

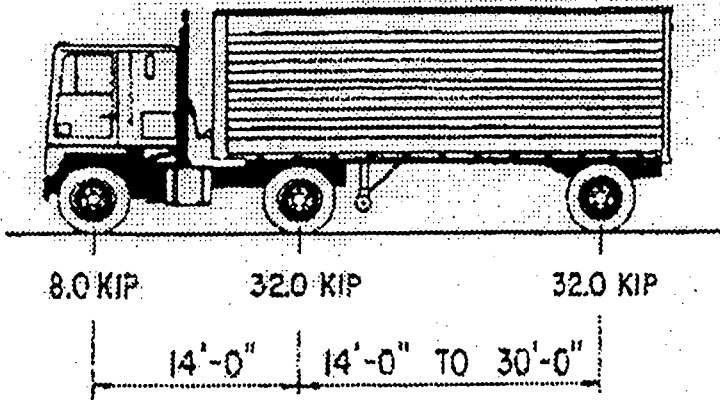
LRFR

Prestressed Concrete Bridge
Rating

Design Truck – HL-93

Loading Case #1

Design Truck



+

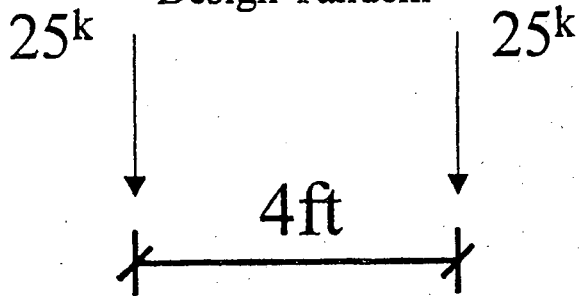
0.64 K/ft



Lane Load

Loading Case #2

Design Tandem



+

0.64 K/ft



Lane Load

NORTH CAROLINA LEGAL LOADS

BRIDGES CARRYING INTERSTATE TRAFFIC

SINGLE VEHICLE(SV)		TRUCK TRACTOR SEMI-TRAILER(TTST)	
REF. #	SCHEMATIC	REF. #	SCHEMATIC
ISH	<p style="text-align: center;">5K 20K 25K 12.5 TON</p>	IT4A	<p style="text-align: center;">11K 7.5K 19K 19K 56.5K 28.25 TON</p>
IS3A	<p style="text-align: center;">7.5K 19K 19K 45.5K 22.75 TON</p>	IT5B	<p style="text-align: center;">6.5K 19K 19K 9.75K 9.75K 64K 32 TON</p>
IS3C	<p style="text-align: center;">5K 19K 19K 43K 21.5 TON</p>	IT6A	<p style="text-align: center;">11K 4K 19K 19K 9.5K 9.5K 72K 36 TON</p>
IS4A	<p style="text-align: center;">11.5K 4K 19K 19K 53.5K 26.75 TON</p>	IT7A	<p style="text-align: center;">11K 4K 19K 19K 9K 9K 9K 80K 40 TON</p>
IS5A	<p style="text-align: center;">11K 6K 19K 19K 6K 61K 30.5 TON</p>	IT7B	<p style="text-align: center;">11K 9.5K 9.5K 6K 6K 19K 19K 80K 40 TON</p>
IS6A	<p style="text-align: center;">11K 6.66K 6.67K 19K 19K 6.67K 69K 34.5 TON</p>		
IS7A	<p style="text-align: center;">11K 6.66K 6.67K 19K 19K 6.67K 11K 80K 40 TON</p>		
IS7B	<p style="text-align: center;">11K 7K 7K 19K 19K 7K 7K 77K 38.5 TON</p>		

7/17/1995

NORTH CAROLINA LEGAL LOADS

ALL BRIDGES EXCEPT THOSE CARRYING INTERSTATE TRAFFIC

SINGLE VEHICLE (SV)			TRUCK TRACTOR SEMI-TRAILER (TTST)		
REF. #	SCHEMATIC		REF. #	SCHEMATIC	
NSH		27K 13.5 TON	NT4A		66.15K 33.075 TON
NGARB S2		40K 20 TON	NAGRI T4		76K 38 TON
NS3A		54.05K 27.025 TON	NT5B		74.4K 37.2 TON
NCOTT S3		51K 25.5 TON	NAGRI T5A		90K 45 TON
NAGGR S4		69.85K 34.925 TON	NAGRI T5B		90K 45 TON
NS5A		71.1K 35.55 TON	NT6A		83.2K 41.6 TON
NS6A		79.9K 39.95 TON	NT7A		84K 42 TON
NS7B		84K 42 TON	NT7B		84K 42 TON

Note: Includes 10% Tolerance where applicable.

Revised 10/25/2005

6A.4.2 General Load-Rating Equation

The following general expression shall be used in determining the load rating of each component and connection subjected to a single force effect (i.e., axial force, flexure, or shear):

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

Eq. (6-1 6A.4.2.1-1)

For the Strength Limit States:

$$C = \phi_c \phi_s \phi R_n$$

Where the following lower limit shall apply:

$$\phi_c \phi_s \geq 0.85$$

For the Service Limit States:

$$C = f_R$$

where:

- RF = Rating factor
- C = Capacity
- f_R = Allowable stress specified in the LRFD code
- R_n = Nominal member resistance (as inspected)
- 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
- γ_{DC} = LRFD load factor for structural components and attachments
- γ_{DW} = LRFD load factor for wearing surfaces and utilities
- γ_P = LRFD load factor for permanent loads other than dead loads = 1.0
- γ_L = Evaluation live-load factor
- ϕ_c = Condition factor
- ϕ_s = System factor
- ϕ = LRFD resistance factor

Table 6-2 6A.4.2.3-1 Condition Factor: ϕ_c

Structural Condition of Member	ϕ_c
Good or Satisfactory	1.00
Fair	0.95
Poor	0.85

Table 6-3 6A.4.2.4-1 System Factor: ϕ_s for Flexural and Axial Effects

Superstructure Type	ϕ_s
Welded Members in Two-Girder/Truss/Arch Bridges	0.85
Riveted Members in Two-Girder/Truss/Arch Bridges	0.90
Multiple Eyebars in Truss Bridges	0.90
Three-Girder Bridges with Girder Spacing ≤ 6 ft.	0.85
Four-Girder Bridges with Girder Spacing ≤ 4 ft.	0.95
All Other Girder Bridges and Slab Bridges	1.00
Floorbeams with Spacing > 12 ft. and Non-Continuous Stringers	0.85
Redundant Stringer Subsystems Between Floorbeams	1.00

Limit States and Load factors for Load Rating

For Prestressed Concrete Bridge

Limit State	Dead Load γ_{DC}	Dead Load γ_{DW}	Design Load (HL-93)		Legal Load γ_L
			Inventory	Operating	
			γ_L	γ_L	
Strength I	1.25	1.50	1.75	1.35	1.80 for ADTT \geq 5000 1.65 for ADTT = 1000 1.40 for ADTT \leq 100
Service III	1.00	1.00	0.80	-----	1.00

ADTT : Average Daily Truck Traffic.

Prestressed Concrete Bridge Strength I Rating Example:

New BI-36 Box Beam Bridge
74 ft. Span Length

Max. Unfactor Dead Load	Load Factors
$M_{\text{NCDL}} = 531$ kips-ft	$\gamma_{\text{DC}} = 1.25$
$M_{\text{FWS}} = 50$ kips-ft	$\gamma_{\text{DW}} = 1.50$
$M_{\text{Barrier+OtherDL}} = 94$ kips-ft	$\gamma_{\text{DC}} = 1.25$

Max. Unfactor LL+I	Load Factors
$M_{\text{HL-93}} = 457$ kips-ft	Inventory $\gamma_{\text{L}} = 1.75$
	Operating $\gamma_{\text{L}} = 1.35$
$M_{\text{NS7B Legal Load}} = 434$ kips-ft	$\gamma_{\text{L}} = 1.80$ (ADTT ≥ 5000)

Factor Moment Capacity
$M_r = \phi M_n = 1887$ kips-ft
Using $\phi_c = 1.00$, $\phi_s = 1.00$, and $\phi = 0.90$

For HL-93 Load

$$\text{Inventory Rating} = (1877 * 1.0 * 1.0 - 531 * 1.25 - 50 * 1.50 - 94 * 1.25) / (1.75 * 457) \\ = 1.28$$

$$\text{Operating Rating} = (1877 * 1.0 * 1.0 - 531 * 1.25 - 50 * 1.50 - 94 * 1.25) / (1.35 * 457) \\ = 1.65$$

For Legal Load

$$\text{Rating} = (1877 * 1.0 * 1.0 - 531 * 1.25 - 50 * 1.50 - 94 * 1.25) / (1.80 * 434) \\ = 1.31$$