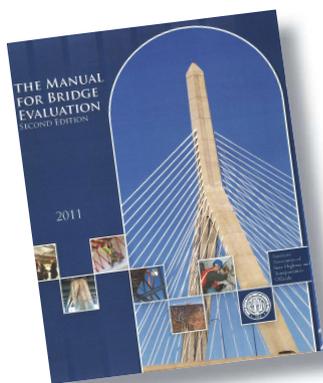


Load Rating Concrete Bridges: Part 3



by Dr. Dennis R. Mertz



The load rating of concrete bridges using the load and resistance factor rating (LRFR) methodology of Section 6, Part A of the American Association of State Highway and Transportation Officials' (AASHTO's) *Manual for Bridge Evaluation* (MBE) is summarized in the adjacent table adapted from MBE Table 6A.4.2.2-1.

As indicated in the table, the specified strength limit states are mandatory while the newly included service limit states are for the most part optional. Note that while MBE Table 6A.4.2.2-1 indicates that the Service III limit state is optional at the legal load level for prestressed concrete, it is mandatory for segmentally constructed prestressed concrete.

In previous columns, the mechanics of the LRFR methodology—the load-rating equation, where the loads, load factors, and resistance factors can be found, and the purposes of the different load levels—was discussed.

Let's discuss the intent of the limit states, specifically the optional service limit states. The strength limit states of the LRFR methodology are much the same as those of the older load factor rating (LFR) methodology. In general, they check the remaining load-carrying capacity to reach a moment or shear limit at the specified load level.

The service limit states check the remaining load-carrying capacity to reach a stress limit. When applied, these limit states

Material	Limit State	Load Level			
		Design		Legal	Permit
		Inventory	Operating		
Reinforced Concrete	Strength I	mandatory	mandatory	mandatory	n/a
	Strength II	n/a	n/a	n/a	mandatory
	Service I	n/a	n/a	n/a	optional
Prestressed Concrete	Strength I	mandatory	mandatory	mandatory	
	Strength II	n/a	n/a	n/a	mandatory
	Service I	n/a	n/a	n/a	optional
	Service III	mandatory	n/a	optional	n/a

NOTE: n/a = not applicable for the associated load level.

protect the bridge against specific damage.

The Service I limit state is suggested by the MBE for reinforced and prestressed concrete bridges under the permit load level. The stress limit for the Service I limit state is 90% of the yield strength of the reinforcement, either nonprestressed or prestressed, for all loads factored by a load factor of one. The Service I limit state allows cracking of the concrete but precludes yielding of the reinforcement. Thus, cracks can form and open but should close after passage of the legal or permit load. A prudent owner should consider using the Service I limit state to protect against permanent deformation and open cracks.

The Service III limit state at the design load level at inventory is identical to that of the *AASHTO LRFD Bridge Design Specifications* with a live-load load factor of 0.8 and with all of the other loads factored by a load factor of one. It is mandatory for prestressed concrete bridges. The stress limit for the Service III limit state is the modulus of rupture. The MBE suggests the Service III limit state for prestressed concrete members at the legal load level,

but with a live-load load factor of 1.0. The specification of the load factor of 1.0 is appropriate as the LRFD-specified load factor was developed specifically for the nominal HL-93 live-load model as opposed to the legal truck configurations. Again, a prudent owner should consider using the Service III limit states to protect against cracking of prestressed members under legal loads.

With that, our series of discussions on load rating concrete bridges using the LRFR methodology of the 2011 edition of the MBE are complete. 

EDITOR'S NOTE

If you would like to have a specific provision of the AASHTO LRFD Bridge Design Specifications explained in this series of articles, please contact us at www.aspirebridge.org.