In this study, an Adaptive Neural Fuzzy Inference System (ANFIS) model for predicting the Marshall Stability (MS) of basalt fiber reinforced asphalt concrete mixtures and various mix proportions has been developed ...

Creep behavior of nylon fiber-reinforced asphalt concrete
H Taherkhani, S Afroozi - Iranian Polymer Journal, 2017 - Springer
230 days ago - Abstract This study aims to investigate the permanent deformation behavior of asphalt concrete reinforced by nylon fibers. Nylon fibers (12 mm length) have been added to a typical asphalt concrete at different percentages of 0.05, 0.1, 0.15, 0.2, 0.25, and

Numerical Analysis for Basalt Fiber Reinforced High-viscosity Asphalt Concrete Bridge Deck Pavement
C Yin, Q Ge, X Hu, Z Huang - DEStech Transactions on ..., 2016 - dpi-proceedings.com
279 days ago - ABSTRACT: Basalt fiber reinforced asphalt concrete has better durability, crack resistance and temperature stability than traditional untreated asphalt concrete, being gradually used in pavement engineering in China over recent years ...

Evaluation of Fiber Distribution in Steel Fiber Reinforced Asphalt Concrete based on CT Image Analysis
H Liao, XT Pei, YG Zhong, HP Wang - ... on Engineering and ..., 2016 - dpi-proceedings.com
279 days ago - Abstract The premise of steel fiber reinforced asphalt concrete (FRAC) to exhibit multifunctional applications is that fibers are uniformly dispersed in the asphalt mixtures. In this paper, image analysis method was applied to evaluate the fiber distribution

Investigation on Reinforced Mechanism of Fiber Reinforced Asphalt Concrete Based on Micromechanical Modeling
Y Gao, Q Guo, Y Guo, P Wu, W Meng - Advances in Materials ..., 2017 - hindawi.com
335 days ago - Short fibers have been widely used to prepare the fiber reinforced asphalt concrete (FRAC). However, internal interactions between fiber and other phases of asphalt concrete are unclear although experimental methods have been used to design the FRAC

MODELING MARSHALL STABILITY OF COIR FIBER REINFORCED ASPHALT CONCRETE
T Suresh, TJ Vijay, A Chandrasekar - 2016 - irjet.net
346 days ago - ABSTRACT: Flexible pavements with bituminous surfacing are widely used in India. Exponential increase in traffic, overloading of commercial vehicles and significant variations in daily and seasonal temperatures have shown some limitations of conventional
FHWA Evaluation of D-20

Jack Youtcheff/HRDI-10 - The proposal is overly broad considering time and funding limitations of NCHRP studies. This might be better served in addressing the use of fibers in SMAs separately from cracking durability, though construction guidance (e.g., control and assessment of fiber dispersion) from either approach would benefit the other. The value of the fibers with enhancing deformation resistance is dubious.

Dave Mensching/HIAP-20 - This project should look at side-by-side comparisons with polymers and other materials which have proven improvements to performance. The use of fibers in asphalt mixes has been in decline for about 20 years now and research as to its long-term effectiveness has shown the results with regard to field performance are hit-and-miss. Recommend limiting the scope and first documenting field sites where fiber performed better than other additives.

Submitter Response for 2019-D-20
Use of Fibers in Asphalt Concrete to Enhance Material Performance

From: [email: stacey.diefenderfer@vdot.virginia.gov]

Comments:

The objective of the proposed project is to provide guidance and specifications for the use of fibers as mechanical reinforcement in asphalt mixtures to improve resistance to cracking. Cracking has rapidly become a significant issue nationwide for many agencies, and fiber-reinforcement offers an alternative solution if significant gaps in the state of knowledge can be addressed. The use of reinforcement fibers has not been widely adopted, in part due to a lack of current assessment of available fibers that includes field performance. Additionally, the Superpave system of mix design does not address such additives as fibers, so without specific guidance adoption prospects are limited. While some laboratory studies have shown potential benefits that are estimated to offset initial costs, there has been a lack of comprehensive evaluation that includes field validation efforts. In addition, there is a lack of standardized guidance for application selection, as well as specifications for design, production and construction. This information is necessary for potential users to be able to assess when and how to use these mixtures to take advantage of their benefits and is addressed by this project.

Given further consideration of the need for comprehensive assessment that includes field evaluation, the submitters concur with the NCHRP review and would ask for consideration of a 48-month project, and funding in the amount of $1.25 million. While this is a substantial investment, the identification of valid fiber-reinforcement technologies, coupled with guidance for implementation of fiber-reinforcement as a means to mitigate mixture cracking has high potential to result in significant improvements in mixture/pavement performance and provide substantial long-term payoffs in the form of longer-lasting asphalt mixtures to owner/agencies.

We agree that, while these fibers may also enhance rutting resistance, the focus of the project should be on improved cracking durability. The project is not intended to focus on the use of fibers in such mixtures as SMAs and open-graded or porous mixtures as these are generally well-documented.

Contact Info:
Stacey Diefenderfer
Virginia Transportation Research Council
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-D-21

II. PROBLEM TITLE


III. RESEARCH PROBLEM STATEMENT

The proliferation of method specifications, many of which are antiquated and outdated, has resulted in surface treatment performance deficiencies. In response to these difficulties, contractors, industry, and agencies have begun moving toward the development and implementation of performance specifications for chip seal emulsions and other Emulsion based treatments.

The key challenge in the development of performance specifications is the need to identify appropriate testing protocols and acceptance criteria which will reliably predict long-term treatment performance or the potential for failure. By developing reliable acceptance criteria, agencies will have the means to determine when a treatment has been satisfactorily constructed and to aid in assessing the appropriate level of compensation.

Emulsified Asphalt technologies’ have been the long-overlooked stepchild of asphalt technologies in general, specifically Hot Mix Binder that has taken most of the R&D resources over the last three decades. This effectively has held Emulsion technologies stagnant with very little advancement in the technology, practices and specifications.

As the demand for asphalt emulsions has increased due to the widespread acceptance of pavement preservation, it is recognized that a need exists to develop a nationally-accepted performance related specification for an all-encompassing emulsified asphalt similar to the SuperPave binder specifications, for use by state DOTs and local agencies. It is envisioned that the specification will utilize readily available testing equipment (i.e. superpave based testing equipment) and be based on environmental and traffic conditions; and validated with field trials. It is anticipated that the recent findings from NCHRP 9-50 and FHWA/TX-12/0-6616-1 will also be incorporated.

IV. LITERATURE SEARCH SUMMARY

The following is a list of related research that will be reviewed and leveraged for this study:


*Progress Toward Performance-Graded Emulsified Asphalt Specifications*, Transportation Research E-Circular Issue Number: E-C182, various authors, 2014


As the list above suggests, there has been research completed on testing methodology and some localized field verification of performance related specifications for emulsified asphalt. This study will leverage the above research and develop a specification that is nationally validated and usable on a national basis.

V. RESEARCH OBJECTIVE

The objective of the study is to develop and validate a national performance related specification for emulsified asphalt for use with chip seals. The study would leverage the recently completed research on emulsified asphalt performance related specifications and build on these in order to create a consensus national specification that is validated and ready for implementation by State DOTs.

Because of much previous research on testing methodology and feasibility, it is envisioned that this study would focus on field validation and implementation. This is a critical component lacking in previous research projects.

The following tasks have been identified to complete the work for this project:
Task 1. Literature Search and Review – Collect and evaluate existing literature including published and unpublished sources and personal contacts with industry and DOT leaders.
Task 2. Analysis of Existing Field and Laboratory Test Data - Utilize field and laboratory data to evaluate correlation between laboratory test results and field performance.
Task 3. Develop performance specifications; particularly performance graded residue specifications.
Task 4. Validate specifications via field studies performance evaluation.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

The estimated funding for this project is $950,000.

Research Period:

The research will take approximately 42 months to complete.

VII. URGENCY AND POTENTIAL BENEFITS

This is a high priority issue fully endorsed by the AASHTO TSP2 Emulsion Task Force, National Center for Pavement Preservation, and numerous states including Rhode Island, Texas among others.

Increased performance life of chip seals and reduced costs to agencies are the expected benefits of this study. Every year thousands of miles of chip seal surface treatments are placed across the U.S. and billions of dollars are spent on surface treatments. It is conservatively estimated that implementation of a performance related specification will extend the life of chip seals by one year on 10 to 20 percent of the chip seals placed. The resulting annual savings are in the tens of millions of dollars.
It is also clear that producers and agencies both want a specification for polymer-modified emulsions that show the benefits of polymer and the appropriate locations and climates to use polymer.

VIII. IMPLEMENTATION PLANNING

Implementation:

The target audience for the research findings will be State DOT Materials Engineers and their staff, because they have significant influence on the implementation of emulsified asphalt specifications. Outreach to Materials Engineers during state or regional user/producer meetings will be an important aspect of the implementation strategy. The AASHTO SOM tech section 2a will also be a key implementation partner as this tech section is responsible for AASHTO emulsified asphalt standards. Finally, industry/producers will key partners as in the end they will have to supply and produce material that meets any new standard.

Another key implementation strategy will be the development of a lead states group. It is envisioned that 5 or more states would make up this group and represent different geographic and climatic areas of the U.S. The states would be the lead adopters and help shepherd the implementation for other states.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

Colin Franco, P.E.

XI. SUBMITTED BY

Colin Franco P.E  
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Co-Chair: AASHTO TSP2 Emulsion Task Force

NCHRP Review of D-21

Reviewed By:  
Edward T. Harrigan  
eharriga@nas.edu
Comments:

A. Is the problem potentially solvable through research?

The problem statement is potentially solvable through an NCHRP research project.

B. Is it likely of interest to at least 2/3s of the DOTS?

The research is likely of national interest.

C. Is there a reasonably clear objective?

The objective as stated is clear and concise.

D. Is the scope of the research reasonable?

The scope, as expressed by the proposed tasks, is reasonable.

E. Can the research be done in 2-3 years at the most?

Due to the emphasis on field validation of the national specification developed in the research, it is likely that the research will require a minimum of 4 years.

F. Is the budget adequate?

The proposed budget is adequate.

G. Comments on current or past research on the topic.

As noted in the problem statement, proposed specifications for performance-graded asphalt emulsions have been recently developed independently by NCHRP Project 9-50 (NCHRP Research Report 837 published in 2017) and TXDOT Project 5-6616-01 (published as a proposed Special Provision in 2015). Both specify properties of the emulsion and properties of the emulsion residue in a format similar to that of AASHTO M 320 for performance-graded asphalt binder. However, there are differences in test methods used in the two specifications that this research would likely need to reconcile or at least consider in developing and then validating a "national" specification.

FHWA Evaluation of D-21

Jack Youtcheff/HRDI-10 - Proposed activity is a logical follow on to the NCHRP 9-50 study to develop a (purchase based) performance related specification for emulsified asphalt. Focus is on validation of a consensus specification and its readying for implementation. Dave Mensching/HIAP-20 - What is the basis for pay? Life of the chip seal? Performance-related specifications are needed across the asphalt materials community and this will be a good first step. However, it is anticipated that more resources are needed to foster implementation.
Research Field E

SOILS AND GEOLOGY
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER
2019-E-01

II. PROBLEM TITLE
RESEARCH PROBLEM STATEMENT PROBLEM TITLE: FIELD GUIDANCE FOR DEVELOPING EXPEDIENT SPATIAL INFILTRATION TEST

III. RESEARCH PROBLEM STATEMENT
To meet federal and state volume and pollutant requirements, departments of transportation (DOTs) must effectively minimize offsite runoff using stormwater management practices. DOTs commonly use green infrastructure because they provide hydrologic and water-quality benefits through infiltration. Measuring surface infiltration rate is a customary practice when determining suitable locations for stormwater infiltration practices. NCHRP Report 565 recommends DOTs and other state agencies perform post-construction infiltration tests to verify actual site infiltration properties. A standardized infiltration test method is the “ASTM-D3385 Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer”. The test requires the cumbersome setup of a 60-cm outer ring and 30-cm inner ring driven into the ground 15-cm; and enough water to sustain constant heads in both rings for a 24-hr period. This current technique limits comprehensive spatial assessment of infiltration rates due to time and resource constraints.

Alternative tests can be more efficient than this ASTM method in terms of time, ease of use, measurement quantities, and resources expense. These alternate tests can be compared to the current ASTM method to determine if results are similar. An easier, faster test would allow multiple tests to be taken to identify the maximum infiltration rate for placement of a management practice while reducing costs. This research would help establish an alternative to ASTM-D3385 to provide a nationally accepted standard. An alternative method would be used by a wide range of DOTs, highway and land development designers, regulators, stormwater researchers, and planners.

IV. LITERATURE SEARCH SUMMARY
There is considerable existing literature regarding manufactured and handmade infiltration devices that include single-ring infiltrometers, Philip-Dunne, modified Philip-Dunne, Turf-Tec, Borehole infiltrometers, MiniDisk, etc. Comparison tests to the double-ring are included in the literature review. These previous infiltration assessment studies could be expanded to determine if a secondary method of infiltration measurement could be identified that provides equal or improved quality to methods currently used by DOT’s. This preliminary literature review provided a partial identification of literature available with the understanding that the research effort will focus on summation of said literature review. This review also included spatial field measurement and data analysis to provide evidence for a formal standard on expedited infiltration test.


V. RESEARCH OBJECTIVE

The purpose of this study is to identify and accept at least one infiltration method that expedites infiltration field testing to access the spatial variability covering a DOT's project site. A less cumbersome and labor intensive method would reduce cost by decreasing setup and test time, along with lowering water requirements, while increasing equipment portability between sites.

For this study, pertinent infiltration data parameters are to be compiled. Data will be gathered from sites where the infiltration rate is known and a regression model that estimates infiltration rates based on site characteristics, will be created. This study will expand upon previous infiltration assessment studies to determine if an alternative method would be analogous, equal or superior to the ASTM method currently used by DOTs. Data will be collected from additional field measurements and a review of other scientific studies around the country, will be completed. Collecting and analyzing this information could lead to the discovery of a new procedure for DOTs that is more cost effective and time efficient. The three most suitable methods to measure infiltration rates, based on the literature review, will be tested in the field to validate their accuracy against the ASTM double-ring infiltrometer.

Phase I: Determine a preliminary selection of three infiltration devices based upon existing literature. Predetermined test sites are to be selected based on soil conditions. Spatial variability infiltration tests will be performed at each site. These sites will be categorized into infiltration rates of low, medium, and high.
Phase II: One low and one medium infiltrating site will test the three infiltration methods at three locations, where each device will have replicate tests at each site. The three tests would determine if the infiltration rates are repeatable and reduce the error when comparing the three devices.

Phase III: The device will be selected based on a percent difference to the geometric mean compared to the double ring test. Additional side by side testing of the double ring and chosen method will be conducted to determine if a correction factor is needed for the infiltration rate based on soil type. This would require additional replicate infiltration tests.

Phase IV: The last step is to determine the relative percent difference at a high infiltration site. Tests will be performed at three locations within one site; comparing the double ring to the selected methods. Data analyses will summarize each infiltration method, pros and cons of the methods, and any correction factors to the infiltration rates compared to the double ring.

Phase V: Develop a guidance document detailing procedures for using the expedient spatial infiltration test for DOTs.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $200,000

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The Senior Personnel salary is for the Principal Investigator to provide overall management of the project, oversee the design and implementation of field experiments, ensure that all interim reports and final deliverables are prepared and submitted on time, and meet with the panel to discuss the interim reports.

The Other Personnel salary is for Assistant Researchers to conduct the literature review, work on the experimental design, and perform field infiltration tests. Equipment and supplies are for purchase of double ring, other testing devices, and other ancillary field items. Travel is for travel to and from the field sites and potential meetings.

**Research Period:** 30 months, includes report reviews and publishing time.

**VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION**

Results of this research will provide state DOTs with guidelines on a rapid assessment of spatial infiltration rates that is faster, less expensive, and more comprehensive than the current ASTM method since more infiltration data could be collected. A quicker infiltration test allows DOTs to more efficiently evaluate post-construction green infrastructure practices to determine if maintenance is required. This test would also assist the DOTs, as well as local and state agencies in the planning phase of future projects by identifying areas suitable for infiltration.

**VIII. IMPLEMENTATION PLANNING**

(a) **Appropriate target audience for the research findings and products** – The target audiences are transportation system developers such as DOTs that are required to perform site evaluations for stormwater management practices. A less burdensome test would allow design staff to locate stormwater management practice sites more efficiently through more extensive and thorough infiltration testing. A reliable standard testing method could also be adopted by state performance standards to provide consistent regulation that practitioners need follow.

Regulatory agencies that develop infiltration standards are another audience. Many such agencies promote storm water infiltration as a means to reduce pollutant concentrations, thus
reducing environmental impacts. These agencies also understand the difficulties with obtaining accurate infiltration data and are willing to accept new, properly researched methodology.

Specific audiences:
- Wisconsin Department of Natural Resource
- Wisconsin Standards Oversight Council
- Wisconsin Department of Safety & Professional Development
- Washington Department of Transportation
- Minnesota Department of Transportation
- Ohio Department of Transportation
- Massachusetts Department of Transportation
- California Department of Transpiration
- Maryland Department of Transportation

(b) Key decision-makers who can approve, influence, or champion implementation of the research products - Key decision makers would include state DOTs and state agency policy staff with performance standards. These professionals would champion these tests to reduce the inconsistencies when implementing policies for pre- and post-infiltration practices. Stormwater designers and researchers would also welcome a more efficient sampling process.

Specific decision makers: See (b) above.

(c) AASHTO committees and other individuals and organizations with likely responsibility for adoption of the results -

Specific committees and research projects:
- AASHTO Center for Environmental Excellence’s Stormwater Community of Practice
- NCHRP 14-39 Using Vegetated Compost Blankets to Achieve Highway Runoff Volume and Pollutant Reduction
- NCHRP 25-51 Limitations of the Infiltration Approach to Stormwater Management in the Highway Environment

(d) “early adopters” – state DOTs that would be willing to evaluate the research products in their agency - States such as Wisconsin that have infiltration requirements and are looking for an alternative method, at the bequest of municipalities, would readily implement recommendations from this research. Wisconsin allows additional credit if post-construction infiltration test is conducted to verify actual soil properties. However, this testing is typically not conducted due to the amount of effort it takes for double ring test.

Specific DOT for possible early adoption:
- Wisconsin DOT
- Washington DOT
- Ohio DOT
• Maryland DOT
• Oregon DOT
• Minnesota DOT
• Organizations tasked with improving surface and groundwater quality such as the Chesapeake Bay Foundation or Washington Environmental Council in the Puget Sound region.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROBLEM MONITOR

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Email: roberta.armstrong@dot.wi.gov

XI. DATE AND SUBMITTED BY

October 16, 2017

Bob Armstrong, PE, CPESC
Stormwater Engineer
WisDOT
4802 Sheboygan Ave., Rm 451
Madison, WI 53707
NCHRP Review of E-01

Reviewed By:
Amir N. Hanna
ahanna@nas.edu

Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem appears to be solvable through research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

The topic of research is likely to be of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, does not provide a clear intent of the research. The objective should be simply stated as identifying or developing an improved test method for infiltration rate of soils.

D. Is the scope of the research reasonable?

The stated scope appears specific and may not yield the expected product. The scope should be developed based on an evaluation of existing test methods, and identification of their deficiencies, and needed improvements.

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 30 months appears adequate although 36 months would be more appropriate to allow time for validation of the test method.

F. Is the budget adequate?

The proposed budget of $200,000 appears insufficient; an increase to $400,000 is recommended.

G. Comments on current or past research on the topic.

Several studies have been cited, but further literature review should be performed as part of the research.

Review Date:
11/29/2017
FHWA Evaluation of E-01

Susan Jones/HEPE-30 - Efficiency of an ASTM standard does not warrant having an NCHRP problem statement. While a more efficient means for conducting infiltration tests might be nice for DOTs, this research effort does not warrant to be one for NCHRP. Research money should not be used to compare existing, and likely proprietary devices against one another. This should be the responsibility of the industry or the manufacturers to show the value of technology.

AASHTO Committee Evaluation for E-01

Field Guidance for Developing Expedient Spatial Infiltration Test

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – This research would be helpful for states looking for a more cost effective and less intrusive method of testing. Identification of more than 3 devices for testing, and a discussion of the pros and cons of all acceptable devices, would provide additional options for states to consider.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-E-02

II. PROBLEM TITLE

Develop Guidelines for Estimating the Spatial Variability of Scour around Bridge Foundations

III. RESEARCH PROBLEM STATEMENT

Recent efforts to provide more realistic predictions of bridge scour have focused on addressing the geotechnical properties of the soil, combination of scour components and time-rate development of scour; however, no concerted effort has been made to improve the scour prediction methodology by addressing the spatial variability of scour.

In current practice, scour at bridge foundations is calculated from equations which are typically derived from data of the maximum scour depths resulting from laboratory flume studies. In turn, the geotechnical capacity and structural stability of the predicted scoured foundation is commonly assessed by applying these maximum scour values to the entire bridge foundation. However, lab and field experience demonstrates that scour typically occurs nonuniformly around a bridge foundation with the maximum scour often being localized to a specific region of a pile group or bridge support and lesser scour occurring in other regions. In fact, a large body of flume data exists from recent research (e.g., NCHRP 24-37, FHWA research on Pressure Scour, etc.) to support the nonuniform shape of scour holes which has documented in great detail the equilibrium scour contours for various scour scenarios. This type of topographic scour data provides a basis for developing spatial variability guidelines and could be further expanded to fill gaps or validated as needed by collecting additional field, lab or modeling data. By identifying clear patterns for how scour varies spatially, guidelines could be developed to assist engineers to make a more realistic determination of the overall stability of a bridge. Engineers analyzing many common scour scenarios could benefit from a more detailed spatial scour prediction including the following cases:

- Scour at a pier wall which is skewed to the flow and commonly shows maximum scour near the downstream end of the wall
- Lateral and vertical contraction scour where the maximum scour occurs at the downstream side of the bridge
- Abutment scour where maximum scour can occur near the upstream and downstream ends of the bridge
- Scour in pile groups where scour may be reduced as flow passes through the piles

While a conceptual idea about typical scour hole geometries is already known and has been qualitatively discussed for specific research topics in literature, this collective set of data has not been quantified in any comprehensive or robust manner so that an engineer can confidently use this information to make informed judgements about the true vulnerability of the structure and so that a more accurate understanding of the risk can be made for programming countermeasure design or monitoring of these bridges. Instead, evaluations based on assuming uniform, maximum scour occurs throughout the bridge may result in inaccurate scour evaluations, unnecessary repairs or overly conservative foundation designs.

IV. LITERATURE SEARCH SUMMARY
A database search of TRID and World Cat did not provide any results showing that a comprehensive study has been made to define the spatial variability of scour for various types and combinations of scour events. While it is common for journal articles and other publications to sow detailed topography of scour holes in their papers and to qualitatively describe the general terrain of the scour hole, no comprehensive or guidance material was found which summarizes this information in a clear way for use by practicing engineers.

V. RESEARCH OBJECTIVE

The objective of this research is to provide guidance for how to define the spatial variability of scour at bridge foundations for common scour scenarios including, but not limited, to skewed flow at pier walls, abutment scour, scour around pile groups and lateral and vertical contraction scour.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

$500,000

**Research Period:**

36 months

VII. URGENCY AND POTENTIAL BENEFITS

There are multiple benefits of having clear guidance for defining the spatial variability of scour. First, it will improve the accuracy of the scour evaluation process by providing needed information to the Geotechnical and Structural engineers about how much various elements of the substructure may be exposed or undermined. This may reduce some unnecessary conservatism in the scour evaluation outcome and reduce the cost of required mitigation. Secondly, countermeasure design may be improved by ensuring that proper depths are attained in regions most in need of the mitigation, but may be reduced in other areas saving cost and possibly reducing environmental permitting issues. Thirdly, by knowing where the deepest regions of scour will occur, critical field measurements during flood events can be targeted to maximize the time spent obtaining data during these challenging and hazardous events. Finally, having more comprehensive guidelines about how scour will develop will aid future researchers in calibrating or validating numeric models which make scour predictions. Without a clear depiction of the variability of scour, engineers will continue to analyze and design using assumptions that are, in some cases, overly conservative and field and researchers will have limited knowledge with which to make measurements and improve modeling of scour.

VIII. IMPLEMENTATION PLANNING

This proposed research will be directly useful for engineers involved with evaluating scour or designing scour mitigation including engineers working in bridge hydraulics, bridge design, geotechnical and structural ratings. The results could be disseminated through FHWA via publication in future Hydraulic Engineering Circular (HEC) publications such as HEC-18 for Evaluation Scour at Bridges and HEC-23 on Bridge Scour Countermeasure Design.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Kevin Flora, PE
X. **AASHTO MONITOR**

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. **SUBMITTED BY**

Contact information for individuals submitting or supporting this problem statement.

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**NCHRP Review of E02**

The problem statement is well written, and the objective is well-defined. The problem is suitable for funding in the FY 2019 NCHRP. The problem statement is a medium priority.

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**FHWA Evaluation of E-02**

Kornel Kerenyi/HRDI-40 and Joe Krolak/HIBS-20 - More knowledge on spatial variability of scour around bridge foundations is needed especially because of the trends in numerical modeling. Currently 2D models can roughly predict only potential areal shear stress amplifications on the river bed around bridge foundation but a correlation from bed shear stresses to scour depth is not possible because of changing unit discharge as the scour spatially varies and forms. CFD is currently making big progress on scour modeling but knowing the spatial variability of scour from experiments or field observations would help tremendously for calibration and validation. Ultimately, with this research CFD could support 2D models to develop correlations from areal bed shear to potential scour forms.

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**AASHTO Committee Evaluation for E-02**

**Develop Guidelines for Estimating the Spatial Variability of Scour around Bridge Foundations**

Submitted By:  
Patricia Bush  
AASHTO Liaison  
AASHTO Committee on Design
Comments:
Committee on Design - The proposed research would be beneficial by providing guidance for variability of scour at bridge foundations, abutment scour, scour around pile groups and lateral and vertical contraction scour hence improving the design and reducing the cost of scour countermeasures.
Mitigation of pressure flow scour by improving the hydrodynamic conditions at the upstream of the bridge superstructure

As a result of extreme weather events, rainfall is expected to be more extreme in the future. Existing bridges throughout the country are expected to experience pressure flows in the coming years. The frequency of occurrence of the pressure flow at many existing bridges would also be higher. Pressure flow might be unavoidable in some new bridges, due to the limitations in the vertical alignment of existing roadways.

During a pressure flow, a bridge superstructure (e.g. girder, beam, slab, etc.) where no streamline shaped was considered during the design of the superstructure experience more flow separation (vertical contraction) and entrance loss than a streamline shaped superstructure. Since the depth available to convey the flow through the opening under the bridge is reduced by this flow separation, the scour caused by pressure flow can be significantly greater than that of non-pressure flow. Furthermore, a high entrance loss that occurs during a pressure flow condition would result in a higher flood stage at the upstream. It could also contribute to a high debris accumulation as well as excessive hydrodynamic pressure on the bridge superstructure. Therefore, it is important to study if some of these detrimental effects on the bridge could be minimized by improving the hydrodynamic condition at the upstream face of the bridge superstructure.

This research is intended to determine the feasibility of retrofitting existing bridge superstructures or designing of new ones by improving the hydrodynamic conditions at the upstream bridge face, so that in the event of a pressure flow, the streamlines are relatively parallel and would result in a reduction in the flow separation, hydrodynamic force on the superstructure, debris accumulation, upstream flooding, and the entrance loss at the bridge.

A literature search through http://trid.trb.org and Journal of Hydraulic Engineering (www.ASCE.org) provided no such studies on the hydrodynamic shaped bridge superstructure.

A preliminary study was carried out by a study, as mentioned in this Report No. FHWA-HRT-09-041 (https://www.fhwa.dot.gov/publications/research/infrastructure/hydraulics/09041/09041.pdf), in order to determine the effect of girder shapes on pressure flow scour. It was found that a streamline shaped bridge superstructures produced “a significantly shallower scour hole than those beneath the bridges with rectangular girders”. However, this report suggested the need for additional research to study the effect of different deck and girder shapes on scour.

Computational Fluid Dynamics (CFD) models as well as physical models are needed in order to determine the optimized hydrodynamic shape of the upstream face of the bridge superstructure,
under different bridge opening configurations. The objective of the study includes analysis with CFD models and physical models for pressure flow at bridges, to understand how the intensity of the following parameters diminish, as compared to superstructures with no hydrodynamic modifications:

- bed shear stress
- pressure flow scour
- drag force, or hydrodynamic forces (Horizontal and Uplift forces) on the bridge superstructure
- debris accumulation at the upstream face of the superstructure
- flooding at upstream of the bridge

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

$500,000:

**Research Period:**

36 months.

VII. URGENCY AND POTENTIAL BENEFITS

As more bridges are expected to experience pressure flows in the coming years, it is important to explore the feasibility of retrofitting existing bridge or designing new bridges by using a streamline shaped superstructure. Numerous studies are available to understand the benefit of hydrodynamic shaped bridge piers. However, the superstructure of the bridges that experience a pressure flow has not been studied extensively for their improved hydrodynamic shape at the upstream. An improved superstructure shape could help reduce the detrimental effects experienced by these bridges.

There are various benefits that may be achieved from this study.

a. Firstly, this study could help us to determine the standard shapes of the upstream face of superstructures that results in a reduced
   i. Flow Separation (therefore, reduction in pressure scour)
   ii. Entrance loss (therefore, reduction in the uplift force and horizontal force on the deck; as well as less flooding at the upstream).

b. Additionally, the debris accumulation at the upstream face of a streamlined shape bridge superstructure is expected to be less.

c. Furthermore, the superstructure could be easily modified during a bridge widening projects or during the addition of a pedestrian bridge at the upstream side. Therefore, a reduction of the detrimental effects as described above, could be achieved in an existing bridge without much additional efforts.

d. Finally, this type of countermeasure could be particularly useful, since any modification to the superstructure is less intrusive to the channel and requires a shorter permitting process, as opposed to placing rocks in the channel. Therefore, the retrofitting projects could be completed relatively faster.

VIII. IMPLEMENTATION PLANNING
The research outcome could be added in different FHWA publications, such as Hydraulic Engineering Circular (HEC) No. 23 as a standard for retrofitting bridge superstructures for countermeasure involving pressure scour, HEC No.18, and Highway Design Manual for different states, for designing new bridge superstructures.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

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NCHRP Review of E-03

The research objective needs to be clarified. Also, the subject has been investigated by FHWA. It is crucial to review related research to avoid any duplication and then define the research objective.

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FHWA Evaluation of E-03


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AASHTO Committee Evaluation for E-03

Mitigation of Pressure Flow Scour by Improving the Hydrodynamic Conditions at the Upstream of The Bridge Superstructure

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design - The proposed research would be beneficial by providing guidance for the design of streamlined upstream superstructure shapes that could help reduce pressure flows at bridges, reduce entrance losses (therefore reduction in the uplift and horizontal forces on the deck; as well as less backwater) and debris accumulation during extreme pressure flows.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-E-04

II. PROBLEM TITLE

Protecting Bridge Approaches during Flooding Events

III. RESEARCH PROBLEM STATEMENT

Flooding can cause significant damage to bridge structures and has for many years been associated with coastal areas as a result of hurricanes and cyclones. Recent trends have shown an increase in both the frequency and the intensity of storms worldwide. At the Southeast Bridge Preservation Partnership meeting, Texas reported on 6 major flooding events in 13 months. Other states, including Louisiana, Georgia, West Virginia and Florida also reported on flood impacts on their structures. Significant flooding events have been reported in North and South Carolina, New York, New Jersey, California and in many Midwest states. Many Powerpoint slides from the Southeast states meeting showed the piers and abutments in place but the bridge approaches washed away. This damage triggers a road closure and a costly repair. While this repair is less costly than a bridge replacement, it is often handled by state work force working 24-7 to reopen the bridge. This approach becomes unsustainable if many structures are affected by the same storm event, or if several events happen in a short period of time.

This research will suggest methods and designs that could protect the approaches of structures from damage during flood events. How would we design and construct a bridge that we could not allow to fail in flooding? No doubt the answer to this question would be cost-prohibitive to use on all structures, but it may point to methods that could be used by bridge designers to greatly reduce this type of flood damage while being practical and cost effective.

This project would support the asset management (10-year risk based asset management plan) and research strategic focus areas of the Maintenance Committee Bridge Technical Working Group.

IV. LITERATURE SEARCH SUMMARY

An abbreviated literature review using TRID was conducted using keywords “bridge approach flood failure.” The majority of the responses related to scour at the bridge piers. Three related items were returned:

1. “Reducing Flood Vulnerability of Communities with Limited Road Access by Optimizing Bridge Elevation” is funded by Research and Innovative Technology Administration, University Transportation Centers Program. FHWA-DTRT13-G-UTC38 448. The work is focused around a bridge failure in Colorado that resulted in residents of a small town being airlifted out of the flood zone. It speaks to using limited access as a design criterion.

2. Greenlee, Neil T., “Design/build Replacement of Beaufort & Morehead Railroad Trestle over Newport River, Morehead City, N.C.” AREMA proceedings of 2000 Annual conference, Dallas, Texas. This paper indicated that the western approach was raised 4 feet to be above the 100-yr flood.

3. Cruikshank, J, “Seven-A-Side”, Highways, Volume 62, pp 18-20. This article outlined multiple approaches for very poor soils at the second Severn crossing. Are there designs or remediation
other than raising the elevation of the bridges and the approaches that can protect the approach area and reduce the amount of approach reconstruction following flooding?

V. RESEARCH OBJECTIVE

This research will suggest methods and designs that could protect the approaches of structures from damage during flood events. It is anticipated that the research will provide agencies with several methods to improve the robustness of their bridge approaches with regard to flooding. The work will include case studies and may include modeling results to support the recommended approaches. Relative costs will be provided so that agencies can weigh the cost of the treatment against the risk of flooding.

The following tasks should be included in the work:

1. Literature search regarding damage to approaches during flooding, design methods for bridge approaches, models of the process of bridge approach wash-out, known methods of preventing bridge approach failure during flooding.
2. Identify the features required to assure that approach failure would never occur. Identify costs associated with this “no risk” design.
3. Identify modifications to current designs that would reduce the risk of approach wash-out and estimate costs for each approach. Select the three most promising modifications.
4. Identify agencies that are using any of the most promising modifications or designs. Describe their experience and performance in case studies. Include relative costs.
5. If a model exists for approach slab washouts during flooding, model the three most promising modifications using real bridge data collected in task 4 above. Suggest further modifications that could improve performance. If actual flooding has occurred, report the structures performance.
6. Prepare final report outlining all work, the most promising methods of preventing bridge approach washout, the relative costs and performance estimates, and recommendations for implementation.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$300,000

Research Period:

24 months

VII. URGENCY AND POTENTIAL BENEFITS

Tools to assist states in maintaining their bridges in working condition following flood events are increasingly needed. The recent flooding over a broad area of Texas, and Superstorm Sandy in New York, demonstrate the occurrence of extreme events and the costs. It is not anticipated that the tools developed in this project would be applied to every structure, but would be applied to critical structures and to structures leading to towns with limited road access.

VIII. IMPLEMENTATION PLANNING

This research will aid agencies in improving the resilience of their structures. With the MAP21 10-year risk based asset management plan, states and local agencies who own or maintain bridge structures will need methods to mitigate damage from adverse weather.
If the research is successful, it would be presented in a variety of forums including Transportation Research Board annual meeting, AASHTO Maintenance Committee, TSP2 regional bridge partnerships, and the National Association of County Engineers.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

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XI. SUBMITTED BY

Contact information for individuals submitting or supporting this problem statement.

The Bridge Technical Working Group (BTWG) of the AASHTO Sub-Committee on Maintenance (SCOM).

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NCHRP Review of E-04

Reviewed By:  
Amir N. Hanna  
ahanna@nas.edu

Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem appears to be solvable through the proposed research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?
The topic of research is likely to be of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research.

D. Is the scope of the research reasonable?

The proposed scope appears reasonable.

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 24 months appears adequate.

F. Is the budget adequate?

The proposed budget of $300,000 appears adequate.

G. Comments on current or past research on the topic.

A few studies have been cited but further literature review, surveys, and information gathering should be performed as part of the research.

Review Date:
11/29/2017

FHWA Evaluation of E-04

Joe Krolak - HIBS-20/Kornel Kerenyi - HRDI-40 - Extensive research was conducted on protecting bridge abutments and abutment embankments for shallow and deep foundations (including HWA-HRT-17-013 "Hydraulic Performance of Shallow Foundations for the Support of Vertical-Wall Bridge Abutments"). As a result of this research, it has become clear that previous guidance on designing and constructing countermeasures to prevent bridge abutment embankment failure, for a given flood standard, has been inadequate. New guidelines on placing scour protection (e.g. riprap) for abutment embankment protection have been developed and are currently being incorporated into HEC-18 and 23. The new guidance is applicable to new and existing bridges in both coastal and riverine environments. Additionally, the problem statement neglects the long practice of designing approaches for overtopping or otherwise as "perched" sections. Neither does the problem statement recognize the recent NCHRP and other studies (Corps, FHWA, others) and synthesis on roadway overtopping and flooding. The statement neglects the piping and other aspects of the situation. As a consequence, the statement is duplicative and varies with accepted research and practice.

AASHTO Committee Evaluation for E-04

Protecting Bridge Approaches during Flooding Events
Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Bridges and Structures

Comments:
Committee on Bridges and Structures – As the possible recommendations include changes to bridge design methods, the panel should include a member from the appropriate technical committee(s).

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – The proposed research does not acknowledge the possible benefits of approach failures, such as lower upstream water surface elevation and protection of the bridge structure itself. Proposed solutions should be evaluated for possible increase on stress and scour of the bridge elements. To ensure these perspectives are considered, the panel should include experts in hydraulic engineering.

Submitted By:
Troy Suing
AASHTO Staff
Committee on Maintenance

Comments:
Committee on Maintenance rank as #5 priority
I. Problem Number 2019-E-05

II. Problem Title

Development of High-Quality Databases of Deep Foundations Load Tests

III. Research Problem Statement

Data at foundation load test sites can be used to verify and optimize the Geotechnical design of foundations for the projects they are used in. In addition, if complete and high-quality data at load test sites are obtained and compiled in databases, they can be used in the future by: a) designers to improve the geotechnical design for production foundations in their projects and, more importantly, b) by researchers in reliability calibration to develop more accurate and economical foundation geotechnical design methods. Reliability calibration is the best option to develop foundation geotechnical resistance factors and to identify and develop quality LRFD foundation geotechnical design methods, and thus for implementation of LRFD. Reliability calibration requires development of a high-quality deep foundation load test database and a good way to store and maintain this database. The contents of this database should include results of: load tests, subsurface investigation, construction and quality control (QC) methods and the conditions employed to obtain these results (e.g., types of: foundations, foundation soils, and construction methods).

As geotechnical practice moved towards LRFD, the vast majority of current LRFD foundation geotechnical design methods were developed based on past experience and judgement. There are only a very small number of reliability-based resistance factors for foundations adopted by AASHTO or State DOTs due to the lack of quality and complete foundation load test databases. Current highway engineering practices emphasize the use of load test results for individual projects, not for future reliability calibration. This could lead to two main problems with the load test data obtained in these projects: a) data is not complete or of good quality (accuracy) for use in the reliability calibration; and b) not reported or compiled for future use. There are variations in the type of data collected at load test sites and the procedures followed for obtaining these data by various State DOTs. There are still issues with the quality of the reported data at load test sites (e.g., clarity, accuracy and completeness), even in some developed load test databases. This problem statement is developed to address those issues and others mentioned above.

IV. Literature Search Summary

Several State DOTs and researchers have developed and are now developing their own foundation load test databases (e.g., Florida, Iowa, Louisiana, and Illinois), but there are still issues with the quality and completeness of these databases. FHWA published recommendations in a 2015 TRB paper to develop and share quality foundation load test databases (Abu-Hejleh et al., 2015). FHWA has recently developed and released version 2 of its Deep Foundation Load Test Database, DFLTD v2. This database added 150 new load test data for large size diameter open end driven piles. The database is relational, and the records can be queried in numerous ways. However, this database needs improvements and also needs additional load test data that cover all deep foundation types. In summary, research work is still needed to develop high-quality national and local databases of deep foundation load tests. These databases need to include an adequate number of complete and high-quality records of data at load test sites and should cover all common foundation design and construction conditions encountered in the United States.

V. Research Objectives and Work Plan

Research Goals:
• Develop a new national deep foundation load test database that includes all available quality deep foundation load test data. This requires development of a national protocol to obtain and report data at load test sites.
• Help State DOTs and other highway agencies develop their local and regional high quality foundation load test databases.
• Develop a plan to market, update and maintain the developed databases of deep foundation load tests.

The work plan has two phases: A and B.

A. Develop a National Database of Deep Foundation Load Tests

• Benefit from all developed deep foundation load test databases developed by State DOTs and researchers.
• Benefit from the developed FHWA DFLTD v.2 database and the 2015 FHWA TRB paper described above.
• Develop/finalize a national protocol to obtain and report quality/complete/consistent data at new load test sites, and to identify and compile existing quality load test data that were not reported in current load test databases.
• Develop/finalize the framework for a quality foundation load test database to store the data collected at load test sites and provide the information needed by designers and researchers for the applications discussed above. This database should be available online, in line with the developed national protocol, flexible so that is can be easily updated, shared, changed, and expanded, and have appealing and user-friendly interface. This database should be compatible with the developed national protocol to obtain and report data at load test sites.
• Collect undocumented good load test data for deep foundations. This requires contacting various highway engineering agencies, including State DOTs, and load testing firms.
• Based on the above, develop the national database described in the 1st goal.
• Develop guidance and examples for applications and limitations of foundation load tests databases.
• Based on above products, develop recommendations to help State DOTs develop their local foundation load test databases and its local protocol for obtaining and reporting load test data.
• Develop recommendations to update, maintain, and share the national and local foundation load test databases.

B. Develop a Plan to Implement, Market, Update, and Maintain the Databases of Deep Foundation Load Tests Developed in Phase A

The goal of this plan is to develop clear and detailed guidance to implement the Phase A products based on recommendations by public and private highway agencies and to ensure the future support of these agencies for maintenance, update, and sharing of the national and local Deep Foundation Load Test databases. These agencies include AASHTO, FHWA, State DOTs, private engineering firms, TRB, ASCE, DFI, ADSC, and PDCA.

Work in this plan includes development of clear and detailed:

• Marketing plan of the study product and recommendation to all public and private highway engineering agencies. This plan should convince agencies of the value and benefits of the study products and recommendations.
• Guidance for State DOTs to develop their own local deep foundation load tests and develop and deploy their local protocol for obtaining and reporting quality data at load test sites. Possible research needs by State DOTs need to be discussed.
• Requirements for maintaining, updating, and sharing the national deep foundation load test database and the value and cost of this work. These would help in selecting the agency or agencies that would take the lead in maintenance and update of this load test database.

C. Estimate of Problem Funding and Research Period

**Recommended Funding:**
$400,000

**Research Period:**
2.5 year

D. Urgency and Potential Benefits

This research study will help move the geotechnical design of deep foundations to true reliability-based design. This is the best option for LRFD implementation since it will lead to development of more accurate and economical foundation geotechnical methods. These advantages will increase the confidence in design methods for foundations and significantly reduce the cost for construction of foundations. Reliability calibration requires development of quality foundation load test databases. Although there have been some notable efforts in the development of such databases, there is still an urgent need to develop a better and complete national foundation load test database and a national protocol to obtain and report data at load test sites. It is a crucial need at this time since the vast majority of the current LRFD foundation geotechnical design methods are developed based on past experience and judgement, not reliability calibration.

E. Implementation Planning

Implementation of the results of this research study can be immediate. State DOTs, consultants, and researchers would have access to use the data developed in the national database.

The study product and recommendations can be implemented through collaboration between national and state transportation agencies (AASHTO, FHWA, State DOTs, ASCE, DFI, ADSC, and PDCA). This collaboration can happen in conferences, like TRB, and led by AASHTO and/or FHWA. One of the outcomes of this collaboration will be a strategy to maintain, update, and share the national and local database of deep foundation load tests. See Phase B of the study workplan for more specific details of a plan to implement study findings.

F. Person(s) Developing the Problem Statement

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G. AASHTO Monitor

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**Cosponsoring Committees and Endorsements:**
- AFP30, Soil and Rock Properties,
- AFS30, Foundations of Bridges and Other Structures
- AFP10 (2), Geotechnical Asset Management
- AFP20 Geotechnical Site Characterization
- North Carolina DOT
- Indiana DOT
- Ohio DOT
- Alabama DOT
- New Mexico
- Missouri DOT
- Louisiana DOTD
- Louisiana Transportation Research Center
- New Hampshire DOT
- Colorado DOT

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**NCHRP Review of E-05**

**Reviewed By:**
Edward T. Harrigan
eharriga@nas.edu

**Comments:**

A. Is the problem potentially solvable through research?

The problem is potentially solvable through an NCHRP research project.

B. Is it likely of interest to at least 2/3s of the DOTS?

Based on its goal of simplifying the design of deep structure foundations, the problem is of likely interest to all the states.

C. Is there a reasonably clear objective?

The stated objectives are clear.

D. Is the scope of the research reasonable?

Staff suggests that the proposed Phase B be deferred until the results of Phase A are available and that it possibly be funded through Project 20-44.

E. Can the research be done in 2-3 years at the most?

The research can be accomplished in 3 years.

F. Is the budget adequate?
Considering the cost of developing and validating even simple software and the potential for field work in the project, staff recommends a minimum budget of $550,000.

G. Comments on current or past research on the topic.

A search on Google Scholar from 2014 to present did not identify research elated to this topic other than that cited in the problem statement.

Review Date:
11/21/2017

FHWA Evaluation of E-05

Jennifer Nicks/HRDI-40 - The collection of load test information is important, and considerable work has been performed on developing databases at the federal and state levels. The type and amount of information collected, however, may vary amongst the different databases. The problem statement addresses this primary issue through the development of a national protocol and database schema which would help provide consistency in data collection amongst transportation agencies. This would also support efforts in the Data Interchange for Geotechnical and Geoenvironmental Specialists (DIGGS) work and the proposed NCHRP problem statement 2019-C-08. S. Nichols/HIBS-20 - Considerable work has been done at the state and federal level to develop load test databases. There is a need to address protocols and governance to support current work on DIGGS, including the current proposed problem statement C-08.
NCHRP Problem Statement Outline

Comments: This problem statement is supported by the Colorado Department of Transportation, TRB's Standing Committee on Engineering Geology and TRB's Joint Section Subcommittee on Geotechnical Asset Management.

I. PROBLEM NUMBER

2019-E-06

II. PROBLEM TITLE

Provide a suggested title, in as few words as possible.

“Deterioration Rates and Unit Costs for Geotechnical Assets.”

III. RESEARCH PROBLEM STATEMENT

“The term ‘asset management’ means a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the lifecycle of the assets at minimum practicable cost.” (23 USC 101(a)(2))

Federal rules in 23 CFR 515.9 encourage transportation agencies to incorporate in their Transportation Asset Management (TAM) Plans all infrastructure assets within the highway right of way. This may include geotechnical assets such as retaining walls, unstable slopes, embankments, and other asset classes whose functionality may affect the whole life cost and/or performance of the network. AASHTO guidance on asset management notes that best practice is the use of deterioration and cost models as central tools in forecasting future preservation needs and estimating life cycle cost.

Agencies implementing geotechnical asset management (GAM) will need to develop consistent quantitative tools to forecast deterioration and costs for best practice asset management and to provide accurate investment plans in the TAM Plan. The deterioration of unstable slopes, embankments, and retaining walls increases the likelihood each year that transportation service in a road corridor will be disrupted by rockfall, slope movement, frost heaves, washouts, and other damage. These problems then require an agency response – either proactive risk mitigation or preservation, or reactive emergency repair – to maintain continuity of service.

IV. LITERATURE SEARCH SUMMARY

Most of the literature regarding geotechnical asset management (GAM) has been published in the last 7-8 years. The original GAM papers were published in the early 2000s. A search of the TRB RNS database yielded a handful of entries. A search in the TRB RIP database yielded 7 records, one of which is the Alaska DOT’s Geotechnical Asset Management Program and one of which is the current NCHRP project 24-26: Development of an Implementation Manual for GAM for Transportation Agencies. The NCHRP project was proposed a few years ago by the TRB GAM Subcommittee (then AFP10(2)). The TRID database search provided more than 30 records, many of which are directly related to GAM, but some of which are from the UK, which has “geotechnical asset management” but not the same concept as has been developed in the US. In addition, one of the authors of the RNS has collected a GAM bibliography (not comprehensive)
which currently has some 40 plus references over the 15 years since GAM publications first appeared.

Most of the research and publications to date address basic concepts of transportation asset management for geotechnical assets including: the role of geotechnical assets and reasons for developing GAM programs, taxonomy for geotechnical assets, methods of inventory and condition surveys (including a number of papers on details of collecting geotechnical data via remote sensing such as InSAR) and the means to express the condition of these assets over time, development of performance measures, incorporation of risk management principles into GAM, several papers addressing progress of development of Alaska DOT’s pioneering comprehensive GAM Program and Colorado DOT’s unique Hazard Management Program. Virtually all of the GAM references and literature are known to the members of the TRB GAM Subcommittee and the proposers of this research, since the development of GAM is relatively new.

The research in this problem statement is proposed precisely because there are some critical gaps in the development of GAM program guidance that have not been filled by current research. One of the gaps has two related parts: a) gaining an understanding of how geotechnical assets deteriorate over time and b) gaining understanding of unit costs for repair, preservation and replacement of elements of deteriorating geotechnical assets – necessary data for conducting the lifecycle cost and return on investment analyses necessary to transportation asset management which all state DOTs are required to implement. A second gap is the development of economic analysis tools for GAM such as those used to support decision-making via TAM plans for pavements and bridges. This will be addressed in another problem statement.

V. RESEARCH OBJECTIVE

The objective of this research is to develop measurable, consistent, broad-based deterioration and cost models for the three most significant types of geotechnical assets; retaining walls, embankments, and unstable slopes. The models will be developed mainly using existing condition assessment data already gathered by transportation and other agencies, and may be supplemented by field surveys conducted by the researchers, particularly to follow up on earlier surveys or to fill in asset classes not covered by available data. Agency data on quantities and costs of past risk mitigation, preservation, and reconstruction projects will also be used. Within the limitations of available data, the models will provide guidance on customization of the models to fit agency variations, regional differences in climate, hydrology, geological character, and other significant variables. Statistical analysis of historical data would be relied on to the greatest extent possible with supplementation from professional engineering judgement from practicing engineers. Limitations and assumptions would be documented that lead to a consistent and broad-based approach to cost analysis. The models must be suitable for use with TAM performance measures (such as condition states) commonly used by transportation agencies.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

Funding Suggested: $300,000+

**Research Period:**

Research Period Suggested: 24-36 months.

VII. URGENCY AND POTENTIAL BENEFITS
Most states are presently paying little attention to GAM assets. Thus far, few agencies have taken steps to incorporate geotechnical assets into their TAM programs. The few states that are moving forward to investigate and develop GAM-based programs are developing unique programs, often building on existing programs such as the Rockfall Hazard Rating System programs that about 2/3 of states are using. One value of conducting the research proposed here is to provide DOTs some of the tools to improve progress to GAM implementation. The tools developed with this research are expected to be useable as created or could be readily adapted to an agency’s specific needs. There is some benefit to uniformity of approach that will make it easier and less expensive for state DOTs to develop GAM programs without re-inventing the approaches that have already been developed.

Currently geotechnical asset management procedures rely exclusively on expert judgment because of the relative newness of the field and lack of sufficient historical data in many agencies. Use of expert judgment in matters regarding long lifespans can be of limited or questionable reliability. Using the models that will be developed with this research, agencies will have a consistent basis for the initial forecasting models they will use in their TAM planning processes, to more credibly tie the forecasts to historical field assessments. Systematic and objective methods will ensure that geotechnical risks are managed consistently and fully considered in planning and programming, contributing to the ease of development of GAM programs in DOTs and in the long run, an improvement in performance, cost and safety of the transportation system.

The negatives without the products of this research include: a more difficult process to develop GAM programs, which is sure to discourage many states from the attempt (especially since inclusion of geotechnical assets in a DOT TAM Plan is voluntary under federal law); the likelihood that each state that does devise a GAM program will create its own unique one-off analysis tools at greater expense and which will be much less likely to be successfully shared among DOTs; the near certainty that those states that do not begin to address management of geotechnical assets soon will be behind the curve as slopes (in particular) that were built in the post-WWII boom of the 50s and 60s are reaching end of service life and are deteriorating at a faster rate.

VIII. IMPLEMENTATION PLANNING

This research is envisioned to feed data and recommendations directly into TAM Plans and management systems for geotechnical assets. Continued FHWA and AASHTO support for asset management and performance management will help to ensure successful and widespread implementation.

a) **Target Audience:** This research is envisioned to directly support development of State (and local) DOT’s TAM Plans and management systems for geotechnical assets.

b) **Key decision-makers and stakeholders:** will include DOT Chief Engineers, senior Geotechnical staff, Asset Management and Planning staff.

c) **AASHTO committees:** committees focusing on Asset and Performance Management, committees addressing geotechnical engineering assets including slopes, embankments and retaining walls and committees that will address maintenance of these assets.

d) **Early adopters:** Several states have been working to develop geotechnical asset management programs. Colorado DOT is the first state to have adopted a GAM- and risk-based GeoHazard Management Program. CDOT also has an independent GAM-based retaining wall management program. Alaska is the first state to conduct a comprehensive research program to develop GAM concepts and develop and GAM Plan in accord with federal TAM Plan guidelines to provide decision-making support for asset management and performance management at AKDOT. The program covers rock and soil slopes, embankments, retaining walls, and materials sources.
Washington State DOT has a long-standing Unstable Slope Management Program and is seeking advice on modifying it to incorporate GAM principles. Wyoming DOT is modernizing its ten year old rockfall hazard program. Numerous states (about 2/3 of US states) have adopted some form of rockfall hazard program, most based on an Oregon DOT research program that resulted in the development of the Rockfall Hazard Rating System.

e) Institutional barriers:

a. A significant barrier is the lack of recognition of the overall value of and supporting role that geotechnical assets perform for every DOT. The tendency of DOT professionals and managers is to “build and forget” geotechnical assets, but these asset have a finite lifecycle and deteriorate with time just as do other assets. The risk associated with this deterioration of aging geotechnical assets rises every year along with the cost for maintaining these assets in a “state of good repair.” The monetary value of geotechnical assets can exceed the value of a DOT’s bridge inventory. Literally every structure asset and every pavement asset of a DOT rests on a geotechnical asset, whether embankment, subgrade, retaining wall or slope. The recent federal rules promulgated for MAP-21 and the FAST Act recognize the value of reducing requirements for including assets other than pavements and bridges that a DOT decides to include in their TAM plans. This will make it easier for DOTs to incorporate geotechnical assets into their asset management and performance management plans. Continued FHWA and AASHTO support for geotechnical asset management and performance management will also help to ensure successful and widespread implementation.

b. Another barrier for GAM implementation is the lack of consistent, relevant and recoverable historical data to support deterioration models and analysis of life cycle costs to support decision-making about geotechnical assets. Depending on the quality of data and models obtained, the Panel may elect to conduct a follow up study to gather additional data for incorporation into the model. In the longer term agencies should be able to repeat the methodology with data collected over longer time frames to improve and further customize the models.

c. Continuous communication of the research contractor with federal, state and local transportation agencies during the research will add to the value of the research and help ensure the product of the research will meet the needs of transportation agencies.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Provide name, title, organization, telephone number, and email address.

Scott Anderson, Ph.D., P.E.                  David Stanley, J.D., L.G., L.E.G.
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Above individuals are co-chairs of AFP00(1) - TRB Joint Section Subcommittee on Geotechnical Asset Management (AFP00 and AFS00 Sections)

X. AASHTO MONITOR

XI. SUBMITTED BY

Ty Ortiz, P.E.
Geohazards Program Manager
Colorado Department of Transportation
Phone: 303-398-6601
NCHRP Review of E-06

Reviewed By: Camille Crichton-Sumners ccrichton-sumners@nas.edu

Comments: Improved methods in forecasting deterioration of geotechnical assets and identifying costs for successful practices in geotechnical asset management will aid asset owners in developing Asset Management investment plans for state Transportation Asset Management Programs (TAMP). This study will generate deterioration and cost models for retaining walls, embankments, and unstable slopes existing condition assessment data gathered by transportation and other agencies. If supplemented by field surveys as suggested, the budget should be increased to 450 K. The time-frame should be 36 months, closer to the upper limit of the suggested project duration range.

Review Date: 11/30/17

FHWA Evaluation of E-06

Mike Adams, HRDI-10 - Geotechnical asset management is an important component that is not widely considered in Transportation Asset Management Plans, in part due to lack of information on the deterioration rates of geotechnical assets, defining serviceability, and the unit costs associated with the life-span of an asset. The proposed research would address this need; however, comparing strategies to prolong serviceability, taking into account construction practices, material and component specifications, and contracting mechanism, and varying climate, hydrology, and other variables is no small feat. The project may be more successful if only one asset was evaluated. This would lay the groundwork for additional assets. S. Nichols/HIBS-20 - GAM is a significant effort, with potential to provide broad support and efficiency to the overall TAM community. One of the prominent gaps in GAM to date is the lack of research and information on deterioration rates and costs associated with managing these assets. This research addresses this gap.
Research Field F

MAINTENANCE
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-F-01

II. PROBLEM TITLE

Impacts of Connected and Autonomous Vehicles on Winter Maintenance

III. RESEARCH PROBLEM STATEMENT

Winter highway maintenance is critically important in the United States, not only to northern tier states with prolonged winter seasons but also to mountainous states and to southern states where occasional winter storms can paralyze surface transportation. Surveys\(^1\) indicate that winter road conditions are a top safety concern among highway users, and delays from adverse conditions and road closures have huge economic impacts on commerce.

Until now, investigations of the relationship of winter road conditions and winter maintenance to connected and automated vehicles have been limited. The most significant activities include:

- States and the Federal Highway Administration have developed Maintenance Decision Support Systems\(^2\) which use time- and location-specific weather reports and forecasts and model the physical system of weather, roadway, traffic, and feasible maintenance treatments to identify effective or optimal maintenance treatments and timing. The MDSS also uses observations from instrumented maintenance vehicles to dynamically assess roadway conditions and communicates recommendations and other information back to the vehicle.

- The Federal Highway Administration recently published *Guidelines for Deploying Connected Vehicle-Enabled Weather Responsive Traffic Management Strategies*,\(^3\) which lays out a framework for acquiring data from intelligent agency fleets, connected vehicles, and connected third party fleet services and travelers. The guidelines focus on formulating traffic management strategies, such as variable speed limits, vehicle restrictions, signal timing, and traffic advisories.

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\(^1\) For example, *SDDOT 2015 Statewide Customer Satisfaction Assessment*, ETC Institute for the South Dakota Department of Transportation Office of Research, December 2016.

\(^2\) For example, Pooled Fund Study TPF-5(054) and TPF-5(347), *Development of a Maintenance Decision Support System*, led by the South Dakota Department of Transportation and involving 17 other states.

IV. LITERATURE SEARCH SUMMARY

The FHWA guidelines do not directly address how connected vehicles could improve maintenance strategies or practices, either alone or in conjunction with a Maintenance Decision Support System. Neither do they address improvements in winter maintenance that might be needed to make connected or automated vehicle travel possible under conditions of limited visibility, snowy and icy pavements, reduced traction, and other typical winter conditions. In summary, prior research does not effectively associate the needs and capabilities of connected and automated vehicles with winter maintenance strategies and practices.

V. RESEARCH OBJECTIVES

The overall objectives of this research will be to:

- identify and describe roadway requirements necessary to safe, successful operation of connected and automated vehicles in winter conditions
- identify and describe how highway agencies could use information from connected and automated vehicles—in conjunction with Maintenance Decision Support Systems or otherwise—to better achieve the level of service needed by those vehicles.

Tasks anticipated in this project could include the following:

1) **Advanced Winter Maintenance Techniques**—Review pertinent literature and conduct outreach to agencies that have planned, deployed, and used advanced winter maintenance techniques, especially those involving vehicle connectivity and predictive capabilities. Identify current and emerging capability as well as needed improvement and development. Work with existing groups (e.g. MDSS Pooled Fund Study, Clear Roads Pooled Fund Study, Connected Vehicle Pooled Fund Study, etc.) to the extent possible.

   *(Deliverable: Documentation of Findings in Technical Memorandum 1)*

2) **Connected and Automated Vehicle Operational Requirements**—Review pertinent literature and conduct outreach to organizations involved in vehicle manufacture and testing to identify current and emerging capabilities of connected and automated vehicles and limitations related to operation in winter conditions.

   *(Deliverable: Documentation of Findings in Technical Memorandum 2)*

3) **Potential Improvements to Winter Maintenance Strategies and Practices**—Identify information that is or could be made available from connected and automated vehicles, including fleet and commercial vehicles, to improve highway agencies’ ability to forecast, detect, and respond to road conditions resulting from winter weather events. Describe the potential application of such information to practical improvements in winter maintenance strategies and practices, including use in conjunction with winter Maintenance Decision Support Systems. Engage potential users to assess the value and practicality of use.

   *(Deliverable: Documentation of Findings in Technical Memorandum 2)*

4) **Final Report.** Assemble all information gathered and compile a final report and presentation materials describing the results of the project.

   *(Deliverable: Final Report)*

VI. URGENCY AND POTENTIAL BENEFITS
State and local transportation departments responsible for maintenance already face great challenges to maintain mobility and safety during winter conditions. These challenges will grow as the number and use of connected and automated vehicles increase. At the same time, the sensing and communication capabilities of connected and automated vehicles may enable transportation agencies to more effectively anticipate and respond to winter weather events and to improve mobility and safety for all vehicles.

VII. FUNDING REQUESTED AND TIME REQUIRED

It is estimated that this research will take 12 months to complete and will require approximately $320,000.

VIII. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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South Dakota Department of Transportation
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IX. AASHTO MONITOR

David L. Huft, Research Program Manager
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X. SUBMITTED BY

David L. Huft
Project Manager, Transportation Pooled Fund Study TPF-5(347), Development of a Winter Maintenance Decision Support System, on behalf of the Colorado, Indiana, Kentucky, Maryland, Michigan, Minnesota, Nebraska, South Dakota, and Virginia Departments of Transportation
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NCHRP Review of F-01

Reviewed By: Camille Crichton-Sumners ccrichton-sumners@nas.edu

Comments: This study is needed since the current body of knowledge includes very little on how connected vehicles could improve winter maintenance strategies (with or without the use of existing Maintenance Decision Support Systems) or what improvements in winter maintenance procedures might be needed to make connected or automated vehicle travel safe under adverse weather conditions. This could potentially be divided into two separate problem statements, however, if they are covered under one study, the budget and time-frame should be increased considering the need for intra-agency coordination and data gathering.

Review Date: 11/30/2017
FHWA Evaluation of F-01

Gabriel Guevara/HOP: This is a good research problem statement and it complements well current efforts of the Road Weather Management Program; particularly, it would complement the efforts of "Automated Vehicles and Adverse Weather" which looks into the performance suitability of discrete sensors and perception systems of C&AV's operating under adverse weather conditions. Morgan Kessler/HRDI-20 - This topic has come up for discussion at the AASHTO EMTSP, TRB AHD60, and others such as AASHTO SCOM. The problem statement captures well the needs and questions being asked by the maintenance community; however, I believe the biggest question will be in regard to how the maintenance agency will collect and use the data produced by CAVs. This problem statement is similar to overall scope to F-03, below, and possibly could be combined into a larger, farther-ranging project that addresses CAVs and infrastructure in all weather/season contexts. James Gray/HIAP-30 - Understanding CAV technology as it relates to Winter maintenance is important for safety. However, this problem statement is overly broad and is unclear as to what the final report would address.

AASHTO Committee Evaluation for F-01

Impacts of Connected and Autonomous Vehicles on Winter Maintenance

Submitted By:
Troy Suing
AASHTO Staff
Committee on Maintenance

Comments:
Committee on Maintenance rank as #6 priority

Submitter Response for 2019-F-01
Impacts of Connected and Autonomous Vehicles on Winter Maintenance

From: [email: dave.huft@state.sd.us]

Comments:

I am pleased that Gabe Guevara confirms that this project would complement current FHWA Road Weather Management initiatives.

Morgan Kessler emphasizes the very real challenge of collecting and using data produced by connected vehicles. If this project and F-03 are similar enough to be combined (I do not have access to F-03), I would not object. James Gray’s request for clearer articulation of expected deliverables is valid and should be considered by the project panel.

Camille Chrichton-Sumners suggests possibly splitting the topic into two topics or else increasing the project funding. My preference would be to keep the topic as one, due to the strong interrelationship between connected vehicles’ potential impact on winter maintenance technology and winter maintenance’s potential impact on vehicle performance.

I appreciate all of the comments offered.
Contact Info: David Huft, SDDOT
Review Date: 12/19/2017
I. PROBLEM NUMBER

2019-F-02

II. PROBLEM TITLE

Determining Pavement Preservation Treatment Lives and Related Pavement Life Extension

III. RESEARCH PROBLEM STATEMENT

Success of a pavement preservation technique is heavily dependent on its optimal application in terms of timing and existing pavement conditions. Performance of different treatments and life extension of existing pavements due to these treatments is a function of existing pavement conditions (e.g., type, severity, and extent of distresses) and prevailing site conditions (pavement type, pavement age at the time of application, traffic, climate, etc.). There is an urgent need to develop methodologies to predict treatment performance, life extension of existing pavements and its related cost savings.

This research is endorsed by the AASHTO Maintenance Committee and was based on recommendations from the 2008 FHWA Pavement Preservation Roadmap.

IV. LITERATURE SEARCH SUMMARY

A literature review returned the following relevant documents on estimating the effectiveness and life extension of pavement treatments. The proposed research will fill gaps related to rigid pavements and will provide more specific methodology for predicting life extension based on functional classification, environment, and traffic. It will also provide guidance on cost savings associated with various treatment options.


Hall, K.T., Correa, C.E., Simpson, A.L., LTPP Data Analysis: Effectiveness of maintenance and Rehabilitation Options, June 2002

Newman, C.M., Casey, W.F., Gee, K.W., Transportation System Preservation Research, Development, and Implementation Road Map, January 2008

V. RESEARCH OBJECTIVE

The objective of this project is to develop methodologies to estimate treatment lives and life extension of both flexible and rigid pavements as a function of treatment type, existing pavement conditions, and environmental and traffic conditions. It is anticipated that existing databases and PMS data will be used to develop these methodologies and estimates for case studies.

The following tasks have been identified to complete the work for this project:
Task 1. Conduct a literature search and survey of transportation agencies nationally and internationally on: (1) pavement preservation techniques used for various existing pavement conditions; (2) performance curves of different pavement preservation techniques; and (3) methodologies to determine the life extension of existing pavements due to the application of pavement preservation treatments.

Task 2. Develop a process to develop family of performance curves for each pavement functional category for different pavement preservation treatment techniques used, as a function of the existing pavement, environment and traffic conditions based on findings from Task 1.

Task 3. Develop a process to determine the life extension of existing pavements as a function of existing pavement, environment and traffic conditions for selected treatment types.

Task 4. Develop a process for estimating the potential cost savings associated with selected preservation treatments given existing pavement, environment and traffic conditions on a per mile basis.

Task 5. Prepare final report.

Proposed Deliverables include:

1) A guide to develop performance curves and methodology to predict the life extension of various pavement preservation techniques for each pavement functional category, environmental and traffic condition.

2) Methodology to estimate cost savings associated with various treatments.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$350,000

Research Period:

30 months

VII. URGENCY AND POTENTIAL BENEFITS

The proposed research will assist states with long-term forecasting of pavement conditions necessary for development of Transportation Asset Management Plans in accordance with MAP-21 and the FAST Act. While initial TAMPs are required to be completed before the proposed research will be finished, the development of these curves will allow states to improve upon their pavement forecasting when future versions of their TAMPs are submitted. Further, the use of these curves will provide practitioners with valuable information to consider when making pavement preservation decisions.

VIII. IMPLEMENTATION PLANNING

The target audience for this research will be state and local agency pavement management professionals. Responsibility for communication and training on the use of the guide developed by this research will be led by the Pavement Technical Working Group of the AASHTO Maintenance Committee. Presentations on the results will be made at the annual Maintenance Committee Meeting, the TSP2 Regional Pavement Preservation Partnership meetings, and to the FHWA Pavement Preservation Expert Task Group.
IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

XI. SUBMITTED BY

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NCHRP Review of F-02

Reviewed By:
Amir N. Hanna
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Comments:

A. Is the problem potentially solvable through research? If not, why?

The problem appears to be solvable through the proposed research.

B. Is it likely of interest to at least 2/3s of the DOTS? If not, why?

The topic of research is likely to be of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research which is limited to developing methodologies to estimate the service life of preservation treatments and their effect on pavement service life.

D. Is the scope of the research reasonable?

The scope is reasonable, as stated in the problem statement appears reasonable.

E. Can the research be done in 2-3 years at the most?
The proposed research duration of 30 months appears high; 24 months should be adequate.

F. Is the budget adequate?

The proposed budget of $350,000 appears adequate.

G. Comments on current or past research on the topic.

A few studies have been cited. Further literature review should be performed as part of the research.

Review Date:
11/28/2017

FHWA Evaluation of F-02

Nadarajah Sivaneswaran/HRDI-20 - There is an active NCHRP project that essentially addresses the objectives of this problem statement for asphalt pavements - NCHRP 14-38 "Guide for Timing of Asphalt-Surfaced Pavements Preservation." While 14-38 is focused only on asphalt pavements, they also represent a large percentage the pavement network, are more sensitive to timing of preservation treatments, and the process will inform approach for rigid pavements. Recommend this project be deferred until findings from NCHRP 14-38 are assessed.

AASHTO Committee Evaluation for F-02

Determining Pavement Preservation Treatment Lives and Related Pavement Life Extension

Submitted By:
Troy Suing
AASHTO Staff
Committee on Maintenance

Comments:
Committee on Maintenance rank as #7 priority
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-F-03

II. PROBLEM TITLE

Determining State DOT Maintenance Program Implications of Connected and Automated Vehicles (CAV)

III. RESEARCH PROBLEM STATEMENT

Connected and Automated Vehicle research and technology is progressing at a rapid rate. Research is underway to examine how traffic control signs, markings, signals and other permanent and temporary ancillary devices (highway assets) can be designed, enhanced or applied for vehicle navigational guidance.

However, state maintenance engineers often cite inadequate resources to maintain the existing highway system and its ancillary highway assets at an acceptable level of service.

Without knowing how the technology of CAV will impact the required level of service or responsiveness for the maintenance, repair or replacement of those highway assets, the use of these assets for CAV vehicle navigation could be impaired and the adoption of CAV hindered.

Research is needed to explore the financial, workforce and level of service impacts demanded to maintain these highway assets for successful CAV navigation.

This research problem statement was the 2nd highest NCHRP priority identified by the AASHTO Maintenance Committee at the 2017 Annual Meeting in Providence, Rhode Island and aligns with the committee’s strategic goals of promoting a safe, reliable highway system and emphasizing innovation and emerging technology.

IV. LITERATURE SEARCH SUMMARY

- Potential Influences on Long-Term Service Performance of Road Infrastructure by Automated Vehicles [http://dx.doi.org/10.3141/2550-10](http://dx.doi.org/10.3141/2550-10)
- Commercial Truck Platooning Demonstration in Texas - Level 2 Automation
V. RESEARCH OBJECTIVE

The objective of this research is to examine the maintenance program implications of the use of highway assets for vehicle navigation for CAV.

The research team should work in conjunction with research underway, CAV developers, and highway asset vendors to determine how the assets will be used to meet the needs of the human driver and the CAV driver.

Identify the current resources (e.g., financial, workforce) allocated to state DOT maintenance programs to maintain, repair and replace highway assets and the associated levels of service (e.g., condition, response time, life-cycle) provided to meet the current needs.

Identify proposed CAV navigational systems, particularly those that rely on highway assets, to determine responsiveness, redundancy, and level of services required for meeting the CAV navigational needs.

The deliverables should include an assessment of the current state of maintenance programs as well as the required future state in order to support CAV needs. It is anticipated suggestions will be provided to CAV developers, highway asset vendors, and state DOT officials to design a system that can be efficiently and effectively maintained.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:**

$300,000

**Research Period:**

24 months

VII. URGENCY AND POTENTIAL BENEFITS

As research continues in the use of CAV technology, its impacts to state DOT’s maintenance programs and its implications to an already stretched budget and workforce need to be examined and thoughtfully considered in order to ensure highway agencies are prepared for the challenges these new vehicles present. The speed of advancement in CAV technology threatens to outpace the speed at which significant changes to highway infrastructure could be implemented. If major changes are determined to be necessary, it is important to begin identification as soon as possible.

VIII. IMPLEMENTATION PLANNING
The target audience of this research will be state and local transportation agency officials responsible for planning, design, construction, and maintenance. The AASHTO Maintenance Committee’s Roadway/Roadside Technical Working Group will seek partnerships with other relevant AASHTO Committees to coordinate the effort to disseminate the results of the research.

IX. PERSON(S) DEVELOPING THE PROBLEM

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XI. DATE AND SUBMITTED BY

October 13, 2017

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NCHRP Review of F-03

Reviewed By:
Amir N. Hanna
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Comments:

A. Is the problem potentially solvable through research? If not, why?

The specifics of the problem are not known at this time, making it difficult to assess the likelihood of success. However, the proposed research would provide a preliminary phase of research that could serve as a basis for a more comprehensive research effort.

F-03/3
B. Is it likely of interest to at least 2/3s of the DOTs? If not, why?

The topic of research is definitely of interest to at least 2/3 of the DOTs.

C. Is there a reasonably clear objective?

The objective, as stated in the problem statement, provides a clear intent of the research. However, accomplishing it will be a challenge at this time.

D. Is the scope of the research reasonable?

The scope is not specifically defined but it is intended to cover all aspects of maintenance (technical, economic, environmental, etc.) that are likely to result from the operation of connected and automated vehicles.

E. Can the research be done in 2-3 years at the most?

The proposed research duration of 24 months appears adequate for a preliminary phase of research.

F. Is the budget adequate?

The proposed budget of $300,000 appears adequate for a preliminary phase of research.

G. Comments on current or past research on the topic.

A few relevant studies have been cited. Further literature review, surveys, and other information gathering should be performed as part of the research.

Review Date:
11/29/2017

FHWA Evaluation of F-03

Morgan Kessler/HRDI-20 - As indicated in the comments for F-01, this is a topic that is much discussed in maintenance circles. This project is very timely, and should possibly be combined with the scope of F-01 to form a farther-ranging project regarding highway infrastructure maintenance and CAVs. This project should incorporate expertise and interaction with the CAV folks in other committees and industry. James Gray/HIAP-30 - Understanding how CAV technology will impact the basics of maintenance operations, such as pavement marking life, is an important safety consideration worth evaluating.

AASHTO Committee Evaluation for F-03

Determining State DOT Maintenance Program Implications of Connected and Automated Vehicles (CAV)

Submitted By:
Troy Suing
AASHTO Staff
Committee on Maintenance

Comments:
Committee on Maintenance rank as #2 priority
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER:
2019-F-04

II. PROBLEM TITLE
Guideline for Decision Making for Repair vs. Replacement of Highway Maintenance Equipment

III. RESEARCH PROBLEM STATEMENT

Equipment failures often force fleet managers to decide if equipment should be repaired or replaced. This may not solely be a financial decision; it is an operational decision as well. Operational impacts such as downtime, loss of function, mission-criticality, etc. need to be included. Fleet managers need resources to evaluate the merits of handling both planned refurbish vs. replacement decisions and unplanned repair vs. replacement decisions for equipment that has not met the established life cycle.

The repair, refurbish or replace decision is a consideration for DOT fleets as a method to manage fleet expenditures and extend lifecycle. Factors considered in cost effective fleet management involves an evaluation of when the correct time to repair, refurbish or replace an asset to include the following:

1. Original Vehicle /Equipment Condition
2. Component condition
3. Added Lifecycle
4. Parts Cost
5. Labor Cost
6. Time required (Out of Service Time, or Downtime)
7. Reliability Added
8. Funding availability
9. Outsourcing
10. Parts Obsolescence
11. Vehicle Obsolescence (customer’s business need changes; they no longer perform the function with this type of equipment)
12. Availability of substitute equipment (in fleet or rental)
13. Cost of rental for temporary replacement
14. Timeline for replacement
15. Critically of the asset to the customer’s mission
16. Repair/Refurbish costs versus full Replacement
17. Residual value before and after repair/Refurbish

It is critical to identify the costs and benefits of repair vs. replace decisions for fleet operations. The requested research should enable an agency managers to make informed business decisions.

This research need was identified as the highest priority for FY 2019 by the voting members of the Maintenance Committee at the 2017 annual meeting in Providence, Rhode Island and aligns with the committee’s asset management strategic focus area.

IV. LITERATURE SEARCH SUMMARY
Our literature review identified numerous studies showing the urgency of this topic. Listed publications did not identify existing tools or methodology that go beyond financial considerations. Operational impacts such as downtime, loss of function, mission-criticality, etc. need to be included. The proposed research will address these shortcomings in the existing body of knowledge.

   The page above links to an article that discusses different techniques that can be used to calculate replacement cycles for medium-duty trucks, with advantages and disadvantages associated with each. The article also discusses elements associated with the cost of repair versus a vehicles residual value.

   The page above links to an article that discusses the viability of refurbishing equipment for fleets. From the article: With costs far lower than those of purchasing replacements, and environmental benefits as well, some fleets are looking to extend the life of their existing off-road equipment rather than purchase a brand-new unit.

   The page above links to an article that discusses some of the economic considerations that can be utilized to cost-effectively determine whether to replace, Refurbish, repair, sell or scrap vehicles and equipment.

   The page above links to an article that discusses additional criteria to consider regarding repair or replace decisions for failing equipment.

   The page above links to an article that stresses the importance of a computerized maintenance management system (CMMS) to weigh the cost of maintenance against the estimated replacement value of equipment. The article includes a case study that may provide useful insight.

   The page above links to TRB’s Report 157 available for purchase that presents a framework that builds upon a set of fundamental concepts and provides a basic set of steps for transit agencies to follow when evaluating and prioritizing capital asset rehabilitation and replacement investments. Though not directly related to fleet equipment, the report may provide useful insight regarding basic concepts that could be applied to repair/refurbish versus replace decision making.
http://docs.trb.org/prp/13-0326.pdf
The page above links to a paper presented at 92nd Annual Meeting of the Transportation Research Board. The paper discusses a practically feasible equipment replacement optimization methodology to replace the right equipment at the right time and discusses equipment replacement decision making in detail.

The page above links to a report by PennDOT that details an analyses used to develop an Equipment Life Cycle Prediction Tool and includes a section on repair versus replace (reference pages 13 – 14).

Bonneville Power Administration, or BPA, is part of the U.S. Department of Energy and markets wholesale electrical power from 31 federal hydroelectric projects in the Northwest. The page above links to a report on BPA fleet asset management strategy and includes a section on the prioritization of repair/refurbishment versus replacement (reference pages 34 – 35).

The page above links to a FTA guide regarding transit asset management practices. Although focused on transit assets such as buses and rail vehicles, the information regarding conditional assessment and performance monitoring may provide useful insight (reference pages 49 – 71).

The page above links to a study regarding state DOT construction equipment to determine if a statistically based method for making replace/repair decisions could be identified.

The page above links to a report on fleet replacement modeling and includes information on utilizing a Repair Cost Limit (reference page 8).

https://www.gsa.gov/portal/mediaid/218887/fileName/Vehicle_Replacement_Standards
The page above links to posted data used by GSA and their customers regarding vehicle procurement services. These vehicle replacement standards may provide additional insight regarding repair/refurbish versus replace decisions.

The page above links to an article that directly addresses criteria to consider regarding refurbish or replace decisions for fire apparatus. From the article: Replacing specialty vehicles and equipment, like fire apparatus, in a timely manner can be a fiscal challenge for any fleet manager. Many operations refurbish such assets, because they perceive this to be more cost effective. This article explores the argument about refurbishing versus replacing expensive fire equipment.

http://library.ctr.utexas.edu/digitized/TexasArchive/phase1/4941-3-UTSA.pdf 
The page above links to a research development project for TxDOT regarding the development of Texas Equipment Replacement Model (TERM); a menu-driven driven system used to calculate and compare life cycle cost profiles and trends for fleet wide replacement decisions.

The page above links to an article that identifies alternative methods that can be used to right-size fleets and includes a brief discussion of renewal.

17. AASHTO Equipment Management Technical Services Program, library of Assessment Management presentations. 
The page above links to AASHTO’s EMTSP library of assessment management presentations. These include presentations on fleet assessment management practices from multiple state DOTs.

http://www.trb.org/Main/Blurbs/170367.aspx 
Available on the TRB website for purchase, this report explores the current state of the practice regarding fleet replacement management by state departments of transportation and includes a discussion of the perceived strengths and weaknesses of different management methods. Though unable to review this report, staff included this reference as the publication may provide useful insight.

This project was based on the six analytical models recently completed for the project “Fleet Management Criteria: Disposal Points and Utilization Rates” and address the need for expansion and application of this approach to management and analysis of equipment, utilization, costs and optimal life cycle for the remaining classes of NCDOT fleet.

The goal of this study was to determine a methodology for evaluating aging (or depreciation), disposal points, and overall utilization.

V. RESEARCH OBJECTIVE
The objective of this research is to provide fleet managers with a methodology and an electronic tool to guide decisions for repairing or replacing equipment. The development of this process and tool would be suitable for endorsement and distribution as an AASHTO guide.

To achieve this objective, the following tasks are anticipated:

1) Conduct a literature review and synthesis of completed and active research in repair vs. replace decision making within DOT fleets.
2) Conduct a survey of State DOT equipment managers to determine what factors and constraints that need to be included when making repair vs. replace and refurbish vs. replace decisions.
3) Develop a methodology that includes the necessary factors and constraints to make repair vs. replace and refurbish vs. replace decisions.
4) Develop a guide that includes the necessary factors and constraints to make repair vs. replace and refurbish vs. replace decisions.
5) Develop an electronic tool using commonly-available applications that includes the necessary factors and constraints to make repair vs. replace and refurbish vs. replace decisions.
6) Develop documentation suitable for endorsement and distribution as an AASHTO guide.
7) Develop a final report and proposed implementation and training plan.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $350,000
Research Period: 24 months

VII. URGENCY AND POTENTIAL BENEFITS

The requested research will develop and quantify the repair vs. replace and refurbish vs. replace decision making processes. These decisions often need to be made urgently. The guide and tool make these decision processes transparent, defensible, and consistent is fundamental to a larger, strategic approach to managing a fleet operations and the fleet management organizations.

VIII. IMPLEMENTATION PLANNING

The target audience for this research would be state DOT fleet managers and maintenance engineers who rely upon availability of equipment to carry out day to day operations. The guide and tool developed by this project would be championed by the AASHTO Maintenance Committee, with the Equipment Technical Working Group taking the lead role for dissemination and training. Details on the use of the guide and tool would be provided through webinars and through presentations at the annual AASHTO Maintenance Committee and the TSP2 Regional Equipment Management Partnerships.

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NCHRP Review of F-04

Reviewed By:
Andrew C. Lemer
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Comments: This problem statement addresses a well-defined and clearly researchable topic; the anticipated result—a methodology and electronic tool to guide decision-making—could be immediately useful to agency managers responsible for vehicle and equipment fleets. However, the value of such a methodology and tool depends entirely on availability of reliable information about component aging and service lives and operating environments. Assuming that adequate information is available, variations among agency practices for inventorying, recording use, and applying repair and replacement policies under adequate or constrained budgetary conditions could require such a methodology and tool to be so generic that its application in any single agency would require substantial customization effort. Development of a guidebook to help managers define the "repair or replace?" decision, understand and collect the data needed to support good decision-making, and measure the impact of better decision-making on fleet performance could be a more appropriate target for this research activity.

Review Date:
11/22/2017

FHWA Evaluation of F-04
Morgan Kessler/HRDI-20 - In regard to an agency's most expensive and complicated assets, fleet resources are near the top for most DOTs. The management of these assets has historically been a function of equipment departments, and rarely is looked at in terms of an agency's total asset management program. Over the past few years, there has been a significant amount of NCHRP research to change this practice, and there is recent and ongoing work to develop methodologies to manage fleet assets more like other more traditional assets. This present problem statement is complementary and congruent with other research efforts, and addresses a previously uninvestigated piece of the overall fleet asset management puzzle. James Gray/HIAP-30 - Making the most economical decision when managing a fleet of maintenance equipment is vitally important to efficient maintenance operations. It does seem though at least some of the foundations of the problem statement have been addressed by http://www.dot.state.mn.us/research/TS/2015/201516.pdf

AASHTO Committee Evaluation for F-04

Guideline for Decision Making for Repair vs. Replacement of Highway Maintenance Equipment

Submitted By:
Troy Suing
AASHTO Staff
Committee on Maintenance

Comments:
Committee on Maintenance rank as #1 priority
I. PROBLEM NUMBER

2019-F-05

II. PROBLEM TITLE

Update the AASHTO Guide for Snow and Ice Control

III. RESEARCH PROBLEM STATEMENT

The AASHTO Guide for Snow and Ice control, NCHRP 20-7(83), was originally published in 1999 and provided a comprehensive guide for snow and ice control. As environmental awareness associated with snow and ice control grew an update was made to the Guide to add content addressing environmental implications and impacts, NCHRP20-7(250) in 2008. Winter weather affects nearly every state not only by snowfall, but also ice events, freezing rain, freezing fog, and other weather events that impact mobility and require a maintenance effort to mitigate affects. The range of winter maintenance operations is not limited to northern climates but includes weather regimes in moderate and maritime climates that require special considerations not currently addressed in the existing AASHTO Guide.

Some specific areas where advancements have been made in research and state of the practice are:

- Equipment – wing plows, belly plows, tow plows, liquid deployment systems and brine making facilities
- Strategies – Maintenance Decision Support Systems, plowing alternative lane configurations such as roundabouts and diverging diamond interchanges, and the utilization of fixed automatic spray technologies for specific locations and critical infrastructure such as structures.
- Deicing technology – liquids and liquid only routes, utilization of slurry, various solid-liquid and liquid-liquid blends to enhance deicing performance.
- RWIS and sensor technology – non-contact sensor technology, mobile RWIS, grip sensors.
- Sustainability and resiliency in the delivery of service and procurement, storage, and deployment of materials.

The proposed research has been endorsed by the AASHTO Maintenance Committee and ranked as the third highest priority NCHRP project at the 2017 annual meeting in Providence, Rhode Island. The research aligns well with the strategic goals of the committee to promote:

- A safe, reliable highway system in a state of good repair,
- Environmental stewardship and compliance, and
- Research, innovation, and emerging technology.

IV. LITERATURE SEARCH SUMMARY

NCHRP Synthesis 344 Winter Highway Operations, 2005
NCHRP Report 256, Snow and Ice Control Guidelines for Materials and Methods, 2004
Snow and Ice Control Environmental Best Management Practices Manual, Fey, et.al., 2015
V. RESEARCH OBJECTIVE

The objective of this project will be to:

1) Evaluate each existing chapter of the AASHTO Guide for Snow and Ice Control and include the best methods, practices, equipment and technologies that have been developed in snow and ice control, and

2) Consider new sections in the Guide to address new strategies, tactics, and technologies that have been developed and are routinely utilized during winter maintenance operations.

3) Ensure that the Guide covers snow and Ice control strategies that address all weather regimes across the United States from; northern snow belt, windswept plains, to moderate/maritime ice belt states. Provide guidance in the long term planning necessary to be responsive to changing conditions.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$225,000

Research Period:

36 months

VII. URGENCY AND POTENTIAL BENEFITS

Many states are experiencing organizational change with the integration of traditional maintenance operations and transportation system operations. The cross cutting issues associated with snow and ice control brought about with this new operations model have also advanced the development of new best practices that should be captured in the AASHTO Guide for Snow and Ice Control. This guide will benefit those states in developing a more robust and responsive winter maintenance program.
VIII. IMPLEMENTATION PLANNING

This research project would result in the publication of an updated guide for snow and ice control addressing the advances in the state of the practice across a variety of climatological regions. The resulting products will provide states guidance in modern snow and ice control.

The target audience for the guide will be state DOT maintenance practitioners responsible for winter storm operations. The AASHTO Maintenance Committee will champion the dissemination of the guide through the Maintenance Operations Technical Working Group and the Snow and Ice Cooperative Pooled Fund Program (SICOP). A webinar on the changes to the guide will be conducted and details will be presented at the Maintenance Committee and the National Winter Maintenance Peer Exchange.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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NCHRP Review of F-05

Reviewed By: Camille Crichton-Sumners ccrichton-sumners@nas.edu

Comments: The objectives of this research are clearly stated and the product, an updated manual: "AASHTO Guide for Snow and Ice Control"-that reflects the needs of a broad range of weather conditions-is needed since it has been nearly a decade since the last manual update. Significant advancements have been made in snow and ice control, and maintenance and operations strategies since 2008. An updated manual will aid maintenance and operations practitioners in planning and decision making. The suggested time-frame seems adequate to include the required coordination with maintenance and operations asset owners responsible for snow and ice control as well as AASHTO representatives. The recommended funding level should also be sufficient.

Review Date: 11/30/2017

FHWA Evaluation of F-05
Roemer Alfelor, HOP/HOTO - The update to the 1999 AASHTO Guide for Snow and Ice Control is long overdue. As stated in the Problem Statement, the guide needs to incorporate more advanced and effective practices and technologies used by agencies for winter maintenance operations, as well as be more inclusive of regions in the country that are not in the snow-belt but experience snow and ice weather events. The proposed research period and cost to complete the update seem reasonable and adequate.

AASHTO Committee Evaluation for F-05

Update the AASHTO Guide for Snow and Ice Control

Submitted By:
Troy Suing
AASHTO Staff
Committee on Maintenance

Comments:
Committee on Maintenance rank as #3 priority

Submitted By:
Sharon Edgar
Chair of its research subcommittee and chair of the NCHRP 20-65 Panel
Council on Public Transportation

Comments:
consider transit, bike and ped
Research Field G

Traffic
I. PROBLEM NUMBER

2019-G-01

II. PROBLEM TITLE

Lane-Keeping Practices Characterizations

III. RESEARCH PROBLEM STATEMENT

Connected Vehicles (CV) and Automated Vehicles (AV) technologies offer a tremendous opportunity to address safety issues of roadway departure crashes, which account for more than half the annual U.S. fatalities and nearly 40% of the serious injuries. However, the capabilities and the gaps between the current state of the art of these technologies and their deployment to counteract roadway departure crashes are still unknown. Human drivers do not follow a perfectly straight line, but move slightly back and forth within a lane. Their lane position is affected by wind, play in the steering mechanism, cross slope on the road, their level of vigilance, and other factors. Manufacturers of lane departure warning systems have made, at least implicitly, assumptions about normal lane-keeping practice, but drivers have been known to disable those systems. The aversion to the warnings is presumably because drivers’ personal practice does not match manufacturers’ expectations; that is, the alarms are too frequent and drivers find them a nuisance.

When lane drift is excessive, it becomes a departure. The vehicle can encounter another vehicle, a fixed object, or an unrecoverable slope, and the departure becomes a crash. Knowing what features of a lane position are indicative of an impending crash would be valuable.

IV. LITERATURE SEARCH SUMMARY

Ghasemzadeh and Ahmed used SHRP2 data to analyze the complex effects of weather, speed limit, and traffic conditions on drivers’ lane-keeping behavior.\(^1\) Pape et al. used quantitative lane-keeping behavior to develop a driver model.\(^2\) Although Sayer et al. found that LDW can have a beneficial training effect in pilot deployments,\(^3\) Reagan et al. and other studies have documented that vehicle owners tend to disable LDW, apparently because of the nuisance alarms.\(^4\) Hallmark et al. found that the frequency of lane encroachments and RwD crashes occurring on left curves and right curves differ significantly.\(^5\) Understanding the differences in how drivers negotiate curves in opposite directions can lead to improvements in both on-board and infrastructure-based departure countermeasures.

V. RESEARCH OBJECTIVE

The objective of this research is to develop a better quantitative understanding of drivers’ lane-keeping behavior in naturalistic driving.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $300,000

**Research Period:** 18 Months
Task 1: Review available resources.
- Compile available sources of lane-keeping behavior.
- Summarize the findings of prior studies on lane-keeping behavior.
- List existing driver steering models and assess each for its suitability to produce naturalistic behavior.

Task 2: Develop a model for generating naturalistic paths.
- Determine which characteristics should affect the model (including, for example, driver demographics, driver condition, roadway classification, road curvature, surrounding traffic, weather).
- Determine which properties of the path the model should produce (including, for example, mean lane position, variance of lane position, and peak excursion from the lane center).
- Select an appropriate form of the model, develop the model, and demonstrate the fidelity of its paths.

VII. URGENCY AND POTENTIAL BENEFITS

This proposal focuses on how drivers negotiate curves and will provide insight into the impacts of geometry, speed, markings, etc., which are of direct interest to FHWA and State/local DOTs. An immediate benefit of this research will be modifications to Lane Departure Warning (LDW) and Lane-Keeping Assist (LKA) algorithms so they warn only when a danger is truly present. Knowledge of normal and pre-crash lane-keeping behavior will enable more realistic vehicle simulations, which could be used for benefits estimates and other purposes.

VIII. IMPLEMENTATION PLANNING

This model can be used to improve the effectiveness of lane departure warning systems. When driver responses to warnings are incorporated in the model, it simulations can be used to evaluate in-vehicle or CV lane departure warnings, which would support system development and contribute to estimating benefits.

An extension to the model would be to include speed selection and deceleration practices, which will aid in evaluating curve warning algorithms.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

XI. SUBMITTED BY

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References:
The proposed work is appropriate for the NCHRP but the value is unclear.

Lane Departure Warning (LDW) and Lane Keeping Assist (LKA) are available on many vehicles being purchased today and their availability is likely to increase. These technologies can reduce crashes but many drivers do turn them off due to the annoyance of false alarms. The problem statement is based on the premise that a better understanding of natural driving behavior would allow the underlying logic to be altered to produce fewer false alarms.

My principal concern is that the LDW and LKA applications are being developed by the vehicle manufacturers and it is not clear whether or how they would use the results of the research. Can the submitter provide any support for the problem statement from the private sector? Is there any consensus on what data or information would be useful (this may be difficult to answer due to proprietary concerns)? Some of these technologies are based on artificial intelligence and machine learning rather than algorithms which would affect the format.

I reached out to a representative of a vehicle manufacturer and he had the following comments: "I am not sure how OEMs would react to the outcome of the research, specifically any recommendations. My company continually improves the features and technologies on our vehicles. This may be based on feedback from customers (particularly rejection of a feature) or incremental improvements to increase functionality and customer satisfaction. These processes could make the results of the proposed NCHRP research redundant."

The literature review includes a study by Hallmark, et al, evaluating driver behavior on two-lane highway curves. I also note that profiles of natural driving behavior on curves are available from HERE Technologies. The problem statement is not clear on why these studies are not sufficient.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-G-02

II. PROBLEM TITLE

Assessing Pedestrian Crashes on the Freeway System: Analysis and Prevention

III. RESEARCH PROBLEM STATEMENT

Pedestrian safety is currently a hot-button issue in the transportation industry. There has been a wealth of research performed for the sake of making road and street conditions safer for the non-motorized user. This research has produced many methods and countermeasures to make pedestrians safer on our roads and streets. Rightfully, most of this research has been conducted on facilities where pedestrians are more likely to be present, such as urban and suburban streets.

However, there still remains a critical problem that state departments of transportation (DOTs) are facing: pedestrian crashes on freeways. From 1995-2015, Arkansas’ largest metropolitan planning organization (MPO) region had 97 non-motorist crashes in a freeway travel lane. Forty of those 97 crashes were fatal, while another 23 involved a serious injury. This is not a problem confined to Arkansas, as AAA reports there were 10,301 pedestrian fatalities on the Interstate system from 1993-2012.

Most non-motorized travel is prohibited on freeway facilities, and research is scarce on this topic likely because of this fact. However, when these types of crashes do occur on freeways, the likelihood of serious injury or death is substantially higher for non-motorists. It then becomes incumbent on the state DOTs to take every measure at their disposal to prevent these types of crashes from happening.

This proposed research would primarily be used by state DOTs. The DOTs would review the findings of this research and determine avenues to implement applicable recommendations.

IV. LITERATURE SEARCH SUMMARY

While there is some research on pedestrian crashes on freeways, it is not nearly as broad or comprehensive as the same crashes on other facility types. Johnson (1997) conducted research on this topic from Texas, Missouri, and North Carolina. From this research he found characteristics of pedestrian crashes on the Interstate Highway System and proposed several countermeasures from this research.

Most other research on this topic has been on a state-to-state basis. More recently, for example, Hudson et. al. (2015) noted that Texas was the worst state for interstate pedestrian fatalities. They surveyed 20 state DOTs about this issue and discussed best practices that the 20 states had been using.

A robust, national research project to address the issue of pedestrian fatalities on the freeway system is needed. Hudson et. al. noted that no state they had surveyed demonstrated a comprehensive or directed program for addressing this particular issue of pedestrian safety. Such a program would be highly beneficial to state DOTs, as they are charged with reducing fatal and serious injury crashes on all public roads.
Johnson, 2017. TRB. Paper No. 970712 Pedestrian Fatalities on Interstate Highways: Characteristics and Countermeasures


V. RESEARCH OBJECTIVE

The objectives of this NCHRP project are to complete a comprehensive, national review of pedestrian fatalities on the freeway or interstate system. This review will include the analysis of relevant crash statistics and reasons why pedestrian crashes occur on freeways. Additionally, this project should utilize a national survey to state DOTs to document best practices and countermeasures currently being used. As well, this research should develop a general framework for a comprehensive program aimed at reducing pedestrian fatalities on the freeway system. This framework should include countermeasures using the four “e’s,” (engineering, education, enforcement, and emergency medical services), and be adaptable for different states.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:
It is estimated that the costs to complete the research will be approximately $250,000
(Note: The level of funded provided may be raised or lowered by the AASHTO Standing Committee on Research if and when the problem statement is selected.)

Research Period:
The time needed to complete the research described herein is estimated to be approximately 24 months.
(Note: This estimate may be changed by the Project Panel.)

VII. URGENCY AND POTENTIAL BENEFITS

While there has been much research on and implementation of countermeasures to reduce pedestrian crashes, not much of this research has been specifically focused on freeway facilities. To fill in this “gap,” more research is needed. To make the most informed decisions on how to reduce pedestrian crashes on the freeway system, practitioners need the most up-to-date information on how best to reduce the number of freeway pedestrian crashes. This topic should be addressed, as states are charged to reduce fatalities and serious injuries on all public roads.

VIII. IMPLEMENTATION PLANNING

State DOTs would be the target audience of this research, as they are the ones who maintain interstates and freeways, and have the responsibility to reduce crashes on all public roads. ARDOT could be an early adopter, as this issue has been raised in Arkansas.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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XI. SUBMITTED BY

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NCHRP Review of G-02

Reviewed By:  
Mark S. Bush  
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Comments:

The problem statement is potentially solvable through research and has a reasonable clear objective. The scope of the research, research period and budget is reasonable or adequate to meet the overall objective. The research results may also address ongoing updates for AASHTO guidance publications in consideration of various committee strategic plans.

Review Date:  
12/1/2017

FHWA Evaluation of G-02

Ann Do/HRDS - The potential payoff from research is estimated to be medium. There are not enough details on this study, need to be more focus. There is an important safety issue to pedestrian but due to the rare crashes at freeway system it maybe a hard to collect sufficient data to conduct the study. FHWA Ped-Bike Team - Based on the numbers they provided (10,301 fatalities in 19 years), there are about 542 pedestrian fatalities on freeways per year (which is about 10% of all pedestrian fatalities). We believe most of those fatalities are contructions workers in highway workzones, police who have done a traffic
stop, and people having car trouble that have to leave their cars that have broken down, etc.). Some of
the measures that have been implemented in states include higher fines in workzones, requiring drivers
to a switch to a further lane when they see police stopped, and deploying vehicles to assist broken down
motorists.

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AASHTO Committee Evaluation for G-02

Assessing Pedestrian Crashes on the Freeway System: Analysis and Prevention

Submitted By:
Steven Buckley
Chair of Research Subcommittee
Committee on Safety

Comments:
4. Most of ours involve pedestrians around their vehicle which has broken down. Not sure what
countermeasures would be available other than education. Pedestrian crashes on the freeways are a
problem that many state DOTs have and crashes of this nature usually end in serious injury or death. An
in-depth report that highlights causes of pedestrian crashes on freeways and methods to prevent them
would be a valuable resource for state DOTs.

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Submitter Response for 2019-G-02

Assessing Pedestrian Crashes on the Freeway System: Analysis and Prevention

From: [email: adnan.qazi@ardot.gov;benjamin.whatley@ardot.gov]

Comments: Concur with the evaluations

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Review Date: December 20, 2017
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-G-03

II. PROBLEM TITLE

Evaluating the Performance of Right-Turn-On-Red Operation at Signalized Intersections (with single and dual right-turn lanes)

III. RESEARCH PROBLEM STATEMENT

Right-turn on red (RTOR) is permitted through many regions in North America, and is widely used by agencies as an efficient strategy to reduce delay and fuel consumption at signalized intersections.

This strategy is widely accepted as an effective approach to reduce control delay at intersections, especially for high demands on right turn movements. However, the conflicting movement of pedestrian crossing is a critical issue to be addressed, from both operations and safety standpoints. As a reference methodology to evaluate and plan RTOR operations is desired, it is unlikely that it may be widely implemented if it may bring significant negative impacts on pedestrians and vehicle safety. Additionally, high density pedestrian flows may also undermine the benefits of RTOR implementation. This trade-off between operations and safety can be found on empirical studies throughout the literature, but a reference methodology to evaluate this issue is still not present.

The Highway Capacity Manual (HCM), in its 6th edition, lacks a methodology to estimate the RTOR flow volume and its effect on delays, leaving field counts as the only option for obtaining this input, which is then subtracted from total right turn movements. This may be feasible for operational analyses on existing intersections, but it is not reliable for either planning or operational level applications.

Some of the main gaps in the HCM methodology and aspects that need to be addressed are:

- The lack of a volume prediction model or resulting right-turn delay. In the current method, input values must be obtained through field observations and subtracted from the right turn volumes. The suggested default value for right-turn volume on red is 0 veh/h, due to the difficulty to estimate it without the support of field data. This is a conservative estimate, and may lead to inaccurate performance estimations.

- The RTOR flow rate should also be used as input for pedestrian methodology and may be affect by pedestrian volumes itself.

- No guidelines are provided on whether RTOR should be implemented or not.

Agencies throughout the country have performed their own research on this topic, probably due to the lack of a reference methodology to evaluate RTOR operations. The development of an HCM methodology is expected to assist agencies and practitioners, especially those who do not have a consolidated body of knowledge on RTOR analysis.

IV. LITERATURE SEARCH SUMMARY
Documented technical discussion on the implementation of RTOR dates to the 1970's (1). From that time until today, some states and cities have sponsored their own analysis on the subject, in order to support local regulations and warrants on this measure. Examples include the states of Virginia (2), Indiana (3) and Minnesota (4). Internationally, countries such as Germany (5) have also considered the use RTOR, accounting for particularities of local conditions.

However, following early work from Preusser et al. (6); Zador, Moshman and Marcus (7); and Joksch (8), most technical and scientific studies on RTOR from the 80's to 2000's focus on safety aspects, for both vehicles and pedestrians (9, 10, 11, 12, 13), with no considerations regarding operation effects of this measure.

Only a few peer-reviewed papers address the operations impact of RTOR. Except for the early work from Lidor and Wiener (14), most studies on this subject were conducted from the 2000's. Those studies have successfully made progress towards resolving some of the current HCM gaps in the matter, including the prediction of the number of vehicles that turn right on red (15), critical headway analysis (16) and the resulting flow profile during a cycle (17). Such efforts could serve as a start point for a comprehensive methodology to be implemented in the HCM arterials chapter.

As for ongoing research on this topic, a limited number of studies are emphasizing the interaction of vehicles and pedestrians factor. A recently completed research project BDV25 977-16 (FDOT) evaluated the interactions between drivers and pedestrians at signalized intersections, suggesting that this aspect must be taken into consideration into RTOR analysis (18).

V. RESEARCH OBJECTIVE

The objective of this research project is to develop methods to evaluate right turn on red (RTOR) operation that can be implemented in the Highway Capacity Manual methodology for signalized intersections and urban arterials.

The following tasks are proposed in order to achieve this goal:

Task 1. General Work Plan. The objective of this task is to develop a general work plan that target the objectives of the study and validate the project objectives, desired deliverables and project schedule.

Task 2. Literature Review and Current Practice. The objective of this task is to review relevant literature and current RTOR practice adopted by agencies throughout the country.

Task 3. Draft Methodologies. The objective of this task is to develop draft methodologies on proposed RTOR analysis, describing the expected inputs, outputs, strengths and limitations. Motorized and non-motorized modes must be included.

Task 4. Data Collection Plan. This task aims to develop plans to guide the collection of data. The research agency is expected to develop a comprehensive list of study locations in a manner that the data reflects different traffic scenarios throughout the country, as well as the key parameters to be collected and which approaches or sources will be adopted to collect data.

Task 6. Data Collection and Preliminary Results. The objective of this task is to implement the approved data collection plan developed in Task 4. The task also includes the preliminary analysis of the data against the proposed draft methodology from Task 3, indicating needs for method review, additional validation, as others.
Task 7. Validation and Methodology Refinement. The objective of this task is to comprehensively analyze and validate the data collected in Task 6, and perform any methodology refinement needs previously identified.

Task 8. Report. The Report shall summarize the work performed on the previous tasks, along with significant conclusions and recommendations for implementation. It must include but not be limited to:

- Methods for estimation of RTOR flow rate;
- Methods for the estimation of the effect of RTOR flow rate on approach delays;
- Recommendations on the adaption of the current pedestrian methodology to the developed method;
- Evaluation of any impacts to vehicle and pedestrian safety that may derive from the proposed methods.
- Recommendations on criteria regarding the implementation of RTOR;
- Guidance for operations on both pre-timed and actuated signal controls;
- Case examples of the proposed methodology application;
- A user-friendly guide that will assist traffic signal engineers in state and local agencies to implement the proposed practices;
- Guidelines for development of a computer engine for software developers.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$300,000

Research Period:

18 months

VII. URGENCY, POTENTIAL BENEFITS AND IMPLEMENTATION

Right turn on red (RTOR) has been used since the 1970’s in many states of the USA and abroad. Most studies on this subject focused only on safety concerns, dedicating little attention to its operation benefits. In the absence of a country-wide accepted methodology, alternative tools are often the only resource to estimate traffic behavior on arterials where RTOR is permitted. Empirical models, however, are still necessary in order to verify if the results produced by alternative tools are compatible with field conditions.

The development of a method comprising RTOR effect on operations can benefit researchers and practitioners, by providing an analytical method for RTOR evaluation, serving as a resource for safety studies and by supporting software development. Ultimately, the better understanding of the effect of right turn on red and its consideration on existing methodology may contribute for more cost-efficient systems where the use of this measure is permitted. Also, the development is of great value for agencies and municipalities, especially those without any guidelines on the subject. This may allow those agencies to direct research resources for different issues.

It is envisioned that this research will lead to the incorporation of the produced methodologies into a future version of the HCM. Any changes or updates to the HCM will need to be formally adopted by the TRB Highway Capacity and Quality of Service (HCQS) Committee (AHB40). Based on the updated HCM methodology and recommendations from the research team, guidelines for RTOR implementation by public agencies will be established.
IX. REFERENCES


X. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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XI. AASHTO MONITOR

XII. SUBMITTED BY

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NCHRP Review of G-03

Reviewed By:
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Comments:

The research is appropriate for the NCHRP and the value is high.

The lack of a method to estimate and analyze RTOR movements has been a shortcoming for years. It is also a concern when using simulation models to evaluate signal operations and the techniques developed could be applied to simulation also. The lack of pedestrian volume data has contributed to this not being addressed but new methods of capturing pedestrian volumes are now available. Other work is underway in the NCHRP on pedestrians at signals (NCHRP 03-118, Decision-Making Guide for Traffic Signal Phasing; NCHRP 03-133, Traffic Signal Design and Operations Strategies for Non-Motorized Users; NCHRP 17-87, Enhancing Pedestrian Volume Estimation and Developing HCM Pedestrian Methodologies for Safe and Sustainable Communities) but these are not addressing the RTOR analysis. The proposed research should benefit, however, from the work done in those projects, particularly the last one that will be developing methods for estimating pedestrian volumes.

Review Date:
11/17/2017
AASHTO Committee Evaluation for G-03

Evaluating the Performance of Right-Turn-On-Red Operation at Signalized Intersections (with single and dual right-turn lanes)

Submitted By:
Steven Buckley
Chair of Research Subcommittee
Committee on Safety

Comments:
4. Right-turn on red (RTOR) is a widely used strategy to reduce control delay and fuel consumption at signalized intersections. However, the Highway Capacity Manual (HCM) lacks a methodology to estimate RTOR flow volume. This research would be very beneficial as it seeks to develop a method to estimate RTOR flow rate, how pedestrian safety can affect RTOR, and develop criteria regarding the implementation of RTOR.

Submitted By:
Jameelah Hayes
liaison
Traffic Engineering

Comments:
1st priority
I. PROBLEM NUMBER
2019-G-04

II. PROBLEM TITLE
Holistic Analysis of Detection and Controller Operations at Signalized Intersections

III. RESEARCH PROBLEM STATEMENT
With increased demands on our traffic signal systems, and little funding to provide additional capacity through expansion, the existing capacity of intersections becomes a critical factor. Typical detection operations focus on the presence of vehicles in a certain predefined location. If a vehicle is present in the predefined location (regardless of its characteristics or speed), the detection system will send a call to the controller to actuate the phase. New technologies exist to assist in the monitoring of vehicle behavior that can use the speed and position of the vehicles to help controller make better decisions. However, these newer detection systems are rarely utilized in practice.

The implementation of advanced detection features along versus advanced controller features is a bit of the “chicken and egg” problem. On one hand, when intersections are designed, the detection systems are planned mostly to support the operations of existing controllers and additional detection coverage and functionalities are often not included because “the existing controllers do not require/support any advanced detection features.” On the other hand, once the detection system is designed and installed, controller manufacturers are not motivated to develop/program new features/control logic because “the existing detectors cannot provide type and granularity of data that is required for new controller features.” In spite of this issue, there have been a number of new features on both detection and controller side that have been introduced during the last few years. However, those are usually not utilized due to a gap in the current practice (level of knowledge) on how those features should be implemented and what type of benefits can be achieved.

To illustrate with a few examples – intersections reaching saturation will operate in a nearly fixed-time mode as phases terminate due to max times rather than detector gap outs. It is rare, though, that all phases reach saturation at the same time. Eliminating wasted time caused by detector operation has the potential to increase capacity at the intersection and delay saturation. To eliminate wasted time extension timers could be programmed to rely less on the predefined safety-based extension values and to rely more on the measurements from the field. Another example is to utilize detection data to predict reliably driver/vehicle’s intentions. For example, by knowing the approach speed of the vehicles and the distance to the stop bar, driver/vehicle intent can be predicted. For example, 75 feet from the stop bar, if the vehicle is going over 20 miles per hour, the vehicle will not stop. On the other hand, if the vehicle is going slow enough to stop, there is no need to put a call into the controller to extend the green. Some of these features are available in volume-density control but their efficiency benefits have not been emphasized enough. The other features, while they may look similar to existing ones, yet need to be developed.

It should be noted here that the intelligence does not always and necessarily to reside within controller. For example, by having intelligence in the detection system to determine when to send calls to the controller, some of the current traffic signal controller technologies may be used. Thus, this research problem requires two-way interaction where opportunities for improvement of operations could be sought on both sides. The development of more intelligent ways to determine the amount of green time and reasons to terminate will take significant algorithm development by controller manufacturers. In the meantime, detection systems can help bridge the gap.
The goal of this research is to investigate opportunities for holistic optimization of detection (including location and functionality) and controller operations to achieve safer and more efficient signalized operations. This goal can be achieved by looking into a number of various issues/opportunities, some of which are listed in the research objective section.

IV. LITERATURE SEARCH SUMMARY
Please refer to the reference list.

V. RESEARCH OBJECTIVES
Objectives of this research can listed threefold: What is available, what can be done in short and long term, and what cases can be demonstrated and their benefits published. The first objective relates to a comprehensive literature review and potential survey of the agencies to find out what practices are used to advance current detection and controller operations, beyond common use of the presence detectors and gap-based strategies. This should probably include survey of various detection technologies and controller firmware to document what advanced detection and controller features are available that fit into this ‘optimized detection-controller framework’. The second objective requires development of cases/recommendations on how existing advanced detection and controller features can be coupled to improve signalized operations. This list of cases/recommendations should be comprehensive, with a significant level of details. The third objective requires a subset of cases identified under objective # 2, to be tested in real-world fashion, in the field and/or simulation. The results of such tests should be accompanied with the estimated operational (and monetary, where possible) benefits.

Tasks anticipated in this project include the following:

- Document the various features and capabilities of existing detection and controller technologies, beyond common use of the presence detectors and gap-based strategies, that would improve intersection efficiency.
- Identify strategies and techniques for improving intersection efficiencies through the combination of optimal detection location, new advanced detection functions, and controller features.
- Develop cases studies on how existing advanced detection and controller features can be coupled to improve signalized operations.
- Quantify, through field studies and/or simulation, the benefits associated with these strategies and techniques.
- Develop implementation guidance on how agencies can utilize these features to improve operational efficiencies.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD
It is estimated that this research can be completed over a 24-month period, at a cost of about $600,000.

VII. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION
The work will help improve the safety and efficiency of signalized intersections through a holistic approach to detection and controller operations; something which historically has not been done. Potential payoff can be realized in improved intersection capacities and reduced congestion and in overall more efficient use of the roadway infrastructure. The research outcomes would be highly implementable because the final report would document a number of case studies (with associated benefits) which will be good candidates for inclusion in the next version of the Signal Timing Manual. This research could also provide a pathway to allow intersection operators to transition their operations in support of connected vehicle operations until substantial market penetration is achieved.

VIII. PERSONS DEVELOPING THE PROBLEM
Mark Luszcz (Mark.Luszcz@state.de.us), Aleksandar Stevanovic (astevano@fau.edu)
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NCHRP Review of G-04

Reviewed By: B. Ray Derr rderr@nas.edu

Comments: The research is appropriate for the NCHRP and would have value but there are challenges.

Some of the vendors have claimed intellectual property rights on their detection features and this could force a proprietary approach to implementing the features. These features and capabilities are also continually evolving, increasing the pace at which the research results will grow stale. If selected, the vendors will have to be involved in the research so that the proprietary technologies can be explored.

Over the past several years, several state and local agencies have been implementing automated traffic signal performance management systems and it is included in the FHWA's Every Day Counts 4 Initiative. NCHRP Project 03-122 and a pooled fund study (http://www.pooledfund.org/Details/Study/487) are building upon the efforts of the Indiana and Utah DOTs and others to make these technologies more widely available. Some of the references in the problem statement stem from this development but the problem statement does not make clear how the proposed research relates to that work.

If the problem statement is not selected, I recommend it be referred to the Traffic Signal Systems Operations and Management Pooled Fund Study for their consideration.

Review Date: 11/20/2017
FHWA Evaluation of G-04

Dale Thompson/ HRDO - This project will identify opportunities to improve intersection efficiency and safety through development of a detection-controller integrated framework and use case development. New data, detection methods, and advanced controller strategies will be combined to take advantage of connected and automated vehicle technologies and information that will be used in specific use cases to optimize traffic operations. The project report will document useful case studies for inclusion in the Signal Timing Manual and other implementation guidance. The level of funding requested appears consistent with the work proposed.
AASHTO SPECIAL COMMITTEE ON RESEARCH AND INNOVATION

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

2019-G-05

II. PROBLEM TITLE

TACTILE WALKING SURFACE INDICATORS TO AID WAYFINDING FOR VISUALLY IMPAIRED TRAVELERS IN MULTIMODAL TRAVEL

III. RESEARCH PROBLEM STATEMENT

Many countries make extensive use of tactile walking surface indicators (TWSIs), and may require them according to adopted standards, to aid wayfinding for travelers who are visually impaired, including those who are blind or who have low vision. TWSIs are typically comprised of attention fields (truncated domes—referred to in the US as detectable warning surfaces [DWS]), and guiding patterns comprised of raised parallel bars. The truncated domes and guiding pattern are combined to define paths of travel in pedestrian areas, including public rights-of-way and multimodal transportation facilities.

While there has been little interest from travelers with visual impairments in the US in having continuous tactile paths of travel, as is commonly found in developed areas in Asia, there is increasing recognition in the US that tactile guiding patterns may be an effective solution to wayfinding problems for visually impaired travelers where there are insufficient cues in the built environment to enable effective wayfinding. Examples are rail and transit stations and hubs, intermodal terminals, plazas, irregular and confusing intersections such as roundabouts and channelized turn lanes, alternative intersections, shared streets, and parallel pedestrian/cycle paths at the same level.

Consistency in cues for wayfinding is extremely important to travelers who are visually impaired in order for them to understand the message of such cues and because they are unable to use many other cues available to travelers with unimpaired vision. TWSIs, including both attention patterns (DWS) and guidance patterns (raised bars) are loosely standardized on the basis of then existing research and practice in ISO 23599 Assistive products for blind and vision-impaired persons – Tactile walking surface indicators (2012). The only systematic use of TWSIs in the US is detectable warning surfaces (DWS), which are required at transit platform edges and curb ramps, and other locations where there is no distinction in level between pedestrian and vehicular ways. Standards ensuring consistency for the surface texture and some consistency in the installation of DWS in the US are contained in 2006 Standards for Transportation Facilities and the 2010 Americans with Disabilities Act Standards. Similar consistency is needed in the surface textures and installation of guiding patterns.

A number of US jurisdictions and transit authorities have begun to explore or to install guiding patterns, in association with DWS or truncated domes, where it has been determined that there are insufficient cues for wayfinding. These include Caltrans, Los Angeles METRO, BART, New York DOT, DC DOT, Seattle, Minneapolis, Cambridge, MA, Vancouver, BC, and Alexandria, VA. While most of these installations are raised bar surfaces, there is great variation in the installation and materials, including the width and height (detectability) of the guiding pattern and where it is located.

The development of guidance on TWSIs installation practices is directly related to the committee’s goal to balance safety and mobility needs for all users efficiently, equitably, and in a context sensitive matter.
IV. LITERATURE SEARCH SUMMARY

Research and practice on TWSIs was reported in 2000 by Bentzen, Barlow and Tabor for the US Access Board. While the emphasis of the synthesis was on DWS, it included research, standards, guidance and practice on both warning and guiding surfaces in nine other countries. There is now much wider use of TWSIs, and international research and standardization has continued, and was the basis for ISO23599. Research on TWSIs focused primarily on identifying surfaces that were reliably detected (at least 90% of trials in repeated human factors experiments) by participants with little or no vision, and surfaces that could be readily discriminated from one another. Many surfaces that were anticipated to be highly detectable were detected by smaller proportions of participants; some were very minimally detectable.

US research on guidance surfaces has been limited to pilot research on the use of a prototype raised bar guidance surface to help pedestrians who are visually impaired locate crosswalks and establish a heading to cross at roundabouts and mid-block crossings (Bentzen et al., accepted for publication). Research on this specific use of a guidance surface is continuing under the National Institute on Disability and Independent Living Rehabilitation Research, Grant #90IF0127-01-00--Effect of Guidance Surfaces on Travelers with Vision and Mobility Impairments. Meanwhile, the FHWA is investigating the need of and uses for TWSIs at shared streets and shared pedestrian/cycle paths under TOPR No. 6501-16080-Innovative Street Design Practices and Accessibility.

What is lacking is comprehensive research on TWSIs, and development of best practice for TWSIs generally, that is also applicable to the uses being explored in concurrent projects. This is the focus of this RNS.

V. RESEARCH OBJECTIVE

The objective of this project will be to produce guidance for transportation planners and engineers, based on research, which will provide for consistency in the design and installation of TWSIs in multimodal transportation in the US. There will be two products: 1) a heavily illustrated guidebook: Tactile Walking Surface Indicators to Aid Wayfinding for Visually Impaired Travelers in Multimodal Travel, and 2) a final report including a review of US and international research and practice, as well as the methods and results of human factors research conducted under this project.

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$600,000

Research Period:

36 months

VII. URGENCY AND POTENTIAL BENEFITS

Jurisdictions and passenger transport agencies are independently installing a variety of TWSIs intended to improve wayfinding for travelers who are visually impaired. Participants in workshops conducted under TOPR No. 6501-16080 found that some of the surfaces used at shared streets and shared pedestrian/cycle paths are not detectable or, as installed, provide poor cues for wayfinding. Research-based guidelines for TWSIs in the US are urgently needed, lest differences in TWSI surface geometries and installations proliferate, thereby rendering them unreliable guides for travelers who are visually impaired.
VIII. IMPLEMENTATION PLANNING

Guidelines resulting from this research could be used by rail and transit agencies, and possibly the basis for an APTA recommended practice document related to both accessibility and mobility management by encouraging the most effective and cost-effective use of existing and emerging wayfinding resources to provide customized service to senior or disabled users of fixed-route transit services. The Federal Highway Administration, in TOPR 6501-16080, identified research needs in line with what is proposed in this research. National Association of City Transportation Officials (NACTO) is also interested in better guidance regarding the installation of guidance surfaces. The US Access Board identified issues related to shared streets and shared use paths and separation of pedestrians and bicyclists in their preamble, and questions in the preamble, in the Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way (proposed PROWAG), published in 2013. Proposed PROWAG has not been finalized at this time and it’s possible that recommendations from this research could be incorporated.

The proposed research is focused on determining optimal technical specifications for and installation of TWSIs in multimodal environments. All tasks should be coordinated with ongoing related research. The following major tasks are envisioned.

5.1 Comprehensive review of TWSI research, standards and current practice in the US and internationally

5.2 Conduct human factors testing to determine the detectability and discriminability of novel surfaces for special purposes, such as to indicate intersections and changes in the direction of travel indicated by guidance surfaces, to indicate the limit of the conflict-free zone for pedestrians at shared streets, and to aid pedestrians who are visually impaired when walking on shared use paths or parallel pedestrian/cycle paths at the same level.

5.3 Conduct human factors field tests of TWSIs with demonstrated detectability and discriminability, to validate their usefulness in ecologically valid wayfinding tasks, and to refine guidance for installation and maintenance in environments including:

- Rail and transit stations and hubs, intermodal terminals, including approaches to the facilities, concourses, mezzanines, and boarding platforms
- Shared streets
- Plazas
- Parallel pedestrian/cycle paths at the same level
- Crossings that are hard to locate using non-visual cues, such as at mid-block crossings, roundabouts, channelized turn lanes and large-radius corners
- Cold/adverse weather climates, such as snow and ice

5.4 Conduct focus groups participants at each field test site to refine the recommendations for selecting and presenting wayfinding information in similar sites

5.5 Analyze results of human factors testing and focus groups

5.6 Prepare final report and guidebook

In order to maximize timely deployment of the research results, problem statement submitters should identify (a) the appropriate target audience for the research findings and products, (b) key
decision-makers who can approve, influence, or champion implementation of the research products, and (c) AASHTO committees and other individuals and organizations with likely responsibility for adoption of the results, and (d) “early adopters” – state DOTs that would be willing to evaluate the research products in their agency. Any institutional or political barriers to implementation of the anticipated research products should also be identified.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

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X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. SUBMITTED BY

AASHTO Committee on Traffic Engineering with co-sponsoring State DOTs:

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NCHRP Review of G-05

Reviewed By:
Stephan A. Parker
saparker@nas.edu

Comments:

This is a well-written problem statement on an important topic. As the proposal states:

"The objective of this project will be to produce guidance for transportation planners and engineers, based on research, which will provide for consistency in the design and installation of TWSIs in multimodal transportation in the US. There will be two products: 1) a heavily illustrated guidebook: Tactile Walking Surface Indicators to Aid Wayfinding for Visually Impaired Travelers in Multimodal Travel, and 2) a final report including a review of US and international research and practice, as well as the methods and results of human factors research conducted under this project."

Research and the development of standards for tactile walking surface indicators (TWSIs) is inherently a multimodal, shared problem. The Transit Cooperative Research Program, which has a total budget of $5 million per year, at its October 2017 meeting allocated $215,740 towards this $600,000 project. The total budget of $600,000 is appropriate to the scope. With the TCRP cost-sharing (approved by TCRP after this problem statement was submitted to NCHRP), the funding from NCHRP can be reduced to $384,260.

As noted in the problem statement, "The proposed research is focused on determining optimal technical specifications for and installation of TWSIs in multimodal environments. All tasks should be coordinated with ongoing related research." NCHRP has an exemplary track record in coordinating research cooperatively with communities of practice at state, local, and national levels, all the way through to implementation, in complementary projects on (1) Accessible Pedestrian Signals and (2) Crossing Treatments at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities. Both of those bodies of work have pointed out the need for improved wayfinding aids. The proposed research is an important, missing component.

Review Date:
12/12/2017

AASHTO Committee Evaluation for G-05

Tactile Walking Surface Indicators To Aid Wayfinding For Visually Impaired Travelers In Multimodal Travel

Submitted By:
Patricia Bush
AASHTO Liaison
AASHTO Committee on Design

Comments:
Committee on Design – The panel should include a member of the Committee on Design Joint Technical Committee on Non-Motorized Transportation.
PROBLEM NUMBER

2019-G-06

PROBLEM TITLE

Temporary Traffic Control at Driveways within a One-Lane, Two-Way Section

RESEARCH PROBLEM STATEMENT

When a lane is closed on a two-lane, two-way road provisions must be made to alternate one-way movement of the two original travel lanes through the work area using methods such as flagger control, a pilot car, or portable traffic signals. However, these methods are not cost-effective for controlling access points, such as residential and business driveways, and so these locations are typically self-regulating. Unfortunately, this creates the potential for drivers entering the roadway from these access points to misunderstand the direction of traffic, enter the roadway going in the wrong direction, and collide with another vehicle travelling through the work zone.

Driveway assistance devices (DADs) were developed to help motorists better understand how to safely enter the one-lane, two-way operation and proceed in the proper direction of travel. Several states have requested permission from FHWA to experiment with a conceptual Driveway Assistance Device on active construction projects and have received MUTCD Experimentation approval. However, a lack of consistent design and application, as well as varying measures of effectiveness, across implementation sites has limited the ability to adequately assess the effectiveness of these devices. The development of guidance on DADs implementation and installation falls within the committee's goal to assess advancements and innovations in equipment that reduce costs, lower energy consumption, improve motorist guidance, and reduce crashes.

LITERATURE REVIEW SUMMARY

Research in 2013 by the Texas A&M Transportation Institute (TTI) resulted in the development of two prototype DADs designs (i.e., blank-out sign and modified hybrid) that could be used to control traffic entering from low-volume access points. Laboratory and field studies in Texas found that the blank-out sign design was better understood than the modified hybrid design. However, the blank-out sign design was somewhat more costly than the modified hybrid design. Furthermore, several variations of the modified hybrid design were recently implemented at work zones in New Jersey, Michigan, and North Carolina, and reportedly did not result in significant problems for the contractor. However, many questions remain as to the appropriate design of the DADs and their effectiveness. Consequently, there is a significant need for cohesive research effort to determine the proper design and application(s) of DADs.

RESEARCH OBJECTIVES

The objectives of this research are to:

- Identify and evaluate DADs for controlling traffic entering a one-lane, two-way section of roadway from driveways and low-volume side streets.
- Develop guidelines regarding the use of these types of devices.
- Develop proposed language for incorporating these types of devices into the Manual on Uniform Traffic Control Devices (MUTCD).

ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $300,000
Research Period: 2 years

URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION
Currently, there is not a cost-effective means of controlling low-volume access points in alternating one-lane operations. The lack of positive control puts the contractor and highway agency at a substantial liability risk to a wrong-way crash within the one-lane section. Vendors can offer possible solutions, but without national research to determine appropriate design and operating criteria for these solutions, agencies and contractors will not know whether the solutions themselves pose a risk due to confusion and improper response by drivers to the devices. In addition, some states are using DADs without a request to experiment from the Federal Highway Administration. A lack of consistent design, application, and evaluation across the implementation sites is hindering the adoption of DADs into the MUTCD.

VIII. IMPLEMENTATION PLANNING

The target audience for the research findings will be state agencies. Early adopters that are currently evaluating or interested in using DADs include, but are not limited to, Michigan DOT, North Carolina DOT, Texas DOT, Ohio DOT, Pennsylvania DOT, and Massachusetts DOT. Currently, the use of DADs requires a request to experiment from the Federal Highway Administration. One of the primary objectives of the research is to identify the most appropriate design of DADs and then develop proposed language for incorporating DADs into the MUTCD.

Implementation tasks include a review of all previous experimental applications of the DAD and documenting the visual cues that were used to convey to the motorists the intent of the device and recognition of the proper direction of travel. Specifically, the type, size and color of the signal/beacon indications used on the DAD will be evaluated to better understand human behavior reaction to each alternative. Several regulatory signs have been used in conjunction with the signal/beacon indications and there is a need to examine what legend is best understood by motorists through human factors testing.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Melisa D. Finley, P.E., Research Engineer, Texas A&M Transportation Institute, 979-845-7596, m-finley@tti.tamu.edu

X. AASHTO MONITOR

XI. DATE AND SUBMITTED BY

AASHTO Committee on Traffic Engineering

XII. REFERENCES


NCHRP Review of G-06

Reviewed By:
B. Ray Derr
rderr@nas.edu

Comments:
The proposed research is appropriate for the NCHRP and a useful device would likely find widespread use.

Minor street and driveway access to a one-lane work zone is common and a third flagger to manage the traffic is costly. A reliable, inexpensive, non-proprietary device would provide positive guidance to drivers. The problem statement indicates that several states are evaluating these types of devices so information should be available to select one or two designs for further development. The number of trials also indicates a high level of interest in developing a solution to this problem.

Review Date:
11/20/2017

FHWA Evaluation of G-06

Jawad Paracha, HOP/HOTM - It is not clear whether field evaluations will go through MUTCD experimental process. Real world field evaluations and documentation of findings will be critical for development of guidance and proposed language for MUTCD. There should be some coordination with recently approved NCHRP Project 03-132 "Guidelines for Safe and Efficient Temporary Traffic Control for Mobile Operations on Two-Lane Roadways".

AASHTO Committee Evaluation for G-06

Temporary Traffic Control at Driveways within a One-Lane, Two-Way Section

Submitted By:
Steven Buckley
Chair of Research Subcommittee
Committee on Safety

Comments:
4. I was expert witness on a case involving this very issue. Didn't know something like this was in the works.

Submitted By:
Jameelah Hayes
liaison
Traffic Engineering

Comments:
2nd highest priority
III. RESEARCH PROBLEM STATEMENT

The USDOT has invested in research on Vehicle to Infrastructure (V2I) connected vehicle applications. For example, the USDOT has funded the Collision Avoidance Metrics Partnership (CAMP) to develop prototype applications for Red Light Violation Warning, Curve Speed Warning and Reduced Speed / Work Zone Warning. Similarly, several federal and state funded projects have developed prototype Signal Phase and Timing (SPaT) safety and eco-driving applications. All of these V2I applications require software inside the vehicle and at the roadside that is specific to the application. The chicken and egg problem hinders operational implementation of these applications in that the application cannot be sold as a feature of the vehicle if the infrastructure to support it is not widely available, and justifying deployment of the infrastructure is difficult without any guarantee that any vehicles will have support for the applications. The current NHTSA Notice of Proposed Rulemaking would only require that vehicles be capable of sending and receiving a Basic Safety Message (BSM) using Dedicated Short Range Communication (DSRC). It will not require support for any V2I application.

Because the NHTSA rule will require all new vehicles to broadcast a BSM, V2I applications that depend only on listening to the BSM from the vehicle will be the most likely V2I applications to be deployable in the near future. The BSM will contain information such as the car's location, speed and heading. Installing DSRC roadside units will allow agencies to listen to the messages the cars are broadcasting and calculate estimates of traffic measures such as travel time and travel time reliability, end of queue in a work zone, queue lengths at traffic signals, intersection delay, etc.

Under the NHTSA rule, each vehicle will be required to broadcast a BSM 10 times per second. As a result, a stream of traffic will produce a large number of point measurements of speed and heading. Converting this large number of point measurements into estimates of traffic measures will require algorithms and processing. The problem this research will address is developing, validating and publishing these algorithms so that agencies and vendors can incorporate the algorithms into software to estimate the traffic measures.

The AASHTO Committee on Transportation Systems Operations (CSTO) is still developing their strategic plan, but connected and automated vehicles and V2I are expected to be important emphasis areas of the committee. CSTO’s predecessor, the Subcommittee on Transportation Systems Management and Operations (STSMO), co-sponsored the Signal Phasing and Timing (SPaT) Challenge, which was approved by AASHTO in 2017 to encourage the deployment of connected and automated vehicles on our roadways. Additionally, STSMO was linked to the V2I Deployment Coalition, with several members serving on both groups.

IV. LITERATURE SEARCH SUMMARY
V.  RESEARCH OBJECTIVE

Objective 1 Document algorithms from previous research.
Previous research reports may include algorithms similar to the subject of this research project. Also, existing research prototype software may contain embedded algorithms. This objective will collect and analyze these algorithms for potential to address the research problem statement.

Objective 2 Identify Candidate Traffic Measures
Identify performance measures required by federal regulations as well as additional performance measures commonly used by transportation agencies. Describe how BSM messages could support the measures. Identify the specific measures to be included in this research effort.

Objective 3 Develop Algorithms
Develop algorithms to convert BSMs into the identified traffic measures. The USDOT Open Source Application Development Portal (OSADP) includes some open source software applications that attempt to develop traffic measures from Basic Safety Messages as well as plug-ins to traffic models that allow creating BSMs that would be generated by vehicles modeled in the traffic model, which could be used to help develop the algorithms envisioned by this project.

Objective 4 Validate Algorithms
Validate the developed algorithms using simulation and using recorded BSMs from the USDOT data portal.

Objective 5 Publish Algorithms
Publish the final validated algorithms in formats that provide for easy use within software as well as in formats that support easy documentation of software algorithms.

VI.  ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$400,000

Research Period:

24 months

VII.  URGENCY AND POTENTIAL BENEFITS

Travel times and end of queue information are important in work zones for safety and mobility, and knowing queue lengths at traffic signals could potentially enable smarter traffic signal control. Listening to vehicle BSM broadcasts is a means to gain early benefits from connected vehicles. Other vehicle to infrastructure connected vehicle applications will require additional capabilities in the car beyond what NHTSA is requiring, whereas generating traffic information from BSMs will be a possibility in the nearer term when vehicles may only have the vehicle to vehicle BSM broadcast capability on board.

Many transportation agencies have a large investment in physical infrastructure to measure traffic flows. Examples include vehicle detectors measuring speeds and volumes and Bluetooth
devices or toll tag readers measuring travel time. Arterial roadways off the freeway typically are not measured. Work zones in areas without instrumentation or where instrumentation has been disrupted by the construction are difficult to measure but may have more need of the measures due to non-typical traffic patterns.

Utilizing permanent or temporary DSRC roadside equipment to capture BSMs could provide a lower cost approach to estimating traffic measures where they are currently unavailable, but this research is not intended to focus solely on DSRC roadside equipment as a means to listen for vehicle BSMs. Rather, the algorithms to convert BSM’s into estimates of traffic measures are intended to operate independently, regardless of communication method.

A lack of the algorithms to convert BSMs to traffic measures would result in a missed opportunity to utilize a potentially lower cost and more geographically complete approach to estimating the needed measures.

VIII. IMPLEMENTATION PLANNING

Target audience for research findings and products: Infrastructure Owner/Operators such as state and local departments of transportation, agency and commercial software developers.

Key decision makers to champion implementation: AASHTO V2I Deployment Coalition

AASHTO committees and others with responsibility for adoption: AASHTO Committee on Transportation Systems Operations - Connected and Automated Vehicle focus area, Connected Vehicles pooled fund study, V2I Deployment Coalition.

Early adopters: Minnesota DOT and other state and local agencies that are currently deploying roadside DSRC.

Institutional or political barriers: Potential privacy concerns. Insufficient agency qualified staff to design, operate and maintain the technology.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Ray Starr, Assistant State Traffic Engineer - ITS, Minnesota Department of Transportation, (651) 234-7050, ray.starr@state.mn.us

X. AASHTO MONITOR

Gummada Murthy, Associate Program Director, Operations, gmurthy@aashto.org

XI. SUBMITTED BY

Scott Marler
Director of Traffic Operations
Iowa Department of Transportation
800 Lincoln Way
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And
Generating Traffic Information from Connected Vehicle V2V Basic Safety Messages: Literature Search

June 20, 2017

Prepared for: Marcus Bekele
Prepared by: Sheila Hatchell
Resources searched: TRID, RIP, Library Catalog, Internet TRIS

Summary: I reviewed 199 records in Research in Progress and selected those that could have related information. Since I could find nothing directly related to the research idea, I looked for studies and reports related to receiving, combining and processing BSMs and traffic information.

Most Relevant Results
I was able to find no most relevant results.

Least Relevant Results

Development and field demonstration of a DSRC-based V2I work zone traffic information system

Abstract:
This report describes the architecture, functionality and the field demonstration results of a newly developed DSRC based V2I work zone traffic information system with V2V assistance. The developed system can automatically acquire important work zone travel information, e.g., the travel time (TT) and the starting location of congestion (SLoC), and relay them back to the drivers approaching the congestion site. Such information can help drivers in making informed decisions on route choice and/or preparing for upcoming congestion. Previously, we designed such a system using DSRC based V2I-only communication, which could not handle longer congestion lengths and the message broadcast range was also very limited. Our current system, on the other hand, can achieve much longer broadcast range (up to a few tens of kms), and can handle much longer congestion coverage length (up to a few kms) by incorporating DSRC based V2I communication with V2V assistance. The new system is also portable and uses only one RSU, which can acquire traffic data by engaging the vehicles traveling on the roadside whether within or outside of its direct wireless access range. From the traffic data, it estimates important traffic parameters, i.e., TT and SLoC, and periodically broadcasts them back to the vehicles approaching the congestion well before they enter the congested area. The results from the field demonstration have indicated that new system can adapt to dynamically changing work zone traffic environments and can handle much longer congestion lengths as compared to the previous system using V2I-only communication without V2V assistance.

Development and field demonstration of DSRC-Based V2I traffic information system for the work zone / prepared by: Buddhika Maitipe and M. Imran Hayee.
Abstract:
This report describes the architecture, functionality and the field demonstration of a newly developed dedicated short range communication (DSRC)-based Vehicle to Infrastructure (V2I) communication system for improving traffic efficiency and safety in the work-zone related congestion buildup on US roadways. The goal was to develop a portable system that can be easily deployed at a work zone site to acquire and communicate important travel information, e.g., travel time (TT) and start of congestion (SoC) location to the driver. By providing this information, i.e., SoC location and TT, drivers can make informed decisions on route choice and be prepared for upcoming congestion. The system is composed of a portable road-side unit (RSU) that can engage the on board units (OBUs) of the traveling vehicles using DSRC technology to acquire necessary traffic data (speed, time, and location). From the acquired data, the RSU periodically estimates the SoC location and TT that are broadcast to all vehicles in its coverage range. An OBU receiving the broadcast message calculates the distance to the SoC location. The distance to the SoC location and TT are then relayed to the driver, who can make smart decisions regarding whether to seek an alternate route and when to expect a sudden speed reduction. Results from the field demonstration have shown that the developed system can adapt to changing work-zone environments smoothly under various congestion patterns on the road.

An Adaptive DSRC Message Transmission Rate Control Algorithm (Contact the library for the full report)
Aaron Weinfield, John B. Kenney, Gaurav Bansal
18th ITS World Congress
October 2011

Abstract:
The U.S. Government and the automotive industry have been developing prototype systems to evaluate the effectiveness of using Dedicated Short Range Communications (DSRC) to support vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) safety applications. Many V2V safety applications rely on each vehicle periodically broadcasting a Basic Safety Message (BSM) at a sufficient interval to provide an accurate representation to surrounding vehicles about the transmitter’s current position, speed, heading, and other critical information. Unfortunately, as the number of vehicles in communication range increases, the ability for each vehicle to reliably receive messages decreases due to increased congestion and packet collisions on the wireless medium. This paper describes an algorithm to dynamically adapt the BSM message transmission rate based on the wireless congestion level. Simulation and test results using real DSRC radios are provided showing the benefits of the algorithm.

Methods to Reduce DSRC Channel Congestion and Improve V2V Communication Reliability (Contact the library for the full report)
Weinfield, Aaron
17th ITS World Congress
October 2010

Abstract:
The U.S. Government, automotive industry, and DENSO have been developing prototype systems to evaluate the effectiveness of using Dedicated Short Range Communications (DSRC) to support vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) safety applications. Many V2V safety applications rely on each vehicle periodically broadcasting a Basic Safety Message (BSM) at a sufficient interval to provide an accurate representation to surrounding vehicles about the transmitter’s current position, speed, heading, and other critical information. A vehicle may also transmit a BSM immediately if some critical event occurs that requires immediate attention by neighboring vehicles. However, as the number of vehicles in communication range increases, the ability for each vehicle to reliably receive messages decreases due to increased congestion and packet collisions on the wireless medium. This paper shows how the congestion level affects the Packet Error Rate (PER) and describes parameters that can reduce
the wireless channel congestion level and transmission methods that can increase the likelihood of receiving critical safety messages. Methods to detect high congestion levels and dynamically adapt these parameters are also provided. Test results using DSRC radios show the benefits of changing these parameters in real world situations.

Vehicle Based Data and Availability / U.S. Department of Transportation

Abstract:
No abstract available, but it's still worth a look.

Research in Progress: Leveraging Connected Vehicles to Enhance Traffic Responsive Traffic Signal Control
Sponsors: US DOT, ECONorthwest, Marshall University at Huntington, Old Dominion University, Virginia Tech Transportation Institute, Office of the Assistant Secretary for Research and Technology.
Performing Organizations: Marshall University at Huntington, Old Dominion University, Virginia Tech Transportation Institute.
Expected Completion Date: October 31, 2017

Abstract: Actuated traffic signal controllers rely on sensors to detect vehicles so that green time can be allocated on a second-by-second basis. Traffic signals that are part of a closed loop system running coordination plans can also utilize detector information to select different pre-programmed plans based on the current traffic state. These Traffic Responsive Plan Selection (TRPS) algorithms currently rely on point detectors that only measure volume and occupancy. With the anticipated implementation of Connected Vehicles, sensors can be installed at signalized intersections to collect the trajectory of these vehicles, which will allow queue lengths to be estimated. Additionally, many radar-based sensors that are currently on the market are capable of tracking vehicles approaching an intersection, which can also be used to estimate queue lengths. This queue length information can be fused with the volume and occupancy data from point detectors to gain an even better understanding of the state of the signal system. This enhanced information could likely allow even better selection of pre-programmed coordination plans. When trajectory-based vehicle information becomes widespread and reliable, it is entirely possible that this information will be used by the controller logic to directly make decisions. In the meantime, this research will investigate whether this information can be leveraged to further enhance TRPS control, which is widely available in most traffic signal controllers. An existing Central system-in-the-loop simulation of a traffic signal system in Morgantown, WV will be utilized to implement and test algorithms for estimating queue lengths from vehicle trajectory data in real-time, estimating the state of the system in real-time, and communicating information back to the controllers to change the timing plans, when appropriate. The advanced TRPS will be compared to basic coordination timing plans and basic TRPS control across various volume scenarios to estimate improvements in delay, emissions, and fuel consumption.

Research in Progress: Enhancing Safe Traffic Operations Using Connected Vehicles Data and Technologies
Sponsor Organizations: Pacific Northwest Transportation Consortium, Office of Assistant Secretary for Research and Technology.
Performing Organization: University of Washington, Seattle
Completion Date: June 15, 2016
Note: This record is listed in Research in Progress; however the research has apparently been completed, but no record exists in TRID for the final report/deliverable.

Abstract: The ultimate goal of the proposed research is to use connected vehicles (CVs) data and technologies to improve traffic safety on mixed-use roadway networks (e.g., freeways and intersections). This goal is relevant to all three themes of Pacific Northwest Transportation Consortium (PacTrans), namely
Technological Impacts on Safety, safe travel on mixed-use roads, and Performance Evaluation of Safety Projects. To achieve this goal, the research team has identified four objectives: (1) Develop a cost-effective communication note (CN) device that is capable of communicating with connected vehicles via Dedicated Short Range Communications (DSRC) and with pedestrians, bicyclists, and unconnected vehicle through cell phones and other mobile devices via Bluetooth, Wi-Fi, or other suitable communication protocols. Such CN devices can serve both as notes of the CV system and as data access and dissemination points for certified mobile devices, including cell phones, tablet personal computers, and laptop computers. These CN devices can set up ad hoc networks that extends the detection to desired locations as illustrated by Figure 1. By placing and properly using such CN devices in the collision-prone locations, traffic safety for all kinds of road users can be significantly improved. (2) Develop a mobile application (app) that allows pedestrians, bicyclists, and drivers of unconnected vehicles to communicate with the CN device and vice versa. Considering the popularity of Android phones and other mobile devices, the mobile app to be developed in this study will be based on the Android system. As a result, the app will allow collecting data on systems users’ location, speed, etc. and sending them appropriate warning messages in response to a particular unsafe scenario. (3) Develop an algorithm to identify unsafe conditions and determine appropriate CV based safety countermeasures (a.k.a. CV safety application) to be presented to system users. In other words, the team will determine what kind of message to be shown to which system users under a specific hazardous scenario. (4) Develop a connected vehicle simulation test-bed to evaluate the safety benefits of the proposed methodology under various traffic and landscape conditions. The CN device system will be implemented in the CV test corridors for the Washington State Department of Transportation (WSDOT). Field observations offers the data needed to calibrate the simulation test-bed. The expected outcomes of the proposed research include an innovative technology to combine personal mobile devices to the CV system and a new mechanism with its mobile implementation to identify and inform different road users about unsafe conditions on a roadway network. Both are important in enhancing safe traffic operations and travel on mixed-use roadways. Additionally, successful completion of the project will add to the body of knowledge for future evaluation of CV technologies and applications.

Research in Progress: Using Connected Vehicle Technology for Advanced Signal Control Strategies
Sponsor Organization: Research and Innovative Technology Administration
Performing Organization: University of California, Riverside
Expected Completion Date: None listed

Abstract:
Today's conventional traffic control strategies typically rely on measurements from point detection, and estimate traffic states such as queue length based on very limited information. The introduction of Connected Vehicle (CV) technology can potentially address these limitations of point detection via wireless communications to assist signal phase and timing optimization. The authors propose to develop agent-based online adaptive signal control strategies based on real-time traffic information available from CV technology. The authors will evaluate various strategies in terms of travel delay and fuel consumption, relative to conventional techniques, e.g., Highway Capacity Manual based methods. It is expected that the proposed strategies will out-perform the conventional methods in both mobility measures (e.g., travel time on an arterial corridor) and in fuel consumption. The new strategies should also be very robust to traffic demand variations.

Research in Progress: Developing Short Range Vehicle-to-Infrastructure Communication Systems
Sponsor Organization: Research and Innovative Technology Administration
Performing Organization: Texas Southern University, Houston
Expected Completion Date: January 31, 2016 – but the project is listed as Still Active

Abstract:
The objective of this project is to develop dedicated short-range communication systems (DSCS) to connect vehicles with roadside infrastructures (traffic signs, work zone barrels, traffic signals...) so as to not only enhance the safety but also reduce emissions and fuel consumptions of vehicles. The field test beds will be selected in typical work zone and stop sign areas, and simulations in the driving simulator will be also conducted to understand the drivers' reactions due to this type of short range communication system.

**Research in Progress:** High-Resolution Micro Traffic Data from Roadside LiDAR Sensors for Connected-Vehicles and New Traffic Applications

**Sponsor Organization:** Office of the Assistant Secretary for Research and Technology

**Performing Organization:** None listed

**Expected Completion Date:** September 30, 2018

**Abstract:**
The connected-vehicle crash-avoidance applications rely on real-time (location, speed and direction) information of each vehicle, pedestrian and bicyclist at a frequency of at least 1 HZ. This traffic data is named as high-resolution micro traffic data in this proposed research, meaning high-frequency high-accuracy data of each individual. High-resolution micro traffic data can be collected by conventional probe vehicles with the global positioning system (GPS) logging function. However, probe vehicles provide only sample data of the traffic fleet on roads, while the connected vehicle system needs the data of all road users. The current connected-vehicle deployment only receives high-resolution micro traffic data from the limit number of connected-vehicles. The traditional traffic sensors such as loop detectors, video detectors, Bluetooth sensors and radar sensors mainly provide macro traffic data such as traffic flow rates, average speeds and occupancy, so the existing sensors cannot provide the micro traffic data needed by connected vehicles. Even the crowdsourced data, such as real-time travel time data from Wave, is still the macro level traffic information. A new method to collect high-resolution micro traffic data for the connected-vehicle system is needed to help the current connected-vehicle deployment and the future connected-vehicle applications. The high-resolution micro traffic data will also change existing traffic safety engineering and traffic operation. For example, the micro-level trajectories of vehicles and pedestrians at intersections can be used to analyze intersection traffic safety and signal performance with much more details than the traditional safety and performance analysis. The existing Rectangular Rapid Flash Beacon (RRFB) for midblock pedestrian crosswalks can be upgraded to an automatic pedestrian signal with the real-time high-resolution micro traffic data. Warning of wildlife crossing highways can be automatically triggered when the real-time micro traffic data shows wildlife crossing. The high-resolution micro traffic data can also support adaptive traffic signal control systems. Unconnected vehicles and pedestrians can all benefit from the high-resolution micro traffic data. The new laser radar (LiDAR) technology has the capability to detect the 360-degree surrounding objects with high accuracy (centimeter level) and long measuring distance (300 feet radius or longer). This proposed research project is to develop methodologies of extracting high-resolution micro traffic data from the roadside LiDAR sensor data. The key objectives for the research are listed in the following: 1. Development of a method to extract location and speed trajectories of vehicles from the roadside LiDAR data. 2. Development of a method to extract location and speed trajectories of pedestrians from the roadside LiDAR data. 3. Development of a method to extract location and speed trajectories of bicyclists from the roadside LiDAR data. 4. Investigate possible applications of the high-resolution micro traffic data in traffic safety engineering, traffic operation and the connected-vehicle system with sample data generated by the developed methods.

**Research in Progress:** Internet of Moving Things using Full Duplex Mesh Networks

**Sponsor Organization:** Office of the Assistant Secretary for Research and Technology

**Performing Organization:** Data-Supported Transportation Operations and Planning Center

**Expected Completion Date:** December 31, 2018

**Abstract:**
Through years of research, true full duplex communication systems (transmission and reception in the same band at the same time) have been developed using novel off the shelf components. Such radios are unique in their ability to listen while transmitting at the same frequency at the same time. Although other full duplex technologies exist (from work conducted at Stanford, Rice and Columbia), these technologies are typically antenna or custom-chip based. The project team's solution is unique in that it is based on off-the-shelf discrete components together with software. This ability to build a software-centric full duplex solution has many advantages, including low-cost, rapid reconfigurability, and agility. Full duplex radios are able to listen and talk simultaneously, making them ideally suited for mesh networking applications. Conventional mesh networking is highly prone to poor performance due to massive overheads and rigidity. Full duplex radios are much more flexible and adaptable, and can perform tasks such as handoff and scheduling in a low-overhead, rapid manner. This makes them ideally suited to be the basis for the Internet of Moving Things (IoMT). IoMT aims to connect all moving (and static) objects with one another—buses, cars, people, even their pets—without using a cellular or satellite backbone. It enables vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) connectivity in a much more seamless fashion than currently thought possible. Full duplex based IoMT will provide low-cost connectivity between people, while helping us understand how people and vehicles move.

Research in Progress: Identifying Potential Workzone Countermeasures Using Connected Vehicle and Driving Data
Sponsor Organizations: Michigan Dept. of Transportation, Office of the Assistant Secretary for Research and Technology
Performing Organization: University of Michigan Transportation Research Institute
Expected Completion Date: April 20, 2018

Abstract:
Work zones present an ongoing safety challenge to the road safety community. Traffic management in a work zone is done through movable, temporary elements, and the novelty and complexity of the situation can challenge even attentive drivers. In the United States, (U.S.) 576 (2%) fatalities occurred in work zones in 2010 (Federal Highway Administration) FHWA 2015. For example, speed management and lane shifts can be challenging and can introduce safety issues in work zones. The advent of vehicle communication affords a new opportunity to develop countermeasures for work zones. Infrastructure can monitor work-zone driving behavior and potentially provide adaptive or even targeted interventions to help drivers manage work-zone driving more appropriately. This proposal seeks to identify workzone countermeasures that might be implemented using Vehicle-to-Infrastructure (V2I) and Infrastructure-to-Vehicle (I2V) communication. This work extends current data explorations taking place at University of Michigan Transportation Research Institute (UMTRI) to use driving data to understand workzone behavior. While that project focuses on driver behavior from a naturalistic driving study, this one will focus on connect-vehicle data available in UMTRI’s Safety Pilot Model Deployment study. Additional data from the Ann Arbor Connected Vehicle Test Environment may also be used.


Task 12. Business Models to Facilitate Deployment of CV Infrastructure to Support AV Operations

Abstract:
Connected vehicle (CV) technology will be essential to support the operation of automated vehicles in ways that will generate societal benefits rather than disbenefits. Different jurisdictions will have varying levels of interest in deploying CV infrastructure, based on varying perceptions of the benefits that they will gain from CV systems. Limited availability of CV infrastructure will seriously impede the ability of autonomous vehicles (AVs) to operate everywhere and is likely to deter growth of the market for AVs. How should this problem be addressed, to provide policy frameworks and/or business models that can facilitate widespread deployment of the needed CV infrastructure? The objective of the research is to provide guidance for agency decision-makers to use in evaluating possible business models for their CV
investment and policy decisions. The project needs to start from a basis of solid analysis showing the importance of CV technology to enable AV systems to produce societal benefits, and then explore how to deploy the needed CV infrastructure. Task 1. Review and summarize existing authoritative research results to show the differences in traffic flow dynamics (and hence congestion, energy use, and pollutant emissions) associated with AV versus CV automation systems at various levels of automation. Based on these results, estimate the net difference in societal benefits of AV implementation with and without CV capabilities for a variety of representative deployment environments (large and small metropolitan regions, intercity corridors with different traffic volumes, etc.). Assess these separately for infrastructure-to-vehicle (I2V) and vehicle-to-vehicle (V2V) cooperative automation (for which the infrastructure requirements are likely to be substantially different). For cases in which the existing literature does not provide sufficient information about the differences, perform additional modeling studies to produce refined estimates. Note: The U.S. DOT is developing a benefits assessment tool that could be foundational to this effort. Task 2. Define how the requirements for CV systems to support AV operations could potentially be more stringent than they would be for other intelligent transportation systems (ITS) applications, in ways such as: (a) limited tolerance of holes in communication coverage when driving from one jurisdiction to the next; (b) greater availability requirements based on safety and productivity implications of the loss of communications by the AV applications; (c) need for additional data elements beyond the minimum required basic safety message (BSM) Part I data elements that will be required for cooperative collision warnings under National Highway Traffic Safety Administration (NHTSA) regulations; and (d) enhanced cyber security needs. Based on considerations such as these, identify the extent to which AV usage could impact the costs of deploying and/or operating the infrastructure elements of both I2V and V2V cooperative systems. Task 3. Define potential business models for deployment of the CV infrastructure needed to support AV use of CV technology, accounting for public agencies sensitivity about providing others with access to their traffic signaling infrastructure. These could include: (a) combinations of designing, building, owning, operating, and maintaining the CV systems by the public agencies themselves; (b) franchising or contracting out to third parties; (c) offering right-of-way access to third parties in exchange for them providing the CV infrastructure; (d) other forms of public-private partnerships in which the AV industry or AV operators would finance the CV infrastructure costs based on their own direct benefits; (e) relying on cellular infrastructure as available rather than deploying dedicated short range communications (DSRC), considering the potential differences in communication capabilities and system performance as well as costs and responsibilities for the public agencies. Task 4. Based on the findings from the previous tasks, develop recommendations for what actions states should take regarding implementation of both I2V and V2V connectivity infrastructure to support AV operations, addressing topics such as: (a) criteria states should use to prioritize locations for I2V and V2V CV infrastructure deployment and (b) how the CV deployments should be financed (what business models for what operating environments) based on the levels of implementation costs and of societal benefits relative to direct private user benefits.

Intelligent Transportation Systems – Connected Vehicle Safety Pilot
USDOT ITS Joint Program Office - New Data Sets are Available in the Research Data Exchange (RDE):
MMITSS, BSM Emulator and Leesburg VA Vehicle Awareness Device

Abstract: No abstract available.


Abstract: No abstract available

5.9 GHz Dedicated Short Range Communication Vehicle-based Road and Weather Condition Application:
Messaging Requirements
Final, Version 2, August 2013
Abstract/Introduction:
Prepared for Cooperative Transportation Systems Pooled Fund Study by Synesis Partners LLC. Significant effort has been expended in the Federal Highway Administration’s (FHWA) Road Weather Management Program and in various federal and state connected vehicle programs to identify opportunities to acquire data from vehicles acting as mobile sensor platforms. It is also well-recognized that weather has a significant impact on the year round operations of the nation’s roadway system. This 5.9 GHz Dedicated Short Range Communication (DSRC) Vehicle-based Road and Weather Condition Application project is the synergistic result of those converging opportunities.

Accurate, timely and route-specific weather information allows traffic and maintenance managers to better operate and maintain roads under adverse conditions. The research system developed by this project will collect weather observation data from mobile sensors on transportation agency vehicles; transmit the data by way of DSRC roadside equipment (RSE) to one or more collection systems; and ultimately make the data available to other information systems such as the New York State DOT INFORM system and the U.S. DOT’s Weather Data Environment. In this way, the additional weather information from mobile platforms will eventually enable traffic managers and maintenance personnel to implement operational strategies that optimize the performance of the transportation system by mitigating the effects of weather on the road ways.

This document will define the mobile data messaging requirements against which the research application will be designed and implemented. The desired data elements will first be identified, and then be compared against the data elements that are available.

The comparison exposes the gaps between the intent and the implementation and illustrates that not all desired data elements may be captured in practice. Following the identification of data elements, applicable connected vehicle communication and messaging standards are reviewed. These in turn, drive the message formats and the subsequently documented messaging requirements.

DSRC: Deployment and Beyond
WINLAB Research Review
John B. Kenney, Toyota Info Technology Center
May 14, 2015

Abstract: No abstract available.

NCHRP Review of G-07

Reviewed By:
B. Ray Derr
rderr@nas.edu

Comments:
The proposed research is appropriate for the NCHRP and the expected value is high. The likelihood of success is high.
New vehicles should soon be transmitting the BSM and figuring out ways to take advantage of this data is timely. As noted in the problem statement, these could supplement or replace current techniques of collecting data and there will be opportunities to reduce costs.

Review Date:
11/17/2017

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**FHWA Evaluation of G-07**

Dale Thompson/ HRDO - V2V and V2I applications using Basic Safety Messages (BSM) have been developed and tested, and based on their expected benefits are now being deployed in pilot sites and grant locations across the country. Simple, standardized approaches and methods to use BSMs for traffic performance measurement is critical to their consistent widespread use to improve TMC operations providing not only local and regional metrics, but national as well. This study provides an opportunity to develop new algorithms and tools for processing the extremely large amount of BSM data into industry accepted estimation of traffic measures. The level of funding appears adequate to conduct the level of work proposed.

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**AASHTO Committee Evaluation for G-07**

**Algorithms to Convert Basic Safety Messages into Traffic Measures**

Submitted By:
Steven Buckley
Chair of Research Subcommittee
Committee on Safety

Comments:
3

Submitted By:
Galen McGill
Research Coordinator
Committee on Transportation System Operations (CTSO)

Comments:
The membership of CTSO collectively decided this is the #2 priority. It is also of particular importance to the CTSO Working Groups on Connected and Automated Vehicles and Systems Operations Strategies.