Federal Highway Administration • Turner-Fairbank Highway Research Center

Office of Infrastructure R&D

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The ***Office of Infrastructure Research and Development (R&D)*** *continually improves infrastructure-related technology through research, development, and testing; through an outreach process to identify future targets of opportunity; and with the pursuit of advanced research initiatives. It supports program offices and the resource center in the development of near-term Research, Development, and Technology (RD&T) program plans and projects; demonstration field tests of technologies; and evaluation of customer needs, acceptance, and benefits of new infrastructure-related products.*

SUPERPAVE

Superior Performing Asphalt Pavements (SUPERPAVE®) is a new mixture design and analysis system that will produce more durable, longer lasting asphalt pavements. It was initially developed under the Strategic Highway Research Program (SHRP) and is now being refined, validated, and implemented by the Federal Highway Administration (FHWA). FHWA has developed testing procedures; refined equipment; conducted a national pooled-fund equipment purchase; developed training materials and conducted training courses; and organized hundreds of workshops, meetings, and seminars concerning this new technology. Forty-nine States have adopted the SUPERPAVE binder specifications. Thirty States have adopted the SUPERPAVE mixture design specifications.

HIPERPAV

The High-Performance Paving system (HIPERPAV™) is a user-friendly computer program for preventing uncontrolled cracking in new concrete pavements. The program enables engineers to consider and avoid potential construction problems and to reduce the number of early-age pavement distresses. This leads to increased long-term pavement performance, improved life-cycle costs, and reduced highway user delays due to maintenance and repair. HIPERPAV I™ (early-age behavior of jointed plain concrete pavements, JPCP) was developed under a research contract and implemented through a series of field trials and workshops. HIPERPAV II™ (HIPERPAV I plus long-term behavior of JPCP and early-age behavior of continuously reinforced concrete pavements, CRCP) was developed under a second research study, and implementation is underway.

High-Performance Bridge Materials Testing

The FHWA Structures Laboratory has been instrumental in testing and accelerating implementation of high-performance, steel bridge materials with the goals of delivering steel bridges that are easier to construct and that are less susceptible to fractures and corrosion. A new class of high-performance steel (HPS) has been developed to improve the quality, durability, and cost efficiency of steel bridges. In partnership with the U.S. Navy and the American Iron and Steel Institute, FHWA implemented a highly successful steel development program that resulted in three new steel grades with improved weldability, fracture resistance, and corrosion resistance. To date, over 140 bridges have been constructed nationwide using HPS and hundreds more are under construction. HPS enables designers to use longer span lengths and lighter girders, resulting in substantial cost savings for many jobs. Cost savings as high as 10 percent have been documented in some cases. In addition, the properties of HPS promise to increase durability and help reduce future maintenance costs for these structures. Since its inception, use of HPS continues to grow nationwide and is rapidly becoming the material of choice for many bridge applications.

Ultra High-Performance Concrete for Bridges

One of FHWA's highest priorities is to develop and promote construction materials that are stronger and more durable for replacing or rehabilitating deteriorating bridges. The next generation of high-performance concrete, known as ultra high-performance concrete (UHPC), is currently being evaluated at the Turner-Fairbank Highway Research Center (TFHRC) Structures Laboratory. UHPC is a steel fiber-reinforced reactive powder concrete that can typically reach a compressive strength of 200 MPa (30 ksi), which is more than twice that of any high-performance concrete used to date for U.S. bridge construction. Other distinctive advantages of this material include little or no post-cure creep or shrinkage, no mild reinforcement requirements, and significantly increased durability. The program includes testing to failure of a 70-foot-long, single span UHPC bridge. This concept bridge was built utilizing innovative precast sections that integrate girder and deck elements into an 8-foot-wide, 70-foot-long member. This enabled a complete bridge to be erected in less than two hours.

Horizontally-Curved Steel Girder Bridges

A landmark research study is underway at FHWA to develop modern design and construction methodologies for horizontally-curved steel bridges. Curved structures are an essential tool for accommodating complex roadway alignments in areas with restricted right-of-way access. A full size curved girder bridge has been erected and is currently undergoing extensive testing at the FHWA Structures

Laboratory. This is the largest, most extensive bridge test ever performed in the United States. Experimental testing, combined with advanced computer simulation technology, has formed the basis for a complete revision of the American Association of State Highway and Transportation Officials' (AASHTO) steel bridge design specifications. The new specifications have simplified design methodology, improved design efficiency, and promise to reduce fabrication and erection problems for curved steel bridges. This work is making a significant improvement in practice that will benefit all steel bridge construction across the country.

Nondestructive Evaluation of Bridges

The Nondestructive Evaluation Validation Center at the Turner-Fairbank Highway Research Center is developing new technologies for the inspection of bridges. This includes the development of the next generation of ground-penetrating radar technologies for the assessment of concrete bridge decks, improved ultrasonic methods, new thermal imaging systems, and advanced applications of nuclear methods for nondestructive evaluation. The Center is also developing new instrumentation and methods to measure stress in steel and prestressed concrete bridges, deflection measurement technologies for load rating of bridges, and crack detection techniques to monitor the health and safety conditions of bridge structures in support of asset management.

Earthquake Protective Systems

Bridge engineers have continually sought an alternative seismic design philosophy that avoids or limits damage to bridge elements. One promising approach in limiting damage to bridge columns due to moderate ground motions is the use of seismic isolation systems. An FHWA testing program was developed and executed to provide bridge engineers and owners with credible information on static and dynamic performance, and on the selection and quality of the available seismic isolation and energy dissipation systems. FHWA experts provided much-needed technical assistance to bridge engineers in Turkey and Taiwan during their recovery efforts.

National Bridge Coatings Qualification Testing Program

AASHTO recently launched the first national qualification testing program for bridge coating materials. This was done through the AASHTO National Transportation Product Evaluation Program (NTPEP). This program provides a level testing playing field for the testing of commercial paints and coatings products. The data is collected in an online data mine with access given to all State bridge owners. For the first time, product choices and decisions directly affecting the durability of steel structures will be made nationwide using a common data set. FHWA staff and the TFHRC Coatings Laboratory have directly supported the formation and implementation of this program. The Coatings Laboratory has assisted in developing appropriate test protocols and evaluation criteria, and personnel have served as oversight for the various commercial testing laboratories that perform the bulk of the routine testing. The Coatings Laboratory also has developed improved evaluation techniques and conducted round robin testing of materials to set benchmarks for the program. Use of the data generated by this program is expected to have a significant impact on the quality of coating materials supplied for painting bridges nationwide.

Scour Evaluations for Woodrow Wilson Bridge

The TFHRC Hydraulics Laboratory and FHWA hydraulics specialists from the Resource Center worked with the design team, led by the Maryland State Highway Administration, to apply the latest technology available for estimating scour at the piers proposed for the replacement Woodrow Wilson Bridge. This structure is the only federally owned Interstate bridge in the United States, and is a major mobility link for North-South transportation for the I-95 corridor.

LTPPBind

LTPPBind is a new software tool developed by the Long-Term Pavement Performance (LTPP) team to help highway agencies select the most suitable and cost-effective Superpave Performance Grade (PG) for a particular site. Based on the original binder selection software, SHRPBind, LTPPBind features a database of high and low air temperatures (minimum, mean, maximum, standard deviation, and number of years) for 7,835 U.S. and Canadian weather stations, along with several modifications to the initial SHRP methodology that provide users with the ability to: (1) select PGs based on actual temperature conditions at their site and the level of risk designated by their highway agency, (2) use either the original SHRP models or LTPP's revised temperature models for determining a site's binder PG, and (3) adjust the PG selection for different levels of traffic loading and speed.

DataPave Online

DataPave Online is a simple, user-friendly web application that contains all LTPP releasable data. These data include inventory, materials testing, pavement performance monitoring, climatic, traffic, maintenance, rehabilitation, and seasonal testing data from more than 2,500 pavement test sections at 932 locations on inservice highways throughout North America. http://www.datapave.com/

Distress Identification Manual

This manual was developed to provide a consistent, uniform basis for collecting distress data for the LTPP program. It provides a common language for describing cracks, potholes, rutting, spalling, and other pavement distresses being monitored by the LTPP program. The manual is divided into three sections, each focusing on a particular type of pavement: (1) asphalt concrete-surfaced, (2) jointed portland cement concrete, and (3) continuously reinforced portland cement concrete. Each distress is clearly labeled, described, and illustrated. Distress Identification Manual for the Long-Term Pavement Performance Program can be found at http://www.tfhrc.gov/pavement/ltpp/reports/03031/index.htm

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