CHAPTER 18
BRIDGE LOAD RATING
18.6.2 Materials and Other Information/18.6.3 Section Properties

Future wearing surface = 2.0 in. (25 psf)  
Parapet weight = 411 lb/ft
Concrete strength (girder) $f'_c = 5.0$ ksi  
$E_c$ (girder) = 4,287 ksi
Concrete strength at release (girder) $f'_{cl} = 4.0$ ksi  
$E_{cl}$ (girder) = 3,834 ksi
Concrete strength (deck) $f'_c = 3.4$ ksi  
$E$ (deck) = 3,535 ksi
Unit weight of concrete $w_c = 150$ pcf

Allowable tensile stress at service (midspan, Inventory) = $6\sqrt{f'_c} = 0.424$ ksi
Allowable tensile stress at service (midspan, Operating) = $7.5\sqrt{f'_c} = 0.530$ ksi
Prestressing strand strength, $f_{pu} = 270$ ksi  
$E_s$ = 28,500 ksi
Area of prestressing strand = 0.153 in$^2$
Rating vehicle (Design) = HS20 for rating based on the Standard Specifications
= HL-93 for rating based on the LRFD Specifications
Rating Vehicle (Permit) = FL-120 (See Fig. 18.6.2-1)
ADTT > 5000

Figure 18.6.2-1
FL-120 Permit Truck

18.6.3 Section Properties
The beam cross section is shown in Figure 18.6.3-1 and properties are listed below. The section properties are calculated based on the 7.5-in.-thick structural slab. The difference of material properties between slab and beam are considered with an equivalent width of slab. The effective flange width is calculated to be 98.00 in.

<table>
<thead>
<tr>
<th>Non-Composite Section</th>
<th>Composite Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y_{Nt} = 24.73$ in.</td>
<td>$y_{ct} = 17.43$ in.</td>
</tr>
<tr>
<td>$y_{Nb} = 20.27$ in.</td>
<td>$y_{cb} = 35.07$ in.</td>
</tr>
<tr>
<td>$I_N = 125,390$ in.$^4$</td>
<td>$I_c = 364,324$ in.$^4$</td>
</tr>
<tr>
<td>$A_N = 560$ in.$^2$</td>
<td>$A_c = 1,166$ in.$^2$</td>
</tr>
</tbody>
</table>


Figure 18.6.3-1. Cross Section at Midspan

18.6.4 Dead Load Calculations
The noncomposite section carries the girder self-weight and slab weight (8 in. thick), while the barrier and future wearing surface weights are uniformly distributed among the six girders and are carried by the composite section.

Girder moment: \[ M_G = \frac{qL^2}{8} = \frac{(560)(0.150)(65)^2}{(144)(8)} = 308.07 \text{ ft-kips} \]

Slab moment: \[ M_S = \frac{qL^2}{8} = \frac{(8.17)(8)(0.150)(65)^2}{(12)(8)} = 431.48 \text{ ft-kips} \]

Barrier moment: \[ M_B = \frac{qL^2}{8} = \frac{(0.411)(2)(65)^2}{(6)(8)} = 72.35 \text{ ft-kips} \]

Future wearing surface: \[ M_w = \frac{qL^2}{8} = \frac{(43.5)(0.025)(65)^2}{(6)(8)} = 95.72 \text{ ft-kips} \]

Total dead load moment: \[ M_d = 907.62 \text{ ft-kips} \]

18.6.5 Stresses and Strength

18.6.5.1 Prestress Losses
Initial prestressing force/strand = (0.153)(0.69)(270.0) = 28.50 kips

Initial prestress force: \[ P_{si} = (22)(28.50) = 627.00 \text{ kips} \]

Eccentricity of prestress force: \[ e = y_{nb} - y_{bs} = 20.27 - 4.27 = 16.0 \text{ in.} \]