

Priority, Market-Ready Technologies and Innovations

Load and Resistance Factor Design (LRFD) and Rating of Structures

Problem: Transportation agencies seek a more uniform level of safety and reliability for highway structures

A 1987 Transportation Research Board study concluded that the American Association of State Highway and Transportation Officials' (AASHTO) *Standard Specifications for Highway Bridges* contained gaps and inconsistencies and did not use the latest design philosophy and knowledge. In response, AASHTO first adopted the *Load and Resistance Factor Design (LRFD) Bridge Design Specification* in 1994 and the *Guide Manual for Condition Evaluation and Load and Resistance Factor Rating (LRFR) of Highway Bridges* in 2002.

What is LRFD?

LRFD incorporates state-of-the-art analysis and design methodologies with load and resistance factors based on the known variability of applied loads and material properties. These load and resistance factors are calibrated from actual bridge statistics to ensure a uniform level of safety.

How does LRFD work?

With LRFD, a bridge designer focuses on a design objective or limit state, which can lead to a similar probability of failure in each component. Bridges designed with the LRFD specifications should have more uniform safety levels, which should ensure superior serviceability and long-term maintainability.

Because of LRFD's impact on the safety, reliability, and serviceability of the Nation's bridge inventory, AASHTO, in concurrence with the Federal Highway Administration (FHWA), has set a transition deadline of October 1, 2007. After this date, States must design all new bridges according to the LRFD specifications.

Putting It in Perspective

- The National Bridge Inventory (NBI) contains more than 590,000 bridges.
- Forty percent of all NBI bridges are more than 40 years old.
- Design life when these bridges were constructed was often only 50 years.

Solution: Provide resources to help States implement LRFD

To facilitate and ensure that the States accomplish this transition by the 2007 deadline, FHWA has developed a strategic plan. The plan involves the following:

- Identify past, current, and future State LRFD implementation plans.
- Identify and deploy showcases of successful State LRFD implementations.
- Deploy a general implementation plan and guidelines that States can use to identify and prioritize steps toward a successful LRFD implementation: make decisions, set priorities, determine actions, review performance on a regular basis, and make needed changes to the plan.
- Deploy planning assistance to provide hands-on implementation and transition planning that integrates States into the detailed implementation planning process.
- Deploy comprehensive design examples.
- Deploy prompt technical LRFD training and assistance to States.

Benefits

- Uniform level of safety and reliability.
- State-of-the-art specifications that use the latest research and bridge knowledge.
- Superior serviceability and long-term maintainability.
- More robust structures with longer service lives and reduced need for major maintenance.

- Deploy training seminars and workshops.
- Develop and deploy detailed, hands-on training courses.
- Compile and maintain a comprehensive list of LRFD resources (books, software, courses).
- Support LRFD research.

FHWA has a team of structural engineers who are available to meet with individual States and provide guidance in developing a State-specific LRFD implementation plan. In addition, the following products have been developed to assist States:

- Tips for successful LRFD implementation.
- A model State implementation plan.
- Comprehensive LRFD resource list.
- Two comprehensive design examples (steel and prestressed (PS) concrete from deck to foundation).
- 1-day steel and PS concrete workshops.
- Comprehensive 1-week substructure and superstructures training courses.

Successful Applications: Sixteen States have fully implemented LRFD

According to the AASHTO Oversight Committee (OC) 2005 survey, 16 States have fully implemented LRFD, and most remaining States are progressing toward full implementation.

Deployment Statement

LRFD is a design platform that is routinely used around the world for the design of civil engineering features. The benefits of LRFD design

According to this map, 16 States have fully implemented LRFD specifications, while most of the remaining States have partially implemented the specifications.

compared with other designs are many, including uniform safety, improved communication between structural and geotechnical disciplines, and more cost-effective and efficient designs.

Deployment Goal

By October 2007, all new bridges and structure designs using Federal-aid funds will be designed using LRFD.

Deployment Status

Sixteen States have fully implemented LRFD, and most remaining States are progressing toward full implementation.

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