# Load Rating Concrete Bridges: Part 2

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A single equation forms the basis of load rating 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) *Manual for Bridge Evaluation* (MBE). All load rating factors (*RF*) for design, legal, or permit load levels and strength or service limit states are calculated using MBE Equation 6A.4.2.1-1:

$$RF = \frac{C - (\gamma_{DC})(DC) - (\gamma_{DW})(DW) \pm (\gamma_P)(P)}{(\gamma_{LL})(LL + IM)}$$

where

$C$ = capacity

$DC$ = dead load effect due to structural components and attachments

$DW$ = dead load effect due to wearing surface and utilities

$P$ = permanent loads other than dead loads

$LL$ = live load effect

$IM$ = dynamic load allowance

$\gamma_{DC}$ = LRFD load factor for structural components and attachments

$\gamma_{DW}$ = LRFD load factor for wearing surfaces and utilities

$\gamma_P$ = LRFD load factor for permanent loads other than dead loads = 1.0

$\gamma_{LL}$ = evaluation live load factor

All the loads except live load, *LL*, and dynamic load allowance, *IM*, are defined in Section 3 of the AASHTO *LRFD Bridge Design Specifications*. Live loads, *LL*, for design, legal, and permit load rating are defined in MBE Articles 6A.4.3.2.1, 6A.4.4.2.1, and 6A.4.5.4.1, respectively. Dynamic load allowance, *IM*, for design, legal, and permit load rating are defined in MBE Articles 6A.4.3.3, 6A.4.4.3, and 6A.4.5.5, respectively.

## Locations of Load Factors in the MBE

| Load Factor | Rating | MBE Table |
|---|---|---|
| $\gamma_{DC}$ | All | 6A.4.2.2-1* |
| $\gamma_{DW}$ | All | 2278 |
| $\gamma_{LL}$ | Design load | 31,941 |
| $\gamma_{LL}$ | Legal load, commercial traffic | 1710 |
| $\gamma_{LL}$ | Legal load, SHV** | 1170 |
| $\gamma_{LL}$ Strength limit states | Permit load | 1075 |
| $\gamma_{LL}$ Service limit states | Permit load | 1166 |

*Also specified in the *LRFD Specifications*
**SHV = Specialized hauling vehicles

For the strength limit states, the capacity, *C*, is defined in MBE Equation 6A.4.2.1-2:

$$C = \varphi_c \, \varphi_s \, \varphi \, R_n$$

where

$\varphi_c$ = condition factor

$\varphi_s$ = system factor

$\varphi$ = LRFD resistance factor

$R_n$ = nominal member resistance (as inspected)

The optional condition factor, $\varphi_c$, and the optional system factor, $\varphi_s$, are specified in MBE Tables 6A.4.2.3-1 and 6A.4.2.4-1, respectively. The LRFD resistance factor, $\varphi$, and the nominal member resistance, $R_n$, for concrete members are as specified in Section 5 of the LRFD Specifications.

For the service limit states, the capacity, *C*, is defined in MBE Equation 6A.4.2.1-4:

$$C = f_R$$

where

$f_R$ = stress limit specified in the LRFD Specifications

A future article will discuss the application of MBE Equation 6A.4.2.1-1 to the load rating of concrete bridges at the various load levels. ◬