

NCHRP AT 50 YEARS



THE NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
Advancing transportation and meeting states' needs for half a century

ON NCHRP'S 50TH ANNIVERSARY

Fifty years after its birth in 1962, the National Cooperative Highway Research Program remains an extremely important part of the evolution of the national highway system. While NCHRP continues to move forward, this 50th anniversary publication provides an opportunity to take a glance back at the history and accomplishments of the program.

As representatives of the partner organizations guiding NCHRP, we recognize that our support is critical to the program's continued success. We each have a unique appreciation of NCHRP, yet share common perspectives about its value and benefits. NCHRP has consistently provided practitioners with timely and relevant research results. These results have either been incorporated into an AASHTO standard, guide, or specification or delivered as a NCHRP publication directly applicable to the states and their needs. Research and innovation that state departments of transportation can implement remain a cornerstone of the program.

NCHRP has adapted its research so that it effectively addresses the increasingly complex and ever-changing issues that state DOTs face. As the transportation landscape has shifted these past five decades with new societal, political, and financial demands, states have sought to learn about innovative new solutions and alternatives through NCHRP research. NCHRP has evolved as challenges have evolved over the years to better address the broad range of issues involved with sustaining and improving the nation's highway system.

In addition, we cannot overstate the importance of the investment state DOTs have made in NCHRP. NCHRP's partnership with the states has led to the continued financial support of the program and the tireless efforts of hundreds of state DOT staff every single year. Their work on AASHTO committees and on NCHRP project panels, along with FHWA staff and other volunteers, has helped to make NCHRP the uniquely collaborative research program it is today.

This document commemorates the first 50 years of NCHRP's success and highlights some of the outstanding research that continues to have an impact on how state highway agencies are building, managing, maintaining, and evolving the nation's highway system.

FHWA, AASHTO, and TRB together proudly acknowledge and commend all the individuals who have been involved with NCHRP over the years. To anyone who ever supported NCHRP research—had a research idea, helped select a project, conducted or provided oversight on a project or program, or implemented NCHRP results—we offer our sincerest thanks.



Victor Mendez
Administrator
Federal Highway Administration



John Horsley
Executive Director
American Association of
State Highway and
Transportation Officials



Robert Skinner
Executive Director
Transportation Research Board
of the National Academies

“NCHRP’s cooperative research provides states with the flexibility and resources to target new and emerging needs that surface from the front lines of the transportation industry.”

—John Halikowski
Director of Arizona DOT and Chair of
AASHTO’s Standing Committee on Research



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A Program Whose Time Had Come

The signs were all there in the early 1960s. Construction of the Interstate highway system was under way; traditional highway problems were about to become a lot more complex. At the same time, responsibility for highways in the United States was more decentralized than for any other public service, and no single agency had the mandate or the resources to meet the growing demands. Moreover, individual state highway research efforts had become highly duplicative, with limited sharing of results and few opportunities for conducting cooperative research.

These signs all pointed to the same thing: the need for a program through which state highway departments could pool resources to address common research problems. A National Cooperative Highway Research Program.

Born of discussions between the executive director of the American Association of State Highway Officials (AASHO, the predecessor of today's AASHTO) and the assistant commissioner for research at the federal Bureau of Public Roads (now the Federal Highway Administration), NCHRP was envisioned as a research body to advance the state of highway technology for all states and provide technical guidance across the highway transportation sector.

The Highway Research Board (HRB, which later became the Transportation Research Board) was the natural choice to administer NCHRP. By the early 1960s, HRB had nearly completed its administration of the landmark AASHO Road Test, then the single largest cooperative research effort in the highway sector. Using funds pooled from state governments and federal agencies, the Road Test was the first national study to examine the impacts of moving truck loads on various asphalt and concrete pavement designs, and the data generated served as the basis of highway designs for decades to come. HRB was well positioned to manage NCHRP.

On June 19, 1962, AASHO, the Bureau of Public Roads, and the National Academy of Sciences (HRB's parent organization) entered into a three-way agreement that brought NCHRP into being.

It proved to be good timing, with a renewed focus on state research and planning activities appearing in the Federal Aid Act of 1962 (these provisions eventually developed into the State Planning and Research Program in today's federal-aid highway program). With the newly formed NCHRP now providing a mechanism to leverage funding toward common research problems, the states elected to voluntarily contribute a portion of their federal-aid funds to sponsor the program.

Thirty-four projects valued at \$3.5 million were initiated in the first year of the program. In the 50 years to follow, NCHRP would work to help solve DOTs' most pressing problems, deliver transportation research over a wide range of issues, and establish standards for how our nation's highways are designed, built, operated, and maintained.



Highways rise up in Florida: The Interstate construction boom in the late 1950s and early 1960s drove the need for cooperative research efforts. (Image courtesy of Florida Department of State)

“The public is demanding we do things faster, do them cheaper, and do them greener than ever before... The only solution that I can see is a stepped-up effort to incorporate innovation, research, and new technologies in everything we do.”

—Victor Mendez, Administrator
Federal Highway Administration

HIGHLIGHTS OF NCHRP'S 50 YEARS

As NCHRP hits the half-century mark, some research results and outcomes jump out as vital pieces of the NCHRP story. The project results highlighted on the following pages changed how state agencies deliver transportation, or helped them rise to meet the challenges of a changing transportation landscape. They are a few examples among the many in NCHRP's long history of targeted problem solving. In addition, "NCHRP Works" sidebars explain key features of this unique, collaborative, state-driven research program.

A LASTING COMMITMENT TO SAFER TRANSPORTATION

Transportation agencies' drive to ensure safe transportation for all users is evidenced in publications going back to the very beginning of NCHRP. Some of the earliest reports documenting traffic and safety improvements include *NCHRP Report 50: Factors Influencing Safety at Highway-Rail Grade Crossings* (project initiated in 1964) and *NCHRP Report 79: Development of Improved Methods for Reduction of Traffic Accidents* (project initiated in 1966).

Over the decades, state DOTs' commitment to safety has continued, as seen in the numerous publications, guidelines, and synthesis reports developed through NCHRP as well as the ongoing efforts of the states through AASHTO. In 1998, AASHTO approved its Strategic Highway Safety Plan, which includes strategies to address highway safety in various target areas. Through Project 17-18(3), NCHRP developed a series of guides to assist state and local agencies in reducing injuries and fatalities related to the plan's target areas.

Published as volumes of *NCHRP Report 500*, these 23 guides address a wide range of areas, from user factors (impaired and aggressive drivers, older drivers, pedestrians) and vehicle

types (heavy trucks, motorcycles) to collision types (head-on, run-off-road) and highway configurations (unsignalized intersections, work zones). For each area, the guides provide specific countermeasure strategies with suggested implementation steps.

Another recent contribution of NCHRP to highway safety was the publication of AASHTO's *Highway Safety Manual*. Modeled upon the success of TRB's *Highway Capacity Manual* and driven by needs at the state and federal levels, this document was developed to provide the best factual information and tools for roadway planning, design, and operational decisions, with consideration of their safety consequences in mind.

This highly visible product built on NCHRP research provides the next generation of highway safety data, models, and analysis tools to help DOTs incorporate the explicit and quantitative consideration of safety into planning and project development.

"Typically, state-sponsored research, including NCHRP, is highly applied... often leading to new specifications and design guidelines. Many states also play a leadership role in introducing innovations to local governments, which have little research capability on their own."

—Robert Skinner, Executive Director
Transportation Research Board



NCHRP and AASHTO together address safety challenges such as those presented by road construction, nighttime driving, and poor weather. (Image courtesy of FHWA)

KEEPING BRIDGES ON THE CUTTING EDGE

Bridges are high-profile structures, with many rising up as icons on the nation's transportation landscape. Large and small, bridges are also costly, and their safe operation is paramount.

The need for good construction, management, and maintenance of bridges has remained a focus of NCHRP since its beginning. Over the years, NCHRP research has helped advance techniques like accelerated bridge construction (for example, *NCHRP Report 698: Application of Accelerated Bridge Construction Connections in Moderate-to-High Seismic Regions*) and the use of epoxy-coated reinforcement (*NCHRP Report 370: Performance of Epoxy-Coated Reinforcing Steel in Highway Bridges*) and precast elements (*NCHRP Report 584: Full-Depth Precast Concrete Bridge Deck Panel Systems*).



Old and new: Nearly 60 years' worth of bridge design advances—many supported by NCHRP research—are evidenced in the construction of the twin spans of the Tacoma Narrows bridge in Washington state.

At the same time, NCHRP research provides guidance to state highway agencies in the detection and repair or retrofit of such damaging effects as fatigue (*NCHRP Report 206: Detection and Repair of Fatigue Damage in Welded Highway Bridges*), scour (*NCHRP Report 587: Countermeasures to Protect Bridge Abutments from Scour*), and seismic activity (*NCHRP Report 472: Comprehensive Specification for the Seismic Design of Bridges*).

Perhaps no research effort better exemplifies the states' drive to advance bridge design than the development of the Load and Resistance Factor Design specifications, an effort that began in the 1980s. Compared with previous methods, LRFD represented a leap forward in bridge design: a reality-based approach designed to provide a uniform level of safety regardless of materials or bridge length.

Guided by collaborative input from AASHTO's Highway Subcommittee on Bridges and Structures, NCHRP helped make LRFD specifications a reality. NCHRP Project 12-33 was a five-year effort that led to the first edition of the *AASHTO LRFD Bridge Design Specifications* in 1994.

Over the next 17 years, NCHRP conducted follow-up research to support specification updates and to address states' needs in taking the new designs from publication to practice. These efforts assisted state DOTs in meeting the 2007 requirements to use LRFD methods for federally funded bridges and helped ensure a future of safe, high-performance bridges for a modern transportation system.

“Developing recommendations for AASHTO LRFD specifications was a monumental effort, and the NCHRP process was ideal for the job.”

—Robert Reilly, Former Director of Cooperative Research Programs, TRB

THE FIRST WORD ON HIGHWAY CAPACITY

In 1962, the year of NCHRP's founding, annual vehicle-miles traveled in the United States totaled 770 billion. The most recent data from 2009 show an annual figure of 3 trillion. With every passing year, addressing highway capacity becomes a more critical challenge.

TRB's *Highway Capacity Manual* has long served as an authority on strategies for assessing and addressing capacity issues. The manual serves as technical guidance for highway agencies making capacity decisions and provides approaches for assessing the costs and impacts of transportation infrastructure options that affect capacity.

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 it was one of TRB's top-selling publications. Now, another 25 years into the program, ongoing NCHRP research has kept the manual relevant and on pace with changes in traveler demographics, technologies, and management approaches.

The latest edition of the manual, published in 2010, incorporates NCHRP research to address new topics such as roundabouts, shared-use paths, and active traffic management. The new tools and methods in the 2010 *Highway Capacity Manual* are helping state DOTs address congestion for all modes of travel and improve the movement of travelers and goods.



Demand exceeds supply during rush hour: While capacity challenges may be obvious, the solutions often require advanced techniques based in collaborative research.

NCHRP WORKS

SEEKING HIGH REWARDS WITH THE IDEA PROGRAM

Though NCHRP is known for the applied research results it delivers, the program also recognizes the considerable potential of high-risk, high-reward exploratory research. Since the early 1990s, NCHRP has sponsored the Innovations Deserving Exploratory Analysis program, which funds research into promising but unproven innovations for highways.

As a complement to more traditional incremental research efforts, IDEA projects represent potentially game-changing technologies. Among these are novel uses of materials and construction techniques, automated and computerized transportation technologies, and quicker and more reliable test methods.

There have been approximately 150 NCHRP IDEA projects to date, and for many—such as the next-generation hybrid-composite bridge beam—the investment is paying off. Thanks to this jump start, some innovations continue on to development and commercialization, and others have been fully implemented by transportation agencies.

“The [Highway Capacity Manual’s] methodologies are the way to evaluate the adequacy of existing and planned roadways to meet the public’s needs.”

—Dirk Gross, Administrator
Office of Roadway Engineering, Ohio DOT

NCHRP AND AASHTO PARTNER IN GEOMETRIC DESIGN

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.

Since its inception, NCHRP has contributed to the development of the geometric design process, supporting these manuals with critical research. NCHRP has helped address a number of developments over the years affecting geometric design, including external factors like changes



Over the years, NCHRP has been a source of updates to AASHTO’s “Green Book” on geometric design of highways and streets. (Images courtesy of AASHTO)

in highway speeds and vehicle types as well as improved methods for the design, construction, and management of roads, bridges, and other assets.

NCHRP contributions to the Green Book in the last 20 years cover a range of topics, including medians (*NCHRP Report 375: Median Intersection Design*), sight distance (*NCHRP Report 383: Intersection Sight Distance*), access management (*NCHRP Report 420: Impacts of Access Management Techniques*), vehicle types (*NCHRP Report 505: Review of Truck Characteristics as Factors in Roadway Design*), and vehicle speeds (*NCHRP Report 613: Guidelines for Selection of Speed Reduction Treatments at High-Speed Intersections*). TRB’s *Highway Capacity Manual* is another valuable source of information and data for the Green Book.

NCHRP WORKS

SYNTHESIS REPORTS DOCUMENT THE STATE OF THE PRACTICE

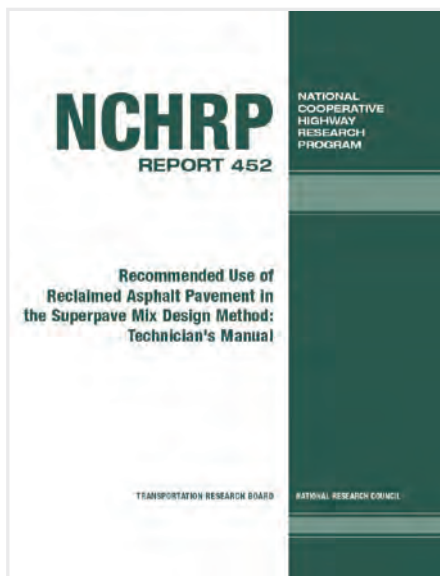
When states have pressing transportation concerns, sometimes the best solutions are revealed not through new research but by uncovering best practices from other states and countries who are leading the way. This is the basis of NCHRP’s Project 20-05, “Synthesis of Information Related to Highway Problems,” established in the program’s early years and an ongoing source of NCHRP’s knowledge base ever since.

Syntheses of Highway Practice—or synthesis reports—are comprehensive summaries of the state of the practice for a given topic based on literature reviews and detailed surveys of state initiatives and activities. The reports inform managers and practitioners about innovations of others that may be applicable to their own needs and circumstances.

NCHRP has published more than 400 synthesis reports, covering a wide range of topics in virtually every area of highway research. Synthesis reports are an important complement to original research and represent the commitment among state DOTs to finding and sharing practices that work.

DOTs AIM TO BE GREENER; NCHRP SHOWS THE WAY

1970 saw the formation of the Environmental Protection Agency and the passage of the National Environmental Policy Act. Heightened awareness and new regulations concerning environmental issues in the years that followed have affected all segments of society. With the help of NCHRP research, highway agencies have been leaders in responding to emerging issues without compromising the transportation system.



One highly visible example of DOTs' green stewardship is asphalt recycling, which emerged in the 1970s and developed into a highly successful practice among many highway agencies. Following the development of Superpave mix designs in the 1990s, state DOTs looked to accommodate recycled asphalt in their new designs.

NCHRP provided the technical guidance in *NCHRP Report 452: Recommended Use of Reclaimed Asphalt Pavement in the Superpave Mix Design Method: Technician's Manual*.

NCHRP research has similarly helped DOTs conserve virgin materials in concrete mixes by providing guidance for replacing portland cement with fly ash and other industrial byproducts, as detailed in *NCHRP Report 566: Guidelines for Concrete Mixtures Containing Supplementary Cementitious Materials to Enhance Durability of Bridge Decks*. Findings like these help DOTs deliver high-performance pavements while enjoying green benefits as well as cost savings.

Environmental concerns go far beyond materials management and recycling. NCHRP helps

"[The NCHRP compendium Environmental Stewardship Practices, Policies, and Procedures for Road Construction and Maintenance] provides practical, hands-on examples of effective programs, solutions, and best practices."

—William Hauser, Former Administrator, Office of Stewardship and Compliance, New Hampshire DOT

transportation agencies address a vast array of issues related to natural, cultural, and social aspects of the environment through research results like *NCHRP Report 565: Evaluation of Best Management Practices for Highway Runoff Control* and *NCHRP Special Report 245: Expanding Metropolitan Highways: Implications for Air Quality and Energy Use*. Such reports, together with NCHRP synthesis reports and quick-turnaround research for AASHTO's Standing Committee on the Environment (NCHRP Project 25-25), help state DOTs comply with standards, preserve natural resources, and become better corporate citizens.

NCHRP ENVIRONMENTAL RESEARCH TOPICS

Air and Water Quality	Historic Bridges and Places
Alternative and Early Mitigation Strategies	Land Development Impacts
Climate Change	Noise Barriers and Quiet Pavements
Community Impacts	Pollutant Discharge Elimination
Design-Build Issues	Road Construction and Maintenance
Emissions and Greenhouse Gases	Secondary Impacts and Cumulative Effects
Environmental Performance Measures	"Smart Growth" Initiatives
Environmental Project Costs	Solar and Wind Power
EPA Assessments and Impact Statements	Stormwater Treatment
Geophysical Remote Sensing	Stream Restoration and Dam Removal

SMARTER SPENDING AND PRESERVATION THROUGH ASSET MANAGEMENT

Advances in transportation asset management—the use of systematic and data-driven approaches to making investment decisions about physical assets—led to the formation of AASHTO’s Planning Subcommittee on Asset Management in 1997. Since that time, NCHRP has worked closely with that subcommittee, helping define the principles of asset management and putting tools in the hands of state transportation agencies.

Based on the results of NCHRP Project 20-24(11), AASHTO published its 2002 *Transportation Asset Management Guide*, the definitive handbook for managing transportation assets large and small. It goes well beyond bridges and highways, presenting techniques that are equally applicable to drainage facilities, overhead lighting, sign structures, retaining walls, intelligent transportation systems, and traffic control systems.

Since its publication, a growing number of transportation agencies have adopted the methodologies presented in the guide to make critical decisions on when and how to extend the life of existing assets or put new ones in place. In the current climate of tight budgets and shifting priorities, the analysis-based rationale provided by the guide also helps DOTs justify their choices—sometimes difficult ones—to a sophisticated and demanding audience of transportation users and elected officials.

As agencies continue to implement asset management tools, NCHRP has kept pace in meeting their needs. Through Project 20-07, Task 277, NCHRP partnered with AASHTO with additional support from FHWA and developed updates for a forthcoming new edition of AASHTO’s *Guide to Pavement Management*. To make the original *Transportation Asset Management Guide* more accessible to a wider range

of users, NCHRP provided research (Project 8-69) for a new volume of that document published in 2011. Subtitled *A Focus on Implementation*, the complement to the original guide expands on specific implementation strategies and provides steps agencies can use to refine their asset management practices and make well-informed spending decisions.



Assets large and small in Utah: Agencies can make sound decisions on assets of all sizes—pavements, bridges, signs, luminaires—using guidance built on NCHRP research.

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

—Carlos Bracerias, Deputy Director, Utah DOT

PUTTING DECISION-MAKING TOOLS IN EXECUTIVES' HANDS

State DOT executives and managers need both a broad understanding of today's transportation system and a clear vision of tomorrow's. Good decision-making tools are essential for the continued health of the nation's highway system.



2006 Leadership Forum: State DOT executives benefit tremendously from collaborative research and opportunities to share solutions that work. (Image courtesy of University of Minnesota Center for Transportation Studies)

Over the last two decades, NCHRP has conducted focused research with the needs of transportation agency CEOs and senior managers in mind. The Project 20-24 series of research reports for AASHTO and state DOT leaders responds to the evolving challenges facing state DOT decision makers.

NCHRP 20-24 reports deliver timely information on a wide range of topics covering the business of building and maintaining transportation infrastructure, including asset management, e-business, and innovative financing and contracting. They also present strategies to help DOTs become strong and efficient organizations, addressing performance measures; strategic planning; and employee retention, training, and development.

Together, these reports provide the tools and facts that help DOTs get the best return on taxpayer dollars while delivering a high-performance transportation system.

“State DOT executives face unique challenges. AASHTO members rely on NCHRP Project 20-24 results to stay ahead of these challenges and meet them head-on.”

—John Horsley, Executive Director, AASHTO

NCHRP WORKS

NOT JUST RESULTS— IMPLEMENTABLE RESULTS

Implementable, applied research is the cornerstone of NCHRP. Through its operational structure and relationships with organizations like AASHTO and state DOTs, the program is positioned to ensure that its results are relevant and usable.

AASHTO committees, representing state DOTs, play a central role in defining NCHRP research needs and selecting research projects. Once a project is under way, the unique NCHRP project panel structure—dependent on the volunteer efforts of many state, federal, industry, and academic experts—is geared toward developing implementable research results.

These results are the basis of NCHRP publications, including Research Reports, Syntheses of Highway Practice, Research Results Digests, Legal Research Digests, Web-Only Documents, and CD-ROMs. Moreover, NCHRP findings are often developed into new or revised AASHTO guides and specifications. Over the years, many AASHTO publications have been developed or revised based on the direct input of NCHRP research. Through these critical documents, practitioners at every level—including a great many who may not think of themselves as connected to research—are the beneficiaries of the states' collaborative research efforts.

HELPING STATES ADDRESS EVOLVING LEGAL ISSUES

At the time of NCHRP's founding in 1962, construction of the Interstate highway system was in full swing. With this enormous undertaking came a wide range of legal concerns for state highway agencies. Given the long-standing partnership between HRB and AASHTO in identifying and addressing legal questions, the states turned to NCHRP for answers.



The early Interstate in Oklahoma: Intensive nationwide highway construction raised myriad legal questions for state DOTs. Targeted NCHRP research provided answers and kept projects moving. (Image courtesy of Oklahoma DOT)

Some of NCHRP's earliest legal reports and guidance centered on such topics as route location, right-of-way, property acquisition, eminent domain, and valuation changes due to improvements. These findings from the 1960s assisted states in the safe and timely building of the Interstate highway system.

As the pace of Interstate construction stabilized in the decades that followed, states' most pressing legal needs changed. Through publication series like *Selected Studies in Highway Law* and *NCHRP Legal Research Digests*, and in coordination with TRB's Annual Workshops on Transportation Law, NCHRP legal research evolved to address the states' latest concerns.

For example, *NCHRP Synthesis 106: Practical Guidelines for Minimizing Tort Liability* from 1983 provided tools for states to address the increasing number of tort suits brought against them for alleged construction and due process deficiencies.

More recently, *NCHRP Legal Research Digest 54: Practice Under the Environmental Provisions of SAFETEA-LU* is one example of ongoing legal guidance that NCHRP has provided to address environmental legal issues, which have been rapidly evolving since the 1970s.

Though tomorrow's developments in transportation law are unknown and undoubtedly will be complex, NCHRP will continue to help states identify and address the tough legal questions as they arise.

“Transportation law has become a much broader field in the last 50 years. NCHRP has time and again updated its guidance based on the highly dynamic legal landscape.”

—Larry Thomas
Former Counsel for Legal Research, TRB

THE NEXT BIG THING IN PAVEMENT DESIGN

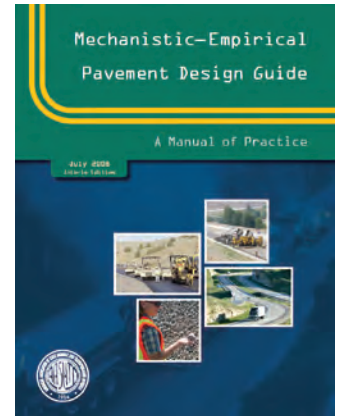
Without pavements there aren't highways. State DOTs have long been focused on improving pavement design through research, even before there was an NCHRP. The 1950s AASHTO Road Test was managed by HRB, and the data served as input to the empirical equations underlying AASHTO's *Interim Guide for Design of Pavement Structures*.

This essential guide for state DOTs was revised several times over the course of NCHRP's history—notably the much-cited 1972 edition—and then superseded by new AASHTO guides published in 1986 and 1993 and supplemented in 1998. All of these updates depended on numerous NCHRP research projects and a concerted cooperative effort among the states through NCHRP and AASHTO.

In the 2000s, state DOTs seized the opportunity to take a wholly different approach to pavement design: mechanistic-empirical design, which 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 1-37A, which led to the creation of AASHTO's *Mechanistic-Empirical Pavement Design Guide* and DARWin-ME™ software. These tools offer precise, scientific design techniques that allow DOTs to build longer-lasting pavements more cost-effectively.

Progress among state DOTs in shifting from traditional to mechanistic-empirical design has been necessarily deliberate. As highway agencies continue to test, calibrate, implement, and validate the new methodologies, NCHRP remains actively involved with several ongoing research projects to support these efforts and ensure a smooth transition.



NCHRP research has served as the foundation for several generations of pavement design, most recently AASHTO's *Mechanistic-Empirical Pavement Design Guide*. (Image courtesy of AASHTO)

NCHRP WORKS

ADDRESSING NEEDS ACROSS A DOT

Administration and Management	Freight Transportation	Pavements
Bridges and Other Structures	Geotechnology	Planning and Forecasting
Construction	History	Policy
Data and Information Technology	Hydraulics and Hydrology	Safety and Human Factors
Design	Law	Security and Emergencies
Economics	Maintenance and Preservation	Society
Education and Training	Materials	Terminals and Facilities
Energy	Operations and Traffic Management	Vehicles and Equipment
Environment	Passenger Transportation	
Finance		

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

—Charles Dougan, Former Director of Research and Materials, Connecticut DOT, and NCHRP Project 1-37A Panel Chair

BETTER, MORE USEFUL PLANNING TOOLS

Federal planning requirements in the 1960s and 1970s, together with advances in computing technology, drove travel demand planning and modeling efforts in those decades. Early planning tools were expensive and data-intensive, and state DOTs needed ways to make the process simpler and more useful.

This led to NCHRP research and *NCHRP Report 187: Quick-Response Urban Travel Estimation Techniques and Transferable Parameters: User's Guide*. Published in 1978, it became widely used by planning offices. The guide had a significant impact, providing a basis for selecting highway improvements using simplified inputs to provide low-cost, highly effective solutions. The methods in the publication were updated and expanded upon in *NCHRP Report 365: Travel Estimation Techniques for Urban Planning*, published in 1998.

Another example of NCHRP planning research is *NCHRP Report 255: Highway Traffic Data for Urbanized Area Project Planning and Design*, published in 1982. This project refined data analysis techniques for planning models and gave improved estimates for key highway data needed by planners. The report was used extensively, and well beyond state DOTs. Agencies like metropolitan and county planning authorities that needed a finer level of detail in their data relied heavily on these research results.

NCHRP Reports 187, 255, and 365 serve as principal guidance for planning and modeling tools used today. The ongoing support of NCHRP by state DOTs, along with the long-term institutional knowledge of state DOT staff, provided opportunities for follow-up efforts through subsequent



Keeping pace with California travel demand: NCHRP research helps turn the endless stream of vehicles into usable data and models vital to transportation planners.

NCHRP studies. These refinements incorporated new computing technologies and analysis methods as well as valuable implementation experiences of highway agencies across the nation.

“NCHRP is one of the best examples of applied research that I’ve seen in any discipline within government. It’s the model for several TRB programs for other transportation modes.”

—Neil Pedersen, Former Administrator
Maryland State Highway Administration

SECURITY AND EMERGENCY MANAGEMENT IN A CHANGING WORLD

The 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.

They responded with NCHRP Project 20-59, which produced the *NCHRP Report 525* series. Each of these concise reports—16 volumes and growing—focuses on a specific security or emergency management issue. Published beginning in 2004, the series broke new ground for transportation agencies, providing guidance on integrating security into current practice for handling all hazards, natural or manmade.

By covering the breadth of surface transportation security issues, the series enables transportation professionals in all roles, including those not directly involved with security or emergency management, to expand their body of knowledge on emergency preparedness.

The effort is ongoing, with NCHRP coordinating closely with AASHTO's Special Committee on Transportation Security and Emergency Management to identify the states' and the nation's most urgent needs related to security and emergency planning.

State DOTs continue to use these reports, along with other NCHRP research studies and synthesis reports, to form strategies for security and infrastructure protection, develop staff training, and incorporate security into long-range planning.

REPORT 525 SERIES GUIDES ON TRANSPORTATION SECURITY

- | | |
|--|---|
| 1 Responding to Threats | 9 Emergency Drills and Exercises |
| 2 Information Sharing and Analysis | 10 Public Health Disasters |
| 3 Incorporating Security into Planning | 11 Disruption Impact Estimation |
| 4 Terrorism-Related Risk Management | 12 Tunnel Security Countermeasures |
| 5 Managing Sensitive Information | 13 Traffic Control for Agricultural Emergencies |
| 6 Emergency Operations | 14 Physical Security Primer |
| 7 Security Awareness for Employees | 15 Costing Asset Protection |
| 8 Continuity of Operations Planning | 16 Emergency Response Planning |

NCHRP WORKS

NCHRP ADAPTS TO STATE DOT NEEDS

The “N” in NCHRP stands for “National,” but it’s state-driven at heart. Voluntarily funded by state DOTs and guided in its research by state DOT staff, NCHRP is very much the states’ program. That explains why the scope of NCHRP has evolved the way it has in the past 50 years.

Some needs remain constant: How can states deliver, operate, and maintain long-lasting, high-performing pavements and structures?

Other needs are in flux, driven by changes in the makeup of the driving population, vehicles on the roads, technologies available, and societal issues. A prime example is the host of new and complex transportation planning issues emphasized in the 1991 highway federal aid act, the Intermodal Surface Transportation Efficiency Act, or ISTEA. The legislation spurred new planning efforts by state DOTs, and a surge in planning research by NCHRP quickly followed.

Similar patterns can be seen for NCHRP research about pedestrians and bicyclists, security, the environment, freight, and other areas. In addition, NCHRP has developed targeted efforts, like Project 20-83, “Long-Range Strategic Issues Facing the Transportation Industry,” to help states identify, adapt to, and influence evolving challenges in transportation.

Moreover, since changes don’t happen all at once (or everywhere at once), NCHRP’s domestic and international scan programs have proved to be important vehicles to help agency representatives dialogue with peers—in a neighboring state or across the globe—who are leaders in developing new technologies and practices for responding to shifting transportation demands.

IMPROVED MATERIALS AND TESTING EXTEND HIGHWAY LIFE

New design methodologies are only part of the story when it comes to advancing pavements and bridges. Parallel NCHRP research into materials and construction has been instrumental to the delivery of longlasting, high-performance highways.



Built for the long haul in Wisconsin: Motorists can expect long pavement life thanks to advances in materials testing and construction. (Image courtesy of Wisconsin DOT)

NCHRP studies on highway concrete have advanced pavements (such as *NCHRP Report 540: Guidelines for Early-Opening-to-Traffic Portland Cement Concrete for Pavement Rehabilitation* and *NCHRP Report 607: Specifications and Protocols for Acceptance Tests on Processing Additions in Cement Manufacturing*) as well as bridges (*NCHRP*

Report 628: Self-Consolidating Concrete for Precast, Prestressed Concrete Bridge Elements, for example). The results of these efforts have helped highway agencies improve concrete performance and durability while reducing costs, accelerating construction, and better utilizing resources.

NCHRP research has similarly advanced asphalt pavement materials. NCHRP supported state DOTs' implementation of new Superpave mix designs of the early 1990s with ongoing research on material testing, including *NCHRP Research Results Digest 237: Superpave Gyrotory Compaction Guidelines*, *NCHRP Report 464: The Restricted Zone in the Superpave Aggregate Gradation Specification*, and others. Together with advances in practical and cost-effective mix testing methods, NCHRP research has helped DOTs deliver asphalt pavements built to specifications and built to last.

Moreover, recognizing the critical role of aggregates in concrete and asphalt pavements alike, NCHRP conducted several projects to evaluate aggregates used in pavement mixtures and base layers. These efforts provided methods to better evaluate aggregates for different applications; the

NCHRP WORKS

QUICK-RESPONSE RESEARCH FOR AASHTO COMMITTEES

AASHTO and its committees often need quick answers to address the rapidly changing concerns of state DOTs. NCHRP has established ongoing projects to deliver targeted research in several areas:

Research for the Standing Committee on Highways (Project 20-07): Transportation guides, standards, and policies, and other AASHTO activities

Research for the Standing Committee on Planning (Project 8-36): Statewide and metropolitan transportation planning, programming, and development

Research for the Standing Committee on the Environment (Project 25-25): Environmental analysis, streamlining, stewardship, and planning

Research for the Standing Committee on Public Transportation (Project 20-65): Transit planning, operations, and delivery

Research for Administration of Highway and Transportation Agencies (Project 20-24): Resource development, decision support, and financial management

Surface Transportation Security Research (Project 20-59): Emergency incident prevention, mitigation, preparedness, response, and recovery

Individual studies are typically narrower in scope and shorter in turnaround time compared with traditional NCHRP research, and they are tailored to answer AASHTO's and the states' most immediate questions.

techniques have been incorporated into AASHTO's *Standard Specifications for Transportation Materials and Methods of Sampling and Testing*.

MAINTENANCE FOR TODAY, PRESERVATION FOR TOMORROW

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.



Strategies for maintaining existing assets are an integral part of transportation agencies' long-term preservation programs.

Beyond its publications that address best maintenance approaches for a variety of transportation infrastructure items—including

everything from pavements to highway medians to suspension bridges—NCHRP has also 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.

Winter weather represents another major maintenance challenge for many states. NCHRP research helps agencies handle winter storm events on a storm-by-storm basis through such guidance as *NCHRP Report 526: Snow and Ice Control: Guidelines for Materials and Methods*. Together with guidance like *NCHRP Report 511: Guide for Customer-Driven Benchmarking of Maintenance Activities* and the *AASHTO Maintenance Manual for Roadways and Bridges* (updated through NCHRP Project 20-07, Task 170), NCHRP research gives highway agencies the tools to make the right maintenance choices at the right times to best serve their customers.

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

—Alison Lebwohl, Section Chief, Wisconsin DOT

NCHRP WORKS

STATE DOTs MAXIMIZE THEIR RESEARCH INVESTMENT

By pooling funds to address common concerns through NCHRP, state DOTs make the most of their research investment.

For small states, the benefits jump into high relief. Consider New Hampshire, whose state research program budget is less than a fortieth of NCHRP's annual program. Glenn Roberts, chief of research for New Hampshire DOT, says, “It would be impossible for New Hampshire to try to achieve individually what NCHRP is able to provide us.”

The benefits scale up for large states, too. Caltrans, the largest state DOT with the greatest annual contribution to NCHRP, identified fully 48 research projects in fiscal year 2010 as having “high value” to the state. According to Caltrans, those projects represent \$26.2 million in research—a big return on investment even for a big DOT.

Across the nation, state DOTs large, small, and every size in between could tell similar stories on the dollars-and-cents reasoning behind their consistent financial commitment to NCHRP.

NCHRP is an extremely smart way for our department to leverage our research funding.”

—William Temple, Former Chief Engineer,
Louisiana DOTD



NCHRP WORKS

DEDICATED PEOPLE AND STRONG ORGANIZATIONS COLLABORATE FOR SUCCESS

Credit for the success of NCHRP is shared among its partners and sponsors. The collaborative efforts of thousands of individuals in many different organizations have kept NCHRP moving forward for the past 50 years:

- The **American Association of State Highway and Transportation Officials** partners with NCHRP at every juncture in the research cycle, and its members help to identify research needs and select projects. These efforts are primarily carried out by the members of AASHTO's Standing Committee on Research and supported by its Research Advisory Committee.
- **State DOTs**, in addition to being the sole funding source for NCHRP, provide an unparalleled resource in the form of the many talented individuals who voluntarily serve on AASHTO and TRB committees and NCHRP project panels. This extraordinary commitment ensures that research results can be implemented and are ultimately put to use across the nation.
- The **Federal Highway Administration** is a close collaborator in NCHRP work. FHWA representatives provide guidance on NCHRP research efforts and help ensure that this state-driven research is well coordinated with changes in research and policy happening at the federal level.
- The **Transportation Research Board** of the National Academies administers NCHRP, and TRB's staff manage NCHRP projects and guide the activities of NCHRP project panels.

“Our investment in NCHRP continues to pay dividends. All across our agency, we’re innovating and improving by implementing NCHRP research.”

—Sandra Larson, Research and Technology Bureau Director, Iowa DOT, and Chair of AASHTO's Research Advisory Committee

“NCHRP brings together the best minds to address a given problem. I see that as a real strength of the program.”

—Francis Francois
Former Executive Director, AASHTO



LOOKING FORWARD

NCHRP staff, past and present, feel fortunate to have played a role in improving this nation's transportation system over the past 50 years. It has been a pleasure and a privilege to work with so many outstanding project panels, AASHTO committees, and contract research agencies, which have been critical to the success of NCHRP. It has been rewarding for all involved to see the state DOTs and other transportation agencies—and thereby the public—benefit from the research described throughout these pages. There have been and always will be challenges to be met, and research can help address them. As the demands on our transportation system continue to grow and evolve, I am confident that the NCHRP partnership will continue to assist the states in delivering a safe, efficient transportation system through collaborative research.



Crawford Jencks
Manager, NCHRP

For details about these and other research activities, visit www.trb.org/nchrp or www.transportation.org.

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