Developing a Research Agenda for Transportation Infrastructure Preservation and Renewal

November 12–13, 2009
Keck Center of the National Academies
Washington, D.C.

Organized by
Transportation Research Board

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Research and Innovative Technology Administration,
U.S. Department of Transportation

www.TRB.org/conferences/2009/Infrastructure
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TRANSPORTATION RESEARCH BOARD
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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. The National Research Council 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. www.TRB.org
Many elements of the nation’s surface transportation infrastructure are deteriorating as a consequence of aging and growing stresses. The American Recovery and Reinvestment Act of 2009 provides an initial infusion of funds for transportation infrastructure renewal and restoration, but these resources are not yet sufficient for rebuilding and sustaining the condition and performance of that infrastructure. Under these circumstances, it is particularly important to develop and deploy the best methods and technologies to support effective management of transportation infrastructure.

This conference brings infrastructure owners and decision makers together with researchers to consider problems, needs, and achievements—and to define the directions for essential research to manage and preserve the nation’s surface transportation infrastructure. Using presentations, breakout discussions, and posters presenting research successes, we will work together to understand the challenges and opportunities facing the highway, public transit, and rail systems. The following four areas for future work will be examined in detail:

- Inventory and condition assessment methods, including technologies for intelligent infrastructure health monitoring; remote, automated sensing and reporting; and advanced models of deterioration processes;
- Innovative and environmentally responsible materials and methods for preservation, restoration, and reconstruction of transportation infrastructure;
- Strategies for rapid repair and rehabilitation, including new designs, construction procedures, contracting, incentives, and project management tools; and
- Methods to estimate life-cycle costs and to support decision making for infrastructure preservation and renewal.

The primary goal of this conference is the definition of an infrastructure research road map to assure the condition, performance, safety, and security of the nation’s transportation system in the years ahead.

—Joseph L. Schofer
Conference Chair
Professor of Civil and Environmental Engineering
Northwestern University
Thursday, November 12

7:30 a.m.–8:30 a.m.
**Breakfast**

8:30 a.m.–8:45 a.m.
**Welcome and Introductions**
Joseph L. Schofer, Northwestern University, presiding

8:45 a.m.–9:30 a.m.
**Challenges Facing Our Transportation Infrastructure**
James L. Oberstar, House Transportation and Infrastructure Committee (invited)

9:30 a.m.–10:15 a.m.
**Federal Roles in Transportation Infrastructure Preservation by U.S. Department of Transportation Representative**
A high-ranking official from the U.S. Department of Transportation will provide information on transportation infrastructure issues from the department’s perspective and speak about the federal commitment to infrastructure preservation and maintenance.

10:15 a.m.–10:45 a.m.
**Break**

10:45 a.m.–11:15 a.m.
**Status and Needs of Our Highway Systems**
Randell H. Iwasaki, California Department of Transportation

The chief deputy director of one of the largest state transportation departments will relate the importance and the challenges of preserving a large highway system to support a complex economy in a fiscally constrained environment. He will discuss strategies and techniques that are being used in California and the needs for new approaches that might come from future research.

11:15 a.m.–11:45 a.m.
**Ensuring Our Transit Systems**
Robert H. Prince, AECOM Transportation

The experience at the Massachusetts Bay Transportation Authority (MBTA) illustrates how transit agencies are beginning to approach infrastructure preservation. The MBTA developed a state-of-good-repair (SGR) database to evaluate and quantify the condition and level of ongoing reinvestment needed for its entire physical plant. The SGR database forecasts asset renewal and replacement needs over time and allocates available budgets to infrastructure needs on the basis of established capital program goals and objectives.

11:45 a.m.–12:15 p.m.
**Condition and Needs of U.S. Railroad Systems**
David A. Connell, Union Pacific Railroad Company

This presentation will provide an up-to-the-minute look at where freight rail infrastructure stands, the issues the industry faces in managing that infrastructure, and how progress is being made to deal with these issues. The elements of most concern in addressing the immediate and future needs of the rail industry will be identified. This presentation also will address how public–private partnerships can be executed to address rail freight infrastructure issues.

12:15 p.m.–1:15 p.m.
**Lunch**
1:15 p.m.–1:35 p.m.
**Topic Keynote: Inventory and Condition Assessment**  
Leonard R. Evans, Ohio Department of Transportation

Effective management of transportation infrastructure depends upon timely and actionable information regarding asset needs. Inventory and condition assessment is a fundamental activity supporting the transportation agency decision-making processes. This session features developments in data collection and analysis techniques (such as the use of GPS and alternative sensing technologies such as LIDAR) and presents future opportunities affecting resources and equipment.

1:35 p.m.–1:55 p.m.
**Topic Keynote: Innovative Materials for Preservation, Restoration, and Reconstruction**  
Larry Galehouse, National Center for Pavement Preservation

The uncertainty of material supplies and the changing economic climate require improved materials to assure long-term infrastructure performance. Significant recent attention has focused on studies of nanoscience and nanotechnology for infrastructure. Directed research can drive the development of revolutionary materials technologies for infrastructure, including polymers, biomaterials, and carbon materials. The need for new and improved materials will be discussed.

1:55 p.m.–2:15 p.m.
**Topic Keynote: Strategies for Rapid Repair and Rehabilitation**  
Robert L. Peskin, AECOM Transportation

This presentation develops a strategic context for considering alternative approaches for rapid implementation of infrastructure renewal. It addresses the rationale for the goal of rapid implementation, including early interruption of deterioration, minimizing adverse operational impacts, reducing inflationary impacts on construction cost, and avoiding repeated deployment and mobilization costs. It describes measures of effectiveness to gauge achievement and offers a framework for classifying rapid implementation tools. Understanding and measuring the impacts of rapid implementation of infrastructure renewal activities provides a basis for the selection, management, and financing of these projects. Several example projects will be discussed to illustrate the costs and benefits of alternative implementation approaches.

2:15 p.m.–2:35 p.m.
**Methods to Estimate Life-Cycle Costs and Support Decision Making for Infrastructure Preservation and Renewal**  
Samer Michel Madanat, University of California, Berkeley

This presentation will describe the state of the art and the challenges to advancing the science and practice of decision support for infrastructure preservation and renewal. Existing methods for performance modeling, cost prediction, and maintenance and repair optimization will be reviewed. Gaps in these methods will be identified, and recent research developments will be introduced.

2:35 p.m.–2:45 p.m.
**Charge to the Research Agenda Working Groups**  
Joseph L. Schofer, Northwestern University

2:45 p.m.–3:15 p.m.
**Break**

3:15 p.m.–5:30 p.m.
**Research Agenda Working Groups**

Conference participants will separate into four working groups to develop components of an agenda of the most important and promising research to address critical issues facing transportation infrastructure. Groups will be organized around the four themes of the conference. Each group will meet Thursday afternoon and again Friday morning. These groups will begin with brief participant introductions. Each poster presenter will describe the substance and implications of his or her research. This session will discuss the following:

- Critical issues facing the topic area;
- Recent developments and breakthroughs in this part of the field that should rise to the top of the implementation agenda, or that provide a foundation for the next stage of research; and
- Beginning to identify and discuss the most promising research areas and topics, considering both (1) identifying the greatest NEED and (2) identifying the greatest PROMISE for success.
Inventory and Condition Assessment Research Agenda Group
Leonard R. Evans, Ohio Department of Transportation; Michael P. Freeman, Union Pacific Railroad, presiding

Innovative Materials for Preservation, Restoration, and Reconstruction Research Agenda Group
Larry Galehouse, National Center for Pavement Preservation; Ali Maher, Rutgers University, presiding

Strategies for Rapid Repair and Rehabilitation Research Agenda Group
John J. Myers, Missouri University of Science and Technology;
Robert L. Peskin, AECOM Transportation, presiding

Methods to Support Infrastructure Preservation and Renewal Research Agenda Group
Samer Michel Madanat, University of California, Berkeley; Sue McNeil, University of Delaware;
Butch Wlaschin, Federal Highway Administration, presiding

5:30 p.m.–6:45 p.m.
Posters and Reception: Inventory and Condition Assessment
Poster Session

Integration of Fundamental–Applied Studies and Laboratory–Field Demonstrations for Structural Health Monitoring of Transportation Infrastructure
F. Necati Catbas, Mustafa Gul and Ricardo Zaurin, University of Central Florida

Structural Behavior Monitoring
Genda Chen, Missouri University of Science and Technology

Integrating Automated Pavement Data Collection Techniques into a Pavement Management System for Timely Identification of Candidate Projects for Pavement Preservation
Tanveer Chowdhury, Virginia DOT; Steve Vernedoe, National Center for Pavement Preservation

Use of Continuous Deflection Measurement for Network-Level Pavement Health Monitoring
Gerardo W. Flintsch, Virginia Polytechnic Institute and State University; Brian Walter Ferne, Transport Research Laboratory, United Kingdom; Brian Keith Diefenderfer, Virginia Transportation Research Council

Nondestructive Evaluation Technologies for Comprehensive Condition Assessment and Better Management of Bridge Decks
Nenad Gucunski, Rutgers University

Real-Time Bridge Monitors for Condition Assessment Decisions
Victor J. Hunt, Arthur J. Helmicki, and James A. Swanson, University of Cincinnati

Benchmark Problem on Health Monitoring of Highway Bridges: A Multi-Objective, Optimization-Based Approach
Sungmoon Jung, Seung-Yong Ok and Junho Song, FAMU-FSU College of Engineering

Continuous Remote Condition Monitoring of an In-Service Historic Utility Tunnel
David Kosnik, Mathew Kotowsky, Daniel Marron, Richard Finno and Charles Dowding, Northwestern University Infrastructure Technology Institute

Continuous Remote Structural Health Monitoring for Life Extension of an Uplift Bearing Assembly on the I-65 John F. Kennedy Bridge in Louisville, Kentucky
David Kosnik, Matthew Kotowsky and Daniel Marron, Northwestern University Infrastructure Technology Institute; Theodore Hopwood, University of Kentucky

Assessment of Steel Bridge Details with Acoustic Emission Monitoring
David Kosnik and Daniel Marron, Northwestern University Infrastructure Technology Institute

Wireless Sensor Networks to Monitor Crack Growth on Bridges
Matthew Kotowsky and Charles Dowding, Northwestern University Infrastructure Technology Institute

A National Committee on Performance-Based Infrastructure Asset Management
Franklin L. Moon, Drexel University; David Lowdermilk and Emin Aktan, Pennoni Associates, Inc.

Visual Inspection and Accuracy Improvements for Bridge Condition Assessment—A Municipal Perspective
Md. Saidur Rahman, Bangladesh Railway

Assessing Asphalt Concrete Deterioration Model from In-Service Pavement Data
Saad Sarsam, Baghdad University-Engineering College

Modeling Asphalt Pavement Surface Texture Using Field Measurements
Saad Sarsam, Baghdad University-Engineering College

Rapid Pavement Condition Assessment
Nicholas P. Vitillo, Center for Advanced Infrastructure and Transportation (CAIT)

Sensor Technology for Cold Region Pavement Preservations
Xiong Yu, Case Western Reserve University
6:00 p.m.–7:15 p.m.  
**Posters and Reception: Innovative Materials for Preservation, Restoration, and Reconstruction**  
*Poster Session*

**Performance-Related Specifications of New Jersey Asphalt Mixtures for Critical Applications: Implementation and Performance**  
Thomas A. Bennert, Rutgers University; Robert Blight, Robert W. Sauber, and Eileen C. Sheehy, New Jersey Department of Transportation

**Enamel Coating: A New Approach for Steel Structure Preservation and for Long-Term RC Structure Performance**  
Genda Chen, Richard Brow, Jeffrey Volz, Signo Reis, Dongming Yan, Chris Werner, Xing Tao, and Mike Koenigstein, Missouri University of Science and Technology

**Flexible-Start, Fixed-Duration Contracting for Construction of Transportation Projects: A Case Study of the Paseo Bridge Maintenance Project**  
Thomas Maze*, Kelly Strong, Amr A. Kandil, and Mohammed Al Qady, Iowa State University

**Crack-Free Concrete Made with Nanofiber Reinforcement**  
Zoi Metaxa and Maria S. Konsta-Gdoutos, ACBM Center, Northwestern University; Surendra P. Shah, Northwestern University

**Potential Applications for High-Strength Stainless Steels in Prestressed Concrete Bridge Piles**  
Robert D. Moser, Lawrence F. Kahn, Kimberly E. Kurtis, and Preet M. Singh, Georgia Institute of Technology

**Structural Steel Coatings Technologies for Corrosion Mitigation**  
John J. Myers and Wei Zheng, Missouri University of Science and Technology

**Applications of Basalt Fiber Reinforced Polymer (BFRP) Reinforcement for Transportation Infrastructure**  
Anil Patnaik, University of Akron


**A Self-Healing Cementitious Composite Using Oil Core–Silica Gel Shell Passive Smart Microcapsules and Microcarbonfiber**  
Xianming Shi, Montana State University; Zhengxian Yang, Montana Department of Transportation

**A Self-Healing Coating System Using Passive Smart Microparticles for the Corrosion Protection of Metals**  
Xianming Shi, Montana State University; Zhengxian Yang, Montana Department of Transportation; Xiaodong He, Western Transportation Institute

**Optimizing the Use of a High-LOI Bottom Ash, Nanoclay, and Ultrafine Fly Ash for Portland Cement Mortar**  
Xianming Shi, Montana State University; Zhengxian Yang, Montana Department of Transportation; John Hollar, Montana State University

**Strength and Durability Properties of Portland Cement Mortar with Recycled Materials**  
Xianming Shi, Montana State University; Zhengxian Yang, Montana Department of Transportation; John Hollar, Montana State University

**Evaluation of Electroless Ni, Ni-P and Ni-Zn-P Coatings for Protecting Steel Rebar from Chloride-Induced Corrosion**  
Xianming Shi, Montana State University; Tuan Anh Nguyen, Western Transportation Institute

**Evaluation of Piezo-Polymer WIM Uniformity Using Asphalt Pavement Analyzer**  
Patrick J. Szary, Rutgers University

**Pavement Performance Models by Regression and Artificial Neural Network Techniques**  
Ephrem Taddesse and Helge Mork, Norwegian University of Science and Technology

**Threshold of Vibrations During Initial and Final Curing Period of Green Concrete in Drilled Shaft Construction**  
Kamal Tawfiq, Florida State University; Primus Vincent Mtenga and John Olusegun Sobanjo, Florida A&M University–Florida State University

**Structural Performance Evaluation for Post-Treatment Corrosion Inhibitor System**  
Richard E. Weyers, Virginia Polytechnic Institute and State University; Jonathan Winker, Virginia Tech; Neal S. Berke, W.R. Grace and Company

* recently deceased
6:00 p.m.–7:15 p.m.
Posters and Reception: Strategies for Rapid Repair and Rehabilitation
Poster Session

The “Managing Agent Contractor” (MAC) Contract—Getting it Right the First Time
Andrew Ardrey, Halcrow

Reclamation of Asphalt Pavements Using Coal Combustion Byproducts
Tarunjit Butalia, Ohio State University; William E. Wolfe, Ohio State University

Lightweight Concrete Solutions for Transportation Infrastructure Needs
Reid Castrodale and Ken Harmon, Carolina Stalite Company

External Confinement and Energy Dissipation for Seismic Accelerated Bridge Construction
Genda Chen, Missouri University of Science and Technology

New Tools for Inspection and Evaluation of Steel Truss Bridge Gusset Plates
Christopher C. Higgins, Quang Nguyen, O. Tugrul Turan, and Robert Connor, Oregon State University

Effects of Design–Construction Interactions on PCC Pavements Constructability and Staging
Methodologies in Georgia
Javier Irizarry, Daniel Castro, and Carlos Arboleda, Georgia Institute of Technology

Techniques for Rapid Repair and Strengthening Using Composite Technologies: Missouri Perspective
John J. Myers, Missouri University of Science and Technology

Digitization of Transportation and Civil Infrastructure for Assessment, Preservation, and Renewal
Bahram Ravani and Ty A. Lasky, University of California, Davis

Development of Pavement Maintenance Management System for Baghdad Urban Roadway Network
Saad Sarsam, Baghdad University-Engineering College; Amna Talal, University of Baghdad, Iraq

Use of Nanoclays to Improve Slipform Paving Derived from Self-Consolidating Concrete
Nathan Tregger and Surendra P. Shah, Northwestern University

6:00 p.m.–7:15 p.m.
Posters and Reception: Methods to Support Infrastructure Preservation and Renewal
Poster Session

Incorporating Strategic Flexibility in Pavement Design Life-Cycle Cost Analysis (LCCA)
Baabak Ashuri, Georgia Institute of Technology; Nicola Chiara, Columbia University

Decision Support System for Infrastructure Preservation and Management
Eddie Yein-Juin Chou, University of Toledo

Exploiting Advanced Inspection Technologies to Support Condition Assessment, Forecasting, and Decision Making
Pablo Luis Durango-Cohen and David Corr, Northwestern University

Using Current Service Models to Determine Future Research and Data Collection Needs: An Examination of Regional Salt Loads
Evan C. Bentz, University of Toronto, Canada; Mark Ehlen and M. D. A. Thomas, Life-365 Consortium I; Tony Kojundic, Elkem Materials

Performance-Based Private Sector Management of Transportation Facilities—Lessons Learned and Blueprint for the Future
Theodore R. Ferragut, TDC Partners, Ltd.

Methodology for Sustainable Transportation Infrastructure Planning
John Guenther, Sharon DeMonsabert, and Maria Pena, George Mason University

The Impact of O&M Activities for Asset Preservation and Renewal on Life-Cycle Costs: Case Study from I-595 Corridor roadway Improvements Project—A 35-Year Life-Cycle Project
Charles Henningsgaard, Roy Jorgensen Associates, Inc.; Ramón Villaamil Perez, ACS Infrastructure Development

Pavement Preservation Saves Lives
Roger M. Larson, Applied Pavement Technology, Inc.
Life-Cycle and Economic Efficiency Analysis for Pavement Marking Materials: Two-Year Data Collection for the State of Maryland
Young-Jae Lee, Morgan State University

Optimization of Maintenance and Replacement Policies for a Heterogeneous System of Infrastructure Facilities
Samer Michel Madanat and Charles-Antoine Robelin, University of California, Berkeley

Integrating Climate Change Mitigation Strategies into the Infrastructure Decision-Making Process
Sue McNeil, University of Delaware

Pavement Preservation and Sustainability
David G. Peshkin and Thomas John Van Dam, Applied Pavement Technology, Inc.

Improving Tomorrow’s Infrastructure: Extending the Life of Concrete Structures with Solid Stainless Steel Reinforcing Bar
Raymond Schnell and Michael Bergmann, Tally Metals

Modeling Costs and Effectiveness of Bridge Preservation Actions
John Olusegun Sobanjo, Florida A&M University–Florida State University; Omar Thomas, Florida State University

The Need to Preserve Existing Freight Infrastructure in the Face of Rapid Urban Development
Rachel Susan Wiggins, North Central Texas Council of Governments

Use of Treemap Data Visualizations to Understand Bridge Status and Performance
Trefor P. Williams, Rutgers University

7:15 p.m.–9:00 p.m.
Planning Team Meeting (by invitation)
Friday, November 13

7:30 a.m.–8:30 a.m.
Breakfast

8:30 a.m.–10:00 a.m.
Research Agenda Working Groups (continued)
The Friday discussion objectives follow:

- Continue to identify and discuss most promising research areas.
- Derive general priorities based on need and promise. Focus should be on intermediate term—5-year time frame, with more general long-term research targets considered if relevant and time permits.
- Identify and discuss implementation barriers and opportunities.

Inventory and Condition Assessment Research Agenda Group (continued)
Leonard R. Evans; Michael P. Freeman, presiding

Innovative Materials for Preservation, Restoration, and Reconstruction Research Agenda Group (continued)
Larry Galehouse; Ali Maher, presiding

Strategies for Rapid Repair and Rehabilitation Research Agenda Group (continued)
John J. Myers; Robert L. Peskin, presiding

Methods to Support Infrastructure Preservation and Renewal Research Agenda Group (continued)
Samer Michel Madanat; Sue McNeil; Butch Wlaschin, presiding

10:00 a.m.–10:30 a.m.
Break

10:30 a.m.–noon
Reports from the Research Agenda Working Groups
Joseph L. Schofer, Northwestern University, presiding

Inventory and Condition Assessment Research Agenda Group
Leonard R. Evans and Michael P. Freeman

Innovative Materials for Preservation, Restoration, and Reconstruction Research Agenda Group
Larry Galehouse and Ali Maher

Strategies for Rapid Repair and Rehabilitation Research Agenda Group
John J. Myers and Robert L. Peskin

Methods to Support Infrastructure Preservation and Renewal Research Agenda Group
Samer Michel Madanat, Sue McNeil, and Butch Wlaschin

Noon p.m.–1:00 p.m.
Lunch
Developing a Research Agenda for Transportation Infrastructure Preservation and Renewal—Gaps and Priorities
Joseph L. Schofer, Northwestern University, presiding

This closing session will define an infrastructure research road map to assure the condition, performance, safety, and security of our transportation system in the years ahead. Participants will build on the work of the following four groups to identify the most promising research areas and topics, considering (1) the greatest need and (2) the greatest promise for success.

1. Inventory and Condition Assessment;
2. Innovative Materials for Preservation, Restoration, and Reconstruction;
3. Strategies for Rapid Repair and Rehabilitation; and

Special discussion will focus on themes that crosscut the areas.

Planning Team Meeting (by invitation)
Register online at www.TRB.org/conferences/2009/Infrastructure

Registration Information

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www.trb.org/conferences/2009/Infrastructure/abstracts

Hotel Information

Hyatt Regency Washington on Capitol Hill
400 New Jersey Avenue, NW
Washington, DC 20001
Phone: 202-737-1234; fax: 202-737-5773

Special TRB rate: $209
Cutoff: September 10, 2009

Event Name: Transportation Infrastructure Preservation and Management Conference
http://washingtonregency.hyatt.com/groupbooking/wasrwtrb12009

Contacts

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(tpalmerlee@nas.edu, mamiller@nas.edu).

Upcoming Events

June 2–3, 2009
Data and Tools for Linking Goods Movement, Air Quality, and Transportation Infrastructure Decisions
Irvine, California

July 19–22, 2009
2009 TRB Joint Summer Conference
Seattle, Washington

July 22, 2009
Northwest Traffic Data Workshop
Seattle, Washington

September 14–15, 2009
Integrated Corridor System Management Modeling Best Practices Workshop
Irvine, California

September 16–17, 2009
North American Freight Flows Conference 2009
Irvine, California

October 19–22, 2009
8th National Conference on Asset Management
Portland, Oregon

January 10–14, 2010
TRB 89th Annual Meeting
Washington, D.C.

January 10–14, 2010
North American Travel Monitoring Exposition and Conference (NATMEC)
Seattle, Washington