IMPACT REPORT
2018
Acknowledgements

This report, prepared by the National Cooperative Highway Research Program (NCHRP), acknowledges the members of NCHRP project panels, the research teams, and the employees of state transportation agencies who contributed the quantitative and qualitative evidence that forms the basis of this report. NCHRP also acknowledges the significant contributions of Lori Sundstrom, Mary Wright, Hilary Freer, Doug English, and Deborah Irvin in preparing and editing this report. Questions about this report should be sent to Sid Mohan at smohan@nas.edu.

Version 15 November 2018
The National Academy of Sciences was established in 1863 by an Act of Congress, signed by President Lincoln, as a private, nongovernmental institution to advise the nation on issues related to science and technology. Members are elected by their peers for outstanding contributions to research. Dr. Marcia McNutt is president.

The National Academy of Engineering was established in 1964 under the charter of the National Academy of Sciences to bring the practices of engineering to advising the nation. Members are elected by their peers for extraordinary contributions to engineering. Dr. C. D. Mote, Jr., is president.

The National Academy of Medicine (formerly the Institute of Medicine) was established in 1970 under the charter of the National Academy of Sciences to advise the nation on medical and health issues. Members are elected by their peers for distinguished contributions to medicine and health. Dr. Victor J. Dzau is president.

The three Academies work together as the National Academies of Sciences, Engineering, and Medicine to provide independent, objective analysis and advice to the nation and conduct other activities to solve complex problems and inform public policy decisions. The National Academies also encourage education and research, recognize outstanding contributions to knowledge, and increase public understanding in matters of science, engineering, and medicine.

Learn more about the National Academies of Sciences, Engineering, and Medicine at www.national-academies.org.

The Transportation Research Board is one of seven major programs of the National Academies of Sciences, Engineering, and Medicine. The mission of the Transportation Research Board is to increase the benefits that transportation contributes to society by providing leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal. The Board’s varied activities annually engage about 7,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

Learn more about the Transportation Research Board at www.TRB.org.
Systematic, well-designed research is the most effective way to solve many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation results in increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

Recognizing this need, the leadership of the American Association of State Highway and Transportation Officials (AASHTO) in 1962 initiated an objective national highway research program using modern scientific techniques—the National Cooperative Highway Research Program (NCHRP). NCHRP is supported on a continuing basis by funds from participating member states of AASHTO and receives the full cooperation and support of the Federal Highway Administration (FHWA), United States Department of Transportation.

The Transportation Research Board (TRB), part of the National Academies of Sciences, Engineering, and Medicine (National Academies), was requested by AASHTO to administer the research program because of TRB’s recognized objectivity and understanding of modern research practices. TRB is uniquely suited for this purpose for many reasons:

- TRB maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn;
- TRB possesses avenues of communications and cooperation with federal, state, and local governmental agencies, universities, and industry;
- TRB’s relationship to the National Academies is insurance of objectivity; and
- TRB maintains a full-time staff of specialists in highway transportation matters to bring the findings of research directly to those in a position to use them.

The program is developed on the basis of research needs identified by chief administrators and other staff of the state highway and transportation departments, by committees of AASHTO, and by FHWA. Topics of the highest merit are selected by the AASHTO Special Committee on Research and Innovation (R&I), and each year R&I’s recommendations are proposed to the AASHTO Board of Directors and the National Academies. Research projects to address these topics are defined by NCHRP, and qualified research agencies are selected from submitted proposals. Administration and surveillance of research contracts are the responsibilities of the National Academies and TRB.

The needs for highway research are many, and NCHRP helps solve highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement, rather than to substitute for or duplicate, other highway research programs.
Each year, the National Cooperative Highway Research Program (NCHRP) produces dozens of research results that offer guidance on a wide range of topics that are important to state departments of transportation as well as others within the highway industry. In some instances, the benefits of applying NCHRP research results are evident immediately, whereas the impact of applying other research results may not be understood or realized for several years. While there are no easy predictors or uniform measures of outcomes and impacts, the use of NCHRP research results has consistently and repeatedly generated value to practitioners, researchers, and decision makers from state DOTs and other transportation agencies, and consequently to the general public.

The NCHRP Impact Report 2018 is the first attempt to document and present that value, in the form of outcomes and impacts, of the application of NCHRP research results. Containing data, case studies, and anecdotes compiled from a variety of different sources, this report presents an overview of recent NCHRP research results, how the results are disseminated, and the impacts of their application.

From 2013 through 2017, NCHRP produced over 300 research products, which were downloaded over 142,000 times. In the same period, NCHRP research products were also the focus of 91 webinars hosted by TRB, which were attended by over 28,000 attendees. Over 500 transportation practitioners provided feedback in 2017 on where and how NCHRP research results were applied, and 88 anecdotes from them are included in this report. Another 45 anecdotes have been extracted from other sources, including previous NCHRP briefs, publications, and reports. All 50 states and the District of Columbia applied NCHRP research results to policy decisions or used them to introduce or change practice, as a reference source, or for new or additional research.

NCHRP will periodically update this report by systematically collecting and synthesizing new data and evidence of the use of NCHRP research products and by improving its methods to identify and analyze impacts on agency practices. NCHRP Project 20-44(09), “Quantitative and Qualitative Methods for Capturing the Impacts and Value of NCHRP Research”, will begin in 2019 and is expected to provide guidance on measuring the impacts of NCHRP research, and implementation of the recommendations that result from this research will inform future NCHRP Impact Reports.
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The National Cooperative Highway Research Program—NCHRP—has provided research-based solutions to challenges faced by state transportation agencies since 1962. NCHRP Research Reports, Syntheses of Highway Practice, Legal Research Digests, Innovations Deserving Exploratory Analysis (IDEA), and other research products form a comprehensive body of top-quality guidance relied upon by state departments of transportation (DOTs) from coast to coast and entities around the world. Many of the dozens of research products that NCHRP produces each year offer guidance for immediate application - better ways to design, build, and maintain roads and bridges; to keep motorists and highway workers safe; and manage DOTs more efficiently and effectively.

The subject matter of NCHRP research products extends across the full spectrum of concerns within the highway industry and demonstrates AASHTO’s interest in finding answers to the many acute problems facing DOT administrators and engineers.

This report groups the above subject matter into 8 different areas, for ease of analysis and reporting:

**ADMINISTRATION**
Includes Economics, Law, Finance, and Agency Administration.

**DESIGN**
NCHRP research products go through three key phases—Generating Knowledge, Disseminating Knowledge, and Producing Impacts—the rest of this document examines these phases and how the states and other stakeholders benefit from each phase.

Key phases of transforming research into impacts
One of the most immediate outcomes of NCHRP research is the generation of new knowledge and resources to support practice, guidance and standards, policy decisions, and further research. Research products such as final reports or other deliverables are a key means of disseminating this knowledge.

In the past 5 years, NCHRP has produced over 300 research products in support of new knowledge, and these products extend across 8 broad areas of a department of transportation - Administration, Design, Maintenance, Materials and Construction, Soils and Geology, Special Projects, Traffic, and Transportation Planning.

Number of NCHRP research products produced from 2013 through 2017

NCHRP research products produced from 2013 through 2017 by area

Design 36%
Traffic 15%
Materials and Construction 12%
Transportation Planning 12%
Administration 12%
Maintenance 5%
Special Projects 4%
Soils and Geology 2%
NHCRP uses a wide range of dissemination techniques to make users aware of what research is produced, how that research can benefit users and organizations when put into practice, and how that research can be implemented.

### DISSEMINATING KNOWLEDGE THROUGH WEBINARS

From 2013 through 2017, NCHRP research products were the focus of 91 webinars hosted by TRB, which were attended by over 28,000 attendees. Although attendees were primarily state DOT personnel, educational institutions, federal organizations, and the private sector also participated.

Number of NCHRP webinars and webinar attendees from 2013 through 2017

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Webinars</th>
<th>No. of Webinar Attendees</th>
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<tr>
<td>2013</td>
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<td>2,373</td>
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<td>25</td>
<td>6,992</td>
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<tr>
<td>2017</td>
<td>33</td>
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### DISSEMINATING KNOWLEDGE THROUGH BRIEFS

NCHRP produces a series of briefs and brochures, each highlighting different parts of the research process and covering topic areas of interest to departments of transportation.

- **Paths to Practice** explore how NCHRP research results are successfully implemented at state departments of transportation.
- **Ready Results** are briefs on select NCHRP reports that summarize the research and provide practical next steps for implementation.
- **Research Topic Highlights** summarize the results of several NCHRP research projects within a topic area.
ENABLING USE THROUGH DOWNLOADS, OPENBOOK SESSIONS, AND CATALOG SESSIONS

The 300+ research products that NCHRP produced from 2013 through 2017 were downloaded over 142,000 times and had over 87,000 OpenBook and over 43,000 Catalog sessions.

Chart of Downloads, OpenBook sessions, and Catalog sessions of NCHRP research products produced from 2013 through 2017

<table>
<thead>
<tr>
<th>Downloads</th>
<th>OpenBook Sessions</th>
<th>Catalog Sessions</th>
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<td>142,737</td>
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a OpenBook sessions are the number of times a report has been read online.
b Catalog sessions are the number of times a potential reader has visited NAP.edu to get more information about a report.
c Data current as of August 17, 2018.

WHY ARE NCHRP RESEARCH PRODUCTS DOWNLOADED?

NCHRP research products bring value to practitioners, researchers, policymakers, decision makers, and the general public in many ways. An analysis of over 18,500 comments provided by downloaders of our research products published from 2012 through 2016 reveals that nearly half of all downloads are intended for use in new or additional research or for use in practice.

For downloaders from departments of transportation (DOTs), the primary intended use was for practice and as reference material, a pattern that’s similar to downloaders from governmental agencies (excluding DOTs). Downloaders from educational institutions primarily intended to use NCHRP research products in new or additional research.

Intended use of NCHRP research products by different downloader affiliations

<table>
<thead>
<tr>
<th>Intended Use a</th>
<th>All N = 18,753</th>
<th>Departments of Transportation b N = 2275</th>
<th>Government c N = 1464</th>
<th>Educational Institutions d N = 1755</th>
</tr>
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<tbody>
<tr>
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<td>12%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Highlighted cells represent the top two categories for each type of downloader.

a Comments provided by downloaders were classified into the categories provided. For comments with multiple possible categories, only the first category mentioned was considered.
b Determined by using the email domain name. Includes state and federal agencies.
c Determined by using the email domain name. Includes state and federal agencies. Excludes .dot email domains.
d Determined by using the email domain name.
FOR POLICY DECISIONS
AT SCDOT Pre-construction Policy group we need to update our 2008 memo about adhesive anchors and need to see the recommended wording for consideration by AASHTO.

South Carolina

To promote ABC technologies by developing decision matrix tools and other policies in Illinois.

Illinois

We are re-evaluating our statewide policy on the use of rumble strips/stripes and we want to know what other areas of the country are doing.

Texas

AS A REFERENCE SOURCE
As a reference guide in my duties as a traffic safety engineer with the NCDOT.

North Carolina

As the ODOT Emergency Operations Manager this will be a guidance for me for the FEMA and the FHWA programs.

Oregon

I work for Caltrans (California DOT) and plan to share concepts presented in this report with my management and peers. Great information! Could help us as we transition to new approaches in mobility, such as sustainability and livability. Thanks!

California

TO INTRODUCE OR CHANGE PRACTICE
As an FHWA employee, I will use this manual to work with my state counterparts to improve preliminary planning and engineering.

Federal Government

As an IT project leader, I am leading projects that are integrating data and I am looking for ideas on how to develop data standards regarding data sharing and inter-operability.

Wisconsin

As an ODOT District Design Engineer I will reference this report to see if there are opportunities to improve our scoping and plan development process.

Ohio

FOR NEW OR ADDITIONAL RESEARCH
I work at the FDOT and we are working to consolidate our data and manage it in one location. I am doing research to see what is done elsewhere and is recommended.

Florida

In researching impact of parking policies on transit demand in Southern Maine for Maine DOT.

Maine

WSDOT is considering adding pylons to managed lanes in certain sections and we want to research the potential impact to speeds.

Washington
NCHRP RESEARCH PRODUCTS CONTRIBUTE TO FORMULATING NATIONAL GUIDANCE AND STANDARDS

AASHTO, FHWA, and TRB all rely on NCHRP research as the basis for other publications widely used by transportation agencies. The publications serve as industry standards and are often the result of continuous cycles of research conducted under the NCHRP program.

AASHTO’s *Mechanistic–Empirical Pavement Design Guide* (MEPDG) and DARWin-ME software, based on NCHRP research, represent a fundamental shift in pavement design that reflects the influences of traffic, climate, and soil composition. NCHRP guidance continues to support states shifting to the MEPDG approach.

A Policy on Geometric Design of Highways and Streets—known as AASHTO’s “Green Book”—contains comprehensive guidance for highway engineers and designers. Updates have incorporated NCHRP research on roadway features, access management, and vehicle types and speeds.

AASHTO’s *Highway Safety Manual* provides the best factual information and tools for considering safety implications in roadway planning, design, and operational decisions.

AASHTO’s *Load and Resistance Factor Design (LRFD) Bridge Design Specifications* for structures—including bridges, decks, tunnels, signs, and supports—are a direct output of NCHRP research guided by AASHTO committees.

FHWA’s *Manual on Uniform Traffic Control Devices* (MUTCD) relies on NCHRP research to develop standards for signage, road surface markings, and signals.

TRB’s current *Highway Capacity Manual* takes an integrated multimodal approach to the analysis and evaluation of urban streets from the perspectives of drivers, transit passengers, and cyclists.
Highway Safety Manual

All agencies need to incorporate safety into their overall transportation management processes. That's laid out in Part B of the manual, "Roadway Safety Management Process." The HSM strongly supports our state's data-driven approach to safety and complements our own analytical tools. We have incorporated parts of the HSM into our processes, including the predictive methods outlined in Part C and the crash modification factors in Part D. For example, we have identified locations that are either underperforming or exceeding expectations and applied benefit-cost analysis and the crash frequency assessment tools presented in the manual. The HSM helps us look at safety design alternatives and exceptions and quantity their impacts.

Kevin Hanley
AASHTO Coordinator
Caltrans 2011

Highway Capacity Manual

Emerging technologies and issues make ongoing research and updates to the manual critical. Caltrans looks forward to employing the new tools and methods in the [updated] Highway Capacity Manual to address congestion and improve the movement of travelers and goods. The essential and compelling impact of addressing capacity is an improvement in quality of service and a reduction in delay. Those in turn lead to a wide range of economic and safety benefits. The ongoing research investment in capacity is well worth it.

Jay Goldbaum
Pavement Design Program Manager
Colorado DOT 2008

Mechanistic–Empirical Pavement Design Guide (MEPDG)

In Colorado, we have estimated that we will save roughly $10 million per year because of new mechanistic–empirical design software made possible by LTPP. Those savings come from long-term overall pavement life, and because the state will be able to identify where it can install thinner pavement sections and still receive adequate performance, or where installing thicker pavement sections will save money by reducing maintenance costs.

Voices from the field: NCHRP impacts on formulating guidance and standards

Mechanistic–Empirical Pavement Design Guide (MEPDG)

We've always used 9 inches of concrete and 6 inches of gravel for all our concrete pavements. But some of our traffic is getting heavier, especially around the interstates, and we're realizing that we need to use thicker slabs in those locations. The MEPDG has been very useful for those situations.

Don Hill
Pavement Design Engineer
Montana DOT 2008

Highway Capacity Manual

The Highway Capacity Manual is invaluable for planning. It provides the data required for the careful balancing of costs and impacts in the planning and design of transportation infrastructure. The manual provides the level of service for a given project in simple terms graded A through F. Those are terms that policymakers and members of the public can understand, and they facilitate policymaking discussions and decisions.

Dirk Gross
Administrator, Office of Roadway Engineering
Ohio DOT 2011

Highway Safety Manual

By providing a numerical 'star' rating of the impact of different crash mitigation treatments, the HSM gives us confidence that our choices are statistically valid. That's the real strength of the manual. In times of tight budgets, the HSM allows us to spend our safety dollars wisely and use techniques that will provide the best safety benefits.

Darryl Belz
Safety & Scoping Unit Manager
Maine DOT 2012

Mechanistic–Empirical Pavement Design Guide (MEPDG)

Previous national pavement design guidance was not well equipped to address regional variability of such parameters as materials, climate, and traffic. The new mechanistic–empirical approach not only allows a better automation of pavement design, but it also takes advantage of advanced computing technologies.

Charles Dougan
Director of Research and Materials
Connecticut DOT 2012

Load and Resistance Factor Design (LRFD) Bridge Design Specifications

NCHRP was integral in making LRFD specs a reality. The seminal research was NCHRP Project 1-23, a five-year effort that led to the first edition of the AASHTO LRFD Bridge Design Specifications in 1994.

Mal Kerley
Chief Engineer
Virginia DOT 2011

Highway Capacity Manual

Here in Florida, it's the authoritative document for addressing highway capacity, quality of service, and level of service. The manual's methodologies are the way to evaluate the adequacy of existing and planned roadways to meet the public's needs. Agencies like our state land planning agency and local government rely on this document. This is critical because planning always has the potential to be controversial. By recognizing the Highway Capacity Manual in Florida, we are able to point to a national, authoritative document to help us justify decisions. It helps ensure that everyone involved in a project or decision plays by the same rules and uses the same tools.

Doug McLeod
Florida DOT 2011
NCHRP RESEARCH PRODUCTS STIMULATE FURTHER RESEARCH THAT BENEFITS STATE DOTS

Each year AASHTO’s Research Advisory Committee selects four high-value research projects from each of the four AASHTO regions. These award-winning “Sweet Sixteen” projects often reference one or more NCHRP research products. Since 2013, 37 of the 96 Sweet Sixteen projects have referenced a total of 102 NCHRP research products (see Appendix A for a full list of the referenced NCHRP work).

“Sweet Sixteen” state research projects that referenced NCHRP research products

Several of the “Sweet Sixteen” projects that referenced NCHRP research products resulted in appreciable impacts for their respective states. Some examples of those impacts follow. 

**2014 |** Wyoming DOT developed a research-based simulation tool to analyze its project pipeline and consider different funding scenarios, leading to process improvements and new techniques to reduce the risk of incurred holding costs. The techniques also shift revenue uncertainties from major projects to minor ones, helping keep critical, high-impact projects from sitting on the shelf. Bottom-line savings from the new methods were calculated at a representative 3%, an average savings of $9 million annually for a 10-year project pipeline of about $3 billion.
After 11 bridges in coastal Georgia were found to have remaining service lives of only 24 to 58 years, Georgia DOT investigated replacing conventional steel in prestressed concrete piles with stainless steel alloys. Results showed that these alloys can be used with the same design requirements and construction procedures as conventional prestressing strand and wire reinforcement, but with an expected service life of more than 100 years. Based on this research, Georgia DOT used piles reinforced with stainless steel on a bridge completed in 2016 in Liberty County, and nearby states are constructing and testing bridges with similar reinforcing.

A study sponsored by Indiana DOT found that it is possible to use some locally available aggregates in surface mixes—at about 20 to 30%—without a significant decrease in friction, which was a previous cause of concern. Researchers also developed a low-cost laboratory screening test to identify which candidate local aggregates warrant the expense of additional field trials, leading to further cost savings.

To minimize excessive road and bridge wear caused by heavy sugarcane haulers ($2,000 per vehicle to highways and $3,500 to bridges), a law was passed in 2012 requiring a minimum of six axles per vehicle. Passed in lieu of hiking the permit fee, it not only stemmed the costly cycle of damage and repair to roads and bridges, but tax incentives helped cover truck owners’ costs to convert or replace noncompliant trailers.

Minnesota DOT, with the help of hobbyists, developed a low-cost alternative to fiber-optic inspection systems, which cost upward of $100,000. Called Hydraulic Inspection Vehicle Explorer (HIVE) and with a total price tag of $2,000, the remote-control, waterproof unit was fitted with a camera and lights and designed for operation by a single specialist. In tests of the first unit, video collected helped identify hidden areas of rebar exposure, deformation, and water infiltration far into a culvert. In another test, the HIVE showed that a culvert was in generally good condition despite deterioration at the ends, saving $44,000 in unnecessary repairs.

Missouri DOT, after studying the operational benefits of diverging diamond interchanges (DDIs), turned to assessing the safety benefits of DDIs over conventional diamond interchanges. The research found that DDIs offered significant crash reduction benefits for all severities of crashes, with the highest crash reduction observed for fatal and injury crashes. Researchers found that the total crash frequency decreased by 41% at the project level and by 57% at the site-specific level. As an added safety benefit, crashes occurring at DDIs also tended to be of lower severity than crashes at conventional interchanges.

Montana DOT researchers updated the state’s rock slope rating criteria and identified critical rock fall sites. The new Rock Slope Asset Management Program includes a condition rating scale based on rock fall history and ditch effectiveness, as well as new descriptive condition states to aid with deterioration modeling and risk analysis. Programmatic costs, performance measures, and long-term risks all factor into slope preservation planning tools that focus on maintaining the network, rather than reactive repair efforts. Using this approach, the agency has reduced costs from $35 million to $28 million annually while achieving the same outcomes, a 19% or $7 million annual savings, with a 114% return on preservation investment.

A New Mexico DOT research study found that traditional cost assumptions on adding modifiers to liquid asphalt were outdated. With updated costs, an economic analysis showed that for the state’s annual $100 million asphalt expenditures, using elastic polymers would cost less than an additional 5%, but would extend the pavement life by more than 20%. This would net an annual savings of over $4.5 million using typical prescribed formulations. The study also revealed that optimization using up-to-date knowledge about prices, modified asphalt behavior, and test procedures will further decrease lifecycle costs.
**2017 |** Virginia DOT partnered with the National Center for Asphalt Technology to perform one of the first full-scale accelerated loading studies of instrumented pavement sections using cold central-plant recycling (CCPR), an effective method for processing recycled asphalt for reuse in the field. Based on the results of this study, Virginia is now using these techniques on a 7-mile-long project along Interstate 64 to reconstruct two existing lanes. In addition to the environmental benefits of using recycled materials, the agency expects to save $10 million on this project by using a recycled design in place of a traditional pavement structure.

**2018 |** Wisconsin DOT used researchers to investigate the interplay between asphalt mix properties and their impacts on pavement durability and verified the findings through field tests of mixes sampled from asphalt plants. WisDOT used these findings to modify its asphalt mix specifications, which are expected to increase pavement life span by 2 or more years and result in significant annual cost savings. WisDOT expects these improved mixture specifications to reduce pressure on WisDOT's letting program and could save the agency more than $25 million annually, by conservative estimates.

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All impacts extracted from Research Impacts publications found at https://research.transportation.org/High-Value-Research-Projects/.
NCHRP RESEARCH PRODUCTS HELP ALL AREAS OF A TRANSPORTATION ORGANIZATION

In 2017, NCHRP surveyed practitioners, researchers, and decision makers within state departments of transportation (DOTs) and the larger transportation community to determine how use of NCHRP research products benefits various areas of a transportation organization. 48 publications from the year 2012 were used in the survey, and over 500 respondents provided valuable insights into how those publications were used within their respective organizations. Appendix B contains a full list of publications used in the survey.

What were NCHRP research products used for?

Survey respondents said that NCHRP research products were most useful as guidance documents and for setting standards and specifications. Notably, 10% of the respondents used the research products for making management decisions, and 9% of the respondents indicated changes to policy through the use of NCHRP research products.

What benefits did the use of NCHRP research products produce?

Safety, durability, and reliability of the highway system were the biggest benefits of using NCHRP research products, according to over a third of the survey respondents.
Knowledge Management (KM) and Information Management

As DOTs lose employees to retirement, downsizing, and reorganization, agencies face a critical challenge: how to retain those employees’ knowledge and share it within the organization. To address this need, NCHRP Project 20-98 set out to develop a guide to help DOTs implement effective agencywide knowledge management (KM) practices.

KM can involve everything from succession management, leadership development programs, and mentoring programs to communities of practice, after-action reviews, and information management in support of KM. Although KM practices and tools have been developed and adopted by a range of private- and public-sector organizations, they have not been systematically used by most DOTs.

The document resulting from the project, NCHRP Report 813: A Guide to Agency-Wide Knowledge Management for State Departments of Transportation, lays out principles and practices DOTs can use to capture, organize, and share critical knowledge in pursuit of their strategic mission. Published in 2015, the guide is already having a major impact on the transportation industry, and has been presented at numerous conferences and meetings.

The guide is designed to be a starting point for agencies interested in implementing KM and will be helpful particularly to senior and mid-level management staff responsible for an agency’s strategic direction, as well as others seeking to put KM into practice.

A related research project, NCHRP Project 20-90, focused on providing DOTs with guidance on information management. Information management encompasses data and documentation of all kinds, from reports and manuals to maps and photographs, any of which can be in print or electronic form. Information management is especially important as DOTs move from central filing systems to electronic records and modernized information practices. It is also critical for responding to public requests and providing transportation professionals with the information they need to make good decisions.

The research findings, published as NCHRP Report 754: Improving Management of Transportation Information, provide effective strategies that DOTs can use to improve information capture, preservation, and retrieval.

Transportation Asset Management

From stop signs to suspension bridges and assets of every size in between, transportation agencies have zeroed in on asset management in recent years as an important strategy to help direct spending decisions.

AASHTO’s Transportation Asset Management Guide, published in 2002 based on NCHRP research, is the key resource agencies turn to. Asset management used to only be about pavements and bridges, but transportation agencies are responsible for many other assets. The Transportation Asset Management Guide helps agencies expand beyond pavements and bridges in their asset management decisions. The guide takes a very pragmatic approach, with methods that can be applied equally well to drainage facilities, overhead lighting, sign structures, retaining walls, intelligent transportation systems, and traffic control systems.

NCHRP is actively involved in further developing tools to assist transportation agencies with asset management.

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a Extracted from NCHRP Impacts on Practice: Knowledge and Information - Critical DOT Assets.
b Extracted from NCHRP Impacts on Practice: Making Every Asset Count.
Voices from the field: Our impacts on Administration

NCHRP Report 813: A Guide to Agency-Wide Knowledge Management for State Departments of Transportation
The guide is a great resource for our agency. Knowledge management is helping us run as efficiently as possible without wasting resources. Our mentoring program for new employees helps get them up to speed during the onboarding process, so that they can add value to our organization as quickly as possible. We also have a lessons-learned process after major projects, and are looking at how our data is captured and how easy our information is to retrieve.

John Holkowksi
Director
Arizona DOT
2016

The Transportation Asset Management Guide is a prime example of why NCHRP is so important to us.

Carlos Braceras
Deputy Director
Utah DOT
2012

When Report 480 came out, it was the best available snapshot of where things stood with CSS and the states and organizations that were starting to embrace it, and we incorporated the report into our training reference manual. Some of the approaches discussed in the report, such as risk management and safe and feasible solutions, help validate the CSS process for agencies and assure them that it’s not about unacceptable compromises and throwing safety and standards out the window.

Scott Bradley
Chair, Transportation Research Board Task Force on Context Sensitive Design/Solutions
Minnesota DOT
2007

NCHRP Report 723: A Model for Identifying and Evaluating the Historic Significance of Post-World War II Housing
MoDOT uses the results as guidance when evaluating post-war architectural resources. It reinforced the practices we were using for identifying these resources and provided us with a way to consistently name the resources across projects and working historians. We have referred the results to numerous consultants for use when working on MoDOT projects, especially in urban areas, which has made the evaluation of post-war resources easier and more consistent across the state. We have also promoted the availability of the results at a state wide historic preservation conference, our State National Register Review Board and to our Certified Local Government Training, encouraging survey and evaluation of post-war resources and a standard terminology for the residential resources.

John Horsley
Executive Director
AASHTO
2012

Our design, construction and planning staff have all used the information in Report 480. Some of the most important things we’ve taken away from the report are the case studies and the discussions about effective decision making and tort liability. We drew on the ideas about tort liability for a two-day training workshop on that issue.

Phil Bell
Associate Landscape Architect
New York State DOT
2007

NCHRP Project 20-24: Administration of Highway and Transportation Agencies
State DOT executives face unique challenges. AASHTO members rely on NCHRP Project 20-24 results to stay ahead of these challenges and meet them head-on.

John Horsley
Executive Director
AASHTO
2012

We set up our own in-house CSS manual online, and rather than do a separate section on tort liability and risk management, we deferred to Report 480 for that discussion. A host of people used this manual. We initially developed it as a resource for our in-house and consultant staff, but some of the state’s local governments also use it.

Ben Buchan
State Urban Design Engineer
Georgia DOT
2007

NCHRP Report 723: A Model for Identifying and Evaluating the Historic Significance of Post-World War II Housing
As a Section 106 practitioner, I frequently encounter this property type when reviewing transportation projects for our department. I have used it as a guide in evaluating post-war properties. I recommend the publication to our consultants and to other staff.

Carey Coxe
Louisiana DOT
2018
VOICES FROM THE FIELD: OUR IMPACTS ON ADMINISTRATION

NCHRP Project 20-24: Administration of Highway and Transportation Agencies
State DOT executives face unique challenges. AASHTO members rely on NCHRP Project 20-24 results to stay ahead of these challenges and meet them head-on.

John Horsley
Executive Director
AASHTO
2012

The Transportation Asset Management Guide is a prime example of why NCHRP is so important to us.

Carlos Braceras
Deputy Director
Utah DOT
2012

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Ben Buchan
State Urban Design Engineer
Georgia DOT
2007

When Report 480 came out, it was the best available REPORT of where things stood with CSS and the states and organizations that were starting to embrace it, and we incorporated the report into our training reference manual. Some of the approaches discussed in the report, such as risk management and safe and feasible solutions, help validate the CSS process for agencies and assure them that it’s not about unacceptable compromises and throwing safety and standards out the window.

Scott Bradley
Chair, Transportation Research Board Task Force on Context Sensitive Design/Solutions
Minnesota DOT
2007

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Phil Bell
Associate Landscape Architect
New York State DOT
2007

NCHRP Report 723: A Model for Identifying and Evaluating the Historic Significance of Post-World War II Housing
The Utah DOT has a large, controversial new alignment that is almost ready for FEIS release. Because this EIS has taken so long, we had to update the architectural resource survey, and several of the buildings that came of age in the interim period between the initial survey and the FEIS were built in what I consider to be that troublesome, no-man's-land of domestic architecture: the late 1960s and early 1970s. Our consultants referred to Report 723 and applied the standards for this period to a handful of homes that are split-level, split-entry, etc. and have undergone a variety of alterations. Having solid ground from the report to assess the eligibility of these late-1960's/early'70s residences helped immensely in the Section 106 consultation with our SHPO. Our consultation letter was signed on May 10 by SHPO, so the timeframe is very recent. I can’t
stress the relief I felt as I read the consultants' report and realized the role Report 723 had on the survey update for this project. The use of Report 723 is also significant in that by laying out the framework for decision-making of this period of buildings, we have guidance we can use for this period of buildings for future projects. Buildings from this time period will only become more prevalent in our projects.

Elizabeth Giraud
Utah DOT
2017

NCHRP Report 723: A Model for Identifying and Evaluating the Historic Significance of Post-World War II Housing

As a Section 106 practitioner, I frequently encounter this property type when reviewing transportation projects for our department. I have used it as a guide in evaluating post war properties. I recommend the publication to our consultants and to other staff.

Carey Coxe
Louisiana DOTD
2018

Mead & Hunt has applied findings to survey efforts conducted for state DOTs. MnDOT is developing a suburban context for the Twin Cities that is informed by the study. The context will aide in future project-related environmental compliance efforts.

Amy Squitieri
Mead & Hunt, Inc.
2017

NCHRP Report 723: A Model for Identifying and Evaluating the Historic Significance of Post-World War II Housing

MoDOT uses the results as guidance when evaluating post-war architectural resources. It reinforced the practices we were using for identifying these resources and provided us with a way to consistently name the resources across projects and working historians. We have referred the results to numerous consultants for use when working on MoDOT projects, especially in urban areas, which has made the evaluation of post-war resources easier and more consistent across the state. We have also promoted the availability of the results at a statewide historic preservation conference, our State National Register Review Board and to our Certified Local Government Training, encouraging survey and evaluation of post-war resources and a standard terminology for the residential resources.

Anonymous
2017

NCHRP Synthesis 434: Use of the U.S. Census Bureau’s Public Use Microdata Sample (PUMS) by State Departments of Transportation and Metropolitan Planning Organizations

(1) Used PUMS to validate and improve base year household and employment estimates for growth forecasts used in long-range transportation planning activities. (2) Used PUMS to analyze and report on travel trends and changes in modal share distributions in the metropolitan Washington region

Anonymous
2017
over a series of years. (3) Used PUMS to analyze the worker classification-industry-occupation characteristics of workers who reported that they usually worked from home in the previous week. (4) Used PUMS to analyze industry-occupation clusters of workers for an economic development, regional economy diversification study. The insights provided by Synthesis 434 opened up and expanded the use of PUMS data for a wide variety of research and analysis activities in our MPO. I believe that the information in Synthesis 434 could benefit both MPOs and State DOTs in measuring and setting targets for Non-Single Occupancy Vehicle (SOV) Travel as part of FHWA Transportation Performance Management requirements.

Robert E. Griffiths
Metropolitan Washington Council of Governments
2018

NCHRP Report 813: A Guide to Agency-Wide Knowledge Management for State Departments of Transportation

The guide is a great resource for our agency. Knowledge management is helping us run as efficiently as possible without wasting resources. Our mentoring program for new employees helps get them up to speed during the onboarding process, so that they can add value to our organization as quickly as possible. We also have a lessons-learned process after major projects, and are looking at how our data is captured and how easy our information is to retrieve.

John Halikowski
Director
Arizona DOT
2016

NCHRP Report 813: A Guide to Agency-Wide Knowledge Management for State Departments of Transportation

Transportation agencies are becoming increasingly interested in knowledge management. Some agencies are creating knowledge management initiatives and using NCHRP research results as a resource for developing their programs. Such programs are helping Washington State DOT and other agencies identify risks for knowledge loss and develop strategies to protect critical institutional knowledge in the rapidly changing DOT environment.

Leni Oman
Knowledge Strategist
Washington State DOT
2016
Structural Supports for Highway Signs, Luminaires, and Traffic Signals

State DOTs look to AASHTO’s standard specifications for guidance in designing and constructing structures. Previous NCHRP work (Project 17-10) resulted in an extensive revision of AASHTO’s support structure specifications in 2001, but several technical issues still needed to be resolved. NCHRP initiated a follow-up study to address these topics, including further research on wind loading, fatigue and vibration, and foundations and anchor bolts.

The study results were published as NCHRP Report 494: Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Several of the results have been incorporated into the AASHTO specifications, while others will be part of future code revisions.

NCHRP Report 494 has also allowed state DOTs to build on the guidance in the current AASHTO specifications. For example, California DOT turned to the report’s guidance on anchor bolt design for help in testing a new design method.

As design specifications evolve, NCHRP Report 494 promises to be influential for years to come, when NCHRP initiates a project to develop AASHTO Load and Resistance Factor Design (LRFD) specifications for support structures.

Seismic Bridge Design

NCHRP and AASHTO work closely to advance seismic design for bridges. This means not only redefining seismic design through AASHTO specifications but also responding to trends in bridge design and fabrication techniques like accelerated bridge construction (ABC). The use of isolation bearings, such as sliding or other specialty bearings, can be a powerful tool in protecting bridges from catastrophic failure during earthquakes.

NCHRP Report 472 has had a lasting effect on seismic design. With the support of NCHRP and the contributions of AASHTO SCOBS Technical Committee T-3 members, many of the report findings were incorporated into the AASHTO Guide Specifications for LRFD Seismic Bridge Design, first published in 2009. The guide specs featured approved design alternatives to requirements in AASHTO’s LRFD Bridge Design Specifications.

Seismic design is still evolving, and NCHRP is keeping pace with the latest trends. For example, accelerated bridge construction has come into its own in the last decade. ABC offers an array of savings—reduction in costs, construction times, and traveler delays—and it is a featured technology promoted by FHWA’s Every Day Counts initiative. Yet seismic activity represents a significant challenge to ABC.

Two 2011 publications, NCHRP Report 698: Application of Accelerated Bridge Construction Connections in Moderate-to-High Seismic Regions and NCHRP Report 681: Development of a Precast Bent Cap System for Seismic Regions, provide guidance to enable transportation agencies in seismic areas to deploy ABC while meeting seismic design requirements.

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\( ^{a} \) Extracted from NCHRP Impacts on Practice: New Design Specs for Support Structures.

\( ^{b} \) Extracted from NCHRP Impacts on Practice: Better, Safer Bridges for When the Earth Shakes.
In response to cross median crashes, FDOT District 3 is installing their first cable barrier systems in the median of Interstate 10 in North West Florida.

David C. O’Hagan
Florida DOT
2017

NCHRP Report 711: Guidance for the Selection, Use, and Maintenance of Cable Barrier Systems

The bridge world is supportive and appreciative of NCHRP and this research. Bridge owners have limited resources, and the performance requirements that came out of this study provide confidence that modular deck joints will perform the way they’re intended to. At the same time, cooperative national research makes it feasible for manufacturers to innovate and design toward one set of national specifications, rather than having each state heading off in a separate direction.

Ralph Anderson
Bridges and Structures Bureau Chief
Illinois DOT
2008

NCHRP Report 467: Performance Testing for Modular Bridge Joint Systems

The bridge world is supportive and appreciative of NCHRP and this research. Bridge owners have limited resources, and the performance requirements that came out of this study provide confidence that modular deck joints will perform the way they’re intended to. At the same time, cooperative national research makes it feasible for manufacturers to innovate and design toward one set of national specifications, rather than having each state heading off in a separate direction.

Arlen Ottman
Minnesota DOT
2018

NCHRP Report 472: Comprehensive Specification for the Seismic Design of Bridges

There is not a one-size-fits-all solution when it comes to seismic design. NCHRP Report 472 was instrumental in capturing some of the latest thinking in seismic bridge design, most notably the use of a displacement-based design approach rather than the traditional force-based R-Factor method. We feel that displacement-based design presented in the guide specs is a more realistic, more modern way of approaching bridge design. It’s good to have this as an approved alternative design approach. The guide specs offer right-sized solutions for less seismically active states as well. The guide specs offer a low-level, no-analysis designs—simple detailing that doesn’t require any additional engineering or computer modeling. This helps low-seismic states address seismic design with relative ease.

Richard Pratt
Chief Bridge Engineer
Alaska DOT and Public Facilities
2012

John Svaalenak
Oregon DOT
2018

Arlon Goldbaum
Pavement Design Program Manager
Colorado DOT
2008

Voices from the field: Our impacts on Design
VOICES FROM THE FIELD: OUR IMPACTS ON DESIGN

Mechanistic–Empirical Pavement Design Guide (MEPDG)
The fact that we can now design thinner pavements really provided us with the tangible benefits that we needed to justify the cost of doing the local calibration. In some areas, we were designing 14-inch concrete pavements—we even had some 20-inch asphalt sections. We didn't have a justifiable reason not to do it. We didn't have a better design method at our fingertips. Now we do.

John Donahue
Pavement Engineer
Missouri DOT
2008

Mechanistic–Empirical Pavement Design Guide (MEPDG)
Previous national pavement design guidance was not well equipped to address regional variability of such parameters as materials, climate, and traffic. The new mechanistic–empirical approach not only allows better customization of pavement design, but it also takes advantage of advanced computing technologies.

Charles Dougan
Director Of Research And Materials
Connecticut DOT
2012

Mechanistic–Empirical Pavement Design Guide (MEPDG)
In Colorado, we have estimated that we will save roughly $10 million per year because of new mechanistic–empirical design software” made possible by LTPP. Those savings come from longer overall pavement life, and because the state will be able to identify where it can install thinner pavement sections and still receive adequate performance, or where installing thicker pavement sections will save money by reducing maintenance costs.

Jay Goldbaum
Pavement Design Program Manager
Colorado DOT
2008

Mechanistic–Empirical Pavement Design Guide (MEPDG)
The MEPDG should give us better predictions of pavement performance in our state, which will help with pavement management and budgeting.

Roger Green
Pavement Research Engineer
Ohio DOT
2008

Mechanistic–Empirical Pavement Design Guide (MEPDG)
We’ve always used 9 inches of concrete and 6 inches of gravel for all our concrete pavements. But some of our traffic is getting heavier, especially around the Interstates, and we’re realizing that we need to use thicker slabs in those locations. The MEPDG has been very useful for those situations.

Dan Hill
Pavement Design Engineer
Montana DOT
2008

From this project we learned that rigid pavements constructed on lean concrete bases developed premature cracking compared with concrete built over dense-graded aggregate bases. As a result, Ohio discontinued using rigid bases for concrete pavements. We developed an understanding of moisture in subgrades and bases that eventually led to the moratorium on free-draining bases in Ohio. Other outcomes at Ohio DOT included the establishment of nationally recognized expertise in pavement instrumentation, the refinement of subgrade acceptance criteria, and new requirements for tack coats on new asphalt construction.

Adam Au
Pavement Research Engineer
Ohio DOT
2015
NCHRP Report 467: Performance Testing for Modular Bridge Joint Systems

The bridge world is supportive and appreciative of NCHRP and this research. Bridge owners have limited resources, and the performance requirements that came out of this study provide confidence that modular deck joints will perform the way they’re intended to. At the same time, cooperative national research makes it feasible for manufacturers to innovate and design toward one set of national specifications, rather than having each state heading off in a separate direction.

Ralph Anderson
Bridges And Structures Bureau Chief
Illinois DOT
2008

NCHRP Report 467: Performance Testing for Modular Bridge Joint Systems

All MBJS in Minnesota must conform to these standards. This includes systems put into new bridge construction and replacement systems alike. Before these specifications, we never knew if we were getting what we needed or how long these systems would last. This report helped ensure quality for a bridge part that should be built to perform for decades, and at least as long as the other components of the bridge deck.

Arlen Ottman
Bridge Design Unit Leader
Minnesota DOT
2018


1. Developed and taught course on human factors in roadway design. 2. Developed and presented workshops and webinars on human factors in roadway design. 3. Used HFG content to diagnose crash data and identify countermeasures. State DOT staff in Nevada, Arizona, Delaware, Wisconsin, Idaho, and Alabama have used it for training, for diagnosing crashes/hot spots and to support RSA’s. As part of NCHRP 17-80, a survey was conducted of potential HFG users - 258 individuals responded. 40% of those responding had read, received training on and/or actively used the HFG.

Anonymous
2018

NCHRP Report 711: Guidance for the Selection, Use, and Maintenance of Cable Barrier Systems

FHWA Memo of November 27, 2012, addressed information from NCHRP 711 on deflection based on post spacing from 711 and anchor spacing which was a change from previous approach to determine deflection based on linear interpolation with post spacing. The memo references NCHRP 711 directly and recommendations from NTSB to reference

Anonymous
2017
NCHRP 711. The memo has affected policy in several states such as Alabama and West Virginia. I am not sure of the time frame the States applied the changes but limits the length of cable runs based on manufacturers deflection tables included in the report.

Anonymous 2017

NCHRP Report 711: Guidance for the Selection, Use, and Maintenance of Cable Barrier Systems

In response to cross-median crashes, FDOT District 3 is installing their first cable barrier systems in the median of Interstate 10 in Northwest Florida.

David C. O'Hagan
Florida DOT 2017

NCHRP Report 711: Guidance for the Selection, Use, and Maintenance of Cable Barrier Systems

TTI and MwRSF used the simulations in the analyses that led to their recommendations for new cable barrier tests for the most recent version of MASH. This will insure that the crashworthiness of various barriers can be evaluated for placement on sloped surfaces. This will aid the states in selecting barriers for specific applications.

Kenneth S. Opiela
FHWA Liaison 2017


Applied the methods in the design of AASHTOWare Bridge Management 5.2.3. Developed deterioration models for bridges, unstable slopes, retaining walls, and other asset classes for various state DOTs including Florida, Virginia, Alabama, Alaska, Montana. Developed a national bridge deterioration model for FHWA's National Bridge Investment Analysis System. Bentley Systems uses it in their development and use of AASHTOWare Bridge Management. Colorado DOT developed a model using the guide. Iowa State University has used it in some of their research for Iowa DOT.

Paul D. Thompson
Purdue University - School of Civil Engineering 2018

NCHRP Report 718: Fatigue Loading and Design Methodology for High-Mast Lighting Towers

The results were incorporated into the AASHTO Design Specifications. 1. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals 2. AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

Andre V. Pavlov
Florida DOT 2018

NCHRP Report 719: Calibration of Rutting Models for Structural and Mix Design

We have performed tests for local calibration of the AASHTOWare Pavement ME Design software for a couple of State Highway Agencies. We used the report to determine how to conduct the permanent deformation testing. We are also preparing a practitioner's guide for testing of resource responsible asphalt mixtures for the FHWA. We have referenced the publication in that guide. We also sell and service asphalt materials testing equipment. We refer customers to this report for repeated load permanent deformation testing and analysis.

Dr. Ramon Bonaquist
Advanced Asphalt Technologies, LLC 2018

NCHRP Report 720: Estimating the Effects of Pavement Condition on Vehicle Operating Costs

I use these results to compute benefit and/or cost components when I evaluate the recommendations for changes to pavement design or maintenance policies.

James Selywn Gillespie
Virginia DOT 2018
NCHRP Report 720: Estimating the Effects of Pavement Condition on Vehicle Operating Costs

I use the Vehicle Operating Cost Model that resulted from Report 720 to address the effects of pavement condition changes in benefit: cost analyses required for Federal discretionary grant applications. In the past, my state's legislature has asked, "What are the economic benefits of spending more on pavement preservation?" Report 720 provides a methodology for answering that question. The resulting model has been used to estimate "state of good repair" benefits in several BCAs conducted for Federal discretionary funds applications. The resulting model has been used to analyze the implications of gradual pavement disinvestment on highway users in the state. It is anticipated that the model will be used to indicate the benefits of pavement preservation programs to legislators.

John Svadlenak
Oregon DOT
2018

NCHRP Report 728: Guidelines for Evaluating and Selecting Modifications to Existing Roadway Drainage Infrastructure to Improve Water Quality in Ultra-Urban Areas

Material used as supplemental resource and background information for stormwater designers and environmental staff.

William Fletcher
Oregon DOT
2017

NCHRP Report 730: Design Guidance for Freeway Mainline Ramp Terminals

Caltrans incorporated some specific guidance in its Highway Design Manual.

John Roccanova
David Evans & Associates
2018

NCHRP Report 730: Design Guidance for Freeway Mainline Ramp Terminals

We recently completed two major interchange designs in Maryland and the design team referred to this document for guidance.

Kenneth T. Briggs
KCI Technologies Inc.
2017

NCHRP Report 730: Design Guidance for Freeway Mainline Ramp Terminals

Current Standard Drawings have been updated and will be implemented at the end of Aug. 2016. Additional information that was removed from the current edition of the "Green Book" and re-evaluated was invaluable at determining ramp acceleration and deceleration rates and subsequent lengths to more accurately represent current driver behavior as much of the existing data from the "Green Book" is based on studies from the late 1930's and 1940's. This study helped clarify the original use and application of those studies as well as provided data to better apply more current data for the design of our ramps throughout the state.

Chris Whipple
Utah DOT
2017

NCHRP Synthesis 423: Long-Term Performance of Polymer Concrete for Bridge Decks

Reviewed the report to compare the findings to my agency practice. Report: Evaluation of Thin Polymer Overlays for Bridge Decks - Wisconsin Department of Transportation - The research team focused its survey work on follow-up inquiries to a national survey conducted in the NCHRP Synthesis Report No. 423 on performance of thin polymer overlays for bridge decks.

Jeffrey Milton
Virginia DOT
2018
NCHRP Synthesis 425: Waterproofing Membranes for Concrete Bridge Decks
We reviewed the document, and used some of the terminology in our latest specifications. We have had suppliers of various products make reference to it.
Anonymous
2018

NCHRP Synthesis 428: Practices and Procedures for Site-Specific Evaluations of Earthquake Ground Motions
The results of the work have been used to improve geotechnical earthquake engineering practice in state DOTs and consulting firms that are often contracted by state DOTs. It leads to safer bridges and more economical design in seismically active states.
Anonymous
2017

NCHRP Synthesis 429: Geotechnical Information Practices in Design-Build Projects
I was a Panel Member, therefore familiar with the objectives and findings of the Synthesis. I presented the Best Practices the study identified at a high level management meeting. The findings of the study reinforced many of the MaineDOT’s current D-B practices, such as 1-on-1 meetings during the RFP period, informal over the shoulder meetings during design, limiting review times, performing adequate geotechnical investigations prior to issuing the RFP, deliberate risk allocation, and Alternative Technical Concepts (ATC’s). The most valuable take away is the finding that QUALITY is most influenced in the procurement phase and then it rapidly falls off. This points to the importance of those decisions made as to what to include in the RFQ and the RFP & the weight of geotechnical evaluation criteria. I presented a summary of the DRAFT findings and recommendations of this research at the Sept. 2011 Northeast States Geotechnical Engineers Conference in Portland, Maine.
Laura Krusinski
Maine DOT
2017

NCHRP Synthesis 431: Practices to Manage Traffic Sign Retroreflectivity
I directed a few agencies who asked questions about practices to the document. I have it linked from the FHWA website under our Implementation Tools webpage: https://safety.fhwa.dot.gov/roadway_dept/night_visib/signimplementationtools.cfm.
Anonymous
2018

NCHRP Synthesis 429: Geotechnical Information Practices in Design-Build Projects
I presented a summary of the draft findings and recommendations of this research at the September 2011 Northeast States Geotechnical Engineers Conference in Portland, Maine. DOT geotechnical engineers from NY, CT, NH, VT, MA and RI were present. My objective was to share the innovations and best practices which Synthesis 428 identified for design-build projects, specifically: (1) allocating geotechnical risks, (2) the level of geotechnical information provided, (3) the level of geotechnical design criteria and (4) methods to enhance innovation. Annually, the Northeast states DOT geotechnical engineers meet and conclude their meeting with roundtable discussions. Geotechnical practices on DB projects is a popular, re-occurring theme - and I always reach to Synthesis 429 and share its findings which incorporate many of MaineDOT’s DB geotechnical practices. MaineDOT management participated last year in a DB roundtable hosted by VTrans, and our representative presented some to our geotechnical DB practices which are reflected in Synthesis 429.

Load and resistance factor design (LRFD) specifications
Adopting LRFD specifications was an enormous undertaking, but it was too important not to do. Compared with earlier design methods, LRFD represented a reality-based approach that provides a uniform safety factor regardless of materials or bridge
length. It also more easily incorporates new materials, loads, and construction methods. We believe in the LRFD approach, and we've used the AASHTO specifications with its modifications and updates to roll out LRFD in phases over the last seven years—first superstructures, then substructures, and then footings and piling. At last, we've arrived at fully finished standards.

Loren Risch
State Bridge Operations Engineer
Kansas DOT
2011

Load and resistance factor design (LRFD) specifications

NCHRP was integral in making LRFD specs a reality. The seminal research was NCHRP Project 12-33, a five-year effort that led to the first edition of the AASHTO LRFD Bridge Design Specifications in 1994.

Mal Kerley
Chief Engineer
Virginia DOT
2011

Load and resistance factor design (LRFD) specifications
As states started actually using the specifications, questions arose that demanded attention. For example, the original specifications included two completely different methods for designing straight girders and horizontally curved girders. Subcommittee members saw a need for a simplified and unified approach, and this led to NCHRP Project 12-52. The specification changes drawn from Report 549 provided more intuitive design methods that allow engineers to assess whether the outputs of the design calculations are reasonable. Thanks to NCHRP research, our understanding of LRFD continues to improve.

Ed Wasserman
Civil Engineering Director
Tennessee DOT
2011

NCHRP Report 472: Comprehensive Specification for the Seismic Design of Bridges

In South Carolina, we developed our own state seismic design specifications for highway bridges, drawing in part from the findings of NCHRP Project 12-49 and NCHRP Report 472. Our specifications follow the performance-based design approach, which we believe provides a better insight into actual structural behavior and a more consistent level of seismic protection for our bridges.

Lucero Mesa
Seismic Design Support Engineer
South Carolina DOT
2012

NCHRP Report 472: Comprehensive Specification for the Seismic Design of Bridges

There is not a one-size-fits-all solution when it comes to seismic design. NCHRP Report 472 was instrumental in capturing some of the latest thinking in seismic bridge design, most notably the use of a displacement-based design approach rather than the traditional force-based R-Factor method. We feel that displacement-based design presented in the guide specs is a more realistic, more modern way of approaching bridge design. It’s good to have this as an approved alternative design approach. The guide specs offer right-sized solutions for less seismically active states as well. The guide specs offer low-level, no-analysis designs—simple detailing that doesn’t require any additional engineering or computer modeling. This helps low-seismic states address seismic design with relative ease.

Richard Pratt
Chief Bridge Engineer
Alaska DOT and Public Facilities
2012
Highway Maintenance Quality Assurance (MQA) a
State DOTs expend tremendous resources to maintain their highways, bridges, and other facilities. Many states use Maintenance Management Systems to plan and budget for maintenance activities, but, until recently, DOTs’ quality assurance programs were largely limited to the realm of construction.

Responding to this need, NCHRP initiated Project 14-12, “Highway Maintenance Quality Assurance,” to expand the use of QA programs in highway maintenance. The project’s goal was to create a template for an MQA program that could be implemented by any state DOT. A program like this allows agencies to make educated decisions about where to invest limited maintenance resources and to assess the benefits of investing in one type of asset over another.

The program template took the form of NCHRP Report 422: Maintenance QA Program Implementation Manual. The report lays the groundwork for developing and implementing an MQA program, including guidelines for a level-of-service (LOS) rating system and for field inspections, analysis, and reporting.

For Wisconsin DOT, NCHRP Report 422 was a key factor in the 2001 launch of the department’s ambitious maintenance quality assurance program, Compass. Tennessee DOT also put NCHRP Report 422 to use in developing its Maintenance Rating Index, including program details such as TDOT’s inspection form and the weighting factors assigned to roadway characteristics.

A unique aspect of NCHRP Project 14-12 was its aggressive approach to technology transfer. The project included funding for six workshops that brought the manual’s principles to state DOT managers and maintenance professionals across the country. The workshops helped expand awareness of the new NCHRP manual and of the MQA concept, which was in its infancy when the manual was published in 1999. By the time Wisconsin DOT and the University of Wisconsin held a Maintenance Quality Assurance Peer Exchange in 2004, participation was very strong, with staff from more than 35 agencies attending the event.

Snow and Ice Control b
Experienced snowplow drivers often hit on the right snow and ice control practices for each winter storm. But in the past, state DOTs lacked standard guidelines, based on solid research, to help field supervisors and drivers of all experience levels choose the most appropriate strategy for different locations and conditions. That changed in 2004, when NCHRP Report 526: Snow and Ice Control: Guidelines for Materials and Methods was published. The guide helps agencies choose winter maintenance strategies to meet LOS objectives and pavement condition goals for different highway types—ensuring that materials are used cost-effectively and waste is minimized.

To create the guide, investigators conducted extensive fieldwork, working with 24 agencies to evaluate five combinations of snow removal tactics and anti-icing and deicing strategies. They studied these methods over three winters to assess their effectiveness in different climate, site, and traffic conditions.

The result was a set of detailed guidelines that gave state DOTs and local agencies a scientific approach for addressing complex challenges, such as how to design a salt application rate to account for dilution caused by precipitation, traffic, and accumulated snow and ice on the road surface. The guidelines codified the experiences of field personnel across the country. The report includes a step-by-step procedure that field supervisors can use to determine the best treatment plan for various conditions.

To make the guidelines even more accessible to field personnel, AASHTO incorporated portions of NCHRP Report 526 into its computer-based training modules on snow and ice control. The benefits of the training...
continue long after the instruction is complete: Field personnel can use the software during winter weather events to compute salt application rates and design treatment plans.

a Extracted from NCHRP Impacts on Practice: Quality Assurance for the Maintenance World.
b Extracted from NCHRP Impacts on Practice: Snow and Ice Control—One Storm at a Time.
**VOICES FROM THE FIELD: OUR IMPACTS ON MAINTENANCE**

**NCHRP Report 422: Maintenance QA Program Implementation Manual**

[NCHRP Report 422] was a real stepping stone to advancing the national trend toward maintenance quality assurance.

-Alison Lebwohl

Section Chief
Wisconsin DOT
2012

**NCHRP Report 422: Maintenance QA Program Implementation Manual**

Report 422 was used in developing TDOT’s Maintenance Rating Index, including program details such as TDOT’s inspection form and the weighting factors assigned to roadway characteristics. Before TDOT developed the Maintenance Rating Index, Tennessee county supervisors evaluated roadway conditions using a traditional “windshield inspection”—rating highway segments while driving.

-Anonymous

Tennessee DOT
2007

**NCHRP Report 422: Maintenance QA Program Implementation Manual**

Report 422 was a key factor in the 2001 launch of the department’s ambitious maintenance quality assurance program, called Compass.

-Anonymous

Wisconsin DOT
2007

**NCHRP Report 511: Guide for Customer-Driven Benchmarking of Maintenance Activities**

ODOT revamped its maintenance evaluation process and put much more emphasis on outcomes. Performance across the state improved dramatically, and the results we’re measuring are observable by the public. Using performance frontiers makes a lot of sense from a DOT standpoint. In Ohio we have 88 counties, all different sizes with different mixes of resources. If we ask ourselves who’s doing the best job, it’s not necessarily the county that gets the most work done, it’s the one that gets the most work done with the resources that it has.

-Leonard Evans

Transportation Systems Administrator
Ohio DOT
2008

**NCHRP Report 526: Snow and Ice Control: Guidelines for Materials and Methods**

Core winter maintenance solutions such as anti-icing, prewetting, and Road Weather Information Systems were defined and developed through the 1980s and 1990s. But as we refined and improved our use of these approaches over time, we needed updated guidance that reflected those changes. Report 526 brought it all together.

-Paul Pisano

Team Leader, Road Weather Management
Federal Highway Administration (FHWA)
2008

**NCHRP Synthesis 426: Performance-Based Highway Maintenance and Operations Management**

This document has been utilized by the respondent as a reference and model in operational practices.

-Anonymous

2017
Investigation of the Restricted Zone in the Superpave Aggregate Gradation Specification \textsuperscript{a}

Superpave—the Superior Performing Asphalt Pavements program—initially recommended against the use of pavement aggregates that had an overabundance of fine particles, classifying these into a “restricted zone” based on aggregate size.

However, engineers at Georgia DOT were among those who thought the restricted zone seemed too limiting. When Superpave was initiated, Georgia already had high-quality pavements in place that were constructed from restricted zone aggregates. Superpave discouraged the future use of these same aggregates, along with others used by DOTs across the United States that appeared to be performing very well.

Researchers from the National Center for Asphalt Technology at Auburn University investigated Superpave’s restricted zone through NCHRP Project 09-14, and their results were published in 2001 as \textit{NCHRP Report 464: The Restricted Zone in the Superpave Aggregate Gradation Specification}.

The key performance issue turned out to be particle angularity, rather than size. Crushed pieces of Georgia granite have a sharp, angular structure, and even small pieces of aggregate can be part of strong and durable asphalt pavements. On the other hand, rounded particles—such as beach sand—remain inappropriate for pavement construction. However, Superpave already restricted small, rounded particles through its existing angularity and volumetric requirements. Therefore, this NCHRP research concluded that the restricted zone was an unnecessary and redundant component of Superpave. NCHRP Report 464 resulted in changing AASHTO’s Standard Specification for Superpave Volumetric Mix Design to remove the restricted zone, and state DOTs followed suit with local requirements.

Performance Tests for Modular Bridge Joints \textsuperscript{b}

Implemented correctly, modular bridge joint systems (MBJS) can accommodate significant expansion and contraction between bridge decks while minimizing the leaking of corrosive liquids onto the bridge beams and substructure. However, if the systems are poorly designed, specified, or installed—which sometimes happened in the past due to a lack of national specifications—they can underperform and result in costly bridge damage and premature joint replacement.

NCHRP Project 10-52 resulted in \textit{NCHRP Report 467: Performance Testing for Modular Bridge Joint Systems}, authored by researchers from the University of Minnesota. Published in 2002, this report provided performance requirements for MBJS as well as test methods and equipment for prequalification and acceptance.

The performance requirements include tests to simulate conditions that cause failures in the field, such as traffic loading and vertical push-out forces, and help eliminate problems related to poor design, component durability, and installation. NCHRP Report 467, in tandem with \textit{NCHRP Report 402: Fatigue Design of Modular Bridge Expansion Joints}, helped change AASHTO’s \textit{LRFD Bridge Design Specifications} (now in their fourth edition) and \textit{LRFD Bridge Construction Specifications} (in their second edition).

\textsuperscript{a} Extracted from NCHRP Impacts on Practice: Improving on Superpave’s Success.
\textsuperscript{b} Extracted from NCHRP Impacts on Practice: National Standards Raise the Bar for Bridge Joints.
Voices from the field: Our impacts on Materials and Construction

NCHRP Report 698: Application of Accelerated Bridge Construction Connections in Moderate-to-High Seismic Regions

Josh Sletten
Structures Design Manager
Utah DOT
2012

ABC is rapidly changing. We went from precasting elements in 2000 all the way to moving entire bridges into place by 2007. As we move into using ABC for multispan bridges, seismic design becomes much more of a concern, making NCHRP Report 698 particularly relevant to us. It will be the baseline for additional research here in Utah.

Jugesh Kapur
State Bridge and Structures Engineer
Washington State DOT
2012

Every little bit of these NCHRP studies guides us and helps us take additional steps with new ABC implementation in our highly seismic region. The more research that is done—whether NCHRP research or our own state research to address specific concerns—the more confidence we have in using precast elements.

NCHRP Report 714: Special Mixture Design Considerations and Methods for Warm-Mix Asphalt

Results were implemented immediately at the conclusion of this NCHRP study. Small improvements and updates have been made periodically since then. A very large portion of our bituminous mixtures in Minnesota are now warm mix, almost all by plant foaming technology. However, temperature is typically reduced only 5-10 deg F from traditional hot mix. Contractors chose to do this because of increased reliability in obtaining density requirements. Mix design guidelines (via our construction specifications) have been updated based on this study.

Timothy R. Clyne
Minneapolis DOT
2017


The agency recycled 200,000 tons of asphalt per year. But it doesn’t need to stop there. The NCHRP research demonstrates that we can maintain quality while putting even more recycled material under our feet. Using the information provided by NCHRP, we are looking at adding 5 to 10 percent greater RAP content to our base, binder, and wearing courses. New techniques like cold-in-place recycling and warm-mix additives will allow even more widespread use of RAP and higher percentages of RAP in mixes.

Chris Abadie
Materials Research Administrator
Louisiana DOTD
2010

The agency went from using no RAP in 2003 to recycling nearly half a million tons of asphalt in 2009. When we developed our state RAP specification, we drew on this report as a key resource. The report not only gave us assurances that RAP would work, but it also provided guidance on what amounts to use.

Joe Schroer
Field Materials Engineer
Missouri DOT
2010

NCHRP Report 724: Application of LADAR in the Analysis of Aggregate Characteristics

Research results from Report 724 were used in a recently completed Virginia Department of Transportation Research Project entitled Influence of aggregate morphology and grading on the performance of 9.5-mm SMA mixtures.

Hari Nair
Virginia Transportation Research Council (VTRC)
2018
The agency recycles 200,000 tons of asphalt per year. But it doesn’t need to stop there. The NCHRP research demonstrates that we can maintain quality while putting even more recycled material under our feet. Using the information provided by NCHRP, we are looking at adding 5 to 10 percent greater RAP content to our base, binder, and wearing courses. New techniques like cold in-place recycling and warm-mix additives will allow even more widespread use of RAP and higher percentages of RAP in mixes.

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Joe Schroer
Field Materials Engineer
Missouri DOT
2010

The report helped us verify that the application rates we specify on projects are valid. We are going to consider evaluating/implementing some of the test procedures described in the report.

Mark Woods
Tennessee DOT
2018

I have developed a NAPA publication which synthesizes the information for users.

Dale S. Decker
Dale S Decker, LLC
2018

Utilized the survey work to show to industry that other states require calibrations of distributor trucks. We (Materials and Construction) have passed this document out to all of our Areas for their information. Planning on potentially using a presentation made at SEAPUG last year at our Construction Materials Conference coming up this September.

Lyndi Blackburn
Alabama DOT
2018
NCHRP Report 712: Optimization of Tack Coat for HMA Placement

Being used to modify contract specifications for upcoming projects to update best practices.

Anonymous
2017

NCHRP Report 712: Optimization of Tack Coat for HMA Placement

This is a highly successful project resulting in nationwide Asphalt Institute training in all states. It brought the awareness of importance of tack coat within Arizona Department of Transportation. This will be the continuous practice on all paving and overlays projects. The failure of the pavement overlays slipping have been identified due to lack of tack coat. The inspectors are advised to pay close attention on tack coat rate and application. NCHRP Project 09-40A: Field Evaluation of the Louisiana Interlayer Shear Strength Tester, will further validate the effect of tack coat application and provide a means of testing the tack coat.

Anonymous
2017

NCHRP Report 712: Optimization of Tack Coat for HMA Placement

Too many state highway department, county highway department, and contractor personnel around the country to name individually. I travel around the country regularly, teaching seminars and looking at construction projects, both current and past. Getting personnel to apply the tack coat materials uniformly is a key factor. Getting personnel to not run over the tack coat and pick it up before it has set is another very key factor. People generally do not construction roadways incorrectly on purpose. They build failures because they do not understand the best way to construct the pavement, including placement of the tack coat material.

James A. Scherocman
2017

NCHRP Report 714: Special Mixture Design Considerations and Methods for Warm-Mix Asphalt

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Timothy R. Clyne
Minnesota DOT
2017

NCHRP Report 714: Special Mixture Design Considerations and Methods for Warm-Mix Asphalt

MnDOT did utilize Report 714 to develop specification framework for the permissive use of WMA in Minnesota.

John Garrity
Minnesota DOT
2018

NCHRP Report 714: Special Mixture Design Considerations and Methods for Warm-Mix Asphalt

Results from the research allowed the Indiana DoT to finalize specifications regarding design of WMA. In effect, the idea of designing HMA and using WMA (foaming) in place of HMA was confirmed. As a result, INDOT does not differentiate between HMA and WMA.

Gerald Huber
Heritage Research Group
2017

NCHRP Report 714: Special Mixture Design Considerations and Methods for Warm-Mix Asphalt

AASHTO R 35 was modified to include information from this report as an appendix.

Anonymous
2017
NCHRP Report 714: Special Mixture Design Considerations and Methods for Warm-Mix Asphalt
Arizona DOT already had a specification for Warm-Mix Asphalt. It validated the spec.

Anonymous 2017

NCHRP Report 714: Special Mixture Design Considerations and Methods for Warm-Mix Asphalt
Report 714 is a very good reference. TxDOT has utilized Warm-Mix Asphalt for many years with excellent results. TxDOT has established and developed design procedure few years earlier than those outlined in Report 714.

Anonymous 2018

NCHRP Report 719: Calibration of Rutting Models for Structural and Mix Design
CDOT used this information to locally calibrate our PMED software for three types of HMA used in Colorado.

Jay Goldbaum Colorado DOT 2018

NCHRP Report 719: Calibration of Rutting Models for Structural and Mix Design
Pennsylvania Department of Transportation is using the rutting models from this work in their calibration of the AASHTOWare Pavement ME. I believe the models have been implemented in AASHTOWare Pavement ME and are available to agencies using this design software.

Anonymous 2017

NCHRP Report 698: Application of Accelerated Bridge Construction Connections in Moderate-to-High Seismic Regions
ABC is rapidly changing. We went from precasting elements in 2000 all the way to moving entire bridges into place by 2007. As we move into using ABC for multispan bridges, seismic design becomes much more of a concern, making NCHRP Report 698 particularly relevant to us. It will be the baseline for additional research here in Utah.

Josh Sletten Structures Design Manager Utah DOT 2012

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Every little bit of these NCHRP studies guides us and helps us take additional steps with new ABC implementation in our highly seismic region. The more research that is done—whether NCHRP research or our own state research to address specific concerns—the more confidence we have in using precast elements.

Jugesh Kapur State Bridge And Structures Engineer Washington State DOT 2012

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Research Results from Report 724 was used in a recently completed Virginia Department of Transportation Research Project entitled Influence of aggregate morphology and grading on the performance of 9.5-mm SMA mixtures.

Hari Nair Virginia Transportation Research Council (VTRC) 2018
NCHRP Synthesis 430: Cost-Effective and Sustainable Road Slope Stabilization and Erosion Control

Positive outcomes are: Maintenance can focus time elsewhere, fewer shoulder closures, compliance with Storm water regulations, less time maintenance forces are on the roadside. Compared to a concrete wall or slope coverage the cost is potentially huge saving.

Joseph Arnold
Caltrans
2017

NCHRP Synthesis 430: Cost-Effective and Sustainable Road Slope Stabilization and Erosion Control

We have steep slopes around the Lake Tahoe area. We terraced the slopes and hydroseeded with native plants. Re-vegetation in some areas included the use of Rip rap along with hydroseeding. We have also incorporated check dams with the use of staircased wooden stakes with vegetation where stream velocities were reduced to mitigate erosion and sediment transport.

Rupali Mohansingh
Nevada DOT
2018

NCHRP Synthesis 428: Practices and Procedures for Site-Specific Evaluations of Earthquake Ground Motions

I used the results to develop a research proposal that was accepted and resulted in NCHRP Project 12-114: Benchmarking Study of Software for One-Dimensional, Nonlinear Seismic Site Response Analysis with Pore Water Pressure Generation. Some members of the TRB Geo-Seismic Sub-Committee used the publication with me when we developed the research proposal that resulted in NCHRP Project 12-114.

Justice J.G. Maswoswe
Federal Highway Administration (FHWA)
2018

NCHRP Synthesis 430: Cost-Effective and Sustainable Road Slope Stabilization and Erosion Control

Improved geotechnical design of soil slopes in construction and maintenance projects, development of on-call slope repair contracts, use of innovative methods such as soil nails, RSS and GRS, good resource for communicating with maintenance personnel. VDOT already incorporates some of the technologies cited in the synthesis - soil nails, retaining walls, reinforced soil slopes, GRS, flattened slopes, etc.

Chaz Weaver
Virginia DOT
2017

NCHRP Report 717: Scour at Bridge Foundations on Rock

Results of research report 717 were incorporated in 2012 into the latest edition of FHWA’s guidance document, Hydraulic Engineering Circular No. 18. The research provides guidance and helps to remove uncertainty regarding the design of bridge foundations (i.e., piers and abutments) in locations where there is weak rock that is subject to erosion during floods.

Paul E. Clopper
Ayres Associates, Inc., Colorado
2017

Elmer Marx
Alaska DOT and Public Facilities
2017

Additional research has resulted from the synthesis and has recently been selected for advancement by AASHTO SCOBS.
NCHRP Report 717: Scour at Bridge Foundations on Rock

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Elmer Marx
Alaska DOT and Public Facilities
2017

NCHRP Synthesis 430: Cost-Effective and Sustainable Road Slope Stabilization and Erosion Control

Locations around Lake Tahoe (rocky slope) was stabilized using constructed terraces and used native plants for re-vegetation to avoid further erosion.

Anonymous
2017

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Caltrans
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Justice J.G. Maswoswe
Federal Highway Administration (FHWA)
2018
personnel. VDOT already incorporates some of the technologies cited in the synthesis - soil nails, retaining walls, reinforced soil slopes, GRS, flattened slopes, etc.

Chaz Weaver 
Virginia DOT 
2017

NCHRP Synthesis 430: Cost-Effective and Sustainable Road Slope Stabilization and Erosion Control
We added some of the information into our workshops and sessions related to slopes and erosion.

David P. Orr 
Cornell University 
2018

NCHRP Synthesis 430: Cost-Effective and Sustainable Road Slope Stabilization and Erosion Control
EFLHD mostly deals with low volume roads and in general the research has validated current practice for slope stabilization using cost effective methods including reinforced soil slopes, deep patch embankment repair. The publication is also a great toolbox and source of training for engineers with no or moderate experience in the field. It’s well organized, provides good information and additional resources for further information.

Anonymous 
2017

NCHRP Synthesis 430: Cost-Effective and Sustainable Road Slope Stabilization and Erosion Control
Reinforces good practices already practicing. Give confidence to staff that good practices are noticed and have payoffs to contractor and state. Had a contractor grading/excavation foreman on a project who was very pro these ideas and practices as a time saving and company savings cost practice.

Anonymous 
2017
Delivering a safe transportation system is a universal goal among state DOTs. NCHRP was the driving force behind AASHTO’s *Highway Safety Manual (HSM)*, which provides states with a modern, science-based approach to safety management, analysis, planning, and delivery.

NCHRP has been involved at every stage of the *Highway Safety Manual*’s development, including the core research underlying its methods (NCHRP Projects 17-18(4), 17-26, 17-27, 17-29, and 17-34); the production of the manual (NCHRP Project 17-36); and the creation of implementation and training tools (NCHRP Project 17-38). The latest effort, now ongoing, is a project to facilitate implementation of the HSM among 13 lead states (NCHRP Project 17-50). State DOT staff involved in this effort shared how their agencies are employing the HSM’s methods and provided their perspectives on this major undertaking.

**Roundabouts**

Roundabouts have seen unprecedented growth across the United States, from just a handful a decade ago to more than 2,000 and counting. National guidance had to keep pace with the needs of states and communities planning and implementing roundabouts, and NCHRP took a lead role.

As a first step, NCHRP undertook Project 3-65, which led to *NCHRP Report 572: Roundabouts in the United States*, published in 2007. This research established an inventory of roundabouts in the United States with a database of geometric, operational, and safety information. Researchers then developed models for predicting operational and safety benefits.

These models help agencies quantify the projected benefits of roundabouts over traditional intersections. A study of 55 intersections converted to roundabouts revealed an average reduction in crashes by 35 percent and 76 percent fewer severe injuries.

Roundabouts also typically experience significantly less delay than signalized intersections with similar traffic volumes. NCHRP Report 572 has had a direct impact on key national guidance documents, with results incorporated into AASHTO’s *Highway Safety Manual* and TRB’s *Highway Capacity Manual*.


**Highway Capacity Manual**

The many factors that help decide whether and how to add highway capacity represent a long-standing and evolving challenge. TRB has helped transportation agencies address this issue since first publishing its *Highway Capacity Manual* in 1950. NCHRP research has supported supplements and the four editions that followed.

The *Highway Capacity Manual* is one of the three essential highway guides, along with FHWA’s *Manual on Uniform Traffic Control Devices* and AASHTO’s ‘Green Book’—*A Policy on Geometric Design of Highways and Streets*.
**Voices from the field: Our impacts on Traffic Sign Displays**

NCHRP Report 493: Evaluation of Traffic Signal Displays for Protected/Permissive Left-Turn Control

For us, NCHRP 493 was a catalyst that helped us actually change our policies and standards regarding our left-turn signal display. We've converted more than 30 displays to the flashing yellow arrow and have seen a considerable reduction in left-turn crashes.

Ed Fischer
State Traffic Engineer
Oregon DOT
2008


Design of anchor bolt connections to concrete is not well covered by the current AASHTO code, so we have experimented with the design provisions in Report 494 for these connections. We use Report 494 to help us stay up to speed with future changes that may be coming in the code. It lets us plan ahead by researching how potential developments in the future might affect us.

Stan Johnson
Senior Technical Specialist, Signs and Overhead Structures
Caltrans
2008

NCHRP Report 476: Guidelines for Design and Operation of Nighttime Traffic Control for Highway Maintenance and Construction

CDOT added night work zone guidance and diagrams from Report 476 to its work zone safety flipbook, which CDOT provides to its contractors. It kept us from having to start from scratch, and it allowed us to put something out there that has been tried in several states.

K.C. Matthews
Traffic Specifications and Standards Engineer
Colorado DOT
2007


Report 350 was really a watershed document. I don't think we can overstate its significance in improving the performance of our safety devices. As manufacturers sought to get their devices in compliance with Report 350, they implemented innovations that drove a lot of innovation.

David Little
Assistant District Engineer
Iowa DOT
2008

Highway Capacity Manual

The Highway Capacity Manual is invaluable for planning. It provides the data required for the careful balancing of costs and impacts in the planning and design of transportation infrastructure. The manual provides the level of service for a given project in simple terms graded A through F. Those are terms that policymakers and members of the public can understand, and they facilitate policy making, discussions, and decisions.

Dirk Gross
Administrator, Office of Roadway Engineering
Ohio DOT
2011

Highway Safety Manual

By providing a numerical 'star' rating of the impact of different cash mitigation treatments, the HSM gives us confidence that our choices are statistically valid. That's the real strength of the manual. In times of tight budgets, the HSM allows us to spend our safety dollars wisely and use techniques that will provide the best safety benefits.

Darryl Belz
Safety & Scoping Unit Manager
Maine DOT
2012

NCHRP Synthesis 431: Practices to Manage Traffic Sign Retroreflectivity

As a user of syntheses for many decades, I am a believer in their value for roadway professionals. This one has particular value because it contains so much information that local governments (towns, cities and counties) can use. Often what is published in the roadway field is aimed at state DOT's and large cities, both of which have significant resources, so it is good to have a resource that smaller local governments, with small staffs and limited budgets, find relevant and can use in their day-to-day work. It is important that TRB continue to support these types of efforts.

Ronald W. Eck
West Virginia University
2018

Highway Capacity Manual

Here in Florida, it's the authoritative document for addressing highway capacity, quality of service, and level of service. The manual’s methodologies are the way to evaluate the adequacy of existing and planned roadways to meet the public's needs. Agencies like our state land planning agency and local governments rely on this document. This is critical because planning always has the potential to be controversial. By recognizing the Highway Capacity Manual in Florida, we are able to point to a national, authoritative document to help us justify decisions. It helps ensure that everyone involved in a project or decision plays by the same rules and uses the same tools.

Doug McLeod
Florida DOT
2011

**NCHRP IMPACT REPORT 2018**

**Synthesis**

**Report 431: Practices to Manage Traffic Sign Retroreflectivity**

**Report 731: Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections**


**Report 476: Guidelines for Design and Operation of Nighttime Traffic Control for Highway Maintenance and Construction**

**Report 493: Evaluation of Traffic Signal Displays for Protected/Permissive Left-Turn Control**
Highway Capacity Manual

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Dirk Gross
Administrator, Office of Roadway Engineering
Ohio DOT
2011

Highway Capacity Manual

Emerging technologies and issues make ongoing research and updates to the manual critical. Caltrans looks forward to employing the new tools and methods in the [updated] Highway Capacity Manual to address congestion and improve the movement of travelers and goods. The essential and compelling impact of addressing capacity is an improvement in quality of service and a reduction in delay. Those in turn lead to a wide range of economic and safety benefits. The ongoing research investment in capacity is well worth it.

Kevin Hanley
AASHTO Coordinator
Caltrans
2011

Highway Safety Manual

By providing a numerical ‘star’ rating of the impact of different crash mitigation treatments, the HSM gives us confidence that our choices are statistically valid. That’s the real strength of the manual. In times of tight budgets, the HSM allows us to spend our safety dollars wisely and use techniques that will provide the best safety benefits.

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Doug McLeod
Florida DOT
2011

Highway Safety Manual

We have had the opportunity to share Florida’s experiences piloting the HSM’s design exception methods and other tools. In the process, we have gained a great deal in return by dialoguing about approaches that other states are taking. The HSM methodologies are very involved and data-intensive, and ongoing NCHRP efforts help states capitalize on the training and good work that others are doing.

Joe Santos
Traffic Safety Engineer
Florida DOT
2012
complements our own analytical tools. We have incorporated parts of the HSM into our processes, including the predictive methods outlined in Part C and the crash modification factors in Part D. For example, we have identified locations that are either underperforming or exceeding expectations and applied benefit-cost analysis and the crash frequency assessment tools presented in the manual. The HSM helps us look at safety design alternatives and exceptions and quantify their impacts.

Priscilla Tobias
Chief, Safety Engineering Bureau
Illinois DOT
2012

Highway Safety Manual
The HSM provides analytical tools on par with established methods for other areas of highway management, such as capacity, the environment, and asset management. Here in Virginia we are taking the steps for safety planning described in the manual by building our own models and using AASHTO’s SafetyAnalyst software, which helps implement the best practices spelled out in Part B of the HSM.

Stephen Read
Highway Safety Improvement Program Manager
Virginia DOT
2012

Report 350 was really a watershed document. I don’t think we can overstate its significance in improving the performance of our safety devices. As manufacturers sought to get their devices in compliance with Report 350, the implementation became the force that drove a lot of innovation.

David Little
Assistant District Engineer
Iowa DOT
2008

NCHRP Report 350 is widely known throughout the whole DOT. Everybody is either looking for something that will meet the Report 350 testing requirements, or developing things and having them tested to those requirements.

Rory Meza
Director, Roadway Design Section
Texas DOT
2008

NCHRP Report 476: Guidelines for Design and Operation of Nighttime Traffic Control for Highway Maintenance and Construction
CDOT added night work zone guidance and diagrams from Report 476 to its work zone safety flipbook, which CDOT provides to its contractors. It kept us from having to start from scratch, and it allowed us to put something out there that has been tried in several states.

K.C. Matthews
Traffic Specifications And Standards Engineer
Colorado DOT
2007

NCHRP Report 493: Evaluation of Traffic Signal Displays for Protected/Permissive Left-Turn Control
We found that the flashing yellow arrow made significant improvements to left-turn safety compared with the circular green signal. We now know that we’ve found the solution to the permissive left-turn problem that we’re having across the country.

David Noyce
University of Wisconsin–Madison
2008

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Stan Johnson  
Senior Technical Specialist, Signs And Overhead Structures  
Caltrans  
2008

In the DFW region we use the principles outlined in 694 as reference for all ongoing managed lane activities.

Daniel Lamers  
North Central Texas Council of Governments  
2017

NHDOT used Report 707 to compute the recommended length of ATLs and to evaluate existing installations.

Michael Dugas  
New Hampshire DOT  
2018

Gave multiple workshops to staff. Used example problems to better explain how agency-specific safety evaluations can be performed. Taught a high-level transportation safety course at the university.

Anonymous  
2018

The information helps us evaluate and determining funding options for various safety project applications.

Anonymous  
2017

Over the years we have seen the materials contribute to decision making in many State and local agencies at the project and program levels. For example, several states are adopting the Intersection Control Evaluation approach/policy that relies on HSM and other training materials to be properly implemented. CA, GA and FL come to mind as states pursuing this approach.

Patrick Hasson  
Federal Highway Administration (FHWA)  
2017

Learning how to use the Highway Safety Manual through the training materials is making it possible for DOTs, consultants and researchers to explore new concepts such as Performance Based Practical Design, which merges together operational and safety consequences in the alternative phases of design and makes it possible to select the most cost-effective solution considering both operations and design. We are training our traffic engineers, planners and designers on the use of the Highway Safety Manual to better account for safety at every stage of design, and especially in performing safety studies and the evolving concepts of Performance Based Practical Design.

Larry F. Sutherland  
Parsons Brinckerhoff, Inc.  
2017

It was the basis for Highway Safety Manual training delivered across more than 20 states in the US, is the basis for training in colleges (undergraduate and graduate level), and also served as a starting point for customized training for WSDOT. The spreadsheets that were developed as part of the training is the tool used nationally to perform the HSM predictive analysis. WSDOT, ALDOT and IDOT customized the spreadsheets but could not have afforded to develop this tool if it wasn’t developed as part of this project. While other tools exist, these spreadsheets remain the preferred tool in the field.

Ida van Schalkwyk
Washington State DOT
2017

NCHRP Report 716: Travel Demand Forecasting: Parameters and Techniques

During the last 2 years, we have used NCHRP 716 as a basis for our new travel demand model standardization project. We have developed a standardized model structure for the DOT and Iowa’s 9 metropolitan planning organizations.

Anonymous
2017

NCHRP Report 716: Travel Demand Forecasting: Parameters and Techniques

I think the core merit of such an NCHRP document is the opportunity it opens for MPOs (and other agencies, plus forecasting consultants) who are contemplating updates to existing multimodal travel models to "take a good look" at how what has been done compares to some of the information contained in this report.

Ken Cervenka
2018


Minnesota has long considered the opportunities for congestion pricing and tolling in Minnesota. The report helped to set the context for pricing and put a foundation under the reasons for doing each. Congestion pricing in the form of MnPASS Express Lanes are now a well-accepted regional strategy for managing congestion in Minneapolis-St. Paul.

Kenneth R. Buckeye
Minnesota DOT
2018

NCHRP Report 722 v2: Assessing Highway Tolling and Pricing Options and Impacts: Travel Demand Forecasting Tools

Many MPOs adopted advanced modeling methods described in the report. Travel models developed for SANDAG, SCAG, MORPC, OKI, CMAP, NYMTC, ARC, MAG and others included some features substantiated in this report.

Peter Vovsha
Parsons Brinckerhoff, Inc.
2017

Jerry D. Everett
University of Tennessee
2018

This publication was used by management to assess the benefits and risks of working at night rather during the day. The results help form a framework of policy changes between the DOT and local agencies responsible for noise permits.

Anonymous
2017

NCHRP Report 729: Automated Enforcement for Speeding and Red Light Running

This publication was used to start a new public education campaign using cameras to identify and educate specific drivers. Currently State Law does not allow ticketing of these drivers with the use of automated systems.

Anonymous
2017

NCHRP Report 731: Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections

I have presented this information to our regional staff. We are working to update our policy to match the outcome of this study. In the meantime a few regions have already begun using it as their standard as it was close to their current practice and provided further guidance on how to handle left turns.

Joanna L. Bush
Wisconsin DOT
2017

NCHRP Synthesis 431: Practices to Manage Traffic Sign Retroreflectivity

Mainly through the Local Technical Assistance Program (LTAP) network I train local and state roadway and public works officials in roadway safety generally and traffic sign retroreflectivity in particular. I include Synthesis 431 as one of the resources in my course materials and talk about it containing good case studies that locals can use as they develop their own assessment and management approaches. In the presentation, I highlight some of the approaches noted in 431. As a user of syntheses for many decades, I am a believer in their value for roadway professionals. This one has particular value because it contains so much information that local governments (towns, cities and counties) can use. Often what is published in the roadway field is aimed at state DOT’s and large cities, both of which have significant resources, so it is good to have a resource that smaller local governments, with small staffs and limited budgets, find relevant and can use in their day-to-day work. It is important that TRB continue to support these types of efforts.

Ronald W. Eck
West Virginia University
2018
VOICES FROM THE FIELD: OUR IMPACTS ON TRANSPORTATION PLANNING

Increased knowledge and understanding of practice, optimizing decision making.
John Milton
Washington State DOT
2017

Methodology has been used in advancing asset management analysis techniques.
William Johnson
Colorado DOT
2017

Methodology has been used in advancing asset management analysis techniques.
William Johnson
Colorado DOT
2017

NCHRP Report 720: Estimating the Effects of Pavement Condition on Vehicle Operating Costs
For writing or evaluating performance-based specifications, I have borrowed some of the methods and findings from Report 720 when estimating the road user cost impact of surface quality.
James Selywn Gillespie
Virginia DOT
2017

NCHRP Series 25-25: Research for the AASHTO Committee on Environment and Sustainability
William Hauser
Administrator, Office Of Stewardship And Compliance
New Hampshire DOT
2012

NCHRP Series 25-25: Research for the AASHTO Committee on Environment and Sustainability
This program affords individual agencies the opportunity to raise local environmental issues and have them assessed impartially on a national level. These guidelines help states make environmentally conscious and cost-effective decisions.
Tim Hill
Administrator, Office Of Environmental Services
Ohio DOT
2010
NCHRP Series 25-25: Research for the AASHTO Committee on Environment and Sustainability

Series 25-25 research allows us on an annual basis to look at dynamic and emerging issues with confidence that we’ll get information we can act upon quickly. This research effectively addressed the pressing need for immediate access to climate change policies and practices at the state and federal level. This one-stop resource helps guide decisions on climate change throughout our entire agency.

Mia Waters
Washington State DOT
2010


The information helped verify and expand the benefit cost analysis of proposed safety projects for our program.

Anonymous
2017


The work included here provided the basis for approval of NCHRP 07-22 for production of the Planning and Preliminary Engineering Applications Guide. The procedures in the guide will have lasting value for use in multimodal transportation analysis.

Robert W. Bryson
City of Milwaukee Department of Public Works
2017


The Highway Capacity and Quality of Service Committee has used information from Synthesis 427 to develop the Planning and Preliminary Engineering Application Guide. This guide has been published recently and it will soon be incorporated into state agency guidance in Oregon.

Anonymous
2017

NCHRP Synthesis 434: Use of the U.S. Census Bureau’s Public Use Microdata Sample (PUMS) by State Departments of Transportation and Metropolitan Planning Organizations

This report was used to inform the CTPP Oversight Board on the use of PUMS. The CTPP program is a multi-million dollar effort of the state DOTs to provide census data for transportation planning purposes. I also use the report in a course I teach to MPO and state planners.

Ed J. Christopher
2018
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APPENDIX A: LIST OF NCHRP RESEARCH PRODUCTS REFERENCED BY AASHTO “SWEET SIXTEEN” PROJECTS SINCE 2013

- NCHRP Web-Only Document 30: Recommended Use of Reclaimed Asphalt Pavement in the Superpave Mix Design Method
- NCHRP Project 20-07/Task 305: Analysis of New Highway Lighting Technologies
- NCHRP Project 14-26: Culvert and Storm Drain System Inspection Manual
- NCHRP IDEA Report 121: Use of Image Pattern Recognition Algorithms for Processing Video Log to Enhance Roadway Infrastructure Data Collection
- NCHRP Pre-publication Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments
- NCHRP Project 08-69: Supplement to the AASHTO Transportation Asset Management Guide: Volume 2 - A Focus on Implementation
- NCHRP Project 15-44: Guidelines for the Use of Mobile LIDAR in Transportation Applications
- NCHRP Project 08-88: Effective Project Scoping Practices to Improve On-Time and On-Budget Delivery of Highway Projects
- NCHRP Project 09-40: Optimization of Tack Coat for HMA Placement
- NCHRP Project 20-07/task 172: Recommended AASHTO Design-Build Procurement Guide
- NCHRP Report 504: Design Speed, Operating Speed, and Posted Speed Practices
- NCHRP Report 164: Fatigue Strength Of High-Yield Reinforcing Bars
- NCHRP Report 198: State Laws And Regulations On Truck Size And Weight
- NCHRP Report 375: Median Intersection Design
- NCHRP Report 380: Transverse Cracking In Newly Constructed Bridge Decks
- NCHRP Report 405: Aggregate Tests Related To Asphalt Concrete Performance In Pavements
- NCHRP Report 439: Superelevation Distribution Methods And Transition Designs
- NCHRP Report 441: Segregation In Hot-Mix Asphalt Pavements
- NCHRP Report 459: Characterization Of Modified Asphalt Binders In Superpave Mix Design
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<td>Guidelines For Design And Operation Of Nighttime Traffic Control For Highway Maintenance And Construction</td>
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<td>Simple Performance Tester For Superpave Mix Design: First-Article Development And Evaluation</td>
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<td>Optimal Timing Of Pavement Preventive Maintenance Treatment Applications</td>
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<td>Costing Asset Protection: An All-Hazards Guide for Transportation Agencies (CAPTA)</td>
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<td>Relationship Of Air Voids, Lift Thickness, And Permeability In Hot Mix Asphalt Pavements</td>
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<td>Design and Construction Guidelines for Geosynthetic-Reinforced Soil Bridge Abutments with a Flexible Facing</td>
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<td>Manual on Service Life of Corrosion-Damaged Reinforced Concrete Bridge Superstructure Elements</td>
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<td>Transfer, Development, and Splice Length for Strand/Reinforcement in High-Strength Concrete</td>
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<td>Communication Matters: Communicating the Value of Transportation Research Guidebook</td>
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<td>Recommended Design Specifications for Live Load Distribution to Buried Structures</td>
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- NCHRP Report 650: Median Intersection Design for Rural High-Speed Divided Highways
- NCHRP Report 658: Guidebook on Risk Analysis Tools and Management Practices to Control Transportation Project Costs
- NCHRP Report 680: Manual for Emulsion-Based Chip Seals for Pavement Preservation
- NCHRP Report 684: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments
- NCHRP Report 691: Mix Design Practices for Warm Mix Asphalt
- NCHRP Report 706: Uses of Risk Management and Data Management to Support Target-Setting for Performance-Based Resource Allocation by Transportation Agencies
- NCHRP Report 709: Investigation of Short-Term Laboratory Aging of Neat and Modified Asphalt Binders
- NCHRP Report 712: Optimization of Tack Coat for HMA Placement
- NCHRP Report 713 v1: Methodology for Estimating Life Expectancies of Highway Assets
- NCHRP Report 758: Trip Generation Rates for Transportation Impact Analyses of Infill Developments
- NCHRP Report 83: Distribution Of Wheel Loads On Highway Bridges
- NCHRP Report 843: Long-Term Field Performance of Warm Mix Asphalt Technologies
- NCHRP Report 871: Long-Term Aging of Asphalt Mixtures for Performance Testing and Prediction
- NCHRP Project 17-45: Enhanced Safety Prediction Methodology and Analysis Tool for Freeways and Interchanges
- NCHRP RRD 339: Improving the Safety of Mobile Lane Closures
- NCHRP Synthesis of Highway Practice 301: Collecting, Processing, And Integrating GPS Data Into GIS
- NCHRP Synthesis of Highway Practice 333: Concrete Bridge Deck Performance
- NCHRP Synthesis of Highway Practice 339: Centerline Rumble Strips
- NCHRP Synthesis of Highway Practice 367: Technologies for Improving Safety Data
- NCHRP Synthesis of Highway Practice 371: Managing Selected Transportation Assets: Signals, Lighting, Signs, Pavement Markings, Culverts, and Sidewalks
- NCHRP Synthesis of Highway Practice 430: Cost-Effective and Sustainable Road Slope Stabilization and Erosion Control
- NCHRP Synthesis of Highway Practice 439: Use of Transportation Asset Management Principles in State Highway Agencies
- NCHRP Synthesis of Highway Practice 441: High Performance Concrete Specifications and Practices for Bridges
- NCHRP Synthesis of Highway Practice 122: Life-Cycle Cost Analysis Of Pavements
• NCHRP Synthesis of Highway Practice 143: Uniformity Efforts In Oversize/Overweight Permits
• NCHRP Synthesis of Highway Practice 204: Portland Cement Concrete Resurfacing
• NCHRP Synthesis of Highway Practice 255: Ground Penetrating Radar For Evaluating Subsurface Conditions For Transportation Facilities
• NCHRP Synthesis of Highway Practice 291: Evaluation Of Pavement Friction Characteristics
• NCHRP Synthesis of Highway Practice 303: Assessment And Rehabilitation Of Existing Culverts
• NCHRP Synthesis of Highway Practice 317: Dealing With Truck Parking Demands
• NCHRP Synthesis of Highway Practice 333: Concrete Bridge Deck Performance
• NCHRP Synthesis of Highway Practice 342: Chip Seal Best Practices
• NCHRP Synthesis of Highway Practice 359: Bridge Rating Practices and Policies for Overweight Vehicles
• NCHRP Synthesis of Highway Practice 378: State Highway Cost Allocation Studies
• NCHRP Synthesis of Highway Practice 395: Debt Finance Practices for Surface Transportation
• NCHRP Synthesis of Highway Practice 397: Bridge Management Systems for Transportation Agency Decision Making
• NCHRP Synthesis of Highway Practice 398: Cathodic Protection for Life Extension of Existing Reinforced Concrete Bridge Elements
• NCHRP Synthesis of Highway Practice 421: Recycling and Reclamation of Asphalt Pavements Using In-Place Methods
• NCHRP Synthesis of Highway Practice 441: High Performance Concrete Specifications and Practices for Bridges
• NCHRP Synthesis of Highway Practice 500: Control of Concrete Cracking in Bridges
• NCHRP Synthesis of Highway Practice 223: Cost-Effective Preventive Pavement Maintenance
• NCHRP Web-Only Document 102: Future Financing Options to Meet Highway and Transit Needs
APPENDIX B: LIST OF NCHRP PUBLICATIONS PRODUCED IN 2012

- NCHRP Report 712: Optimization of Tack Coat for HMA Placement
- NCHRP Report 714: Special Mixture Design Considerations and Methods for Warm-Mix Asphalt
- NCHRP Report 719: Calibration of Rutting Models for Structural and Mix Design
- NCHRP Report 721: Fatigue Evaluation of Steel Bridges
- NCHRP Report 725: Guidelines for Analysis Methods and Construction Engineering of Curved and Skewed Steel Girder Bridges
- NCHRP Report 710: Practical Approaches for Involving Traditionally Underserved Populations in Transportation Decision-making
- NCHRP Report 716: Travel Demand Forecasting: Parameters and Techniques
- NCHRP Report 722 v2: Assessing Highway Tolling and Pricing Options and Impacts: Travel Demand Forecasting Tools
- NCHRP Report 723: A Model for Identifying and Evaluating the Historic Significance of Post-World War II Housing
- NCHRP Report 730: Design Guidance for Freeway Mainline Ramp Terminals
- NCHRP Report 734: Hydraulic Loss Coefficients for Culverts
- NCHRP Report 737: Design Guidance for High-Speed to Low-Speed Transitions Zones for Rural Highways
- NCHRP Report 724: Application of LADAR in the Analysis of Aggregate Characteristics
- NCHRP Report 728: Guidelines for Evaluating and Selecting Modifications to Existing Roadway Drainage Infrastructure to Improve Water Quality in Ultra-Urban Areas
- NCHRP Report 717: Scour at Bridge Foundations on Rock
- NCHRP Report 707: Guidelines on the Use of Auxiliary Through Lanes at Signalized Intersections
- NCHRP Report 729: Automated Enforcement for Speeding and Red Light Running
- NCHRP Report 731: Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections
- NCHRP Report 720: Estimating the Effects of Pavement Condition on Vehicle Operating Costs
NCHRP Legal Research Digest 56: The Ramifications of Post-Kelo Legislation on State Transportation Projects
NCHRP Legal Research Digest 57: Tort Liability Defense Practices for Design Flexibility
NCHRP Report 693: Attracting, Recruiting, and Retaining Skilled Staff for Transportation System Operations and Management
NCHRP Report 727: Effective Experiment Design and Data Analysis in Transportation Research
NCHRP Report 732: Methodologies to Estimate the Economic Impacts of Disruptions to the Goods Movement System
NCHRP Synthesis 423: Long-Term Performance of Polymer Concrete for Bridge Decks
NCHRP Synthesis 425: Waterproofing Membranes for Concrete Bridge Decks
NCHRP Synthesis 426: Performance-Based Highway Maintenance and Operations Management
NCHRP Synthesis 428: Practices and Procedures for Site-Specific Evaluations of Earthquake Ground Motions
NCHRP Synthesis 429: Geotechnical Information Practices in Design-Build Projects
NCHRP Synthesis 430: Cost-Effective and Sustainable Road Slope Stabilization and Erosion Control
NCHRP Synthesis 431: Practices to Manage Traffic Sign Retroreflectivity
NCHRP Synthesis 432: Recent Roadway Geometric Design Research for Improved Safety and Operations
NCHRP Synthesis 433: Significant Findings from Full-Scale Accelerated Pavement Testing
NCHRP Synthesis 434: Use of the U.S. Census Bureau's Public Use Microdata Sample (PUMS) by State Departments of Transportation and Metropolitan Planning Organizations
NCHRP Synthesis 436: Local Policies and Practices That Support Safe Pedestrian Environments
NCHRP Synthesis 437: Assessing the Long-Term Performance of Mechanically Stabilized Earth Walls
NCHRP Synthesis 438: Expedited Procurement Procedures for Emergency Construction Services
NCHRP Report 718: Fatigue Loading and Design Methodology for High-Mast Lighting Towers
NCHRP Report 711: Guidance for the Selection, Use, and Maintenance of Cable Barrier Systems
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