



Priority, Market-Ready Technologies and Innovations

Load and Resistance Factor Design 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 utilize the latest design philosophy and knowledge. In response, AASHTO adopted the *Load and Resistance Factor Design (LRFD) Specification* in 1994 and the *Load and Resistance Factor Rating (LRFR) Guide Specification* 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?

Without 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 a showcase of successful State LRFD implementations.
- Develop an 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.
- Develop comprehensive design examples.
- Deploy prompt technical LRFD training and assistance to States.

- Develop detailed, hands-on training courses.
- Compile 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 (with roadmap items).
- Comprehensive LRFD resource list (training courses, design examples, books, and software).

FHWA is developing two comprehensive design examples (deck to foundation), and two topic-specific training courses. This training will be available through the National Highway Institute by the end of 2004. FHWA also has developed training workshops for bridge superstructures (steel and concrete), and will develop geotechnical training workshops, as well.

Successful Applications: Some States have completed LRFD implementation

Ten States already have fully implemented the LRFD specifications, with positive results. Another 23 States have partially implemented LRFD or have developed sample LRFD designs. Eleven States have worked with FHWA to develop implementation plans and begin the transition to LRFD. Many other States have expressed a strong interest in working with FHWA to develop an LRFD implementation plan to facilitate their transition to the LRFD specifications by 2007.

Benefits

- Uniform level of safety and reliability.
- State-of-the-art specifications that utilize 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.

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