NOVEMBER–DECEMBER 2012
NUMBER 283

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

TR NEWS

From Vision to Practice

Productive Models

THE NATIONAL ACADEMIES

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The **Transportation Research Board** is one of six major divisions of the National Research Council, which serves as an independent adviser to the federal government and others on scientific and technical questions of national importance, and which is jointly administered by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The mission of the Transportation Research Board is to provide 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.

The National Research Council was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities.

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TR NEWS

NUMBER 283 NOVEMBER–DECEMBER 2012

FROM VISION TO PRACTICE: PRODUCTIVE MODELS

NCHRP's 50TH ANNIVERSARY

FROM CONCEPT TO PROOF TO PRACTICE

The Transportation Research Board's 2012 Annual Report is included in this issue as a special insert between pages 26 and 27.

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COVER: Three productive, working models of applied transportation research—all at milestone anniversaries—are highlighted in this issue.

TR NEWS

features articles on innovative and timely research and development activities in all modes of transportation. Brief news items of interest to the transportation community are also included, along with profiles of transportation professionals, meeting announcements, summaries of new publications, and news of Transportation Research Board activities.

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Javy Awan, Editor and Publications Director
Lea Camarda, Assistant Editor
Jennifer J. Weeks, Photo Researcher
Juanita Green, Production Manager
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A NEW FIELD OF PRACTICE EMERGES

ALSO IN THIS ISSUE:

COMING NEXT ISSUE

Photo: B. Connor, Alaska University Transportation Center

The vulnerability and adaptability of Alaska's transportation system to climate change—and lessons for the rest of the nation; Northern European solutions for managing road condition in cold climates; identifying and mapping naturally occurring hazardous materials in Oregon in relation to transportation activities; and insights from a project of the second Strategic Highway Research Program on systems operation and management strategies for states to combat traffic congestion are among the articles slated for the January–February 2013 *TR News*. Also featured is the annual roundup of findings from state visits by TRB program staff, focusing on the implementation of innovations and summary reports from recent research projects.

(*Photo above:*) Differential settlement on an abandoned section of the Richardson Highway, south of Fairbanks, one year after maintenance ceased.

NCHRP's 50TH ANNIVERSARY: INTRODUCTION

A Half Century of Delivering Research That Works

Lessons from a Proven Organizational Model

JOHN HALIKOWSKI

For 50 years, the National Cooperative Highway Research Program (NCHRP) has provided leadership not only through outcomes and published reports, but in the research process. NCHRP is the backbone of the Cooperative Research Programs, a large and thriving component of the Transportation Research Board (TRB). Following the model of NCHRP, the other programs include TCRP for transit, ACRP for airports, NCFRP for freight, HMCRP for hazardous materials, and NCRRP for rail.

Many research programs at state departments of transportation (DOTs) look to NCHRP for a model that works. In addition, experts in a variety of fields, from industry associations to other divisions of the National Academies—TRB's parent organization—look to NCHRP for ideas and practical insights on research management.

What makes the NCHRP model work so successfully? First, stakeholders are involved throughout the process; second, resources are used efficiently and effectively; third, objectivity is upheld; and fourth, the consultant selection process is competitive.

Stakeholder involvement is key. Those who will implement and benefit from the research participate in the process from beginning to end and develop a sense of ownership of the results. Stakeholders identify, choose, and prioritize research proposals; they help prepare the requests for proposals (RFPs) and provide technical guidance throughout the project, ensuring that the research product will be practical, relevant, and implementable.

Efficient and effective use of resources is an NCHRP hallmark. Because NCHRP addresses problems that affect many states, the states have less need to spend money on independent research projects. The reduction of duplication allows states to apply research funds to specific local needs and at the same time benefit from a national body of knowledge more extensive than they could assemble on their own. NCHRP projects have led to solutions for roadway congestion, to innovations for safety, and to new materials for better-performing, longer-lasting products, saving time, money, and lives. NCHRP products affect people's lives directly and indirectly.

Objectivity characterizes NCHRP's procedures and successes. NCHRP is part of TRB, a division of the National Research Council of the National Academies, which provide independent, objective advice to the nation on science, engineering, and medicine. NCHRP does not own or manage roads, make laws, or set policy and does not need to make a profit or to tailor its research. NCHRP provides a neutral forum for research, without bias or prejudgment, bringing together diverse stakeholder groups with common interests to achieve common goals.

NCHRP selects contractors and consultants by a competitive process. Project panels of expert stakeholders from around the country develop the RFPs for projects, then select the consultant or contractor to perform the research based on qualifications and on the merit of the proposal. This competitive process ensures that NCHRP projects have the best-qualified teams at work, leading to strong and successful outcomes.

NCHRP's effectiveness stems from projects directly targeted at current problems. People are eager to implement the results. Although the NCHRP model has stood the test of time, it is far from unchanging—program staff and the members of the AASHTO Standing Committee on Research, which selects projects and allocates funds, are constantly searching for ways to improve the products and processes. As its highly successful first 50 years indicate, NCHRP will continue to evolve, becoming an even better model for how to do research.

The author is Director, Arizona Department of Transportation, and Chair, Standing Committee on Research, American Association of State Highway and Transportation Officials.

Evolution of an Effective and Productive Partnership

NCHRP's "Splendid History"

CHRISTOPHER HEDGES

The author is Senior Program Officer, Cooperative Highway Research Programs, Transportation Research Board of the National Academies, Washington, D.C.

In the fall of 1960, Alfred Johnson and E. H. Holmes held a conversation about the need for a program that would enable state highway departments to pool resources to address common research problems. Johnson was the Executive Director of the American Association of State Highway Officials (AASHO), the predecessor to the American Association of State Highway and Transportation Officials (AASHTO). Holmes was the Assistant Commissioner for Research at the Bureau of Public Roads, the agency that later evolved into the Federal Highway Administration (FHWA).

The two men shared the view that highway research in the United States was inadequate and often duplicative. In a paper delivered to the American Society of Civil Engineers, Johnson had pointed out that 32 states were conducting research on the same problem simultaneously. Holmes had chaired a 1959 Highway Research Board study that had found highway research was not keeping pace with the rapid expansion of the road system.

Construction of the Interstate Highway System was under way and was generating new problems and challenges. Responsibility for highways in the United States was more decentralized than that for any other public service. Johnson, Holmes, and other highway leaders knew that no single agency had the mandate or the resources to meet the growing demands.

ARCHIVE PHOTO

E. H. Holmes (*center*) of the Bureau of Public Roads (BPR), received the Roy W. Crum Award from K. B. Woods (*left*) and BPR Administrator Rex Whitton at a 1958 ceremony. Holmes was a key figure in the formation of the National Cooperative Highway Research Program.

Landmark Project

When the two men spoke, the single largest cooperative research effort to date was nearing completion. Funded with $27 million pooled from state governments, the Bureau of Public Roads, the Department of Defense, and others, the landmark AASHO Road Test was the first national study to examine the impacts of moving truck loads on various asphalt and concrete pavement designs. The project was larger than any previous pavement studies and included 836 separate pavement test sections. By the end of the program, each section had been subjected to more than 1 million axle-load applications.

HRB—predecessor to the Transportation Research Board (TRB)—administered the AASHO Road Test; the project is regarded as one of the Board's most significant successes. Fred Burggraf was Executive Director of HRB when the Road Test was initiated in 1955; Burggraf had a strong experience in research and research management—he previously worked as a research fellow at the Calcium Chloride Association. Burgraff assigned William N. Carey, Jr., to supervise the AASHO Road Test and W. B. McKendrick to serve as Project Director. Carey later became HRB's sixth Executive Director, from 1967 to 1979.

K. B. Woods of Purdue University chaired an AASHO Road Test advisory committee on which hundreds of the country's leading pavement experts served throughout the life of the program.[1] The AASHO Road Test garnered worldwide attention, attracting more than 14,000 visitors from 62 countries to observe the test procedures. The AASHO Road Test was considered the most significant pavement research effort conducted in the 20th century and served as the basis for pavement design in the United States for the next 50 years.

Early Partnership

Although the AASHO Road Test was the largest cooperative research effort managed by HRB, it was not the first. HRB was formed in 1920 to correlate state highway research activities to assure efficiency and effectiveness for the public and private sectors. Thomas MacDonald, head of the Bureau of Public Roads, was one of the major figures in the formation of HRB. MacDonald was a strong proponent of collaborative research and had pioneered several research partnerships between the bureau and state highway agencies in the early 1920s.

The foundation for these cooperative efforts was the Federal-Aid Highway Act of 1916, which stipulated that the federal and state governments would share responsibilities for the road system. MacDonald soon recognized the challenges in forming and maintaining federal–state partnerships and proposed that the National Academy of Sciences serve as a neutral coordinating body.

An Advisory Board on Highway Research to the National Research Council was formed in 1920. The Advisory Board evolved into HRB. The solid partnerships that TRB, AASHTO, and FHWA currently enjoy were established in those early years and remain key to the success of TRB today.

In 1931, the AASHO Board of Directors formed a special committee to evaluate cooperative efforts between AASHO and HRB. This led to a cooperative agreement and several joint projects; the first was "A Study of the Laws, Funds, Organization, and Technical Practices Relating to Roadside Development," in 1932.

Archive Photo

The AASHO Road Test, administered in the late 1950s by the Highway Research Board, examined pavement and bridge performance and served as the prototype for cooperative research at the national level.

Correlating Research

A lack of dedicated funding, however, made substantial research efforts difficult. In the absence of a true national research program, AASHO adopted a resolution that established HRB's Research Correlation Service in 1944, to identify research needs and ongoing projects and to reduce duplication and promote efficiency. Congress responded a year later by passing new highway legislation that expanded the areas in which federal funds could be used for research.

The Bureau of Public Roads authorized the states to apply a portion of their Federal-Aid money to the costs of the HRB Research Correlation Service. Through the Research Correlation Service, HRB established technical committees, engaged in field visits, and issued publications to share knowledge about research needs and results. The Research Correlation Service became an important foundation for HRB's partnership with the states, and the related activities continue today.

Archive Photo

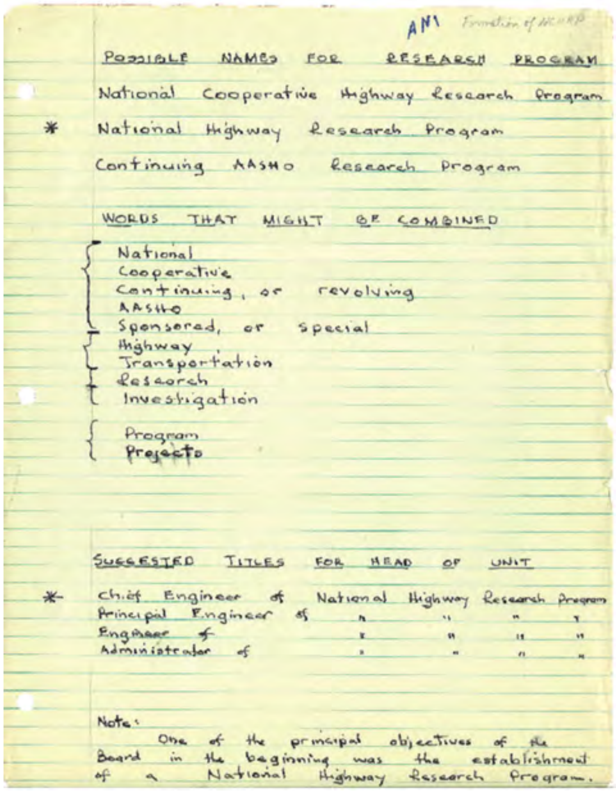
Thomas MacDonald, head of BPR from 1919 to 1953, was integral in the formation of HRB and a leading advocate for collaborative research.

[1] Today, TRB presents annual awards bearing the name of Fred Burggraf, recognizing outstanding papers by young researchers; of William N. Carey, Jr., for distinguished service to transportation research and to TRB; and of K. B. Woods, for outstanding paper in design and construction.

Archive Photo

Fred Burggraf (*right*), with W. N. Carey and A. C. Benkelman, inventor of the Benkelman beam for pavement testing, on site at the AASHO Road Test.

Handwritten notes show some of the names considered for NCHRP. Continuing AASHO Research Program, or CARP, received some early support.



POSSIBLE NAMES FOR RESEARCH PROGRAM

National Cooperative Highway Research Program

* National Highway Research Program

Continuing AASHO Research Program

WORDS THAT MIGHT BE COMBINED

National
Cooperative
Continuing, or revolving
AASHO
Sponsored, or special
Highway
Transportation
Research
Investigation

Program
Projects

SUGGESTED TITLES FOR HEAD OF UNIT

* Chief Engineer of National Highway Research Program
Principal Engineer of " " " "
Engineer of " " " "
Administrator of " " " "

Note:
One of the principal objectives of the Board in the beginning was the establishment of a National Highway Research Program.

ARCHIVE IMAGE

With more state funding now available for research under the new highway legislation, the AASHO Executive Committee approved a formal procedure for the pooling of resources between two or more states. States could submit a project statement describing a research need, a proposed scope of work, and the states expecting to participate.

After approval from the AASHO Committee on Research Activities, HRB would act as the project manager. In this role, HRB would enter into legal agreements with the funding states, provide staff to manage the project, form advisory panels to guide the work, and publish the research findings. The procedures developed in the late 1940s became the model for the National Cooperative Highway Research Program (NCHRP) and for the FHWA Transportation Pooled Fund Program.

Members of an NCHRP panel on smoothness specifications for pavements meet to review research progress. Findings from the project were published in 1997 as NCHRP's first Web-Only Document.

ARCHIVE PHOTO

Touchstone Report

HRB's role in coordinating and managing research reached a pinnacle with the AASHO Road Test, which lasted from 1955 to 1961. During this period, HRB formed a special committee, chaired by Holmes, to study the state of highway research in the United States. The committee's work produced HRB Special Report 55, *Highway Research in the United States: Needs, Expenditures, and Applications*, a touchstone that changed highway research.

The committee's findings made clear that highway research was falling rapidly behind in the face of growing needs. Research results were implemented slowly and sporadically, if at all. The committee noted that highway transportation was more than a factor in the country's economic vitality—it had become a central component of the American way of life.

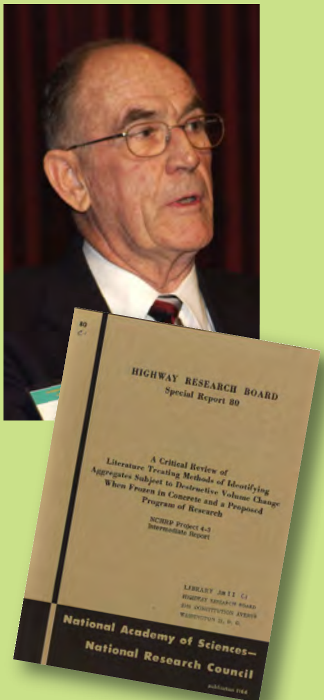
The study predicted increases in motor vehicle registrations and in miles traveled, accompanied by a large-scale migration from rural areas to the cities. These changes would put major demands on the highway system and would create problems and challenges that could not be addressed with current levels of research funding.

Program Launched

These issues were on the minds of Johnson and Holmes during their conversation in 1960. That discussion conceived the idea of a national program for cooperative highway research. The two leaders believed that a pooling of resources would focus research on the most pressing problems and would reduce or eliminate duplication of effort. HRB's success in managing the AASHO Road Test made the Board the logical choice for the new program's home.

The efforts of Johnson and Holmes resulted in the signing of a three-way agreement between AASHO, the Bureau of Public Roads, and the National Academy of Sciences, on June 19, 1962, launching NCHRP. The three-way partnership continues today.

At the same time, the Federal-Aid Highway Act of 1962 increased the level of funding that state DOTs received for research and planning activities; this provision continues today as the State Planning and Research (SP&R) Federal-Aid Fund. With a mecha-



The first NCHRP-related publications—TRB Special Report 80, *A Critical Review of Literature Treating Methods of Identifying Aggregates Subject to Destructive Volume Change When Frozen in Concrete and a Proposed Program of Research: NCHRP Project 4-3 Intermediate Report*, and NCHRP Report 1, *Evaluation of Methods of Replacement of Deteriorated Concrete in Structures*—were produced by Thomas Larson (*left*) and L. Gary Byrd (*right*) and associates, respectively. Both were active in transportation research administration: Larson became Federal Highway Administrator and TRB Executive Committee chair, and Byrd served on the Executive Committee and as interim director of the first Strategic Highway Research Program.

nism to leverage funding to address common research problems, the states elected to contribute a portion of the SP&R funds voluntarily to sponsor NCHRP. The first year of the program initiated 34 projects valued at a total of $3.5 million.

The first Program Director of NCHRP, Earl Campbell, wrote in 1971:

> It is not too hard to portray an institution's physical growth by its increasing budget, its expanding staff, and its accelerating activities—and these are worth portraying—but a more difficult portrayal and one that the historian must attempt is that of the growth of service and the diffusion of worthy ideas in useful form. These are the resources that make a history splendid.

Service and Ideas

The growth of service and the diffusion of ideas in useful form could be viewed as the axiom of NCHRP. Most of the standard technical guidance in the highway transportation sector today is based wholly or partly on NCHRP research. National manuals on geometric design, highway capacity, traffic control, and highway safety are updated regularly with results from NCHRP projects; the guidance and procedures are recognized and accepted as best practices.

Almost 50 years after the AASHO Road Test, for example, an NCHRP project produced the *Mechanistic–Empirical Pavement Design Guide*, published by AASHTO. The guide was the result of more than $10 million of research over several years, and—like the AASHO Road Test in its time—is considered the state of the art in pavement design.

NCHRP's scope has expanded beyond the physical and materials research of the past to include new domains that are driving policy decisions, such as climate change, security, the environment, intelligent transportation systems, and workforce development. State DOTs have implemented innovations from NCHRP projects to save time, money, and lives and to improve stewardship of the public infrastructure. Building on its successful first 50 years, NCHRP will continue to use research partnerships to adapt, to innovate, and to solve the transportation problems of the future.

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Advancing Transportation and Meeting States' Needs

Highlights from NCHRP's Hefty Portfolio

CRAWFORD JENCKS

The author is Manager, National Cooperative Highway Research Program, Transportation Research Board of the National Academies, Washington, D.C.

The National Cooperative Highway Research Program (NCHRP) is a forum for coordinated and collaborative research, addressing issues integral to the functions of state departments of transportation (DOTs) and of transportation professionals at all levels of government and private practice. Through NCHRP, the transportation community assists in finding objectively derived solutions to pressing problems facing the industry and in developing innovations to improve practice. For 50 years, state DOTs and the transportation industry have benefitted from NCHRP results.

TRB has managed or facilitated the business of NCHRP on behalf of its sponsors, the state DOTs, which provide the funds and identify shared and emerging problems, and which participate throughout the process. The successes are attributable to the thousands of expert volunteers and hundreds of contractors who address problems affecting the delivery and operation of the U.S. transportation system.

Although state DOTs drive NCHRP, the Federal Highway Administration (FHWA) plays a significant role by pooling the state funds that support TRB's management of the program. FHWA also provides liaisons to panels to coordinate with its efforts and to provide added, specialized expertise to the problems at hand.

The results of NCHRP research are adopted or adapted into the standards, specifications, guidance, software, and policy documents of the American Association of State Highway and Transportation Officials (AASHTO). Practitioners use the results directly or tailor applications to specific local needs and conditions. Examples can be found on the NCHRP website as part of the *NCHRP Impacts on Practice Series;* the brochure, *NCHRP at 50 Years;* and a recently completed video featuring comments from state DOT and FHWA leadership. The leaders' comments confirm that NCHRP is a successful, results-oriented program that effectively delivers innovation and continuous improvement.

Collaborative Effort

The foundations of NCHRP were established in 1962 with a three-way agreement between the predecessor organizations of AASHTO, FHWA, and TRB. The basic terms and philosophy of that original agreement have remained unchanged for 50 years. The findings and recommendations from the projects have made a difference, through direct guidance to the state DOTs or through other means, such as AASHTO specifications and guides and the updates based on NCHRP research.

What has changed, however, is the breadth and diversity of NCHRP activity, reflecting the changes in transportation and in the functions and operations of state DOTs. As highway and transportation systems have evolved, so has NCHRP.

A meeting of the NCHRP Project Panel on Asset Management Guidance for Traffic Control Devices, Barriers, and Lighting. Panel members select and monitor the progress of contractors addressing priority research needs that have been identified by state DOTs.

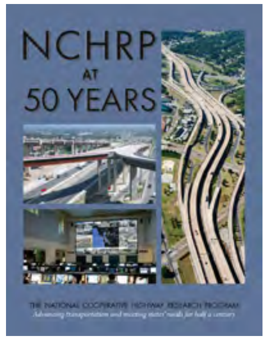
Full Complement of Highway Research

NCHRP research addresses the delivery and operation of highway-related facilities and services from the initial systems and network planning through project development—which involves safety and environmental impacts, design issues, and right-of-way and preconstruction activities—to construction and subsequent maintenance and operations. To keep up with the challenges, research now is dealing more with intermodal planning and connectivity, economic and financial impacts, and freight transport concerns.

NCHRP also engages in fact finding to support state DOT and AASHTO leadership in taking positions with federal decision makers. These efforts have led to many accomplishments over 50 years; a few, select highlights follow.

Advancing Highway Safety

In 1998, AASHTO approved a Strategic Highway Safety Plan. NCHRP Project 17-18(3) helped implement that plan by producing a series of guides for state and local agencies. Published as volumes of NCHRP Report 500, the 23 guides address a range of topics, including user factors such as impaired and aggressive drivers, older drivers, pedestrians; vehicle types—for example, heavy trucks and motorcycles; collision types, such as head-on or run-off-road; and highway configurations—for example, unsignalized intersections and work zones.



The brochure *NCHRP at 50 Years* details program accomplishments and notable research results.

More recent contributions of NCHRP to highway safety are the publication of AASHTO's *Highway Safety Manual* (HSM), which provides information and tools for roadway planning, design, and operational decisions related to safety; the AASHTO *Manual for Assessing Safety Hardware*, an update of NCHRP Report 350; and NCHRP Report 600, *Human Factors Guidelines for Road Systems*, a complement to the HSM.

Better, Safer Bridges

Bridges are high-profile structures; many are iconic. In the late 1980s, NCHRP undertook a recasting of the bridge design specifications in accordance with the newly developed load and resistance factor design format and concept. Improvements and updates to the specifications continue.

NCHRP research has helped advance techniques such as accelerated bridge construction and precast elements; NCHRP Report 698, *Application of Accel-*

How Does NCHRP Work?

◆ Problem statements are solicited annually from state departments of transportation (DOTs), committees of the American Association of State Highway and Transportation Officials (AASHTO), and the Federal Highway Administration (FHWA).

◆ Candidate problem statements are reviewed by stakeholders: the state DOTs; FHWA and NCHRP staff; and the Research Advisory Committee, the Standing Committee on Research, and other AASHTO committees, as appropriate to the topic area.

◆ The AASHTO Standing Committee on Research selects projects and recommends approval by the AASHTO Board of Directors; a two-thirds majority vote is required.

◆ After project selection, nominations are sought for members to serve on the project advisory panels. A panel is formed for each project and typically consists of eight members, mostly experts from state DOTs. The panel membership is approved by the chair of TRB's Subcommittee for National Research Council Oversight.

◆ The first panel meeting develops the request for proposals (RFP).

◆ RFPs are posted on the TRB website (www.trb.org); usually six to seven proposals are received for each project from private consultants and academia.

◆ The second panel meeting selects the contractor.

◆ Projects typically run 18 to 30 months, usually with at least one interim panel meeting.

◆ Products of research projects include NCHRP Reports, Synthesis of Practice, Research Results Digests, Legal Research Digests, Web-Only Documents, and quick-response reports to AASHTO committees. AASHTO also may adapt or adopt NCHRP products for publication as AASHTO specifications, guidance, or policies.

For more information, see www.trb.org/NCHRP/Public/NCHRP.aspx.

NCHRP research adapts to current needs in highway planning and operations; intermodal planning and connectivity, economic issues, and freight transportation have emerged as focus areas.

PHOTO: PORT OF SEATTLE/DON WILSON

erated Bridge Construction Connections in Moderate-to-High Seismic Regions, and NCHRP Report 584, *Full-Depth Precast Concrete Bridge Deck Panel Systems*, are examples.

At the same time, NCHRP research has provided guidance to state highway agencies on detecting such damaging effects as fatigue, scour, and seismic activity, and making repairs or retrofits. Example publications include NCHRP Report 206, *Detection and Repair of Fatigue Damage in Welded Highway Bridges*; NCHRP Report 587, *Countermeasures to Protect Bridge Abutments from Scour*; and NCHRP Report 472, *Comprehensive Specification for the Seismic Design of Bridges*.

Long-Lasting Pavements

NCHRP projects have advanced the design of pavements, including improvements to paving materials and construction techniques and testing. The results have helped highway agencies improve pavement performance and durability while reducing costs, accelerating construction, and efficiently using resources.

PHOTO: WIKIMEDIA COMMONS

Precast concrete piers were used in the Edison Bridge, Fort Myers, Florida. NCHRP research has helped advance the application of techniques such as precast bridge elements.

In the 2000s, state DOTs adopted mechanistic–empirical pavement design, a wholly different approach that uses numerical models to analyze traffic, climate, subgrade composition, and material properties to predict the performance of various pavement designs over their entire service life. NCHRP contributed to the development of this methodology through Project I-37A, which led to the publication of AASHTO's *Mechanistic–Empirical Pavement Design Guide* and the DARWin-ME software. Offering precise, scientific design techniques, these tools allow DOTs to build longer-lasting pavements more cost-effectively.

Design, Operations, and Maintenance Tools

AASHTO has published guidance on geometric highway design since the early 1950s, with updates and new volumes on rural highways, urban highways, and arterial streets in the 1960s and 1970s. These efforts culminated with the "Green Book," *A Policy on Geometric Design of Highways and Streets*, in 1984, with updates in 1990, 1994, 2001, 2004, and 2011.

NCHRP has supported each of these editions with critical research, contributing to the development of the geometric design process. NCHRP has addressed many developments affecting geometric design, including such external factors as changes in highway speeds and vehicle types, as well as improved methods for the design, construction, and management of roads, bridges, and other assets.

When NCHRP marked its 25th anniversary in 1987, the *Highway Capacity Manual* was considered the primary national reference for planning, design, and operational analysis of highway capacity and was one of TRB's top-selling publications. Ongoing NCHRP research has kept the manual—recently released as *HCM 2010,* a fully revised and expanded fifth edition—relevant and responsive to changes in traveler demographics, technologies, and management approaches.

Tools and strategies for preserving the nation's highways make sense in every economic climate. NCHRP research on maintenance helps transportation agencies protect their investments. Beyond publications that address best maintenance approaches for a variety of transportation infrastructure items—from pavements to highway medians to suspension bridges—NCHRP has played a role in advancing the national trend toward quality assurance for all highway maintenance activities. NCHRP Report 422, *Maintenance QA Program Implementation Manual*, published in 1999, laid the groundwork for developing and implementing maintenance quality assurance programs, including guidelines for a level-of-service rating system and for field inspections, analysis, and reporting.

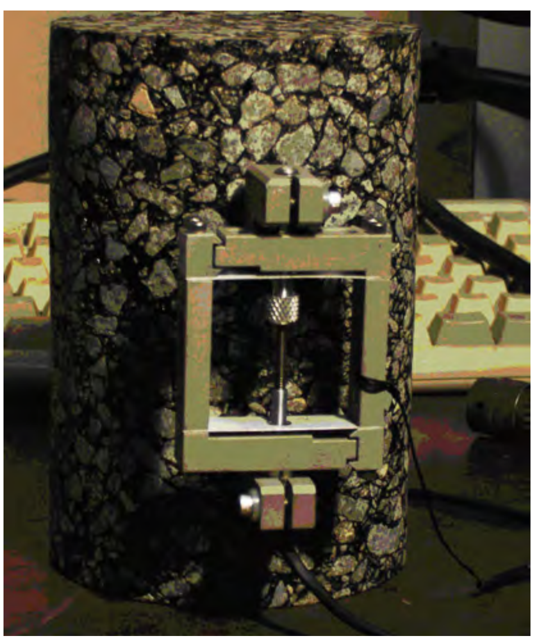
Planning and Environmental Stewardship

In the 1960s and 1970s, federal planning requirements, together with advances in computing technology, focused efforts on travel demand planning and modeling. Early planning tools were expensive and data intensive; state DOTs needed ways to make the process simpler and more useful.

NCHRP Report 187, *Quick-Response Urban Travel Estimation Techniques and Transferable Parameters (User's Guide)*, published in 1978, became widely used by planning offices. The guide provided a basis for selecting highway improvements with simplified inputs to provide low-cost, highly effective solutions. The methods in the publication were updated and expanded in NCHRP Report 365, *Travel Estimation Techniques for Urban Planning*, published in 1998, and more recently in NCHRP Report 716, *Travel Demand Forecasting: Parameters and Techniques*.

NCHRP research has assisted highway agencies to respond to emerging environmental issues without compromising the transportation system. The research has addressed an array of issues related to natural, cultural, air quality, and social aspects of the environment by developing compendia, such as the *Compendium on Environmental Field Work Technologies* (NCHRP Project 25-25, Task 48) and *Compendium of Best Practices for Incorporating Environmental Commitments into Transportation Project Construction Contract Documents* (NCHRP Project 25-25, Task 47).

Incorporating the results of NCHRP research, AASHTO published the *Transportation Asset Management Guide* in 2002—the definitive handbook for managing transportation assets large and small. The guide goes beyond bridges and highways to present techniques that are equally applicable to drainage facilities, overhead lighting, sign structures, retaining walls, intelligent transportation systems, and traffic control systems.



A mounted magnetic extensometer measures strains for the dynamic modulus test on a pavement specimen. The development of a simple performance tester for routine hot-mix asphalt design is one of many NCHRP projects that have advanced the practice of pavement design.

Practical selection criteria for bridge–pier scour countermeasures—tested at the Colorado State University Hydraulics Laboratory—are presented in NCHRP Report 593, *Countermeasures to Protect Bridge Piers from Scour*.

Photo: Risdon Photography

A session at the 2011 TRB Annual Meeting provided an overview of the new approaches in the *Highway Capacity Manual 2010,* the fifth edition of the volume first published in 1950 and updated over the years with research from NCHRP and other programs.

More recently, AASHTO published a second volume on asset management, working with NCHRP research that stresses implementation. Both volumes have advanced transportation asset management in the use of systematic and data-driven approaches to making investment decisions about physical assets.

Infrastructure Security

The terrorist attacks of September 11, 2001, ushered in a new era of security planning in transportation. The situation was urgent—state DOTs needed a coordinated effort to protect their infrastructure and the people who use it. NCHRP responded and continues to respond with guidance on integrating security into current practice for handling all hazards, natural or manmade.

A series of volumes on transportation security was initiated and collected under NCHRP Report 525, with the first released in 2004. Each of these concise reports—l6 volumes and growing—focuses on a specific security or emergency management issue. The series broke new ground for transportation agencies, providing guidance on integrating security into current practice for all hazards. Covering the breadth of surface transportation security issues, the series enables transportation professionals in all roles—even if not directly involved with security or emergency management—to expand their knowledge of emergency preparedness.

Productive Subprograms

Although the main focus of NCHRP activity is to carry out individual research problem assignments selected by AASHTO, each with a specific scope, objective, and budget, several special projects or subprograms address issues on a more ongoing and immediate basis. AASHTO allocates annual budgets for these activities, each managed by an NCHRP panel.

The synthesis program, under Project 20-05, produces reports on the state of the practice and knowledge. The products offer an easy path to expertise on a subject.

Other projects support the activity of various AASHTO committees. One provides research support to the Standing Committee on Highways and its subcommittees in developing and maintaining guides, standards, and specifications, under Project 20-07. Other projects support the member needs of the Standing Committees on Planning, through Project 08-36; on the Environment, through Project 25-25; and on Public Transportation, through Project 20-65.

The NCHRP Innovations Deserving Exploratory Analysis or IDEA program jump-starts innovations by providing seed money for feasibility studies and

Archive Photo

Urban traffic planning in the 1970s was aided by NCHRP Report 187, *Quick-Response Urban Travel Estimation Techniques and Transferable Parameters (User's Guide)*. The guide, published in 1978, was widely used by planning offices and was updated in 1998 and 2012.

Photo: Minnesota DOT

The NCHRP domestic scan team studied Minnesota DOT's right-of-way and utilities relocation procedures for Phase 2 reconstruction on I-494 west of Minneapolis.

the development of prototypes, under Project 20-30.

A legal studies program synthesizes case law on subjects affecting DOTs and their employees, through Project 20-06. During the beginning of the Interstate program, legal studies were a major project, dealing with rights-of-way issues—such as eminent domain and relocation assistance—as well as construction contracts and later, environmental and tort issues. These are collected in an ongoing treatise, *Selected Studies in Transportation Law*.

Project 20-24 assists the leadership of AASHTO and the state DOTs by providing information to frame recommendations on policy and positions to federal decision makers. In partnership with FHWA, NCHRP has supported international scans, under Project 20-36, and domestic scans, under Project 20-68.

Through Project 20-83, NCHRP recently moved into longer-range projects envisioning and preparing for conditions 30 to 50 years out, exploring such topics as the impacts of climate change, alternative fuels, demographic shifts, and adaptation to technological advances. These long-range scenario planning exercises are designed to provide guidance and help DOTs prepare for the unexpected and for the challenges of the future—to become more proactive instead of reactive.

Implementable Research

NCHRP has delivered implementable research and remained relevant by adapting its research to the complex and changing issues that state DOTs face. As the transportation landscape has shifted in the past five decades with new societal, political, and financial demands, states have sought new solutions through research. NCHRP has responded and has grown to address the range of issues involved in sustaining and improving the nation's highway system.

Although the demands on the U.S. transportation system continue to grow and evolve, the NCHRP partnership will be ready to assist the states in delivering a safe, efficient transportation system by implementing the results of collaborative research. The past 50 years emphatically confirm what early visionaries had in mind: NCHRP works!

Keys to NCHRP's Success

◆ State DOT funds are leveraged to work on problems common to many states.

◆ Practitioners identify the research needs and are involved throughout the process.

◆ State DOT representatives make the decisions about NCHRP programming.

◆ Panels composed of technical specialists and expert practitioners guide the research.

◆ Panels competitively select highly skilled contractors.

◆ The process ensures objectivity.

◆ NCHRP's scope covers the many functions of state DOTs.

◆ AASHTO adapts or adopts the research results for standards, software, and guides.

◆ NCHRP staff and panel members interact with AASHTO committees.

◆ FHWA provides assistance through its headquarters, resource center, and technical groups.

◆ TRB provides its publication distribution system, as well as expert assistance from standing committees.

◆ Staff and panel members have flexibility to address and facilitate applications.

Transit Cooperative Research Program Celebrates Two Decades of Service to Public Transportation

Two years after the formation of the National Cooperative Highway Research Program (NCHRP), the Urban Mass Transit Act of 1964 authorized the U.S. Secretary of Transportation to undertake research in all facets of public transit. Studies on planning and system operations were the initial emphasis, but influenced by the burgeoning U.S. space program, the Urban Mass Transportation Administration (UMTA) began to focus in the 1970s on technology-based research.

Among the many issues addressed in the second edition of TCRP Report 100, Transit Capacity and Quality of Service Manual *(TCQSM), are methodologies for analyzing bus operations on grade-separated busways. First published in 1999, TCQSM is one of TCRP's best-selling reports.*

Accumulating Research Needs

UMTA initiated large-scale, high-budget projects—for example, to develop personal rapid transit systems; air-cushioned, levitated trains; and the Transbus, an advanced, safe, and comfortable bus designed to attract the traveling public away from the private automobile. By the late 1970s, transit operators were criticizing these high-tech projects, lobbying for needed improvements to transit systems instead. To create a more balanced, stakeholder-driven research program, UMTA representatives met frequently with transit operators at seminars and workshops.

In the mid-1980s, the Reagan administration reduced the federal role in public transit. Federal funding for transit research declined to approximately one-third of the level in the 1970s; moreover, the research focused on policy issues, which could be funded at relatively low cost. The day-to-day problems of transit operators received little attention, and research needs accumulated.

UMTA asked the Transportation Research Board (TRB) to review the state of federal transit research and to explore mechanisms to address the growing research needs. The study committee appointed by the National Research Council comprised a cross section of industry stakeholders, including representatives of transit agencies, state departments of transportation, contractors, equipment suppliers, and academic researchers. William W. Millar, then Executive Director of the Port Authority of Allegheny County, chaired the committee. Millar also was a member of the TRB Executive Committee and of the Board of Directors of the American Public Transit Association, now the American Public Transportation Association (APTA).

Archive Photo

*William W. Millar (*right*), past president of the American Public Transportation Association, chaired the 1980s National Research Council–TRB study that led to the formation of TCRP.*

The study committee presented its findings and recommendations in TRB Special Report 213, *Research for Public Transit: New Directions*, released in 1987. Recommendations included the establishment of a research program focused on the needs of public transportation operators, addressing high-priority topics of common interest. A report by APTA, *Transportation 2000*, also identified the need for local, problem-solving research.

Launching TCRP

The recommendations resulted in the formation of the Transit Cooperative Research Program (TCRP) on May 13, 1992. Three organizations signed a memorandum of agreement outlining the program's operating procedures: the Federal Transit Administration; the National Academy of Sciences, acting through TRB; and the Transit Development Corporation, Inc., a nonprofit educational and research organization established by APTA.

Photo: Dallas Area Rapid Transit

Mosaic Apartments at the Akard Street Dallas Area Rapid Transit station. TCRP projects have explored transit-oriented development and livable communities.

The program was modeled after the longstanding and successful NCHRP. The TCRP Oversight and Project Selection (TOPS) Committee, an independent governing board, was established to guide the program, which is administered by TRB with funding from FTA; APTA provides a vital link to facilitate implementation of the program results. Millar was appointed the first Chair of TOPS; he later became President of APTA.

TCRP published its first report, *Artificial Intelligence for Transit Railcar Diagnostics,* in December 1994. Since then, the program has published more than 146 titles in the Report series, as well as more than 200 titles in the Transit Synthesis of Practice and other series. At the program's 10th anniversary, a survey of transit operators showed that TCRP project results were widely used in the industry and were providing considerable value. The program's array of key products includes works on capacity and level of service, scheduling, maintenance of transit vehicles, livable communities, security, fare systems, rural transit, bus rapid transit, driver fatigue, and a variety of other topics.

Beginning its third decade of operation, TCRP maintains the commitment to develop near-term, practical solutions to problems facing transit agencies by providing high-quality research results for the 21st century.

Published in 1987, TRB Special Report 213 (left) outlined recommendations for a research program focused on public transportation. In its 20 years, TCRP has published more than 470 titles in several series, addressing transit issues from artificial intelligence (Report 1, right) to communicating with underserved populations (Report 150).

National Cooperative Rail Research Program on Track

The National Cooperative Rail Research Program (NCRRP) has selected its first nine projects for research, including two quick-response studies. Authorized by the Passenger Rail Investment and Improvement Act of 2008, NCRRP has received one year of funding at $5.0 million.

The objective of the Transportation Research Board's (TRB's) newest cooperative research program is to provide applied research in intercity passenger, commuter, and freight rail operations. Topics to be addressed include issues in the forefront of the growing national, state, and regional emphasis on enhancing freight and intercity rail passenger services.

NCRRP projects will help solve common operating problems, adapt appropriate new technologies from other industries, and introduce innovations into the rail industry. Of primary interest are issues and complexities shared by freight, intercity, and commuter rail operating agencies but not adequately addressed in federal research programs.

In September 2010, the Federal Railroad Administration (FRA) signed a contract with the National Academies, acting through TRB, to manage NCRRP. Secretary of Transportation Ray LaHood has appointed an independent governing board, the Rail Oversight Committee (ROC), including representatives from freight, intercity, and commuter rail operating agencies, other stakeholders, and relevant industry organizations such as the Association of American Railroads, the American Association of State Highway and Transportation Officials, the American Public Transportation Association, and the National Association of Railroad Passengers.

Tim Hoeffner (second from right), Michigan DOT, participates in the first meeting of NCRRP's Rail Oversight Committee in May 2012, which identified high-priority research projects for 2013.

Photo: Richard Masoner

Passengers wait to board Caltrain commuter trains in San Jose, California. Tools and procedures for planning and developing intercity passenger rail service are being developed under NCRRP.

The ROC has identified the following highest-priority projects and has defined funding levels and expected products:

◆ A comparison of passenger train energy consumption with that of competing modes;

◆ Production of a handbook of tools and procedures for planning and developing intercity passenger rail service;

◆ The prospects for passenger rail in the context of a competitive economic market;

◆ Building and retaining workforce capacity for the rail industry;

◆ Developing innovative financing approaches for passenger and freight rail projects;

◆ The delivery and operation of passenger rail projects by multistate organizations; and

◆ Legal aspects of rail programs.

The quick-response problems are the following:

◆ Preparation of a strategic plan and research agenda and

◆ Inventorying federal and state passenger and freight rail programs.

Panels are conducting initial meetings, and the first research contracts are expected in early 2013.

Advancing the State of Highway Practice

Testimonials from NCHRP Participants

During a 35-year career in transportation, I have been involved with the National Cooperative Highway Research Program (NCHRP) in a variety of roles. When I headed up a state DOT operating agency, my colleagues and I were users of NCHRP products in many disciplines across the agency. Earlier in my career, as the principal investigator for an NCHRP project, I appreciated the high standards for conducting research and reporting results. As chair of two NCHRP project panels and a participant on several others, I appreciated the integrity of the competitive procurement process in selecting researchers, as well as the importance of the peer review process in ensuring quality products. As a member of the American Association of State Highway and Transportation Officials' (AASHTO's) Standing Committee on Research, I appreciated that research projects were selected based on the highest-priority needs identified by state DOTs and AASHTO committees and subcommittees. As a member and 2011 Chair of the TRB Executive Committee, I appreciated that NCHRP is one of the Board's most important programs and yields some of the most widely used products of the National Academies.

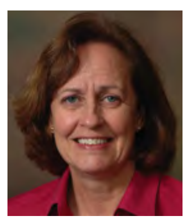
—Neil J. Pedersen
Former Highway Administrator,
Maryland State Highway Administration

More than 40 years ago, as a graduate student, the first research project in which I participated was for NCHRP, on integrating social and environmental impacts into highway project development and system planning. The National Environmental Policy Act had gone into effect, and NCHRP quickly recognized and addressed a research and policy challenge for state transportation agencies. NCHRP continues to maintain its relevance and impact by focusing on the most challenging and important transportation issues. The program has had a profound impact on our understanding of key issues and has advanced the state of the practice in countless areas. I congratulate the sponsors for their vision and commitment to improving transportation and commend the staff for their tireless efforts to make the program an ongoing success.

—Lance A. Neumann
Former President, Cambridge Systematics, Inc.

The foundation and strength of any nation correlates with its foresight and desire to discover and provide fundamentally sound solutions to its problems. In the past half a century, NCHRP has made possible the efficiency, management, and solutions to complex problems in the developing U.S. highway network. One cannot offer enough praise and accolades to the most prestigious transportation research program in the world. The United States owes a special debt of gratitude to the men and women who have worked to transform an idea into a successful program.

—M. W. Witczak
Emeritus Professor of Civil Engineering,
University of Maryland and Arizona State University



Transportation researchers focus on making a difference within their agencies, states, and the industry by improving information and technologies. NCHRP produces excellent and focused research. In any initiative, our DOT's first step is to review and investigate what NCHRP has produced—NCHRP reports are the best resources available. When NCHRP speaks, state DOTs listen. The money the states invest in NCHRP has a tremendous payback in helping to move forward in the technical areas of concern to all.

—Sandra Q. Larson
Research and Technology Bureau Director, Iowa Department of Transportation; Chair, AASHTO Research Advisory Committee

In 44 years of practice in the field of transportation engineering, I have been a participant in, as well as a beneficiary of, NCHRP. The research results from a range of topics have been essential and beneficial to me as a practitioner with Kansas DOT and have provided necessary findings for establishing national criteria through the AASHTO "Green Book," the *Roadside Design Guide*, and other manuals of practice.

—James O. (Jim) Brewer
Engineering Manager, State Road Office,
Kansas Department of Transportation

NCHRP products have maintained a high reputation for quality and applicability among local, state, federal, and international practitioners, managers, and directors throughout the program's 50-year history. As a result, the products are an obvious first resource for many who seek to standardize analysis methods, procedures, and assessment criteria. In this way, NCHRP has a tremendous influence on our profession and on the quality of life in our communities and world. The NCHRP process of identifying a problem, evaluating it, and then funding attention or action has had the ancillary benefit of promoting collaboration, awareness, and consistency in transportation practices among states—a benefit in and of itself. NCHRP projects offer opportunities for academic institutions and private entities to come together to apply their strengths in a common cause. These opportunities are not available in most other venues. The project-specific marriages put together by NCHRP have resulted in better practices in the field, better education in the classrooms, and a much quicker and more effective path for ideas and concepts to move from theory to practice.

—Wayne K. Kittelson
President, Kittelson and Associates

The Value of Research to Transportation Executives

CHRISTOPHER HEDGES

Halikowski

"Why is research important? Because research spawns ideas, and ideas foster innovation. Without innovation, we cannot be good stewards of our highways and spend taxpayers' money responsibly," John Halikowski told a meeting of the Research Advisory Committee of the American Association of State Highway and Transportation Officials (AASHTO). The session featured heads of state departments of transportation (DOTs) discussing the value of transportation research.

Director of Arizona DOT and chair of the AASHTO Standing Committee on Research, Halikowski continued: "The key values of Arizona's transportation department are accountability, integrity, and respect. Good research helps us fulfill all three."

He went on to describe a recent example of how research can help a transportation department save money and operate more efficiently. The Deck Park tunnel on Interstate Highway 10 in downtown Phoenix is a little more than one-half mile long, and electricity fees to light the tunnel are one of the agency's highest expenses. Halikowski asked the research office to look into the feasibility of solar power to light the tunnel. As a result, a private firm is poised to demonstrate a solar lighting technology that will save Arizona DOT hundreds of thousands of dollars.

PHOTO: ALAN STARK

Arizona DOT applied research findings to realize a significant cost savings in lighting the Deck Park tunnel in downtown Phoenix with solar power.

Halikowski emphasized that research must pervade an organization and its daily operations. Important decisions at a highway agency need to draw on the best available information. Research must inform the decision-making and problem-solving processes.

Achieving Goals

Njord

John Njord, Executive Director of Utah DOT, past Chair of the TRB Executive Committee and past President of AASHTO, agrees: "Most DOTs today are facing significant funding constraints. We have to focus on making the most of what we have, and research plays an important role in finding effective and efficient solutions."

Utah DOT has been a leader in developing innovative technologies and solutions to improve the way the department operates. The use of accelerated bridge construction (ABC) techniques has resulted in enormous savings to the traveling public by minimizing traffic disruption.

"At 354 feet, the Sam White Lane Bridge was the largest ever moved in the Western hemisphere using ABC techniques," Njord reported. "We have now moved almost 40 bridges into place using ABC. Why? Because research showed us that the technique was feasible and would result in much shorter delays for the traveling public. We value people's time, and our goal is to minimize the impacts on the public."

Utah's population growth rate far outpaces that of most of

(continued on next page)

The author is Senior Program Officer, Cooperative Research Programs, Transportation Research Board of the National Academies, Washington, D.C.

NCHRP has made it possible for state DOTs and the industry as a whole to share and solve chronic and emerging technical challenges. Without NCHRP, we would be struggling individually and perhaps never would find the most effective solutions. Writing proposals, participating on panels, and receiving the research results have enhanced my career and my state's ability to solve problems with ideas from practitioners.

—Michael T. Long
Project Delivery Manager, Oregon DOT;
Chair, TRB Low-Volume Roads Committee

California DOT was able to leverage State Planning and Research dollars for approximately $30 million in NCHRP projects that would benefit the state. NCHRP offers practical and timely solutions to operational problems facing highway and transportation practitioners and administrators. NCHRP afforded me an opportunity to participate on panels with smart and committed transportation officials who shared the same passion for the topics.

—Randell H. Iwasaki
Executive Director, Contra Costa Transportation Authority;
former Director, California Department of Transportation

The Value of Research to Transportation Executives

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the country, and vehicle-miles traveled also are increasing, but the road network is expanding only marginally. Njord described the four key goals he has set for Utah DOT: "Take care of what we have, make the system work better, improve safety, and increase capacity."

Research has helped to achieve these goals. For example, traffic flow on express toll lanes in Utah averages 10 to 15 percent faster than on regular lanes, making travel times more predictable. State-of-the-art traffic signal timing has reduced delays at key high-volume intersections by as much as 75 percent. The more than 77 miles of innovative cable barriers installed in 2010 have prevented heavy trucks from crossing the median and have reduced crashes and fatalities. These and other innovative techniques are saving lives, time, and money in Utah.

Njord understands the value that research can provide and is committed to taking advantage of the best information from around the world. Utah sends more staff to the TRB annual meeting than to any other conference. The staffers have a mission: bring back and implement new ideas that will benefit Utah.

PHOTO: UTAH DOT

In early 2012, Utah DOT and contractor Provo River Constructors moved the Sam White Bridge using accelerated bridge construction techniques perfected through NCHRP research. The two-span bridge was the longest ever to be moved in the Western hemisphere.

"Research has made our DOT a better organization," Njord observes.

Specifying Benefits

Martinovich

Susan Martinovich, former director of the Nevada DOT and past president of AASHTO, learned the value of research early in her career at the DOT, before rising to the most senior position. Martinovich understands, however, that research has no value until implemented; for that to happen, senior executives need to understand clearly the resulting benefits to the DOT.

"You may think we all suffer from attention deficit disorder, but CEOs have incredible demands on their time and must deal with a vast range of issues and problems every day. We are generally not experts in any narrow field; we are interested in products and benefits, not the technical details." She added: "Explain research to senior executives the way you would explain it to your mother. Give them brief summaries; don't give them long reports or links to websites."

Halikowski agrees. "Be specific about the benefits of research to the organization and to the stakeholders. Quantify whenever possible. Show how research will benefit the internal operations of the department, bring credit to the agency, and improve the quality of life for the agency and for taxpayers. Tell me what you *can* do, don't ask me what you *should* do. If there are barriers, think about possible strategies to overcome them. Don't present roadblocks without some ideas for solutions. Help the CEO, and the CEO will help you engage the other leadership."

All three CEOs understand the value of research and are committed to finding new solutions to address their day-to-day challenges. Njord summed up the session: "Good information makes for good decisions."

The AASHTO Research Advisory Committee promotes quality and excellence in research and in the application of research findings to improve state transportation systems. Each AASHTO member department is represented on RAC. For more information, see research.transportation.org.

NCHRP's half century of expanding horizons through practitioner-focused research built on a collaborative model of professionalism and objectivity has advanced transportation practices from planning to operations. My first exposure to NCHRP began decades ago as a state DOT participant on project panels, and more recently I have served as a principal investigator and researcher on projects. NCHRP has a value-added impact on panel members, on researchers, and most importantly, on advancing the leading edge of industry practices.

—Hal Kassoff
Senior Vice President, Parsons Brinckerhoff

NCHRP has had an impact on the bridge community. NCHRP research developed the AASHTO *LRFD Bridge Design Specifications*, which have been refined and strengthened in subsequent projects. Another major impact of NCHRP, sometimes overlooked, is the opportunity for state DOT staff to participate on project panels. This helps develop the leaders of tomorrow, exposing engineers to new colleagues, new ideas, new processes, and innovations, providing an opportunity for professional growth beyond their jobs. This hidden benefit affects not only the engineer but the state DOT.

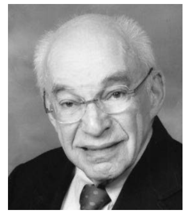
—Malcolm T. Kerley
Chief Engineer, Virginia DOT

The NCHRP process of selecting research topics based on state DOT needs has provided important practical benefits to bridge owners. For example, recent research products for accelerated bridge construction will provide significant benefits to states and to the traveling public. In addition, NCHRP panel membership provides practitioners an opportunity to broaden understanding of a specific topic and to develop a network of colleagues to continue discussions to advance bridge technology.

—Mary Lou Ralls
Principal, Ralls Newman, LLC;
former State Bridge Engineer, Texas DOT

Having been involved with NCHRP since its inception in the early 1960s, I can attest to the importance of the program's research in the pavement and materials areas. NCHRP has been a leader in the development of mechanistic–empirical pavement design and rehabilitation of pavement.

—Carl L. Monismith
R. Horonjeff Emeritus Professor of Civil Engineering,
University of California, Berkeley

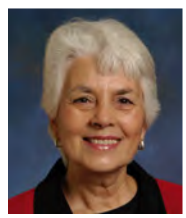


NCHRP enabled me to grow professionally and to contribute to the highway transportation profession. The program has made many contributions, has set the standard for transportation research, and has enabled many researchers to grow and to contribute. May the next 50 years be as promising and productive as the first 50!

—Herbert S. Levinson
Transportation Consultant

NCHRP has been an effective force for continuous improvement across the range of transportation endeavors, providing the challenges, opportunities, and resources that have motivated professionals to make a positive difference beyond the confines of their day jobs. NCHRP has fostered the productive collaboration that many participants would cite as the single most rewarding aspect of their careers in public service.

—Gary R. McVoy
Vice President, Transportation Sustainability and Climate Change,
Parsons Brinckerhoff



The key word in NCHRP is "cooperative." Through the collective financial commitment of the states, this program has advanced the science, knowledge, resources, and partnerships necessary to build a safer, more efficient transportation system in the United States and throughout the world.

—Leanna Depue
Former Director, Missouri DOT Highway Safety Division

During 40-plus years in transportation, I have been acutely aware of the service that NCHRP consistently has provided by researching solutions to critical transportation problems and by facilitating the networking of experts. The research solutions have been practical and have improved transportation services and facilities throughout the country.

—Wesley S. C. Lum
Former Chief, Safety Innovation and Cooperative Research,
California DOT; Past Chair, AASHTO Research Advisory Committee

NCHRP research fills a gap not addressed by environmental research programs outside the transportation sector. Local, state, and federal transportation organizations rely on the research results to develop widely accepted tools, techniques, and technologies. The research is guided by multidisciplinary panels of practitioners familiar with the environmental impacts of transportation from inside and outside the transportation sector.

—Wayne W. Kober
Transportation Consultant

From Concept to Proof to Practice

TRB's IDEA Programs Turn 20

Sparking Innovation Through High-Risk, High-Payoff Research

HARVEY BERLIN, INAM JAWED, LINDA MASON, AND JON WILLIAMS

The authors are longtime staff for TRB's IDEA or Innovations Deserving Exploratory Analysis programs: Berlin and Jawed are Senior Program Officers; Mason is Communications Officer; and Williams is Program Director.

Gary Rayner was driving his car on a sunny day in California when half a brick lobbed from a passing car dented his hood and cracked his windshield; the consequences, of course, could have been much more serious. Rayner wished he had evidence to prosecute those responsible for the road rage and to recover the costs of the damage. An inventor, he thought of the onboard black boxes that record events leading up to airliner crashes. Perhaps he could develop a similar technology for motor vehicles—more than 30,000 people die in highway crashes each year in the United States.

Rayner started to work in his spare time toward developing a video event recorder for motor vehicles. The goal was to monitor driving activity by continuously recording a video of the roadway, audio, and directional g-forces into a digital looping memory. Activities such as hard braking, acceleration, harsh cornering, or collisions generate *g*-forces that could trigger the device to save a recording of the event.

Rayner needed more resources to develop a prototype for the DriveCam. In 1999, fellow inventors advised him to apply for financial assistance from a Transportation Research Board (TRB) program, Innovations Deserving Exploratory Analysis (IDEA). IDEA accepted Rayner's proposal and provided $100,000 to build several units to prove the viability and effectiveness of the technology; California's technology investment program supplied another $66,000 in cost sharing. According to Rayner,

> The timing of the IDEA award was of paramount importance. It was a major vote of confidence and a key catalyst in being taken seriously during our first funding round. The core of the IDEA proposal became the basis of our official business plan, which helped to get that process started in time for approaching investors. We also found that the contacts we made within the U.S. Department of Transportation (DOT), the National Highway Traffic Safety Administration, and the transportation industry because of the IDEA award were almost as valuable as the funding itself.

Today, many vendors worldwide offer enhanced versions of the DriveCam video event recorder. For fleets, the device can communicate with a central database in conjunction with a company driver training program. Fleet owners who regularly review the event recording with their drivers typically report a 40 percent to 70 percent reduction in incidents.

The Federal Motor Carrier Safety Administration recently sponsored a study by the Virginia Tech Transportation Institute on the use of video event recorders in driver training for two fleets of commercial trucks. The study found that risky driving incidents fell by 52 percent in the first fleet and by 34 percent in the second fleet during a 17-week period. For truck fleets, other benefits included reductions in insurance costs, in vehicle damage, in workers' compensation claims, and in personal injury costs.

Public transportation operators also have adopted video event recorders. Bus fleets in Washington, D.C., Los Angeles County, and San Francisco County are equipped with the recorders.

This example epitomizes the IDEA process—propelling high-risk, high-payoff innovation from concept into adopted practice for the benefit of the traveling public.

Photo: WMATA

A technician installs a DriveCam on a Washington Metropolitan Area Transit Authority bus. DriveCam was developed in 1999 with assistance from TRB's IDEA program and has come into use by bus and truck fleets across the country.

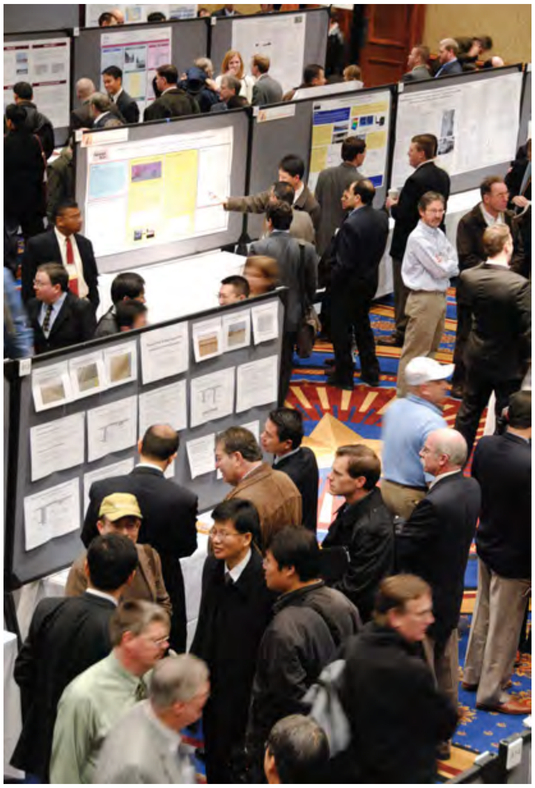


Photo: Risdon Photography

Poster sessions presenting and demonstrating IDEA projects are a regular and well-attended feature at TRB Annual Meetings.

What Is IDEA?

From 1987 to 1992, the National Research Council conducted the first Strategic Highway Research Program (SHRP) on behalf of state transportation agencies. In guiding the program's planned research, the SHRP Executive Committee identified a need to spur innovation. They recognized that innovation, like inspiration, cannot be programmed in a structured research plan with specific projects and tasks.

The SHRP Executive Committee therefore allocated 2 percent of all SHRP funds to innovative, high-risk, high-payoff research. The first IDEA program proved viable and successful; Dean Carlson, then Executive Director of the Federal Highway Administration (FHWA), and Frank Francois, then Executive Director of the American Association of State Highway and Transportation Officials (AASHTO), among others, strongly advocated for the continuation of IDEA after the conclusion of SHRP in 1992. At the recommendation of the Executive Committee, the SHRP IDEA program moved to TRB as the National Cooperative Highway Research Program (NCHRP) IDEA.

At first, FHWA and AASHTO jointly funded the NCHRP IDEA program. FHWA gradually had to reduce its contribution, but the AASHTO leadership, recognizing the value of the program, decided to pick up the deficit. In 1999, when FHWA was unable to continue its support, AASHTO assumed the funding responsibility through NCHRP.

Three new programs soon were added, following the NCHRP IDEA model: Transit Cooperative Research Program (TCRP) IDEA, funded by the Federal Transit Administration; High-Speed Rail IDEA, which is no longer active; and railroad Safety IDEA, funded by the Federal Railroad Administration.

How Does IDEA Work?

IDEA offers early-stage funding for promising but unproven innovations for highways, transit, and railroad safety and performance. The program is independent of the immediate mission concerns of public agencies and of the short-term financial imperatives of the private sector. Government research programs can refer any innovative, high-risk, unsolicited proposals that otherwise might not be funded to the IDEA programs for consideration.

Although the IDEA programs announce general areas of research interest, the projects are investigator driven. The goal is to promote innovations that can progress to next-generation technologies and methods.

Three IDEA programs currently solicit proposals: NCHRP IDEA for highways, TCRP IDEA for transit, and Safety IDEA for railroads. Each IDEA program follows a similar administrative model, adapted for sponsorship arrangements and target

Photo: Risdon Photography

At the 2006 TRB Annual Meeting, Jean-Louis Briaud (*right*) demonstrates the Briaud Compaction Device—developed under the NCHRP IDEA program—to measure soil modulus at the surface of a compacted layer.

Performance of IDEA Programs

	NCHRP 1993–2012	TCRP 1993–2012	Safety 2002–2012
Proposals received	1580	540	225
Awards	171 (11%)	70 (13%)	22 (10)%
Projects completed	147	60	19
Products being used in practice	15%	20%	12%
Great promise for practice	15%	15%	24%

audiences. Each program operates through a committee or panel of volunteer transportation experts who solicit, review, and select proposals that merit research contracts.

Anyone can apply for IDEA funds. The focus is on early-stage projects, not on proven technologies. Two types of projects are eligible:

- **Proof-of-concept projects**, which investigate the feasibility of a concept and its potential for application to transportation; and
- **Prototype projects**, which develop concepts that show particular promise.

Cost sharing is a recommended approach, demonstrating to the oversight panels that others believe in the technology enough to commit funds.

Rarely does a product emerge ready-to-go from an IDEA project. Usually further development, evaluation, commercialization, marketing, and deployment must occur before an innovation is implemented. The trek from concept to application can take years and can be costly.

John Hillman (*left*), inventor of the hybrid composite beam (HCB), describes the innovative technology to a TRB Annual Meeting attendee in 2004.

PHOTO: RISDON PHOTOGRAPHY

Benefits for Inventors and the Public

IDEA awards up to $150,000 for NCHRP IDEA projects, and up to $100,000 for Transit IDEA and Safety IDEA projects. The benefits for inventors are more than monetary, however, and include the following:

- Introduction to potential public agency users who can test the innovation;
- Assistance and peer review by an expert committee and review panel;
- Exposure through TRB's website, publications, and poster sessions at TRB's Annual Meeting; and
- Assistance from TRB staff.

Other programs that can help in later development for commercialization also review IDEA projects for possible candidates. Examples include FHWA's Highways for Life and Every Day Counts initiatives, the Exploratory Advanced Research Program, the Small Business Innovation Research, and AASHTO's Technology Implementation Group.

By nurturing innovation, the programs also benefit the public. In addition to demonstrating valuable products, the programs attract cost-sharing arrangements that boost the value of the public investment. When cost-sharing arrangements augment IDEA funds, the amount of research that the IDEA programs can support is nearly doubled.

John Hillman, inventor of the hybrid composite beam (HCB), summarized his experience with IDEA:

> The IDEA program has been an invaluable asset. The funding is no doubt critical, in that there just aren't many avenues for an independent inventor or small company to gain access to that kind of seed money to pursue the initial stages of research and development. However, beyond the funding, the IDEA program provides a level of credibility that helps gain access to individuals who can help make or break the success of the project. Whether it is potential customers, investors, or panel members who can provide valuable input, the reputation of the IDEA program is highly regarded in the transportation industry and needs no introduction.

Following are several notable success stories from the IDEA programs, starting with Hillman's HCB.

Hybrid Composite Beam for Bridges

Developed under NCHRP IDEA Project 60, the HCB is a high-strength, lightweight, corrosion-resistant beam for bridge construction. The HCB comprises three main subcomponents: a shell, compression reinforcement, and tension reinforcement.

The shell is a fiber-reinforced plastic (FRP) box beam. The compression reinforcement consists of concrete, pumped into a profiled conduit—generally an arch—within the beam shell. The tension reinforcement consists of carbon, glass, or steel fibers anchored at the ends of the compression reinforcement. The HCB combines the strength and stiffness of conventional concrete and steel with the light weight and corrosion resistance of advanced composite materials.

The HCB improves the speed of construction and is well suited to accelerated bridge construction projects. Its service life is estimated at more than 100 years.

An HCB weighs approximately one-tenth of a typical precast concrete beam of the same span length. The lighter weight reduces shipping and erection costs—for example, six HCBs can be shipped on a truck that would carry one beam of precast concrete. HCBs require a 30-ton crane instead of the large 150- to 200-ton cranes for precast concrete beams.

The first cost of construction with HCBs—which includes transportation, installation, preparation for service, and other initial capital expenditures—is competitive with that for conventional methods using prestressed concrete beams. Costs will decrease, however, as demand for HCBs increases, creating economies of scale. With its longer service life, HCB is superior in terms of life-cycle costs. AASHTO's Technology Implementation Group selected the HCB as a focus technology for implementation in 2011.

Examples of structures with HCBs include the Lockport Township High Road Bridge over Long Run Creek in Illinois, the Route 23 Bridge over Peckman's Brook in Cedar Grove, New Jersey—both constructed in 2009—and the Knickerbocker Bridge built in 2011 over Back River in Boothbay, Maine.

Photo: Dale Peabody, Maine DOT

Several transportation agencies are using HCBs in construction and replacement of bridges, as in the replacement of Knickerbocker Bridge in Boothbay, Maine.

The HCB undergoes testing under a project funded by NCHRP IDEA and High-Speed Rail IDEA.

The U.S. Army Corps of Engineers recently used HCBs in Bridge No. 4 at Fort Knox, Kentucky. Virginia DOT is installing HCBs to replace Tide Mill Bridge in Fredericksburg. Missouri's "Safe and Sound Project" is building three HCB bridges with a grant from FHWA Highways for LIFE.

Burlington Northern and Santa Fe (BNSF) is conducting live load tests of a full-scale HCB rail bridge at the Transportation Technology Center, Inc., near Pueblo, Colorado. If the tests prove successful, BNSF may install the span on a structure in revenue service.

For his invention of the HCB, Hillman has received the *Engineering News Record* 2010 Award of Excellence and recently was named recipient of the 2013 Charles Pankow Award for innovation from the American Society of Civil Engineers. Other recognitions include the American Council of Engineering Companies' 2009 Grand Award for the Lockport Township High Road Bridge and the 2010 NOVA Award from the Construction Innovation Forum.

Admixture for Improved Corrosion Resistance of Concrete

The corrosion of reinforcing steel undermines the durability of concrete structures exposed to deicing chemicals or to the marine environment. Through NCHRP IDEA Project 13, inventors–investigators Jack Stephens and James Mahoney, working at the University of Connecticut in collaboration with Connecticut DOT, developed an additive that inhibits the corrosion of reinforcing steel in concrete. The additive is based on highly hydrophobic dipolar alkenyl dicarboxylic acid diammonium salts.

An additive that inhibits the corrosion of reinforcing steel in concrete, developed through an NCHRP IDEA project, now is marketed as Hycrete and has been approved for construction projects in at least two states.

The New England Transportation Consortium evaluated the IDEA product and has established the additive's performance and its effect on concrete properties. The product is now being marketed as Hycrete, a corrosion inhibitor, by Hycrete Technologies, Inc., of Carlstadt, New Jersey. The IDEA product forms the basis of a suite of trademarked Hycrete products for inhibiting corrosion and for waterproofing.

The admixture reduces the permeability of concrete to water and chloride, as well as the corrosion of reinforcing steel bars in cracked concrete. The hydrophobic quality of the admixture makes the concrete waterproof and eliminates the need—and the associated costs—of adding a waterproofing membrane.

Hycrete increases the cost per cubic yard of concrete by approximately 25 to 30 percent. Nonetheless, the advantages outweigh the increase in material costs: superior corrosion resistance, reduced maintenance, and longer service life. A life-cycle cost analysis by Virginia DOT for the 2007 construction season estimated that Hycrete would save $1.5 million each year in net costs and would increase service life by 10 percent.[1]

New Jersey, New York, Ohio, Virginia, Kansas, the six New England states, and the U.S. Army Corps of Engineers have experimented with Hycrete for the past several years, focusing on long-term performance. Virginia DOT and Ohio DOT already have approved Hycrete for construction projects. Despite the slow rate of acceptance by state DOTs, the private sector increasingly is using Hycrete for projects such as parking garages and buildings.

In 2009, President Barack Obama invited the CEO of Hycrete, Inc., to the White House for a roundtable of eight CEOs of clean technology–focused companies to share insights on the economic impact of environmentally friendly technologies.

Corrosion-Resistant Steel for Concrete Reinforcement

Gareth Thomas, inventor and investigator on NCHRP IDEA Project 28, developed an improved, dual-phase ferritic martensitic (DFM) reinforcing steel that has superior mechanical properties and corrosion resistance.

The high-strength DFM steel is a low-alloy, low-carbon metal produced by quenching the alloy from the two-phase ferrite–austenite field, yielding a mixture of ferrite and martensite. The IDEA researcher continued to work with DFM, developing MMFX steel, which has approximately five times the corrosion resistance and twice the strength of conventional steel. MMFX Steel Corporation of America was founded in 1998 in San Diego, California, to commercialize and market the new product.

MMFX steel has superior mechanical properties but is more expensive than regular steel. The manufacturers note, however, that the yield strength of MMFX steel is 100 to 120 ksi higher than that of conventional Grade 60 steel; construction projects therefore can be completed with 20 percent to 50 percent less steel and at labor costs for placement and fabrication that are up to 60 percent lower.

In addition, the superior corrosion resistance adds years to the service life of the structure. In 2007, Michigan DOT projected a higher service life for a bridge with MMFX steel instead of with epoxy-coated steel and concluded that MMFX steel reinforcement was worth the investment of approximately $12 more per square yard.[2]

Several state DOTs and FHWA have evaluated the mechanical performance and corrosion resistance of MMFX steel, validating the superior corrosion resistance. MMFX rebar qualifies as ASTM A615 Grade 75; ASTM A1035-04 low-carbon, chromium steel

[1] Virginia Transportation Research Council Final Report 07-R30; www.virginia.dot.org/vtrc/main/online_reports/pdf/07-r30.pdf.

[2] Michigan Department of Transportation Research Report R-1499; www.michigan.gov/documents/mdot/MDOT_Research_Report_R1499_209781_7.pdf.

MMFX steel was used in the construction of a bridge deck in Gundy County, Iowa. The developer of the corrosion-resistant and high-strength material began experimenting with dual-phase ferritic martensitic reinforcing steel under an NCHRP IDEA project.

bars for concrete reinforcement at 100,000 psi; and AASHTO M31 Grade 75.

MMFX steel is now in use across North America on bridges, highways, parking structures, and residential and commercial buildings. Applications include bridge decks in Connecticut, Delaware, Florida, Kentucky, New Mexico, Pennsylvania, Vermont, Texas, Puerto Rico, and Manitoba, Canada. Washington State DOT has used MMFX steel dowel bars on several pavement projects.

In 2011, a Pennsylvania DOT survey found an increasing use of MMFX steels by state DOTS; 10 states had used MMFX steel on a total of 27 bridges, with Maine's 8 bridge projects and New Mexico's 7 leading the way. No state has reported major issues, although the oldest bridge using MMFX steel is about 9 years old and the newest a little more than 1 year old.

Virginia DOT allows the use of MMFX steel rebars as an alternative to stainless steel or stainless steel–clad rebars. The U.S. Army Corps of Engineers used MMFX steel throughout the structure of the Lake Tenkiller Spillway Channel Bridge in Sequoya County, Oklahoma, and the U.S. Navy has used it in hybrid modular piers in San Diego.

Thomas was named 2002 winner of the ASCE Charles Pankow Award for innovation in design and construction and 2004 winner of the NOVA Award from the Construction Innovation Forum, an international nonprofit, for innovations that improve construction quality and reduce costs. The World of Concrete Exposition recognized MMFX steel with the 2004 Experts' Choice Award.

Automated Rail Wheel Inspection System

Transit IDEA Project 17 assisted inventor Zack Mian in the development of a system for the automated inspection of rail wheel flanges to improve rail track safety. The New York State Energy Research and Development Authority provided additional funding for development of the system.

A series of 3-D laser scanners and cameras is mounted at trackside with a series of ultrasonic sensors to scan an entire cross section of a wheel. The output is a digitized profile of the wheel that is processed through geometric algorithm software. The algorithm incorporates standard wheel measurement data with additional computations to check critical characteristics, such as wheel cracks, flange angle, and wheel diameter.

The product generates a complete profile of a rail wheel and evaluates the wheel and flange for wear. The inspection system improves track performance and safety with a faster and more accurate inspection of wheels, enabling more efficient maintenance.

A Transit IDEA project assisted in the development of a system for automated inspection of rail wheel flanges. The system is now in use in several CSX rail yards and also has been purchased by New Jersey Transit.

CSX has purchased and installed five in-ground wheel inspection systems for CSX yards. New Jersey Transit has purchased the system to inspect wheels on rail transit vehicles. The automated rail wheel inspection system has created jobs for U.S. workers—the U.S. company that developed the system from the Transit IDEA project has sent U.S. employees to build and install the system in Sydney, Australia, and Izmir, Turkey.

Ultraviolet Germicidal Irradiation for Transit Buses

Houston Metro field-tested ultraviolet germicidal irradiation (UVGI) in transit bus air conditioning systems and found significant reductions of mold, bacteria, fungi, and harmful viruses in the vehicles, providing health-related benefits to bus passengers, drivers, and employees. Developed under Transit IDEA Project 53 by inventor Lee Huston, the UVGI

Ultraviolet germicidal irradiation reduces the buildup of mold, bacteria, fungi, and viruses on transit bus air conditioning systems. The Transit IDEA product also increases fuel efficiency and can extend the service life of the system's evaporator.

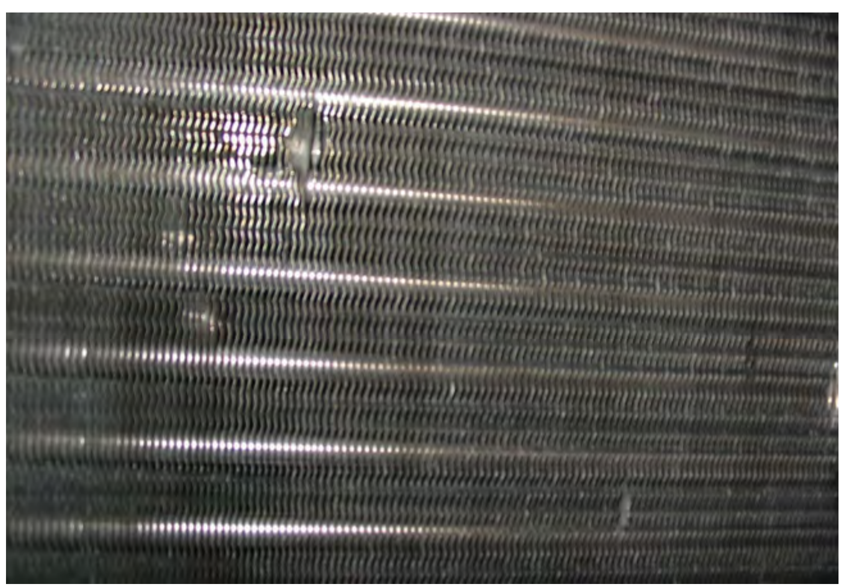


Photo: Risdon Photography

Peter Bartek demonstrates the rail warning system he invented for increased track worker safety with support of the Transit IDEA program.

Since 2002, *Ignition*, the magazine of TRB's IDEA programs, has explored initiatives and products.

also protects against bioterrorist contaminants; increases air flows, contributing to more efficient cooling and lower maintenance costs; and reduces fuel costs for transit buses.

Yet another benefit emerged when the UVGI system was used in conjunction with the newly designed, reusable electrostatic air filter. The system was found to improve particle size capture without reducing the air flow to the evaporator; the reduced cleaning time for the evaporator extended the component's service life.

Transit agencies in Fort Worth, Texas, and in West Palm Beach, Fort Lauderdale, Tampa, and Jacksonville, Florida, have purchased and installed UVGI systems in transit bus air conditioning systems. The Chicago Transit Authority has included the UVGI system in specifications for purchasing new articulated buses. Dallas Area Rapid Transit also has written the UVGI system into its purchasing specifications; 400 buses equipped with the system are scheduled for delivery.

Warning Rail Transit Personnel of Approaching Trains

Peter Bartek invented a system to warn rail transit personnel that trains are approaching and developed the product through Transit IDEA Project 55. When it detects an approaching train, the warning system immediately sends a protected signal that turns on a set of wireless safety lights and horns in the work zone and triggers personal arm band devices worn by track workers, flaggers, and trackwalkers. In addition, a device installed in the train cab warns the operator that transit track workers are ahead.

Staff of the National Transportation Safety Board (NTSB) demonstrated the technology at a public meeting in January 2008 and recommended the adoption of alert technology to prevent track-worker fatalities on rail transit systems (NTSB Report R-08-04). This Transit IDEA–developed product also has created jobs in the United States for the manufacture and installation of the component devices for the U.S. and export markets.

Rail transit operators implementing the technology include the Chicago Transit Authority; the Los Angeles County Metropolitan Transportation Authority; Southeastern Pennsylvania Transportation Authority; Santa Clara Valley Transit Authority in California; the Greater Cleveland Regional Transit Authority in Ohio; Sound Transit serving the Seattle, Washington, area; the Massachusetts Bay Transportation Authority serving Boston; and the Maryland Transit Administration serving Baltimore. The Metropolitan Atlanta Rapid Transit Authority in Georgia and the Charlotte Area Transit System in North Carolina have purchased the devices for installation on their rail transit systems. Queensland Rail of Australia and Russian railways also have purchased the U.S.-manufactured devices.

Opportunities for Inventors

The TRB IDEA programs accept proposals from inventors year round. Oversight committees for each program select innovations for awards twice a year for the highway and the transit IDEA, and annually for the railroad safety IDEA. Information on submitting proposals is posted on the TRB website at www.trb.org/IDEAProgram/IDEASubmitProposal.aspx, or call 202-334-3310 or e-mail dewilliams@nas.edu.

Working Through the Evolving Legacy of Metropolitan Transportation Planning

ALAN E. PISARSKI

Like many transportation professionals, I am a child of the 1962 Federal-Aid Highway Act. In that legislation, Congress mandated that all metropolitan areas with a population of more than 50,000 must have a planning process in place by 1965. This year marks the 50th anniversary of that extraordinary legislation, providing an opportunity to transmit a sense of that productive period to the current generation of planners.

In the scramble to comply with the mandate, the Bureau of Public Roads (BPR)—the predecessor to the Federal Highway Administration—laid out the course to be followed across the country. Pioneers within BPR established policies to implement the act, building on limited experience and available research results to define the scope and nature of the technical process for metropolitan transportation planning and to lay the foundation for the current process. Perhaps most notable is that virtually all of the technical guidance documents from that era bear the name of a BPR staffer as author; similar documents today would bear the name of a consulting firm.

PHOTO: FLORIDA STATE ARCHIVES

Construction of the 20th Street Expressway (now Martin Luther King Parkway) in 1962, in Jacksonville, Florida, east of what would become Interstate 95. Major highway projects already were under way in many metropolitan areas when Congress mandated the establishment of a planning process.

The process was emphatically technical and quantitative from the start—often half or more of new agency budgets supported data collection. Data collection dominated the early years, providing time for the modeling and other elements of the planning process to evolve. Instead of counting traffic on roads, the concepts of true origins and destinations and of travel demand as a socioeconomic phenomenon were born.

How might metropolitan transportation planning have evolved without the federal mandate and guidance? The federal process established the basic requirements. Many areas innovated and designed techniques and approaches that were more sophisticated, but many others might have lagged behind. Although tending toward a common approach, federal guidance and funding provided early training and a set of fundamentals, building competency and establishing the foundations that permitted many areas to develop innovative new tools.

The accompanying feature article and sidebars provide an in-depth look at the 50-year period and at the role of transportation planning, tracing the origins and early years of the act, its evolution, and its ramifications for the profession and for our society. Additional thoughts from other witnesses to that period are posted on the TRB History Committee website; readers are invited to add comments and observations: http://sites.google.com/site/trbcommitteeabg50.

The author is a transportation consultant in Falls Church, Virginia. Author of the Commuting in America *series, he is a longtime volunteer leader in Transportation Research Board committees and project panels and is a recipient of the W. N. Carey, Jr., Distinguished Service Award.*

Metropolitan Transportation Planning

An Abbreviated History of the First 50 Years

KEVIN E. HEANUE AND EDWARD WEINER

Heanue began his 40-year federal career at the Bureau of Public Roads in 1958 and was assigned to the newly established Urban Planning Division in 1962; he retired as Director of Environment and Planning and now works as a consultant in Alexandria, Virginia. Weiner, a consultant in Silver Spring, Maryland, is the author of Urban Transportation Planning in the United States: History, Policy, and Process; *the fourth edition is forthcoming from Springer Science + Business Media, LLC, New York.*

In April 1962, President John F. Kennedy delivered his first message to the U.S. Congress on the subject of transportation. The message emphasized coordination and cooperation and set the stage for enactment of the 1962 Federal-Aid Highway Act with its Section 134 planning provisions and of the 1964 Urban Mass Transportation Act that began federal assistance for transit.

Without significant debate, Congress passed the highway legislation, requiring the establishment of a continuing, cooperative, and comprehensive (3C) planning process in every urbanized area with a population of more than 50,000. Normally planning is the first step in the development of infrastructure proposals. In this case, a planning process was enacted after construction of the Interstate Highway System had begun and as controversy over the system was reaching fever pitch in urban areas.

Origins of the Act

The origins of the metropolitan transportation planning requirements in the Federal-Aid Highway Act of 1962 can be traced to the Federal-Aid Highway Program that began when Congress established the Office of Road Inquiry in 1896 and appropriated financial aid to the states for highway construction in 1916. Also influential was the emergence of city planning as a profession, signaled by a national meeting on city planning in Washington, D.C., in 1909.

The Interstate Highway System traces back to a 1939 report to Congress, *Toll Roads and Free Roads*. A 1944 Congressional report, *Interregional Highways*, further elaborated the system concepts.

In the Federal-Aid Highway Act of 1944, Congress called for a national system of Interstate highways limited to 40,000 miles. The general locations of 37,700 of those miles were announced in 1947; of

PHOTO: CECIL STOUGHTON/WHITE HOUSE PHOTOGRAPHS; JOHN F. KENNEDY PRESIDENTIAL LIBRARY AND MUSEUM

President John F. Kennedy delivers the 1962 State of the Union address. That spring, he would speak to Congress about the importance of cooperating to enact broad transportation legislation and, in June, would sign the 1962 Federal-Aid Highway Act into law.

Photo: Library of Congress Prints and Photographs Division

Road grading in 1916, the year that Congress appropriated financial aid to assist states in highway construction.

those, 2,900 miles were in urban areas. The remaining 2,300 miles within the limit were reserved for urban circumferential and distributing routes.

Between 1947 and 1955, many groups—most notably the Clay Committee appointed by President Eisenhower—addressed the problem of finalizing and enacting the proposed Interstate highway program. The process included many consultations between federal, state, and local officials.

Interstate Vision

In 1955, informed by the Clay Committee, the Eisenhower Administration advanced a proposal for the enactment of an Interstate Highway System. The proposal failed in the U.S. Congress. The administration continued to work with Congress to develop a new proposal overcoming the perceived deficiencies.

A report—known as the Yellow Book—was circulated to members of Congress in September 1955. The report contained a one-page map of the proposed national Interstate system—essentially the 1947 rural highway map—and series of maps of major metropolitan areas with sketch plans of specific Interstate Highway Systems.

The Yellow Book showed the general, schematic location of the original 2,900 urban miles identified in 1947, along with the schematic locations for the 2,300 urban miles that had been reserved but not identified. The Department of Defense argued for beltways around the most congested urban areas; these could connect inland military posts and ammunition depots with ports and would supplement the designated routes through cities.

The 1956 act established the Highway Trust Fund with pay-as-you-go provisions; funding for the system was to be 90 percent federal and 10 percent from the states. All routes were to be limited access.

The development of the Interstate Highway System program involved federal analyses of potential total mileage and candidate routes. The routes were brokered in a series of consultations between the Bureau of Public Roads (BPR) and the states about the rural segments of the proposed system, until a degree of consensus was achieved. Consultations between federal and state officials and representatives of metropolitan areas continued.

Urban Outcry

The 2,900 urban miles identified in 1947 were not adequate; many urban areas lobbied for more mileage. In December 1954, the annual congress of the American Municipal Association (AMA) endorsed with a 90 percent plurality a resolution for additional urban Interstates. The following year, after Congress had failed to act, AMA unanimously passed a similar, more strongly worded resolution.

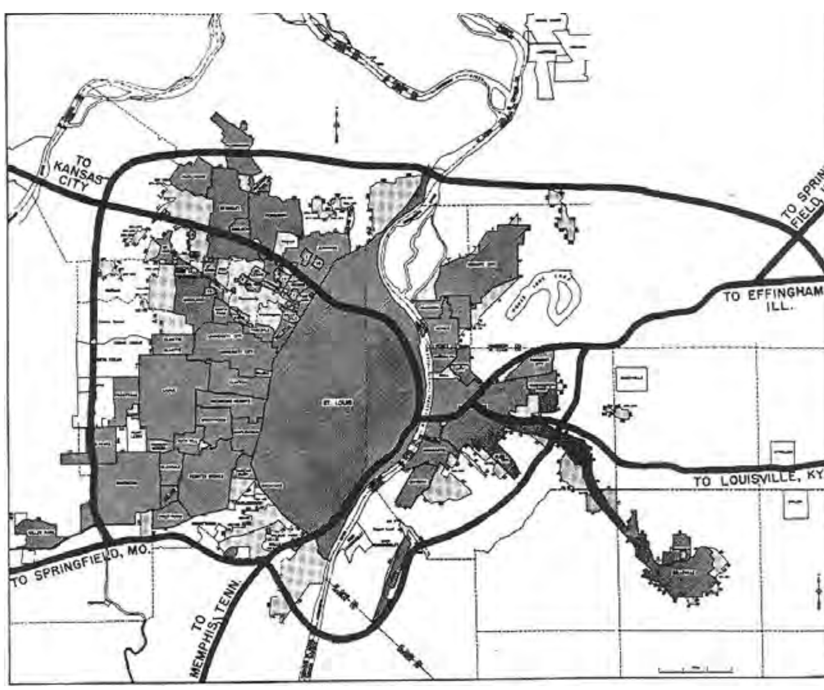
The formal publication of the Yellow Book in September 1955 identified the remaining urban miles. As Frank Turner observed, “then of course the thing hit the fire.”

Many loose ends remained when the Interstate program was enacted in 1956. In many cities, the proposed Interstate alignments were well understood and had been incorporated into city plans. In others, however, the alignments had not been defined; as a result, alternative studies showed a potential impact on more neighborhoods than would occur when the final alignment was determined. “Freeway revolts” arose in several cities, as citizens and local officials realized that houses would be taken and neighborhoods disrupted.

In 1957, the Hartford Conference brought together federal, state, and city officials and associa-

The Yellow Book, which contained sketches of Interstate Highway Systems in major metropolitan areas such as St. Louis, Missouri, was an attempt to reach consensus on federal and local highway plans.

Image: Ajfroggie.com



tions that had worked together to forge the concepts that became the Interstate program. Also participating were representatives from urban planning and other urban interests who were opposed to the Interstate concept.

Ted Holmes, a leading BPR planner, stated that the "conference did little to promote cooperative development between highway people and others. Actually, it promoted adversarial relationships."

Those who had been influential in developing the system debated what went wrong and what could be done. Additional national conferences convened: first at the Sagamore Conference Center at Syracuse University in New York in 1958; next in Hershey, Pennsylvania, in 1962; and finally in Williamsburg, Virginia, in 1965.

Shaping Section 134

In the meanwhile, the Kennedy administration had initiated a series of reviews of federal programs. The Interstate construction program, the urban renewal program, the land use planning program of the Housing and Home Finance Agency, and the highway planning program were among those placed under scrutiny.

In an oral history interview, Holmes described a seminal event in the development of the legislative provision in Section 134 of the 1962 act. Two senior officials of the Bureau of the Budget, Paul Sitton and Gordon Murray, came to his office in 1960 with a proposal. They noted that highway planners employed quantitative analyses to yield traffic volumes and that land use planners employed a quali-

The Federal-Aid Highway Act of 1962

Legislation with a Lasting Impact

JOHN FISCHER

The Federal-Aid Highway Act of 1962 included a few new provisions, most notably the provisions for planning. In contrast to the drawn-out debates that have characterized reauthorizations of surface transportation programs in recent decades, the 1962 legislation took a simple path to passage—almost a textbook civics lesson in how governmental processes should work. The President proposed and Congress disposed; strong Executive Branch and Congressional leadership applied throughout the process. The Kennedy Administration made its views on transportation policy known in April 1962, and less than seven months later, the new act came to fruition—notably, with little controversy.

President Kennedy's "Message on Transportation," a 16-page document covering a range of issues, called for the creation of a planning process that closely resembled the description in the final legislation.[a] The Department of Commerce and its operating agency, the Bureau of Public Roads (BPR), took the lead in promoting the Administration's positions. BPR presented Congress with a strong policy recommendation, which was incorporated into Congressional positions in the following months. Congress began consideration of the highway bill with hearings by the House Committee on Public Works in late April and early May. By the end of June, the Committee had filed its report, and the House passed its bill soon after.

The Senate took up its own bill in early August with hearings by the Senate Committee on Public Works. The Senate Committee filed its report in early September, and the Senate subsequently passed the legislation. A conference committee convened and on October 10 filed a report that was two pages long, with a two-page statement by the House Managers attached. The planning provisions in the House and Senate bills were largely identical and were not a subject of discussion during the conference.

President Kennedy signed the act on October 23, 1962.[b] The legislation was regarded as a notable achievement at the time and has had a wide-ranging and positive impact on U.S. transportation policy to this day.

The author was a specialist in transportation policy at the Congressional Research Service, Washington, D.C., for more than three decades and now works as a consultant in Annapolis, Maryland.

Photo: Abbie Rowe/White House Photographs. John F. Kennedy Presidential Library and Museum

President Kennedy signed the 1961 Federal-Aid Highway Act, which amended certain laws and provisions in the federal highway program and set the stage for the 1962 Federal-Aid Highway Act.

[a] Office of the White House Press Secretary. Message on Transportation: To the Congress of the United States. The White House, April 4, 1962.
[b] Public Law 87-866.

tative approach that yielded colored maps. They wanted to bring the two approaches together, and asked BPR to fund land use planning.

Holmes agreed to cooperate. On a later visit to BPR, Sitton showed Holmes a draft of what was to become the Section 134 language.

Those who wrote the words of Section 134 and those who implemented it drew on the work of leading researchers and practitioners—notably from the broadly based National Committee on Urban Transportation—and mandated the establishment of a data-based, multimodal, analytically oriented process, responsible to state and local officials. Although the process was not in place for planning and designating the urban Interstates, the institutions now known as metropolitan planning organizations (MPOs) have proved their worth, and almost every highway and transit reauthorization that followed has further defined and expanded the roles of MPOs.

Ten Basic Elements of the Continuing, Comprehensive, and Cooperative Planning Process

1. Economic factors affecting development.
2. Population.
3. Land use.
4. Transportation facilities, including those for mass transportation.
5. Travel patterns.
6. Terminal and transfer facilities.
7. Traffic control features.
8. Zoning ordinances, subdivision regulations, and building codes.
9. Financial resources.
10. Social and community value factors, such as preservation of open space, provision for parks and recreational facilities, preservation of historic sites and buildings, and consideration of environmental amenities and of aesthetics.

Implementing the 1962 Act

BPR, then part of the U.S. Department of Commerce, moved quickly to implement the urban transportation planning requirements of the Federal-Aid Highway Act of 1962. BPR's Urban Planning Division carried out a program to interpret the provisions of the act, develop planning procedures and computer programs, write procedural manuals and guides, provide technical assistance, conduct training courses, and develop professional staff. The goal was to assist planning organizations in urbanized areas by standardizing, computerizing, and applying procedures largely created in the late 1950s and by disseminating knowledge of these procedures.

Interpreting the Provisions

An instructional memorandum, published in March 1963,[1] interpreted the act's provisions for a 3C planning process:

◆ *Cooperative* included not only cooperation between the federal, state, and local governments but also among agencies within the same level of government.

◆ *Continuing* referred to the need to reevaluate and update a transportation plan periodically.

◆ *Comprehensive* included the 10 basic elements of a 3C planning process that required inventories and analyses (see box, this page).

These memoranda and later refinements and expansions covered all aspects for organizing and carrying out the 3C planning process.

Funding

The 1962 act also required that 1.5 percent of the funds apportioned to a state for highway construction be spent on highway planning and research (HP&R). An additional .5 percent of highway construction funds could be spent at the option of the state. The state, however, had to match these funds, supplying 50 percent of the project costs. The HP&R funds, combined with a state's matching funds, supported the urban transportation planning process.

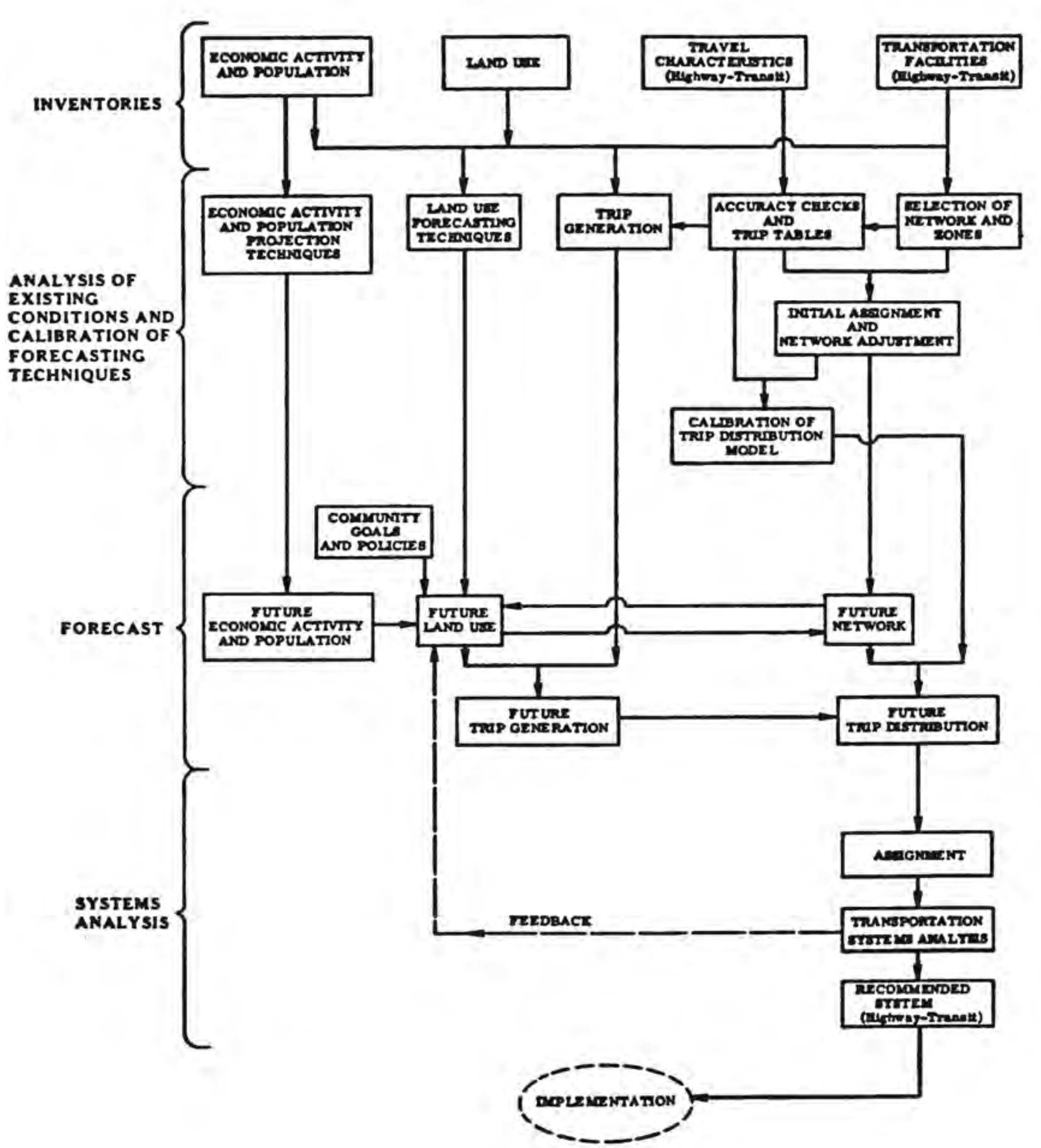
Planning Procedures

BPR defined the steps in a 3C planning process. Pioneered by urban transportation planning studies of the 1940s and 1950s, the empirical approach required a substantial amount of data and several years to complete. The process involved establishing an organization to carry out the planning process; development of local goals and objectives; surveys and inventories of conditions and facilities; analyses of conditions and calibration of forecasting techniques; considering both highway and transit modes; forecasting of future activity and travel; evaluation of alternative transportation networks to produce a recommended transportation plan; staging of the transportation plan; and identification of resources for implementing the plan. The 3C planning studies generally produced an elaborate report tracing the procedures, analyses, alternatives, and the recommended plans.

The 3C planning process included four technical phases: collection of data, analysis of data, forecasts of activity and travel, and evaluation of alternatives. The urban travel forecasting process was central to this approach (see Figure 1, next page), using mathematical models to simulate and forecast travel. This permitted the testing and evaluation of alternative transportation networks.

[1] Instructional Memorandum 50-2-63, later superseded by Policy and Procedure Memorandum 50-9.

FIGURE 1 Urban travel forecasting process.



The four-step urban travel forecasting process consisted of trip generation, trip distribution, modal split, and traffic assignment. These models first were calibrated to replicate current travel from survey data. These models then were used to forecast travel, starting with an estimate of the variables that determine travel patterns, including the location and intensity of land use, social and economic characteristics of the population, and the type and extent of transportation facilities in the area. The variables in turn were used to estimate the number of trip origins and destinations in each subarea of a region—that is, the traffic analysis zone—with a trip generation procedure.

A trip distribution model connected the trip ends in an origin–destination trip pattern. A modal split model divided the matrix of total vehicle trips into highway and transit trips. A traffic assignment model then assigned the matrices of highway and transit trips to routes on the highway and transit networks, respectively.

To analyze future transportation networks with these models, forecasted variables were input for the test year. Travel forecasts were then prepared for each alternative to determine traffic volumes and levels of service. Usually only the modal split and traffic assignment models were rerun for additional networks after completion of a future year forecast for the first network. Occasionally the trip distribution model also was rerun.

This approach to urban travel forecasting quickly entered widespread use. The procedures were tailored specifically to the tasks of regionwide urban transportation planning, and BPR provided substantial assistance and oversight. No other procedures were generally available; urban transportation study groups that opted for other approaches had to develop their own procedures and computer programs.

Computer Software

Travel forecasting on a regionwide scale required a large computing capability. The first generation of computers became available in the mid-1950s. BPR took advantage and adapted the Moore algorithm for telephone routing to operate for traffic assignment on the IBM 704 computer. Additional programs were developed for other functions.

The second generation of computers, circa 1962, provided increased capabilities. The library of computer programs was rewritten for the IBM 709 computer and then for the IBM 7090/94 system. BPR worked with the Bureau of Standards to develop, modify, and test these programs. Some programs were developed for the IBM 1401 and 1620 computers. This effort continued for several years, so that by 1967 the computer package contained approximately 60 programs.

To foster the adoption of these technical procedures, BPR released procedural manuals that became the technical standards for many years to come (see box, this page).

Technical Assistance

Professional staff at BPR provided hands-on technical assistance to state and local agencies for applying these new procedures to their areas. BPR staff traveled to states and urbanized areas to assist in installing computer software and in running the forecasting models. In addition, BPR staff were available by telephone for assistance and technical guidance.

As part of these efforts, BPR developed the *Highway Planning Program Manual* to consolidate and make readily available the technical information on planning practice. First issued in August 1963, the manual primarily addressed the highway engineers in BPR's field offices who administered the highway planning activities of state highway departments and of urban transportation planning groups receiving federal-aid highway planning funds. The manual also provided valuable information for planners in state and local agencies.

The section of the manual devoted to urban transportation planning covered a variety of planning activities and procedures, including organization, use of computers, origin–destination studies, population studies, economic studies, land use, street inventory and classification, evaluation of traffic services, traffic engineering studies, public transportation, terminal facilities, travel forecasting, traffic assignment, developing the transportation plan, plan implementation, and the continuing planning process.

Photo: Lawrence Livermore National Laboratory

In the mid-1950s, IBM 704 and other first-generation computers were put to work by the Bureau of Public Roads for travel forecasting functions.

Training and Staff Development

BPR developed a two-week urban transportation planning course for planners and engineers. The course covered organizational issues and technical procedures for the 3C planning process. The BPR manuals served as textbooks, supplemented with lecture notes to keep the information current and to cover additional mate-

Select Foundational Manuals from the Bureau of Public Roads

- *Calibrating and Testing a Gravity Model for Any Size Urban Area* (July 1963);
- *Calibrating and Testing a Gravity Model with a Small Computer* (October 1963);
- *Traffic Assignment Manual* (June 1964);
- *Population Forecasting Methods* (June 1964);
- *Population, Economic, and Land Use Studies in Urban Transportation Planning* (July 1964);
- *The Standard Land Use Coding Manual* (January 1965);
- *The Role of Economic Studies in Urban Transportation Planning* (August 1965);
- *Traffic Assignment and Distribution for Small Urban Areas* (September 1965);
- *Modal Split: Documentation of Nine Methods for Estimating Transit Usage* (December 1966); and
- *Guidelines for Trip Generation Analysis* (June 1967).

rial. The staff members who had developed the technical procedures, written the manuals, and provided technical assistance taught the course, which was widely attended by state and local government staff, consultants, university faculty and graduate students, and staff from many foreign governments.

Recognizing a need for professional staff trained to implement the 1962 act, BPR developed an 18-month urban transportation training program for new employees with master's degrees. The trainees worked on a rotating basis in regional and division offices, in the Urban Planning Division Office in Washington, D.C., and in ongoing urban transportation studies around the country. Also required was the two-week urban transportation planning course.

After completing the program, trainees received assignments at the Urban Planning Division. In addition, BPR sent five field staff for two years of study and training at Yale University, where they earned certificates from the Yale Bureau of Highway Traffic and master's degrees in urban transportation planning.

State and Local Roles

The implementing rules of the 1962 act required states and local governments to sign a memorandum of agreement to carry out the 3C planning process in their regions. A Unified Annual Work Program set out the various steps and the organization responsi-

J. Douglas Carroll, Jr.

Pioneer of Urban Transportation Planning

ALAN E. PISARSKI

As a college student, I worked for J. Douglas Carroll, Jr., at the Tri-State Transportation Commission, which then covered the New York metropolitan megaregion comprising one-tenth of the nation's population, including 26 counties in New York, New Jersey, and Connecticut. With the implementation of the Federal-Aid Highway Act of 1962, the area became a test for the validity of the concept of metropolitan planning. The Bureau of Public Roads (BPR) recruited that era's stars of the profession and sent a cadre of BPR staff on loan to assure success. Many others from all over the United States took cuts in pay to work for Carroll—the cuts were called tuition.

Carroll was the first doctoral graduate of Harvard University's then-new planning school; the renowned modernist architect Walter Gropius was his adviser. The Tri-State Transportation Commission recruited Carroll from the Chicago Area Transportation Study (CATS), which he had directed since 1955. At CATS he established the basic technical and practical framework for all transportation studies. Carroll extended the lessons he had learned as director of the Detroit Transportation Study from 1952 to 1954 and from an earlier study he had managed in Flint, Michigan. State and local authorities adopted the regional plans Carroll had developed in Detroit and Chicago.

In Detroit, Carroll established the basic six-step process, still recognizable today:

- Data collection.
- Forecasts.
- Goal formulation.
- Preparation of network proposals.
- Testing of proposals.
- Evaluation of proposals.

The Tri-State program's massive data collection effort included aerial photography of the entire 8,000-square-mile region, x-y coordinate delineation of all land parcels on 180,000 blocks, and a face-to-face home interview survey of 65,000 households. The results were "to confirm Doug Carroll's intuitions," according to Tri-State Technical Director Lee Mertz, who later became the Federal Highway Administration's first Associate Administrator for Policy.

For more information about Carroll's work and legacy, see the profile in *Pioneers of Transportation*, which includes biographies of other founders of the transportation planning profession.*

PHOTO: CHICAGO TRANSIT AUTHORITY

Riders exit a Loop-bound Ravenswood B train in Chicago in the 1960s. Led by J. Douglas Carroll, Jr., the pioneering Chicago Area Transportation Study examined Chicago Transit Authority networks and other metropolitan transportation issues.

* See the Institute of Transportation Engineers online bookstore, www.ite.org/emodules/scriptcontent/Orders/ProductDetail.cfm?pc=LP-673-E.

ble for each step.

States and local governments had to make major efforts to organize and develop their own planning process—few areas had an urban transportation planning process in place in 1962. Negotiating the memorandum of agreement, hiring staff, developing work programs, and beginning the technical tasks to develop an urban transportation plan took time. Nevertheless, all of the 224 urbanized areas that fell under the 1962 act had an urban transportation planning process under way by the legislated deadline of July 1, 1965.

BPR's efforts defined the 3C planning process, developed techniques for performing the technical activities, and provided technical assistance that transformed urban transportation planning. The mandatory involvement of local officials and the inclusion of transit—along with the 10 basic elements of the 3C planning process—caused urban transportation planning to spread quickly throughout the United States and to influence urban transportation planning in other parts of the world.

Process at Work

The process and techniques of urban transportation planning have evolved in response to changing issues, conditions, and values; to more advanced planning methodologies; and to an improved understanding of urban transportation phenomena. Urban transportation planning practice today is more sophisticated, complex, and costly than when first practiced in the 1960s and involves a much wider range of participants with a broader range of academic backgrounds.

Although several urban transportation studies had been completed before 1962, in most areas the planning for urban Interstates was based on informal coordination between state and local officials. This cooperative designation process identified routes as candidates for the system in a schematic way.

Beginning in 1962, many forms of urban transportation studies emerged. In every instance, policy and technical committees of state and local officials directed the process.

In the largest urban areas, resident staff conducted surveys, performed required analyses, and developed plans. In many areas, consulting firms undertook the required surveys, analyses, and draft plans under contract. Firms such as Wilbur Smith and Associates, Alan M. Voorhees and Associates, and Barton Aschman Associates, Inc., played major roles in advancing urban transportation planning.

In other areas, notably New York and Texas, states took responsibility for computer-based model analysis on behalf of the planning organizations. Many

ARCHIVE PHOTO

The Washington, D.C., Metro system had lasting impact on the region's development. BPR's 3C planning process transformed urban planning by involving transit and local officials.

planning organizations relied on consulting firms to perform computer-based technical analyses but performed all other functions in-house.

Benchmark Events

Major benchmarks in this evolution include the following:

◆ The establishment in 1962 of federal aid for transit through the Department of Housing and Urban Development.

◆ The availability of federal funding, beginning in the mid-1960s, for the development of land use inputs to the transportation planning process, through a program of the Housing and Home Finance Agency.[2]

◆ The Department of Transportation Act of 1966, which established the new agency and transferred the Urban Transit Administration to it in 1968.

◆ BPR's 1968 definition of "continuing," which clarified that the planning process was not a one-time effort but had a mandatory, continuing role in federal highway assistance to states and metropolitan areas.

◆ The establishment by Congress in 1968 of formula-based funding entitlements for planning for each MPO, in response to concerns that a state objecting to a planning organization's actions could cut off funds.

◆ The National Environmental Policy Act of 1969, which required federal agencies to use a "systematic, interdisciplinary" approach on projects affecting the environment. The process culminated with the preparation of an Environmental Impact Statement.

◆ The Clean Air Act Amendments of 1977, which required transportation plans and programs to conform to established clean air standards. The Clean Air Act created huge policy and analytical burdens for MPOs in nonattainment areas—that is, areas that did not meet the standards.

[2] Under the Urban Planning Assistance Program authorized in Section 701 of the Housing Act of 1954, as amended in 1965.

◆ The Highway Act of 1973, which provided flexibility between highway and transit funds and assigned a major decision-making role to MPOs in the substitution, transfer, and use of urban Interstate system funds for transit. In addition, the governors of each state were asked to designate an MPO for each urbanized area with a population of more than 50,000 as defined by the Census Bureau.

◆ The regulatory consolidation of planning requirements by BPR and the Urban Mass Transportation Administration, implementing the 1973 Highway Act, which merged policy-setting, technical assistance, and training efforts.

◆ The Intermodal Surface Transportation Efficiency Act of 1989, which defined the post-Interstate highway and transit programs and expanded the role of MPOs.

Role of Analysis

This overview of 50 years of U.S urban transportation planning reveals a crosscutting analytical theme. Until the early 1960s, transportation plans were derived from results of large-sample, home-interview surveys, expanded by growth factors to project a future year. The potential usage of the proposed beltways and new river crossings of the Interstate Highway System, however, did not relate to historic travel patterns.

At the same time, the rapid evolution of mainframe computers enabled such pioneers as Alan M. Voorhees, Mort Schneider, and Anthony R. Tomazinis to develop competing simulation models to estimate future travel patterns based on land use and the characteristics of the proposed transportation systems. Following closely, transit planners developed mode choice models to estimate the ridership on transit and the volume of highway traffic in a single, integrated modeling framework. Air quality analysts also built on this work.

Nevertheless, from the mid-1940s and throughout this period, transportation planners had grounded their work on existing and proposed land use. Fortunately, the Bureau of Budget officials Sitton and Murray were aware of the analytical progress in the transportation planning process and framed the language of the 1962 act around analysis.

The planning process will adapt as high-occupancy toll lanes and other new technologies change the face of transportation in the United States.

Photo: Virginia DOT

In the 50-year evolution of the planning process, the Transportation Research Board has served as a partner, continually adapting its committee structure and session programs to provide vision, input from emerging fields, oversight, and in-depth coverage of key technical and policy issues.

Today, virtually every major metropolitan area in the world has a technical transportation process patterned after that of the United States. Yet no other country has replicated the mandatory nationwide urban transportation planning process, and no other country—except China—has attempted anything as ambitious as the Interstate program. No other country has devised a process that allows state and local officials to allocate formula-apportioned funds between highway and transit to serve local conditions, priorities, and needs.

Looking Ahead

The urban planning provisions of the Federal-Aid Highway Act of 1962 were pivotal in the transition of the highway program from a rurally oriented, civil engineering–based activity to a new framework that had a major urban component; that was multimodal, interdisciplinary, and involved local officials; and that was unique in the federal system. No other federal program had or has since tied capital expenditures to the results of a planning process that gives state and local officials a veto over proposed expenditures.

Technically the practice of metropolitan transportation planning may vary by the size of the area, but in all instances, it is data driven, analytically complex, and interdisciplinary.

This year, Congress reauthorized highway and transit programs, and President Obama signed the bill into law. The planning provisions have survived the test of time, and the unique legislative requirements, simply defined in 1962 as continuing, comprehensive, and cooperative, remain central to the legislated planning process.

A host of new issues confronts federal, state, and local officials today and will increase in the future. Changes in vehicle technology, in infrastructure financing practices, and in toll collection methodology, along with continually evolving techniques for planning analysis, provide ample challenges for the planning process.

Acknowledgments

This article and the accompanying sidebars represent a joint effort by members of the TRB History Committee, chaired by Jonathan L. Gifford.

Low-Cost and Environment-Friendly Asphalt-Treated Mixtures

Louisiana Tests Designs

LOUAY MOHAMMAD, CHRIS ABADIE, AND MUNIR NAZZAL

Mohammad is Professor, Louisiana State University, and Director, Engineering Materials Research Characterization Facility, Louisiana Transportation Research Center, Baton Rouge. Abadie is Materials Engineer Administrator, Louisiana Department of Transportation and Development. Nazzal is Assistant Professor, Department of Civil Engineering, Ohio University, Athens.

Asphalt cement materials are costly, and asphalt mixtures have environmental impacts. Alternatives are needed to reduce the cost and to decrease the emissions generated in production and construction without compromising performance. Asphalt-treated mixtures (ATMs) offer one alternative.

ATMs are hot-mix asphalt (HMA) from crushed rock or natural gravel with paving-grade asphalt cement in low percentages—2.5 to 4.5 percent (*1*). Because the mixtures can be produced with less expensive aggregates and with lower percentages of asphalt cement binder, the cost is less than for typical HMA mixtures.

Problem

ATMs can be used in the construction of a pavement's asphalt layer. State agencies' specifications for ATMs, however, are similar to those for conventional asphalt mixtures with an asphalt content of 4.5 to 5.5 percent in the binder and in the wearing course layers. These specifications adversely affect the economic competitiveness of ATMs and limit their use in pavement construction.

(a)

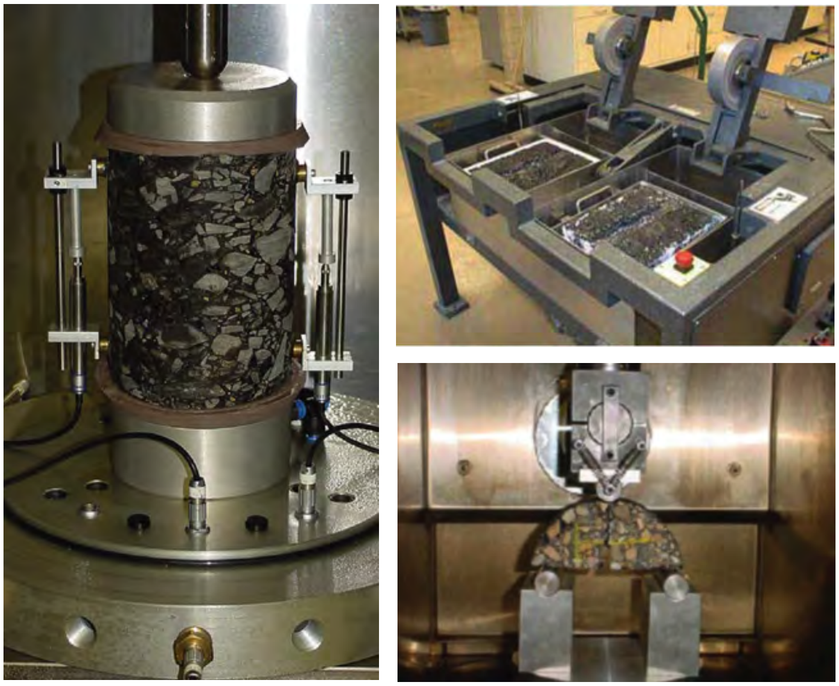
(b)

(c)

(d)

PHOTOS: LOUISIANA DOTD

Construction of asphalt-treated mixture (ATM) layers in Louisiana.



Photos: Louisiana Transportation Research Center

Comprehensive laboratory tests were conducted to evaluate a variety of ATMs.

Research

The Louisiana Department of Transportation and Development (DOTD) initiated research to develop a design methodology for ATMs that would be durable, stable, cost-effective, and environment friendly. Researchers examined eight aggregate sources and two types of asphalt binders and conducted comprehensive laboratory tests to characterize the behavior of the mixture designs.

Results

The research findings contributed to the development of a guideline for designing low-cost ATMs. The guideline recommends a maximum aggregate absorption of 2 percent and micro-Deval loss values of 18 percent. In addition, the power coefficient that describes the gradation curve of the aggregate blend should be at least 0.2; the aggregate blend should be 75 percent 1.5-inch crushed-run aggregate material and 25 percent coarse sand. Also recommended are a maximum rut depth of 0.48 inches on the Hamburg loading wheel test (LWT), a minimum indirect tensile strength (ITS) of 150 psi, and a minimum toughness index value of 0.65.

The results of the LWT, ITS, and flow number tests showed that the ATMs designed with the methodology developed for this project had a laboratory performance similar to that of conventional base course HMA mixtures at high and intermediate temperatures. In addition, the asphalt-treated base mixtures demonstrated a several-fold improvement over unbound granular base materials in stiffness and in permanent deformation resistance. Replacing the unbound granular material with ATMs in a base layer reduced the total pavement rutting by more than 33 percent (2).

Applications

◆ *Roadway shoulders.* Louisiana DOTD implemented the research findings to design ATMs for four overlay rehabilitation projects. In each project, a 1-

TABLE 1 Properties for ATM Mixtures Used in the Field

Mixture Designation	ATM 1	ATM 2	ATM 3	ATM 4	Conventional HMA
Aggregate blend	75% LS 25% CS	75% LS 25% CS	75% NV 25% CS	60% LS 20% RAP 20% CS	44% #67 LS 16% #78 LS 31% #11 LS 9% CS
Binder type	PG 70-22M	PG 64-22	PG 70-22M	PG 70-22M	PG 70-22M
Binder content (%)	3.0	3.0	3.0	3.0	4.0
Design air void (%)	8.0	9.0	10.4	6.7	3.7
Film thickness (m)	3.39	6.15	1.02	3.73	8.2
Permeability (10^{-4} mm/s)	30	98	352	33	44
Tensile strength ratio (%)	84	52	76	100	83
Rut depth in LWT (mm), 50°C, wet	3.6	22	5.3	2.6	5.7
Dissipated strain creep energy (kJ/m^3)	1.48	1.34	0.2	0.84	2.52
LFWD modulus (ksi)	NA	114	86	107	105
PSPA modulus (ksi)	1936	1717	1688	1877	1862

Note: LS = limestone, CS = coarse sand, NV = navoculite, RAP = reclaimed asphalt pavement, LWT = loading wheel tester, LFWD = light falling weight deflectometer, NA = not available, PSPA = portable seismic pavement analyzer.

TABLE 2 Results of MEPDG Analysis

MEPDG Performance Parameter	Section 1 (ATM 1)	Section 2 (ATM 4)	Section 3 (HMA)
Rutting (mm)	1.05	1.12	1.15
Fatigue cracking (%)	0.9	1.1	1.1
International Roughness Index (in./mi)	140	139	143

mile section of the roadway lane shoulder was constructed with ATMs that were produced in the HMA plants and constructed in the field. The ATMs exhibited in situ moduli similar to those of conventional HMA base course mixtures, as shown in Table 1 (page 38). The implementation projects showed that the ATMs also have potential for use in the construction of HMA base course layers of pavement structures.

◆ *Low-volume roads*. The designed ATMs also were evaluated in low-volume roads with traffic of less than 1,000 vehicles per day. The results showed that the mechanistic properties and the performance of ATMs were similar to those of the asphalt mixtures typically used in low-volume roads.

Researchers used the *Mechanistic–Empirical Pavement Design Guide* (MEPDG) software to compare the performance of the low-volume pavement sections incorporating ATMs to those with a conventional HMA mixture. The mechanistic properties and the performance of the ATMs were similar to those of the low-volume pavement structures with conventional HMA mixtures (see Table 2, above).

Benefits

The results show that the ATMs designed in this research project perform comparably to conventional low-volume HMA mixtures. ATMs moreover have the following advantages:

◆ The materials cost of the designs developed for this project was approximately $7.20 less per ton than that of conventional low-volume HMA mixtures. This reduced the price of materials by 16 percent.

◆ The life-cycle assessment showed that in low-volume roads, the new generation of ATMs, compared with conventional HMA mixtures, reduces energy consumption by up to 29 percent, water consumption by 39 percent, and hazardous waste generation by 42 percent (see Table 3, below) (3).

For more information, contact Louay N. Mohammad, Professor, Louisiana State University, LTRC Building, 4101 Gourrier Avenue, Baton Rouge, LA 70808; 225-767-9126; louaym@lsu.edu.

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EDITOR'S NOTE: Appreciation is expressed to Stephen F. Maher and G. P. Jayaprakash, Transportation Research Board, for their efforts in developing this article.

Suggestions for Research Pays Off topics are welcome. Contact G. P. Jayaprakash, Transportation Research Board, Keck 488, 500 Fifth Street, NW, Washington, DC 20001 (202-334-2952; gjayaprakash@nas.edu).

TABLE 3 Life-Cycle Cost Assessment Results for Low-Volume Sections

	Section 1 (ATM 1)		Section 2 (ATM 4)		Section 3 (HMA)
Environmental Variable	Total	Difference (%)	Total	Difference (%)	Total
Energy (MJ)	1,637,890	–29	1,879,443	–18	2,301,874
Water consumption (kg)	421	–39	508	–26	688
CO_2 (Mg)	92	–29	106	–18	130
RCRA hazardous waste generated (kg)	15,035	–42	18,450	–29	26,102

Note: RCRA = Resource Conservation and Recovery Act.

Jean-Louis Briaud

Texas A&M University

From developing barriers that can withstand the impact of a speeding 18-wheeler to reinforcing eroding cliffs in Normandy, France, Jean-Louis Briaud focuses his research on geotechnical engineering. The Spencer J. Buchanan Chair in Civil Engineering at Texas A&M University, Briaud counts foundation engineering, bridge scour, levee erosion, unsaturated soil mechanics, in situ and field testing, shrink–swell clays, risk analysis, and roadside safety among his geotechnical interests.

Briaud also is director of a U.S. National Geotechnical Experimentation Site for the National Science Foundation and the Federal Highway Administration and manages the Geotechnical and Geoenvironmental Engineering Program at the Texas A&M Transportation Institute. He consulted on foundation stability for the rebuilt Woodrow Wilson Bridge in Washington, D.C., and was part of an independent levee investigation team that studied the levee failures in New Orleans, Louisiana, during Hurricane Katrina.

"The number of bridges that collapsed from scour each year in the United States was around 26 from 1965 to 1995, but research efforts have brought that number down to 3 per year. That's a major payoff."

"Only by having a very active research community can we hope to have a big payoff," Briaud observes. "The payoff is not just measured in cost savings for the same level of safety, or in increased safety at the same cost, but also in sharper students ready for the work force, energized faculty members, and even employed citizens."

Born in La Rochelle, France, Briaud received his bachelor's degree from the Ecole Speciale des Travaux Publics in Paris in 1972. He traveled to Canada for graduate school, receiving a master's degree from the University of New Brunswick in 1974. Briaud then completed his military service and, in 1978, received a Ph.D. from the University of Ottawa. The same year, he moved to the United States to join the Texas A&M University faculty as assistant professor. He took the position of Buchanan chair of the Zachry Department of Civil Engineering in 2002.

Studying bridge scour is a matter of safety. "Scour is the number one cause of bridge failures in the United States," Briaud comments. He notes that, according to records in the National Bridge Scour Database, degradation from flowing water has been the culprit in nearly 60 percent of bridge failures. "The number of bridges that collapsed from scour each year in the United States was around 26 from 1965 to 1995, but research efforts have brought that number down to 3 per year. That's a major payoff."

In his research on the erosion of the levee materials during Hurricane Katrina, Briaud and his team analyzed soil samples from various levees and used the Erosion Function Apparatus, which he patented, to determine the speed of surface erosion as a function of water velocity. Site-specific soil tests helped to establish the potential for erosion of the soils around the levees.

Briaud advises young engineers to stay positive, be fair and curious, look for solutions, and communicate with colleagues. "Try to innovate in your work," he adds. "The discovery process is satisfying in itself, but the discovery itself is priceless."

In 1992, Briaud wrote *The Pressuremeter*; his new book, *Introduction to Geotechnical Engineering: Unsaturated and Saturated Soils*, is forthcoming. He has published approximately 300 journal articles, conference papers, and research reports and has produced more than a dozen software packages and has managed more than 60 research projects on subjects from foundations to pavements to software development to scour. He also has chaired three international conferences and has delivered more than 150 lectures worldwide.

At TRB, Briaud served on the Foundations of Bridges and Other Structures Committee from 1984 to 1996. From 2002 to 2010, he served on the Hydrology, Hydraulics, and Water Quality Committee and on a National Cooperative Highway Research Program project panel on riprap design. He is president of the International Society for Soil Mechanics and Geotechnical Engineering, past president of the Geo-Institute of the American Society of Civil Engineers (ASCE), and past president of the United States University Council on Geotechnical Education and Research.

Briaud's innovative contributions to geotechnical research have earned him the Ralph B. Peck Lecture Award, the Martin Kapp Award, and the Huber Research Prize from ASCE; the G. Geoffrey Meyerhof Award from the Canadian Geotechnical Society; and the Hogentogler Award from the American Society for Testing and Materials. Briaud is a registered Professional Engineer in the state of Texas.

Ronald C. Hall

Colorado State University and Bubar & Hall Consulting, LLC

Ronald C. Hall observes that, in tribal policy, transportation is not always a high-profile or glamorous subject—but its significance to the health, safety, and vitality of tribal communities is paramount. "Effective transportation infrastructure is critical for any economy to exist and to remain vital," Hall asserts. "One cannot effectively support tribal communities without engaging and collaborating with local, state, and federal partners."

Research scientist and director of the Tribal Technical Assistance Program (TTAP) at Colorado State University, Fort Collins, Hall has dedicated his career to supporting tribal communities. After graduating from Augustana College with a bachelor's degree in criminal justice studies and sociology, he received a J.D. degree from William Mitchell College of Law in St. Paul, Minnesota. Hall's early work as a law clerk addressed such issues as tribal governmental powers, natural resources, child welfare, education, and federal and state highway programs.

"Adding tribal government perspectives to the state, regional, and national dialogue will improve the opportunities for tribes to participate fully in the complex issues being decided and to improve the cultural competence of everyone involved."

In 1986, Hall joined Fredericks & Pelcyger, a firm specializing in Native American legal issues, as an associate. He also served as executive director for the National Indian Contractors' Association from 1985 to 1988, working with Native American business owners to monitor and comment on federal legislative and regulatory actions. Hall then established and managed the legal department for a surety bond management corporation, ran a solo law practice, and joined the federal Indian law practice of Gover, Stetson, and Williams, P.C., as associate attorney in 1991. From 1989 to 1994, he served as general counsel for Transportation Associates, Inc., a Native American–owned consulting corporation. Today, Hall is an expert in Native American transportation law and policy.

Hall earned certification in mediation from the University of New Mexico Law School in 1989. As president of Bubar & Hall Consulting, LLC, a Native American–owned firm founded in 1993, he mediates disputes across jurisdictions and facilitates agreements to enhance communication, problem solving, and alternative dispute resolution. Hall brings together tribes and leaders from Department of Defense facilities for tribal consultations on cultural resource management.

"Adding tribal government perspectives to the state, regional, and national dialogue will improve the opportunities for tribes to participate fully in the complex issues being decided and to improve the cultural competence of everyone involved," Hall comments.

Since 1994, Hall has served as director and principal investigator of TTAP, leading a program that meets the training, technical assistance, and technology transfer needs of tribal transportation programs in Colorado, New Mexico, Arizona, and Utah. He develops and conducts transportation-related training for tribes and for federal, state, and local partners and has coordinated the National Tribal Transportation Conference since 1998.

Most tribal governments began managing and operating transportation activities after the passage of the Intermodal Surface Transportation Efficiency Act of 1991. "Since that time, tribes quickly have come to appreciate the value of this infrastructure to their people, economies, environment, and overall quality of life," Hall comments. Opportunities created by transportation management include job creation and economic development; the exercise of tribal jurisdiction over public safety, environmental, and other matters; community involvement in long-range planning; and public works projects that can incorporate tribal culture. He notes that, because most tribes have not yet developed the legal and regulatory infrastructure to administer tribal programs effectively, the strings that come with federal dollars sometimes require negotiation between tribes and federal, state, and local agencies.

Hall joined TRB's Historic and Archeological Preservation in Transportation Committee in 1999. In 2001, he founded the Native American Transportation Issues Committee, which he chaired until 2007 and still serves. He also chairs a National Cooperative Highway Research Program panel on public involvement strategies between transportation agencies and tribal communities.

The author of the forthcoming *Tribal Transportation: Native American Profiles*, Hall has addressed such topics in his research as transportation issues on tribal land, communication between transportation agencies and tribal communities, and environmental research needs in transportation. He received the Multiethnic Distinguished Service Award from Colorado State University in 2012 and the Federal Highway Administrator's Service Award in 2008. His work has been recognized by the U.S. Department of Transportation, the U.S. Air Force, the Navajo Nation, and the American Indian Council of Architects and Engineers.

The effects of pavement deflection and road roughness can consume up to 9,000 extra gallons of fuel per lane-mile per year on high-volume roads.

Photo: Christopher Ziemnowicz

Stiffer Pavements May Reduce Fuel Consumption

Using mathematical models to examine the effect of pavement deflection on vehicle fuel consumption, researchers at the Massachusetts Institute of Technology (MIT) Concrete Sustainability Hub have determined that using stiffer pavements on roadways can reduce fuel consumption by as much as 3 percent.

The study defines key parameters in analyzing the structural and material properties of pavements. The model, which was based on the actual mechanical behavior of pavements under load, analyzed data from more than 5,600 representative road sections in Federal Highway Administration data sets. Researchers found that the maximum deflection of a load is behind the path of travel—meaning that a vehicle's tires are always driving up a slight slope. The combined effects of deflection and road roughness can consume an additional 7,000–9,000 gallons of fuel per lane mile per year on high-volume roads.

For more information, see http://web.mit.edu/press/2012/pavement-savings-tires.html.

Ports and Waterways, Airports Facing Investment Gap

Projections from the American Society of Civil Engineers (ASCE) show a $16 billion investment gap in U.S. marine ports and inland waterways and a $19 billion investment gap in airports between now and 2020. According to the report, an anticipated $30 billion is needed for ports and waterways infrastructure, while planned expenditures are about $14 billion; for airports, projected spending is $95 billion and estimated investment needs are approximately $114 billion plus $20 billion to implement NextGen, the state-of-the-art air traffic control system. The ASCE report's projections assume needs and funding based on current trends and do not adjust for possible costs associated with climate change, changes in regulations, or other factors.

Commercial ports, inland and intracoastal waterways, and lock chambers carry more than 70 percent of U.S. imports by tonnage and more than half of the nation's imports by value, according to the report. The scheduled expansion of the Panama Canal by 2015 likely will lead to a significant increase in the average size of container ships and to such modernization projects as harbor and channel dredging at many major U.S. ports. Inland waterways also will require new or rehabilitated lock and dam facilities.

Photo: Dallas–Fort Worth International Airport

An ASCE report estimates a $19 billion investment gap in airports between now and 2020.

Passenger traffic at airports in the 15 major metropolitan U.S. markets is expected to more than double by 2040, according to the ASCE report. Freight shipments by air are expected to grow by more than 50 percent by 2020, and costs attributable to airport congestion will rise from $24 billion in 2012 to $34 billion in 2020 to a projected $63 billion by 2040.

Costs attributable to delays in the nation's inland waterways system were $33 billion in 2010 and are expected to increase to nearly $49 billion by 2020. By closing the investment gap, researchers state, $270 billion in U.S. exports can be protected, along with $697 billion in gross domestic product (GDP), 738,000 jobs per year, and $872 billion in personal income. Additional investment in airports and the development of NextGen can protect $54 billion in exports, $313 billion in GDP, 350,000 jobs, and $361 billion in personal income.

For the full report, visit www.asce.org/failuretoact.

Shipper Installs Solar Array

Old Dominion Freight Line, Inc., installed a 1.8 megawatt photovoltaic (PV) array on the roof of one of its warehouses in Thomasville, North Carolina, to produce more than 2.2 million kilowatt hours of electricity per year. With 7,600 individual solar panels, it is the third largest roof-mounted PV system in the state and produces enough energy to offset more than 90 percent of the building's electricity consumption. The system was built by SunEnergy1.

The freight company has deployed other sustainable initiatives, including energy-efficient bulbs at company service centers, as well as technologies for emissions reduction and fuel efficiency in its fleet of more than 5,800 vehicles. A Leadership in Energy and Environmental Design–certified service center was opened in Ohio last year.

For more information, visit www.odfl.com or call 800-432-6335.

INTERNATIONAL

European Research Groups Form Alliance

Five major European transportation research groups have formed the European Transport Research Alliance (ETRA), an initiative supported by the European Commission and developed under a European Union–funded project. The coalition includes the European Conference of Transport Research Institutes (ECTRI); the European Rail Research Network of Excellence; the Human-Centered Design Network for Information Society Technologies; the Forum of European Road Safety Institutes; and the Forum of European National Highway Research Laboratories (FEHRL), which coordinated the initiative. ETRA will work to facilitate organizational cooperation and the integration of European transportation research, creating the European Research Area.

Objectives of the new alliance include promoting the exchange of knowledge and the implementation of research results; setting joint transportation research priorities and coordinating programs and initiatives; developing crossmodal and interdisciplinary joint research activities; preparing common position papers on key transportation issues; strengthening European research expertise, research infrastructures, and researcher mobility; and promoting European transportation innovation internationally. The coalition also will support and develop the biennial Transport Research Arena Conference. George A. Giannopoulos, Hellenic Institute of Transport, is chair of ETRA.

For more information, contact Steve Philips, FEHRL, Bd de la Woluwe 42/B3, 1200 Brussels, Belgium, at steve.phillips@fehrl.org or 011-32-2-775-82-38.

PHOTO COURTESY FEHRL

Presidents of the groups comprising ETRA at the signing ceremony for the alliance.

Marine Board Welcomes New Members

At the 2012 fall meeting of the Marine Board in Seattle, Washington, outgoing chair Michael Bruno, Stevens Institute of Technology, passed the gavel to incoming chair Thomas Leschine, University of Washington. Vice Admiral James Card, U.S. Coast Guard, Retired, is the new vice chair. The board also welcomed three new members:

Jeanne M. Grasso is a partner at Blank Rome in the firm's Washington, D.C., office. She focuses her practice on maritime, international, and environmental law for clients worldwide, counseling owners and operators of vessels, cargo owners, and facilities, including marine-side and inland manufacturing facilities. Her practice offers compliance counseling for federal and state agencies such as the Coast Guard, the Environmental Protection Agency, U.S. Customs and Border Protection, and the Maritime Administration; maritime environmental compliance and training; pollution incident response; coastwise trade matters; and maritime and chemical security compliance and training. Before joining Blank Rome, Grasso worked in the Office of Congressional Affairs at the National Oceanic and Atmospheric Administration and as staff to the House Committee on Merchant Marine and Fisheries.

Karlene H. Roberts is Professor Emeritus at the Walter A. Haas School of Business at the University of California, Berkeley, where she has taught since 1969. Roberts was chair of the Organizational Behavior and Industrial Relations Group, Associate Dean and Director of the Undergraduate School of Business Administration, and a research psychologist in the Institute of Industrial Relations. She has consulted for many public- and private-sector clients, among them the U.S. Department of the Navy, the Coast Guard, the U.S. Department of the Interior, Siemens Worldwide, Kansai Electric Power Company, and BP. She has served on many National Research Council study committees on topics including human performance, organizational systems, and safety; federal facilities asset management, navigation and piloting; security; and human–systems integration.

After a 38-year career, **Elmer (Bud) Danenberger** retired in 2010 from the U.S. Department of the Interior, Minerals Management Service. For the 6 years before his retirement, he served as chief of Offshore Regulatory Programs, overseeing safety, environmental, and conservation standards for offshore oil and gas operations; regulatory, enforcement, and engineering programs for oil and gas operations in federal waters; standards, regulations, and monitoring programs for renewable energy and alternate uses of offshore facilities; management of research programs to assess petroleum and renewable energy development capabilities and risks; the direction of accident investigations; and the coordination of offshore and regulatory activities. Danenberger has worked in all four U.S. regions of the outer continental shelf: the Gulf of Mexico, Alaska, the Pacific, and the Atlantic.

Presentations from the workshop are available on the TRB website at www.TRB.org/Conferences/ArcticNav2012.aspx.

At the Marine Board's fall meeting, board members and liaisons took a tour of the *Polar Star*, a U.S. Coast Guard icebreaker currently being overhauled at a Seattle shipyard. Attendees included (*left to right:*) Karlene Roberts; Mary Brooks; Kevin Knight; Donald Liu; Brie Schwartz, TRB staff; Michael Bruno, Marine Board Chair; Tom Leschine, Marine Board Vice Chair; Rajiv Khandpur; George Pellissier, commanding officer of the *Polar Star*; and Joedy Cambridge, TRB Senior Program Officer. The October meeting was preceded by a 2-day workshop focused on navigation safety in the Arctic.

International Forum Showcases Geotechnical Research

TRB cosponsored the Second International Conference on Transportation Geotechnics in Sapporo, Hokkaido, Japan, in September. Organized by the Hokkaido Branch and several technical committees of the International Society for Soil Mechanics and Geotechnical Engineering, in association with the Japanese Geotechnical Society, the conference addressed geotechnical issues to facilitate efficient design, construction, and maintenance of the transportation infrastructure. More than 240 attendees from 30 countries exchanged experiences and views and identified needs for future research and development.

Preconference workshops included the following:

- ◆ Intelligent Compaction: Current Status in Europe, North America, and Japan;
- ◆ Challenges for Transportation Geotechnics in Extreme Climates, with featured presentations on frost protection design in cold regions and on the effect of moisture on the behavior of soils and aggregates in transportation infrastructure; and
- ◆ Geotechnical Challenges in Rail Track and Its Transition Zones, addressing ways to minimize or remediate problems related to railway transition zones.

Erol Tutumluer, chair of the TRB Mineral Aggregates Committee, shares research on "Sustainable Pavement Construction Utilizing Engineered Unbound Aggregate Layers" at the Sapporo conference.

In addition to the 140 paper presentations during the conference, seven special lectures covered trends and challenges in transportation earthworks, behavior of volcanic soils during earthquakes, improvement of rail ballast, geosynthetic-reinforced soil structures for roads and railways, sustainable pavements with engineered unbound aggregate layers, thermomechanical properties of asphalt mixtures, and soil suction measurements.

SECOND STRATEGIC HIGHWAY RESEARCH PROGRAM NEWS

Training Course to Debut for Traffic Incident Management

Managing traffic incidents can be dangerous. Between 2003 and 2007, 59 law enforcement, 12 fire and rescue, and 54 highway management personnel died after being struck by vehicles along U.S. highways. Risk of additional crashes increases during the time required to clear the first incident.

To improve traffic incident management, the second Strategic Highway Research Program (SHRP 2) has developed a multidisciplinary training course for responders. The course establishes a foundation for achieving three goals: responder safety; safe, quick clearance; and prompt, reliable, interoperable communications.

SHRP 2 has pilot-tested the multidisciplinary course in six states, conducting the final pilot in Knoxville, Tennessee, in September. Bringing together responders from different disciplines—law enforcement, fire and rescue, emergency medical services, towing and recovery, notification and dispatch, and the U.S. Department of Transportation (DOT)—helps participants learn a common set of core competencies and promotes a shared understanding of national goals.

PHOTO: SHRP 2

A course on multidisciplinary incident response training, developed by SHRP 2, was tested successfully in six states and is being promoted nationwide by FHWA.

"We're trying to have everybody understand what everybody else does—to have the police understand what the tow truck drivers do, have the fire people understand what the DOT does," said David Plazak, SHRP 2 Senior Program Officer.

The course will be implemented nationwide by the Federal Highway Administration.

COOPERATIVE RESEARCH PROGRAMS NEWS

Model for Incorporating Slab and Underlying Layer Interaction into MEPDG Concrete Pavement Analysis Procedures

In jointed plain concrete pavements and continuously reinforced concrete pavements, the concrete slab is placed on a base layer that may consist of a variety of unbound and bound materials. Overlays also are placed over asphalt, concrete, and composite pavements for rehabilitation.

The American Association of State Highway and Transportation Officials' (AASHTO's) *Mechanistic–Empirical Pavement Design Guide Manual of Practice* and associated software provide a methodology for the analysis and performance prediction of concrete pavements and overlays. All aspects of the interaction between the concrete slab and underlying layer—such as incremental change in the level of friction or bonding during the pavement service life and differences in the level of bonding—must be considered to prevent under- or overdesigned pavement structure.

The University of Minnesota has received a $449,998, 30-month contract [National Cooperative Highway Research Program (NCHRP) Project 1-51, FY 2012] to develop a mechanistic–empirical model and associated computational software for the interaction between the concrete slab and underlying layer and the effect of this interaction on pavement performance.

For further information, contact Amir N. Hanna, TRB, 202-334-1432, ahanna@nas.edu.

Developing Precision and Bias Statements for AASHTO Standard Methods of Test

Mitigation of tire–pavement noise is important to highway agencies. Although noise barriers have been in use for many years as a mitigation measure, advances have been made in quiet pavement technology. Methods for measuring the effect of these technologies on tire–pavement noise, traffic noise, and vehicle noise have been introduced in AASHTO's *Standard Specifications for Transportation Materials and Methods of Sampling and Testing*. The test methods include TP 76, TP 98, and TP 99. Precision and bias statements defining limits on precision repeatability and reproducibility have been developed for TP 76 under NCHRP Project 1-44(01), but no statements remain to be developed for TP 98 and TP 99.

HDR Engineering, Inc., of Minneapolis, Minnesota, has received a $450,000, 30-month contract (NCHRP Project 10-88, FY 2012) to develop precision and bias statements for AASHTO Standard Methods of Test TP 98 and TP 99. These statements will help define the extent of uncertainties associated with noise measurements, to improve interpretation of the results.

For further information, contact Amir N. Hanna, TRB, 202-334-1432, ahanna@nas.edu.

Strand Debonding for Pretensioned Girders

Strand debonding is an alternative for reducing stresses at the end regions of pretensioned concrete

TRANSIT RESEARCH PROGRAMMING— Participants hear updates on the Transit Cooperative Research Program (TCRP) at a meeting of the TCRP Oversight and Project Selection Committee, October 25, at the National Academies' Keck Center in Washington, D.C. The committee met to select TCRP research projects for 2013.

beams. Because of the detrimental effects of excessive debonding on shear performance, the AASHTO *Load and Resistance Factor Design (LRFD) Bridge Design Specifications* currently limit the amount of partial debonding to 25 percent of the total strand area within a pretensioned girder. Several states, however, allow significantly higher percentages of debonding—up to 75 percent—that are based on successful past practices. A comprehensive study of partial debonding effects on the performance of pretensioned girders is needed.

The University of Cincinnati has received a $650,000, 36-month contract (NCHRP Project 12-91, FY 2012) to develop a recommended revision to the debonding provisions in AASHTO's *LRFD Bridge Design Specifications* and *LRFD Bridge Construction Specifications*. The proposed revisions shall consider service and strength limit states for strand debonding within pretensioned flexural superstructure members.

For further information, contact Waseem Dekelbab, TRB, 202-334-1409, wdekelbab@nas.edu.

Development of Bridge Foundation Movement Criteria

When designing bridge foundations, geotechnical engineers estimate foundation movements and report the findings to the bridge designer, who then evaluates total movements—including differential movements. The current AASHTO *LRFD Bridge Design Specifications* do not provide clear criteria for movement limitations, however. Clear criteria and guidance are needed to ensure more efficient bridge designs while protecting the short and long-term integrity of structures.

North Dakota State University has received a $350,000, 30-month contract (NCHRP Project 24-38, FY 2012) to develop a framework for determining acceptable levels of bridge foundation movements based on structure tolerance to total and differential movements, considering service and strength limit states, and to propose revisions to the *LRFD Bridge Design Specifications*.

For further information, contact Waseem Dekelbab, TRB, 202-334-1409, wdekelbab@nas.edu.

Culvert and Storm Drain Inspection Manual

In 1986, the Federal Highway Administration (FHWA) developed a comprehensive program to identify, quantify, and rate culverts, which resulted in the *Culvert Inspection Manual*. An updated publication is needed to incorporate new pipe products—such as materials, coatings, and rehabilitative linings—and to include new inspection guidelines and procedures for culverts and storm drain systems. Advances in inspection techniques, facilities for aquatic organism passage, and other elements of storm drain systems such as headwalls, wingwalls, and junctions must be addressed.

Simpson Gumpertz & Heger, Inc., has received a $250,000, 27-month contract (NCHRP Project 14-26, FY 2012) to develop an inspection manual for assessing the condition of in-service culvert and storm drain systems.

For further information, contact Waseem Dekelbab, TRB, 202-334-1409, wdekelbab@nas.edu.

PHOTO: WASHINGTON STATE DOT

In 2011, Washington State DOT concluded a project to replace a long, narrow, round culvert with a larger, fish-friendly box culvert. The inside of the new culvert mimics a natural streambed with rocks, gravel, and sand.

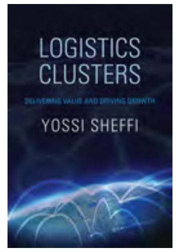
Guidance for Applying the State of Good Repair Prioritization Framework and Tools

Keeping public transportation systems in a state of good repair is essential to sustaining transportation services, providing mobility, and supporting livable communities. Transit agencies have many assets to maintain—buses, facilities, rail cars, stations, fixed guideways, supporting systems, and more. Without adequate funds, many transit agencies could suffer significant reductions in system reliability, which can restrict transit service.

Spy Pond Partners has received a $350,000, 15-month contract (TCRP Project E-09A, FY 2012) to develop guidance for applying the framework and tools developed in TCRP Project E-09, *State of Good Repair: Prioritizing the Rehabilitation and Replacement of Existing Capital Assets and Evaluating the Implications for Transit*, to evaluate and prioritize capital investments in transit assets for achieving a state of good repair.

For further information, contact Dianne S. Schwager, TRB, 202-334-2969, dschwager@nas.edu.

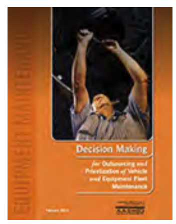
Logistics Clusters: Delivering Value and Driving Growth



Yossi Sheffi. MIT Press, 2012; 304 pp.; $29.95; 978-02-6201-845-6.

This volume provides an in-depth look at the development of logistics clusters—geographically concentrated sets of logistics-related companies and distributors and the logistics functions of retailers and manufacturers. Drawing on interviews and on data from logistics hubs around the world, the book documents the history and characteristics of successful logistics clusters and makes the case for developing and investing in the approach.

Outsourcing and Privatization of Vehicle and Equipment Fleet Maintenance



American Association of State Highway and Transportation Officials (AASHTO), 2012; 92 pp.; AASHTO members, $50; nonmembers, $60; 15-6051-531-9.

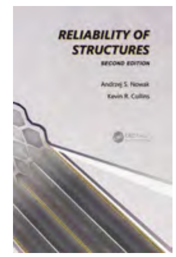
This report offers a framework for conducting systematic analysis and making decisions on the outsourcing and privatization of vehicle and equipment fleet maintenance. A decision process model, which can be applied to a range of outsourcing alternatives, is presented as a step-by-step process focusing on the unique features of state department of transportation (DOT) fleet maintenance.

Manual for Emulsion-Based Chip Seals for Pavement Preservation

AASHTO, 2012; 52 pp.; AASHTO members, $25; nonmembers, $30; 15-6051-530-2.

This manual addresses the factors affecting chip performance, examines design and construction considerations, and identifies procedures for selecting appropriate chip seal materials. The manual provides highway agencies with the information necessary for designing and constructing long-lasting chip seals and preserving pavements.

Reliability of Structures, Second Edition



Andrzej S. Nowak and Kevin R. Collins. CRC Press, 2012; 407 pp.; $99.95; 978-04-1567-575-8.

The authors explore the value of reliability as a dimension of structural design. Presented are the concepts of limit states and limit state functions, methodologies for calculating reliability indices and calibrating partial safety factors, and the probability distributions and parameters used to characterize applied loads and member resistances are described. This revised second edition expands the discussion of U.S. and international codes and of Monte Carlo simulation.

The books in this section are not TRB publications. To order, contact the publisher listed.

TRB PUBLICATIONS

Human Factors Guidelines for Road Systems, Second Edition
NCHRP Report 600

This report completes and updates the first edition of NCHRP Report 600, published previously in three collections. The focus is on specific, actionable design principles supported by a discussion and review of key research and analyses. Special design issues and considerations are presented to address design constraints and trade-offs.

2012; 301 pp.; TRB affiliates, $59.25; nonaffiliates, $79. Subscriber categories: design; safety and human factors.

Guidebook for Sustainability Performance Measurement for Transportation Agencies
NCHRP Report 708

The underlying principles of sustainability as related to transportation, the possible goals that can be used to address those principles, and performance measures that can be used to address those goals are described. The printed guidebook includes a reference compendium of performance measures on a CD-ROM.

2011; 191 pp.; TRB affiliates, $51; nonaffiliates, $68. Subscriber categories: planning and forecasting; environment; society.

Investigation of Short-Term Laboratory Aging of Neat and Modified Asphalt Binders
NCHRP Report 709

A proposed test method that uses the modified German rotating flask as an alternative to the rolling thin film oven test is presented for laboratory aging of asphalt binders.

2011; 68 pp.; TRB affiliates, $36.75; nonaffiliates, $49. Subscriber categories: highways; materials.

TRB PUBLICATIONS *(continued)*

Practical Approaches for Involving Traditionally Underserved Populations in Transportation Decision Making
NCHRP Report 710

This toolkit comprises effective practices, tools and techniques, and data sources for transportation agencies and practitioners to foster meaningful involvement of underserved populations—particularly minority, low-income, limited English proficiency, and low-literacy groups—in transportation decision making.

2012; 508 pp.; TRB affiliates, $71.25; nonaffiliates, $95. Subscriber category: society.

Engineering Economic Analysis Practices for Highway Investment
NCHRP Synthesis 424

This synthesis explores how U.S. transportation agencies have applied engineering economics—benefit–cost analyses and similar procedures—to decisions on highway investments.

2012; 118 pp.; TRB affiliates, $45; nonaffiliates, $60. Subscriber categories: administration and management; economics; highways.

Waterproofing Membranes for Concrete Bridge Decks
NCHRP Synthesis 425

This update to NCHRP Synthesis 220 documents information on materials, specification requirements, design details, application methods, system performance, and costs of waterproofing membranes used on new and existing bridge decks since 1995.

2012; 55 pp.; TRB affiliates, $34.50; nonaffiliates, $46. Subscriber categories: bridges and other structures; highways; maintenance and preservation.

Traveler Response to Transportation System Changes: Chapter 16, Pedestrian and Bicycle Facilities
TCRP Report 95

This report covers traveler response to nonmotorized transportation (NMT) facilities, focusing on the travel behavior and public health implications of pedestrian and bicycle systems; NMT-link and node-specific facilities; and pedestrian- and bicycle-friendly neighborhoods, policies, programs, and promotion.

2012; 490 pp.; TRB affiliates, $73.50; nonaffiliates, $98. Subscriber categories: planning and forecasting; public transportation; pedestrians and bicyclists; operations and traffic management.

Guide for Implementing Bus-on-Shoulder Systems
TCRP Report 151

Guidelines for the planning, design, and implementation of bus-on-shoulder operations along urban freeways and major arterials are presented in this report.

2012; 119 pp.; TRB affiliates, $45; nonaffiliates, $60. Subscriber categories: public transportation; planning and forecasting.

Ridesharing as a Complement to Transit
TCRP Synthesis 98

This synthesis offers ways to enhance ridesharing and public transit and outlines current practices that use ridesharing as a complement to transit.

2012; 62 pp.; TRB affiliates, $36; nonaffiliates, $48. Subscriber categories: policy; public transportation.

Uses of Social Media in Public Transportation
TCRP Synthesis 99

This synthesis explores the use of social media—blogs, Facebook, LinkedIn, Twitter, YouTube, Flickr, and other web-based applications—by transit agencies in the United States and Canada.

2012; 57 pp.; TRB affiliates, $36; nonaffiliates, $48. Subscriber categories: data and information technology; public transportation; society.

Airport Apron Management and Control Programs
ACRP Report 62

The effectiveness of apron management programs is analyzed by comparing U.S. programs to those in airports around the world, with consideration of the operational and ownership differences between U.S. and foreign airports.

2012; 56 pp.; TRB affiliates, $36; nonaffiliates, $48. Subscriber category: aviation.

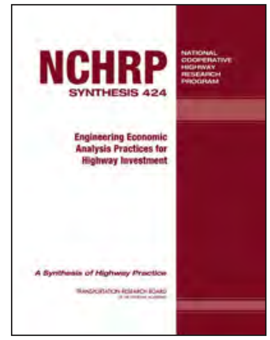
Measurement of Gaseous Hazardous Air Pollutants (HAP) Emissions from Idling Aircraft as a Function of Engine and Ambient Conditions
ACRP Report 63

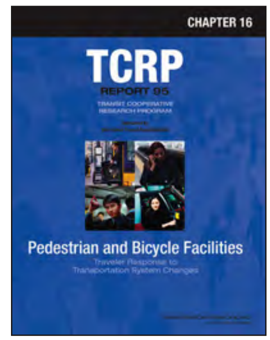
Drawing on specific aircraft operating parameters and changes in ambient conditions, this volume offers ways to improve the assessment of HAP emissions at airports.

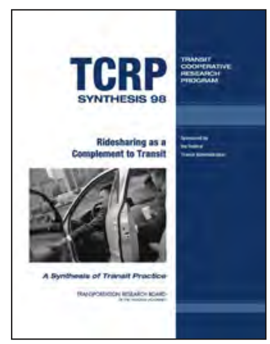
2012; 101 pp.; TRB affiliates, $42.75; nonaffiliates, $57. Subscriber categories: aviation; energy; environment.

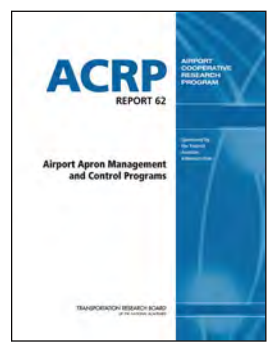
Considering and Evaluating Airport Privatization
ACRP Report 66

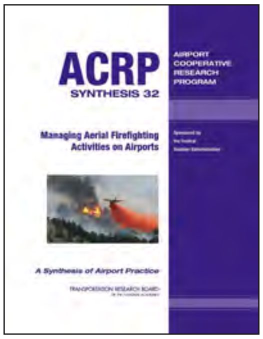
Advantages and disadvantages of various

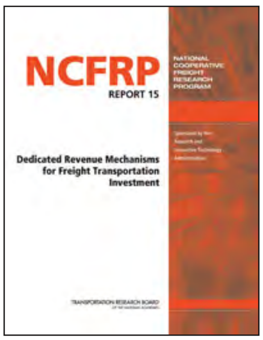


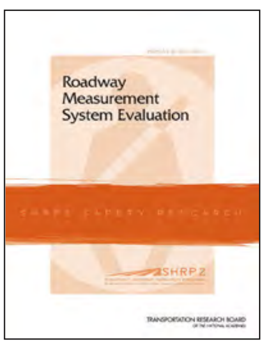












approaches to airport privatization are addressed in this report, which covers a range of potential privatization options and highlights case studies conducted at airports in the United States and abroad.

2012; 113 pp.; TRB affiliates, $52.50; nonaffiliates, $70. Subscriber categories: aviation; administration and management; finance.

Managing Aerial Firefighting Activities on Airports
ACRP Synthesis 32

This synthesis highlights airport and agency practices, policies, and procedures to support aerial wilderness firefighting efforts.

2012; 44 pp.; TRB affiliates, $32.25; nonaffiliates, $43. Subscriber categories: aviation; security and emergencies.

Airport Climate Adaptation and Resilience
ACRP Synthesis 33

Reviewed in this synthesis are risks to airports from projected climate change and the emerging approaches for handling these risks.

2012; 87 pp.; TRB affiliates, $42.75; nonaffiliates, $57. Subscriber categories: aviation; energy; environment.

Dedicated Revenue Mechanisms for Freight Transportation Investment
NCFRP Report 15

Methods for raising revenue to support government investment in freight transportation facilities—such as motor-vehicle fuel tax surcharges, vehicle registration fees, and distance-based road-user fees—are assessed in this report.

2012; 61 pp.; TRB affiliates, $36; nonaffiliates, $48. Subscriber categories: economics; finance; freight transportation.

Roadway Measurement System Evaluation
SHRP 2 Report S2-S03-RW-1

This report presents research to prequalify bidders on a SHRP 2 project on mobile data collection; to evaluate the precision and accuracy of mobile roadway and pavement inventory data collection services; and to produce a recommended list of roadway data elements and associated specifications to be collected.

2011; 26 pp.; web only. Available at http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-S03-RW-1.pdf.

Guide to Integrating Business Processes to Improve Travel Time Reliability
SHRP 2 Report S2-L01-RR-2

Designed to assist agencies seeking to improve travel time reliability, this guide identifies influences on process integration, defines common implementation obstacles, and outlines steps to implementing and institutionalizing procedures.

2011; 41 pp.; TRB affiliates: $30.75, nonaffiliates: $41. Subscriber categories: administration and management; operations and traffic management; highways. Available as e-book.

Preservation Approaches for High-Traffic-Volume Roadways
SHRP 2 Report S2-R26-RR-1

This report presents the state of the practice for preservation approaches for high-traffic-volume roadways and describes the development of preservation guidelines on the basis of assessments of traffic volume, pavement condition, environmental condition, costs, expected performance, and work zone requirements.

2011; 175 pp.; TRB affiliates: $51, nonaffiliates: $68. Subscriber categories: highways; maintenance and preservation; materials; pavement. Available as e-book.

Integrating Business Processes to Improve Travel Time Reliability
SHRP 2 Report S2-L01-RR-1

This project focused on identifying ways that agencies are integrating business processes to improve travel time reliability—process enablers; the roles of key players; recognized benefits; and how the process can be institutionally integrated into an agency.

2011; 78 pp.; TRB affiliates: $39, nonaffiliates: $52. Subscriber categories: administration and management; highways; operations and traffic management. Available as e-book.

Integration of Analysis Methods and Development of Analysis Plan
SHRP 2 Report S2-S02-RW-1

This report identifies and prioritizes key research questions related to the SHRP 2 naturalistic driving study and presents important research elements that must be addressed.

2012; 127 pp.; web only. Available at http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-S02-RW-1.pdf.

Research on Fatigue in Transit Operations
Conference Proceedings on the Web 7

This summary of an October 2011 conference highlights presentations on fatigue in transit operations and other transportation modes, health effects and safety impacts of fatigue, and related issues and

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TRB PUBLICATIONS *(continued)*

initiatives.

Available on the web at http://onlinepubs.trb.org/onlinepubs/conf/CPW7.pdf.

Structures 2011
Transportation Research Record 2251

Papers in this volume examine barge bow force–deformation for bridge design, an innovative vibration absorber, ultra-high-performance concrete beams, controlled low-strength material for use around buried pipelines, and more.

2011; 164 pp.; TRB affiliates, $52.50; nonaffiliates, $70. Subscriber category: bridges and other structures.

Energy and Global Climate Change 2011
Transportation Research Record 2252

Authors present research addressing such topics as California's low-carbon fuel standard, feebates and fuel economy standards, plug-in hybrid and battery electric vehicles, lithium ion batteries, natural gas as vehicle fuel, and climate action plans and long-range transportation plans.

2011; 160 pp.; TRB affiliates, $52.50; nonaffiliates, $70. Subscriber category: energy.

Geology and Properties of Earth Materials 2011
Transportation Research Record 2253

The compactability of recycled concrete aggregate, base material treated with asphalt emulsion, the corrosion potential of coarse backfill aggregates for mechanically stabilized earth walls, and other subjects are addressed in this volume.

2011; 80 pp.; TRB affiliates, $42; nonaffiliates, $56. Subscriber categories: geotechnology; materials; environment.

Travel Forecasting 2011, Vol. 1
Transportation Research Record 2254

Travel forecasting topics, from dynamic activity generation models to a multicriterion dynamic user equilibrium model to planning-constrained destination choice in activity-based models, are presented.

2011; 179 pp.; TRB affiliates, $56.25; nonaffiliates, $75. Subscriber category: planning and forecasting.

Travel Forecasting 2011, Vol. 2
Transportation Research Record 2255

Papers in this volume explore workplace choices and travel demand, the problem of transshipment in travel forecasting, bottleneck and queuing analysis, travel by university students, and more.

2011; 176 pp.; TRB affiliates, $55.50; nonaffiliates, $74. Subscriber category: planning and forecasting.

Urban and Traffic Data Systems
Transportation Research Record 2256

License plate image binarization, optimal paths in a public transit network, nonintrusive technologies for traffic detection, inductive loop detector sensitivity errors, the development of traffic inputs, and other topics are examined in this volume.

2011; 201 pp.; TRB affiliates, $53.25; nonaffiliates, $71. Subscriber categories: data and information technology; operations and traffic management.

Highway Capacity and Quality of Service 2011
Transportation Research Record 2257

Authors present research on developing capacity models for local roundabouts, estimation of work zone capacity, the development of managed-lane access guidelines, the capacity of multilane all-way stop-controlled intersections, and other topics.

2011; 130 pp.; TRB affiliates, $49.50; nonaffiliates, $66. Subscriber categories: operations and traffic management; planning and forecasting.

Maintenance Services and Surface Weather 2011
Transportation Research Record 2258

Addressed in this volume are spatial and temporal speed limit compliance, truck-mounted changeable message signs, speed levels of heavy vehicles on a mountain pass, and more.

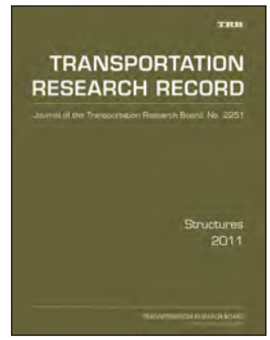
2011; 146 pp.; TRB affiliates, $52.50; nonaffiliates, $70. Subscriber categories: operations and traffic management; safety and human factors; maintenance and preservation.

Traffic Signal Systems 2011
Transportation Research Record 2259

Among the topics presented in this volume are traffic signal control, the benefit of retiming traffic signals, measuring signal phase utilization, intergreen times, automated intersection control, and wireless magnetometers.

2011; 263 pp.; TRB affiliates, $63.75; nonaffiliates, $85. Subscriber categories: operations and traffic management; safety and human factors.

The TRR Journal Online website provides electronic access to the full text of more than 12,000 peer-reviewed papers that have been published as part of the Transportation Research Record: Journal of the Transportation Research Board *(TRR Journal) series since 1996. The site includes the latest in search technologies and is updated as new TRR Journal papers become available. To explore the TRR Online service, visit www.TRB. org/TRROnline.*



C A L E N D A R

TRB Meetings 2013

January

12 2013 TransportationCamp*
Washington, D.C.

12 Data Analysis Working Group Forum on Pavement Performance Data Analysis
Washington, D.C.

13–17 TRB 92nd Annual Meeting
Washington, D.C.
www.TRB.org/AnnualMeeting

April

15–18 Joint Rail Conference: Next Generation Rail—Meeting Challenges of the Future*
Knoxville, Tennessee

16–18 International Highway Technology Summit: Delivering Innovative Approaches and Best Practices*
Beijing, China

30–May 1 Adapting Freight Models and Traditional Freight Data Programs for Performance Measurement
Washington, D.C.

May

15–17 Road Safety on Four Continents*
Beijing, China

20–22 7th National Seismic Conference on Bridges and Highways*
Oakland, California

TBD Integrating Transportation Agency Spatial and Business Data for Improved Management Reporting
Boise, Idaho

June

2–3 10th International Symposium on Cold Regions Development*
Anchorage, Alaska

2–6 30th International Bridge Conference*
Pittsburgh, Pennsylvania

10–12 International RILEM Symposium on Multiscale Modeling and Characterization of Infrastructure Materials*
Stockholm, Sweden

10–12 Meeting State and MPO Information Needs in a Constrained Fiscal Environment: Joint Midyear Meeting for TRB and AASHTO Committees
Washington, D.C.

17–20 7th International Driving Symposium on Human Factors in Driver Assessment Training and Vehicle Design*
Bolton Landing, New York

23–27 International Conference on Ecology and Transportation
Scottsdale, Arizona

TBD Transportation Planning, Land Use. and Air Quality Conference*
Charlotte, North Carolina

July

11–12 8th SHRP 2 Safety Symposium
Washington, D.C.

14–17 8th International Conference on Road and Airfield Pavement Technology*
Taipei, Taiwan

17–19 20th International Symposium on Transportation and Traffic Theory*
Noordwijk, Netherlands

August

26–27 7th New York City Bridge Conference*
New York, New York

TBD Transportation, Climate Change, Energy Security, and Jobs Conference*
Pacific Grove, California

October

16–17 Transit GIS Conference*
Washington, D.C.

23–25 7th International Visualization in Transportation Symposium: Visualization for Big Data
Irvine, California

TBD Development of a Formalized Process for the Adoption, Development, Maintenance, and Enhancement of TransXML Schemas Workshop
Washington, D.C.

Additional information on TRB meetings, including calls for abstracts, meeting registration, and hotel reservations, is available at www.TRB.org/calendar. To reach the TRB staff contacts, telephone 202-334-2934, fax 202-334-2003, or e-mail TRBMeetings@nas.edu. Meetings listed without a TRB staff contact have direct links from the TRB calendar web page.

*TRB is cosponsor of the meeting.

INFORMATION FOR CONTRIBUTORS TO

TR NEWS

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FEATURES are timely articles of interest to transportation professionals, including administrators, planners, researchers, and practitioners in government, academia, and industry. Articles are encouraged on innovations and state-of-the-art practices pertaining to transportation research and development in all modes (highways and bridges, public transit, aviation, rail, marine, and others, such as pipelines, bicycles, pedestrians, etc.) and in all subject areas (planning and administration, design, materials and construction, facility maintenance, traffic control, safety, security, logistics, geology, law, environmental concerns, energy, etc.). Manuscripts should be no longer than 3,000 words (12 double-spaced, typed pages). Authors also should provide charts or tables and high-quality photographic images with corresponding captions (see Submission Requirements). Prospective authors are encouraged to submit a summary or outline of a proposed article for preliminary review.

RESEARCH PAYS OFF highlights research projects, studies, demonstrations, and improved methods or processes that provide innovative, cost-effective solutions to important transportation-related problems in all modes, whether they pertain to improved transport of people and goods or provision of better facilities and equipment that permits such transport. Articles should describe cases in which the application of project findings has resulted in benefits to transportation agencies or to the public, or in which substantial benefits are expected. Articles (approximately 750 to 1,000 words) should delineate the problem, research, and benefits, and be accompanied by one or two illustrations that may improve a reader's understanding of the article.

NEWS BRIEFS are short (100- to 750-word) items of interest and usually are not attributed to an author. They may be either text or photographs or a combination of both. Line drawings, charts, or tables may be used where appropriate. Articles may be related to construction, administration, planning, design, operations, maintenance, research, legal matters, or applications of special interest. Articles involving brand names or names of manufacturers may be determined to be inappropriate; however, no endorsement by TRB is implied when such information appears. Foreign news articles should describe projects or methods that have universal instead of local application.

POINT OF VIEW is an occasional series of authored opinions on current transportation issues. Articles (1,000 to 2,000 words) may be submitted with appropriate, high-quality illustrations, and are subject to review and editing.

BOOKSHELF announces publications in the transportation field. Abstracts (100 to 200 words) should include title, author, publisher, address at which publication may be obtained, number of pages, price, and ISBN. Publishers are invited to submit copies of new publications for announcement.

LETTERS provide readers with the opportunity to comment on the information and views expressed in published articles, TRB activities, or transportation matters in general. All letters must be signed and contain constructive comments. Letters may be edited for style and space considerations.

SUBMISSION REQUIREMENTS: Manuscripts submitted for possible publication in *TR News* and any correspondence on editorial matters should be sent to the Director, Publications Office, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001, telephone 202-334-2972, or e-mail jawan@nas.edu.

◆ All manuscripts should be supplied in 12-point type, double-spaced, in Microsoft Word, on a CD or as an e-mail attachment.

◆ Submit original artwork if possible. Glossy, high-quality black-and-white photographs, color photographs, and slides are acceptable. Digital continuous-tone images must be submitted as TIFF or JPEG files and must be at least 3 in. by 5 in. with a resolution of 300 dpi. A caption should be supplied for each graphic element.

◆ Use the units of measurement from the research described and provide conversions in parentheses, as appropriate. The International System of Units (SI), the updated version of the metric system, is preferred. In the text, the SI units should be followed, when appropriate, by the U.S. customary equivalent units in parentheses. In figures and tables, the base unit conversions should be provided in a footnote.

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