

Technical Advances Extend Bridge Life To 100 Years

New bridge design approach can add years to service life

Bridge replacement is a major source of disruption to the nation's transportation system, so bridge owners need ways to design bridges that last longer. Current bridge design practices consider the "ultimate limit behavior state" that prevents collapse. However, most bridge rehabilitation and reconstruction projects result from deterioration such as cracks, corrosion, and deformation. Knowledge of these "service limit states" is limited and largely based only on qualitative data and experience. Quantitative data from the element distress areas of bridges are needed to inform service-based design.

Design Guidance for 100-Year Bridges: Service Limit State Design

The Solution

Developed through the second Strategic Highway Research Program (SHRP2), this research will create **a quantitative framework to assess service limit states more accurately and provide actual performance data, component-based distress models, and specific guidance for common bridge elements**. Products of this research will be packaged in a toolkit that includes:

- Framework for calibrating service limit state specifications
- Service limit state load and resistance factors
- Bridge design procedures and model specifications for service limit states
- Tools required for future service limit state improvements
- Model specification changes that include designing for durability

The toolkit allows for future improvements in service limit state calibration, particularly as data become available from projects that are currently under way (such as the Long-Term Bridge Performance Program). The **toolkit contains databases, software tools used in the calibration (such as Monte Carlo spreadsheets), instructions for developing new or revised spreadsheets, deterioration models, and a user's manual**.

Study will produce enhanced bridge design guidance

FOCUS AREA: Renewal (R19B)

Toolkit will include a quantitative framework to assess service limit states, bridge design procedures and model specifications, tools for future service limit state improvements, and model specification changes to support designing for durability.

Save Lives

- Enhanced bridge designs based on quantitative deterioration models will reduce the frequency of construction work zones associated with bridge preservation, rehabilitation, and reconstruction activities.

Save Money

- Extending the service life of bridges will save money by reducing the frequency of rehabilitating and replacing these very costly elements of the transportation system.

The framework will calibrate the following AASHTO service limit state design elements:

- Live load deflections
- Bearing movements
- Settlement of foundations and retaining structures
- Permanent deformations of compact steel components
- Fatigue of structural steel and the steel reinforcement in concrete (complementary research being conducted through National Cooperative Highway Research Program [NCHRP] 12-83)
- Slip-critical bolted connections
- Concrete approaches

The Benefits

The products resulting from this SHRP2 project add value by improving service limit state design, which can **increase the service life of bridge components** and enable designers to **select bridge components based on expected maintenance and difficulty of replacement**. The toolkit and framework establish a protocol by which future research and data collection fit easily into the approach to service limit state design. This approach will optimize future efforts by avoiding the collection of incomplete and inaccurate data on service limit state behavior.

How can you learn more?

The bridge design techniques are not yet in use because this product is a foundational study that fills a necessary gap in current bridge design practice. The enhanced bridge design guidance is expected to change how designers approach the bridge design process for service limit state checks. The final report, guidelines, toolkit, bridge specifications, and framework will be available in 2013 at www.TRB.org/SHRP2/publications. For more information, contact Lubin Gao at FHWA, lubin.gao@dot.gov or Kelley Rehm at AASHTO, krehm@aashto.org.

About SHRP2 Implementation



The second Strategic Highway Research Program is a national partnership of key transportation organizations: the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the Transportation Research Board. Together, these partners conduct research and deploy products that will help the transportation community enhance the productivity, boost the efficiency, increase the safety, and improve the reliability of the Nation's highway system.

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