Center Basics

The Center for Sustainable Transportation Infrastructure (CSTI) conducts innovative basic and applied research for accelerating the renewal, increasing safety, reducing lifecycle costs, and ensuring sustainability of transportation infrastructure systems. It also provides an excellent environment, resources, and instruction for students to learn fundamental concepts, acquire advanced knowledge, and gain practical experience.

Mission

- Advance the general knowledge base and state-of-the-practice, and provide high quality education and research in the transportation infrastructure field
- Conduct outreach activities to disseminate and implement research and accelerate technological innovation in the transportation infrastructure field.
- Enhance the transportation infrastructure workforce by increasing the number of undergraduate and graduate students in the field.

Research Capabilities

CSTI has unique capabilities to conduct extensive field and laboratory testing
Available facilities include:
- The heavily instrumented Virginia Smart Road. (see the Smart Road information sheet for more details)
- An advanced materials characterization lab with a state-of-the-art servo-hydraulic material testing system.
- Nondestructive evaluation of surface properties including friction and texture.

Research Examples

National Sustainable Pavement Consortium

The construction and maintenance of a reliable and sustainable transportation infrastructure (that is economically viable, minimizes the impact on the environment, and operates fairly) is a priority for all transportation agencies. CSTI is leading a concerted and collaborative effort between state Departments of Transportation (DOTs) to set up a sustainability framework for research, which includes a full understanding of sustainable pavement practices related to highway construction, maintenance, and operation. The consortium brings DOTs together to share ideas, experiences, and to set up a common agenda to encourage the use and development of a sustainability framework for pavements.

Field Support for VDOT Quiet Pavement Implementation Program

This research effort supports the Virginia Department of Transportation program for exploring lower-noise pavements that includes both asphalt and concrete pavement technologies by documenting all aspects of the progression to “routine application of quiet pavement.” The program is evaluating a New Generation Open graded friction Course (OGFC) mix (often referred to as Porous Friction Course (PFC) and low noise concrete textures constructed using actual diamond grinding equipment (often called Next Generation Concrete Surface, NGCS). Specific tasks include the determination of as-constructed functional and structural properties of the various technologies to be evaluated by monitoring the performance over two full winters of service.

Research Areas

- Sustainability
- Vehicle Based infrastructure performance assessment
- Infrastructure/asset management
- Performance Management
- Infrastructure maintenance and preservation
- Economic analysis of transportation infrastructure investments
- Pavement materials, design, and analysis
- Modeling of infrastructure materials behavior and deterioration
- Innovative sensing technology application
- Information technology application
- Life cycle cost analysis and assessment
- Infrastructure assessment and rehabilitation
- Non-destructive testing
- Winter maintenance and operations
High RAP, High Binder Asphalt Concrete Mixes

This project is helping the Virginia Department of Transportation (VDOT) optimize the binder content in their RAP (Reclaimed Asphalt Pavement) mixes to achieve desirable mix performance. With increasing awareness for greener, more sustainable practices, as well as increases in oil prices, State departments of transportation (DOTs) have seriously considered the economic and environmental benefits of allowing higher percentages of RAP in their mixes. Because the aged asphalt binder in the RAP has different properties than the new un-aged asphalt binder, the proportions of aged and un-aged asphalt binder and how the two binders mix will affect the performance of RAP mixes. The research evaluates the mount of un-aged binder added to the mixture affect its performance.

CSTI is developing an assessment tool to characterize the propensity of highway sections to generate splash and spray.

Splash-Spray Assessment Tool Development Program

CSTI is leading an international team (composed also by TRL, APTech, and VCTIR) that is developing an assessment tool to characterize the propensity of highway sections to generate splash and spray during rainfall and for this propensity to be assessed in terms of the impact of drivers. This FHWA-sponsored project will deliver a robust model to predict splash and spray generation and will consist of three components: (1) water film model, (2) splash/ spray model, and (3) an exposure model. The final model will be practical and applicable by all highway administrations throughout the country.

Development and Demonstration of Pavement Friction Management Programs

This project is helping FHWA in their efforts to help state DOTs implement proactive pavement friction management (PFM) programs. The project is supporting the development of investigatory and intervention thresholds for pavement friction and macro-texture by owner-agencies. It will make a significant contribution to selecting and maintaining the most appropriate (and cost-effective) pavement surfaces to increase highway safety by reducing crashes and their severity. The overall goal is to move towards a proactive approach to help achieve the recent goal of reducing the annual fatalities in half by 2030.

SHRP 2 R06(F) Assessment of Continuous Pavement Deflection Measuring Technologies

The objective of the project is to carry out a critical and unbiased assessment of (1) the potential of existing continuous deflection devices as practical and cost-effective tools for use in the development of optimum pavement rehabilitation strategies on rapid renewal projects, and (2) their capability for screening structural deficient sections and scorping their needs at the network level.

Development of Pavement Structural Capacity Requirements for Innovative Pavement Decision-Making and Contracting

This project focuses on developing tools to analyze pavement structural capacity at the network level to develop and recommend: (1) a "structural" pavement condition index that can be used for network-level pavement management; (2) an algorithm to scope pavement M&R projects at the network level; and (3) a framework for specifying structural capacity thresholds based on non-destructive evaluation and analysis.

Past Projects

Integrated Infrastructure Asset Monitoring, Assessment and Management

This collaborative effort enabled a prototype integrated infrastructure monitoring management-approach spanning all elements of the transportation infrastructure. The project included field tests of typical prototype integrated transportation infrastructure monitoring/ management systems and the development of an integrated system architecture that will pull together monitoring and management systems intended for single elements of the transportation infrastructure and enhance and expand existing data collection activities.

Validation of the Mechanistic-Empirical Analysis Procedure to Determine In-Place HMA Layer Modulus for Rehabilitation Projects

This project evaluated various methods for characterizing existing HMA layers for rehabilitation purposes and provided a recommendation on which one to use in the Commonwealth.

Soft Computing-Based Life-Cycle Cost Analysis of Transportation Infrastructure Investments

This NSF grant used soft computing methods for developing practical economic analysis tools to support transportation infrastructure asset management. The project produced a rule-based software tool that allows infrastructure agencies to analyze the life-cycle costs of roadway rehabilitation projects and proposed a general framework to expand the software and include nonmonetary factors into the analysis.

Multivariate Volumetric Specifications and Dynamic Modulus as a Quality Measure for Asphalt Concrete Materials

This project investigated, through the use of the asphalt concrete dynamic modulus, how performance-related End-Result Specifications (ERSs) can be introduced into a quality assurance (QA) plan. Specifically, the project (1) evaluated the variability of asphalt mixtures VTM, VMA, and AC (2) explored different QA specification plans; and (3) developed and applied a method to predict asphalt concrete rutting performance from dynamic modulus test results using the mechanistic-empirical pavement design guide (MEPDG).

Quality Management of Pavement Condition Data Collection

This project, funded by the NAS, documented quality management practices employed by public road and highway agencies for automated, semi-automated, and manual pavement condition data collection and delivery. The synthesis examined the quality management techniques used in pavement data collection and how these practices impact the quality of the decisions made based on the data collected.