

# Construction Engineering & Management Research Needs

National Cooperative Highway Research Program  
Project 10-58 Final Report

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*Construction projects often challenge transportation agencies to meet faster production schedules while causing minimal disruption to the traveling public.*

# Research for Our Decade

The business of highway construction engineering and management (CEM) is changing as transportation agencies work hard to meet increased project demands, but with minimal disruption to the nation's mobility and productivity. NCHRP Project 10-58 final report, *Construction Engineering and Management Research Needs*, uses the changes and challenges affecting highway agency operations as the basis for a new decade of highway research opportunities. The publication presents the results of NCHRP Project 10-58, Construction Engineering and Management Research Program, a project for the AASHTO Highway Subcommittee on Construction.

*Construction Engineering and Management Research Needs* identifies and prioritizes seventeen research projects designed to help highway and transportation agencies improve the efficiency, productivity, and quality of highway projects.

The NCHRP Project 10-58 research initiative addresses CEM project needs, improvements that address an agency's bottom line. CEM typically represents 5 to 15 percent of a construction contract amount, and improving efficiency and productivity can potentially save agencies millions of dollars.

But, changing CEM practices may increase risks. Implementing high-performance materials could involve a higher installation cost, without a tested service life to support the investment. Promising timesaving procedures may lack performance data to support their merit.

The proposed research affords agencies the opportunity to test and evaluate innovative responses to those changes and responds to today's transportation environment. For example:

**Customer Expectations.** Poor road conditions and trips interrupted by lane closures during maintenance or reconstruction interfere with people's lives and livelihoods. Highway agencies must continually balance customer needs with customer expectations.

## Safety

Ensuring safety for construction workers and the traveling public is the primary concern on any construction project. Nighttime reconstruction and maintenance operations present unique safety challenges.

## Alternative Contract Methods

Properly applied concepts such as incentives/disincentives, cost-plus-time, or design-build can accelerate project delivery. They can also obstruct successful completion if all parties are not committed to their use.



*New materials and procedures can improve construction quality and reduce construction schedules.*

**Time.** Road users want agencies to maintain roads, they just don't want it happening when and where *they* drive. The challenge is to produce high-quality projects that extend road life, but with minimal inconvenience to drivers and businesses.

**People.** People are the crucial resource in any construction project and highway agencies are challenged to find, train, and retain a qualified, experienced workforce. Public agencies now compete with the private sector for fewer qualified workers, and today's students often don't consider transportation as a career option.

**Technology.** New materials, methods, and techniques promise reduced costs and improved construction quality, however, many are untested and not certified for use.

**Roles, Responsibilities, and Risks.** All partners in highway projects recognize the need to allocate these elements to the party(s) best positioned to control and manage them. With the continued blurring of public and private sector roles in highway project construction and management, transportation agencies must better manage the 3-Rs to ensure successful projects.

## Research Categories

In identifying the scope of the new program, researchers developed problem statements that respond directly to seven key issues:

**Safety** — Analyze nighttime effect on safety, construction quality, and productivity while improving safety for workers and the traveling public.

**Alternative Contract Methods** — Evaluate new contracting methods and delivery systems to accelerate project delivery while maintaining or improving construction quality.

**Allocate Risks and Responsibilities** — Expand use of contractor-performed testing responsibilities and implement and evaluate performance-related specifications and acceptance tests to reduce agency workloads.

**Personnel** — Identify ways that transportation organizations can recruit, train, and retain the diverse workforce necessary to meet current and future challenges.

**Faster Construction** — Develop and evaluate new contracting procedures, construction processes, materials testing, and management methods to accelerate construction projects.

**Communication** — Examine best practices for community outreach and involvement during project construction.

**Environment** — Identify better ways to implement and manage environmental restrictions and requirements.

Several projects encompass more than one research category, but each research topic is designed to support strategic CEM priorities and help transportation agencies identify, evaluate, and implement procedures and specifications to improve project performance.

## Allocation of Risks and Responsibilities

Highway agencies are contracting more activities previously performed in-house to private sector contractors. This reduces the agencies' workload and also disperses the risk and responsibility for project performance-related acceptance testing.

# Research Topics Support CEM Priorities

NCHRP Project 10-58 final report, *Construction Engineering and Management Research Needs*, provides complete project descriptions that address important issues affecting highway construction, customer service, and productivity. Project descriptions include specific problem statements, research objectives, research tasks, and project duration and anticipated funding levels.

The following brief research project topics and descriptions are presented in priority order.

## Personnel

Highway agencies depend on a committed, diverse workforce to meet CEM project obligations, but agencies struggle with budget constraints, retirements, and competition with the private sector to recruit, hire, train, and retain qualified employees.

### Implement the Use of New Materials into Highway Construction Practice

Investigate methodologies to use new materials, describe the benefits and problems with current agency practices, and identify barriers associated with implementing the new materials. This study could potentially be divided into four (4) projects that focus on concrete/reinforcement, asphalt, steel, and composites.

### Develop Innovative Rapid Construction/Reconstruction Methods

Develop a knowledge base for best practices in rapid construction methods for concrete pavement, asphalt pavement, and bridge structures; include effects on cost and construction quality, and assess modular techniques for performance and durability.

### Improve Safety of Public and Workers During Highway Reconstruction and Maintenance

Identify best practices by transportation agencies and contractors for work zone management engineering, traffic enforcement, and public awareness for highway maintenance, reconstruction, and rehabilitation (MRR) projects.

### Identify Alternative Contracting Methods and Delivery Systems to Facilitate Faster Construction/Reconstruction

Develop a method to aid the selection of alternative contracting strategies (such as A+B bidding, lane rental, incentive/disincentive provisions, and design build) that minimize the impacts on the traveling public; include effect on project cost, schedule, and construction quality.

### Analyze Nighttime Construction Activities and Impacts on Safety, Quality, and Productivity

Identify best practices and recommend strategies for nighttime construction operations by analyzing current practices to improve safety of construction personnel and traveling public; assess quality of the constructed facility and productivity of nighttime MRR activities.

### Identify Impact of Strategies to Manage Traffic During Highway Projects on Construction Methods, Productivity, Schedule, and Quality

Study best practices and guidelines to produce a synthesis of methods to manage traffic during highway construction projects and minimize inconvenience to highway users and businesses.

### Review Recruiting, Retaining, and Promoting Practices for Qualified Highway Construction Personnel

Identify and develop best practices for public and private sector transportation organizations to recruit, train, and retain qualified personnel for highway construction activities.

### Evaluate and Implement Performance-Related Specifications (PRS) for Highway Construction

Evaluate the current use of performance-related specifications in terms of time, cost, and quality and create an implementation program for PRS in highway construction that considers past experience and lessons learned.

### Evaluate the Use of Incentives/Disincentives (I/D) to Reduce Time to Complete Highway Projects

Evaluate how transportation agencies use incentives/disincentives; assess I/D project selection criteria, their value, and their effect on project quality and safety; quantify their ability to reduce time to complete highway projects.

### Identify, Evaluate, and Implement Rapid Test Methods and Nondestructive Testing to Assess Quality in Construction Process

Develop a comprehensive quality-testing resource guide that concentrates on rapid test methods and nondestructive test methods; include current best practices and cost/time savings versus quality tradeoff of results.

## Faster Construction

Innovative materials and processes hold promise to reduce highway project schedules, but the industry needs data evaluating new construction methods, materials quality, and implementation techniques before many are adopted.

# Communication

Good communication with residents and businesses by telephone, email, meetings, and face-to-face discussion can create partners crucial to successfully completing highway projects.

## Training and Workforce Development of Transportation Agency Personnel

Develop a comprehensive CEM training and workforce development program model that builds on and updates past transportation agency programs.

## Develop Constructibility Review Process Implementation Plan

Identify best practices and recommend strategies for conducting formal constructibility reviews and design an implementation plan for transportation agencies.

## Determine Strategies to Manage the Reduced CEM Staff Size and Increased Workload of Transportation Agencies

Identify current practices used by public and private sector agencies to manage increased workloads through outsourcing and more efficient use of in-house personnel; evaluate the tools used to make those decisions.

## Identify, Evaluate, and Implement Performance-Related Acceptance Tests

Identify current use and future need of performance-related acceptance tests, the properties needed to predict performance, and institutional barriers to implementation.

## Develop Best Practices for Community Outreach and Involvement During Construction

Identify public perceptions regarding the effect of construction on motorists and businesses, identify current community involvement programs, and develop a best practices guide for community outreach and involvement during construction.

## Develop Best Practices for Managing Environmental Restrictions and Requirements

Review currently available programs that focus on compliance with environmental regulations, identify the impact of current and pending noise, air, and storm water management regulations on transportation agency CEM projects; and create a best practices guide to manage environmental restrictions and requirements.

## Evaluate Extended Use of Contractor-Performed QC Processes for Acceptance of Highway Projects

Identify agencies using QC contractor data for acceptance, for which products and tests, and how agency and contractor verification test data compare; evaluate the expanded use of contractor-performed quality control processes for acceptance of highway projects.

## Research Is Building

The CEM research agenda outlines an ambitious 10-year program that builds on two previous programs funded by the FHWA in 1979 and 1990 (FHWA-HO-79-1 and FHWA-RD-90-034, respectively). The seventeen project topics respond to specific changes affecting transportation agency operations today and tomorrow.

It is essential that CEM research continue to:

- Provide better service to the customer – the highway users.
- Improve the quality of highways and bridges.
- Provide safe construction areas for motorists and workers.
- Take advantage of improved products.
- Reduce the time required for completing construction projects.
- Improve communication with communities affected by construction.
- Better manage the environmental impact of construction projects.

The program is the result of a thoughtful approach encompassing a literature search and peer review, acceptance, and approval. It is a coordinated approach that supports the highest CEM priorities, builds on completed work, and promotes successful implementation of research findings.

## Environment

Highway agencies need a better understanding of and ability to track rules and regulations protecting the natural and manmade environment, which greatly affect CEM projects.

## WIIFM\* — and Your Agency?

In addition to the research opportunities available through NCHRP Project 10-58, the potential for collaboration between transportation agencies and their private sector partners holds valuable promise to benefit the industry. The process has already begun as some agencies have identified research topics from the current projects and submitted requests for funding.

All topics must be addressed if the research is to be completed within the 10-year time period, so transportation sector acceptance and support is vital.

The estimated cost of each topic varies from \$200,000 to \$400,000. Your agency may be able to fund research projects of this magnitude through its in-house research programs. If you have a more limited research program, look for partners in other agencies, such as the FHWA, or through other NCHRP projects.

The NCHRP Project 10-58 final report can help your agency improve productivity of its CEM projects, update the state-of-the-practice, enhance safety, and reduce the bottom line.

The final report for NCHRP 10-58 is available on the NCHRP website as NCHRP Web Document 51.

\*What's In It For Me?



*Contractors are assuming added risk and responsibility for performance-related testing.*

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## Disclaimer

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