# Interior Girder (G4) Load Rating

**Bridge Information:**

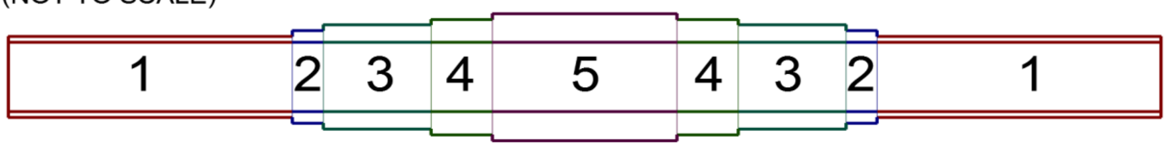
| | |
|---|---|
| Built Approx. : | 1965 |
| Span Length, L : | 147 ft |
| Girder Spacing, S : | 8 ft |
| Slab Thickness, $t_s$ : | 9.5 in |
| Skew Angle, Θ : | 49 degrees |
| Asphalt Thickness : | 2 in |

**Steel Properties:**

| | |
|---|---|
| A36 Steel | |
| $F_y$ : | 36 ksi |
| $f'_c$ : | 3 ksi |
| E : | 29000 ksi |
| rebar cover : | 1 in |
| rebar dia : | 0.625 in |

| | Location of Each Section (ft from West End) | |
|---|---|---|
| 1 | 0 | 37 |
| 2 | 37 | 37.5 |
| 3 | 37.5 | 52 |
| 4 | 52 | 56.5 |
| 5 | 56.5 | 90.5 |
| 4 | 90.5 | 95 |
| 3 | 95 | 109.5 |
| 2 | 109.5 | 110 |
| 1 | 110 | 147 |

Different Section Properties
(NOT TO SCALE)




### Calculate Non-Composite Section Properties

| Section Property 1 | Width (b) in | Height (h) in | I in^4 | Area (A) in^2 | y of plate in | A*y in^3 | d in | I+A*d^2 in^4 |
|---|---|---|---|---|---|---|---|---|
| Top Plate | 20 | 0.875 | 1.116536458 | 17.5 | 61.375 | 1074.0625 | -32.01707 | 17940.245 |
| Web | 0.375 | 60 | 6750 | 22.5 | 30.9375 | 696.09375 | -1.579575 | 6806.1388 |
| Bottom Plate | 22 | 0.9375 | 1.510620117 | 20.625 | 0.46875 | 9.6679688 | 28.889175 | 17214.815 |
| | | | **Σ A =** | *60.625* | **Σ A*y =** | *1779.8242* | **I =** | ***41961.199*** |
| | | | | | **Neutral Axis, y =** | ***29.357925*** | | |

| Section Property 2 | Width (b) in | Height (h) in | I in^4 | Area (A) in^2 | y of plate in | A*y in^3 | d in | I+A*d^2 in^4 |
|---|---|---|---|---|---|---|---|---|
| Top Plate | 20 | 0.875 | 1.116536458 | 17.5 | 62.3125 | 1090.4688 | -39.58846 | 27427.927 |
| Web | 0.375 | 60 | 6750 | 22.5 | 31.875 | 717.1875 | -9.150962 | 8634.1522 |
| Bottom Plate | 22 | 1.875 | 12.08496094 | 41.25 | 0.9375 | 38.671875 | 21.786538 | 19591.532 |
| | | | **Σ A =** | *81.25* | **Σ A*y =** | *1846.3281* | **I =** | ***55653.611*** |
| | | | | | **Neutral Axis, y =** | ***22.724038*** | | |

| Section Property 3 | Width (b) in | Height (h) in | I in^4 | Area (A) in^2 | y of plate in | A*y in^3 | d in | I+A*d^2 in^4 |
|---|---|---|---|---|---|---|---|---|
| Top Plate | 20 | 1.75 | 8.932291667 | 35 | 62.75 | 2196.25 | -32.85522 | 37790.228 |
| Web | 0.375 | 60 | 6750 | 22.5 | 31.875 | 717.1875 | -1.980222 | 6838.2287 |
| Bottom Plate | 22 | 1.875 | 12.08496094 | 41.25 | 0.9375 | 38.671875 | 28.957278 | 34601.199 |
| | | | **Σ A =** | *98.75* | **Σ A*y =** | *2952.1094* | **I =** | ***79229.655*** |
| | | | | **Neutral Axis, y =** | | ***29.894778*** | | |

| Section Property 4 | Width (b) in | Height (h) in | I in^4 | Area (A) in^2 | y of plate in | A*y in^3 | d in | I+A*d^2 in^4 |
|---|---|---|---|---|---|---|---|---|
| Top Plate | 20 | 1.75 | 8.932291667 | 35 | 63.75 | 2231.25 | -38.39299 | 51599.682 |
| Web | 0.375 | 60 | 6750 | 22.5 | 32.875 | 739.6875 | -7.517987 | 8021.7027 |
| Bottom Plate | 22 | 2.875 | 43.56673177 | 63.25 | 1.4375 | 90.921875 | 23.919513 | 36231.619 |
| | | | **Σ A =** | *120.75* | **Σ A*y =** | *3061.8594* | **I =** | ***95853.004*** |
| | | | | **Neutral Axis, y =** | | ***25.357013*** | | |

| Section Property 5 | Width (b) in | Height (h) in | I in^4 | Area (A) in^2 | y of plate in | A*y in^3 | d in | I+A*d^2 in^4 |
|---|---|---|---|---|---|---|---|---|
| Top Plate | 20 | 2.125 | 15.99283854 | 42.5 | 63.9375 | 2717.3438 | -36.27315 | 55934.997 |
| Web | 0.375 | 60 | 6750 | 22.5 | 32.875 | 739.6875 | -5.210648 | 7360.8942 |
| Bottom Plate | 22 | 2.875 | 43.56673177 | 63.25 | 1.4375 | 90.921875 | 26.226852 | 43549.937 |
| | | | **Σ A =** | *128.25* | **Σ A*y =** | *3547.9531* | **I =** | ***106845.83*** |
| | | | | **Neutral Axis, y =** | | ***27.664352*** | | |

## Summary of Non-Composite Section Properties

| Section Property | Length, x ft | A in^2 | I in^4 | y in | Depth in | Stop in^3 | Sbot in^3 |
|---|---|---|---|---|---|---|---|
| 1 | 37.000 | 60.625 | 41961.199 | 29.358 | 61.813 | 1292.921 | 1429.297 |
| 2 | 0.500 | 81.250 | 55653.611 | 22.724 | 62.750 | 1390.438 | 2449.107 |
| 3 | 14.500 | 98.750 | 79229.655 | 29.895 | 63.625 | 2348.922 | 2650.284 |
| 4 | 4.500 | 120.750 | 95853.004 | 25.357 | 64.625 | 2440.996 | 3780.138 |
| 5 | 34.000 | 128.250 | 106845.829 | 27.664 | 65.000 | 2861.764 | 3862.221 |

## Calculate Composite Section Properties

Effective Flange Width, $b_{eff}$ :

Minimum of:

| | | | |
|---|---|---|---|
| (i) 1/4*L | | 441 | in |
| (ii) $12t_s$ + greater of: | | 124 | in |
| $t_w$ | 0.375 | | |
| $1/2*b_{ftop}$ | *10* | | |
| (iii) S | | 96 | in |
| | **$b_{eff}$ =** | ***96*** | in |

Modular Ratio, n :

For 2.9 < $f'_c$ < 3.6 : f'c : 3 ksi

**n =** ***9***

### Short-Term Composite, (n) :

$b_e = b_{eff}/n$ : ***10.66666667*** in

$I_{concrete} = (b_e t_s\text{^}3)/12$

***762.1111111*** in^4

$A_{concrete} = b_e*t_s$

***101.3333333*** in^2

| Section Property | y for concrete | y in | Beam d in | Beam I+Ad^2 in^4 | Concrete d in | Concrete I+Ad^2 in^4 | $I_{ST\text{-}Comp}$ in^4 | $S_{top}$ in^3 | $S_{bot}$ in^3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 66.5625 | *52.63590976* | 23.27798451 | 74811.7381 | -13.92659 | 20415.703 | *95227.441* | *10377.214* | *1809.1725* |
| 2 | 67.5 | *47.57459493* | 24.85055647 | 105829.561 | -19.92541 | 40993.65 | *146823.21* | *9675.0769* | *3086.1684* |
| 3 | 68.375 | *49.38330383* | 19.48852535 | 116735.164 | -18.9917 | 37311.476 | *154046.64* | *10816.594* | *3119.4073* |
| 4 | 69.375 | *45.44176829* | 20.08475484 | 144563.237 | -23.93323 | 58805.802 | *203369.04* | *10601.396* | *4475.3769* |
| 5 | 69.75 | *46.24008621* | 18.57573436 | 151099.505 | -23.50991 | 56770.67 | *207870.18* | *11080.551* | *4495.4539* |

## Summary of Short Term Composite Section Properties

| Section Property | y in | $I_{ST\text{-}Comp}$ in^4 | $S_{top}$ in^3 | $S_{bot}$ in^3 |
|---|---|---|---|---|
| 1 | 52.6359098 | 95227.44063 | 10377.21399 | 1809.1725 |
| 2 | 47.5745949 | 146823.211 | 9675.076902 | 3086.16839 |
| 3 | 49.3833038 | 154046.6403 | 10816.59365 | 3119.40734 |
| 4 | 45.4417683 | 203369.039 | 10601.39616 | 4475.37688 |
| 5 | 46.2400862 | 207870.1758 | 11080.55069 | 4495.4539 |

## Long-Term Composite, (3n) :

$b_e = b_{eff}/n$ : ***3.555555556*** in

$I_{concrete} = (b_e t_s\text{^}3)/12$

***254.037037*** in^4

$A_{concrete} = b_e{*}t_s$

***33.77777778*** in^2

| Section Property | y for concrete | y in | Beam d in | Beam I+Ad^2 in^4 | Concrete d in | Concrete I+Ad^2 in^4 | $I_{ST\text{-}Comp}$ in^4 | $S_{top}$ in^3 | $S_{bot}$ in^3 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 66.5625 | *42.66990492* | 13.31197966 | 52704.4826 | -23.8926 | 19536.288 | *72240.77* | *3773.8232* | *1693.0146* |
| 2 | 67.5 | *35.87244929* | 13.14841083 | 69700.1681 | -31.62755 | 34042.014 | *103742.18* | *3859.8079* | *2891.9738* |
| 3 | 68.375 | *39.70235538* | 9.807576895 | 88728.2761 | -28.67264 | 28023.442 | *116751.72* | *4880.3851* | *2940.6749* |
| 4 | 69.375 | *34.97877719* | 9.621763731 | 107031.838 | -34.39622 | 40216.531 | *147248.37* | *4966.8509* | *4209.6488* |
| 5 | 69.75 | *36.43790717* | 8.773555314 | 116717.907 | -33.31209 | 37737.086 | *154454.99* | *5407.6917* | *4238.8547* |

## Summary of Long Term Composite Section Properties

| Section Property | y in | $I_{ST\text{-}Comp}$ in^4 | $S_{top}$ in^3 | $S_{bot}$ in^3 |
|---|---|---|---|---|
| 1 | 42.6699049 | 72240.77013 | 3773.823237 | 1693.01456 |
| 2 | 35.8724493 | 103742.1826 | 3859.807899 | 2891.97377 |
| 3 | 39.7023554 | 116751.7184 | 4880.385101 | 2940.67486 |
| 4 | 34.9787772 | 147248.3689 | 4966.850916 | 4209.64884 |
| 5 | 36.4379072 | 154454.9935 | 5407.69174 | 4238.85468 |

## Dead Load Analysis:

| | | |
|---|---|---|
| Unit Weight Concrete: | 0.15 | k/ft^3 |
| Unit Weight Steel: | 0.49 | k/ft^3 |
| Weight for Diaphragms: | 0.308 | k |
| Number of Diaphragms: | 6 | |

**Note**: Increase Steel and Diaphragms by : 0.06
to account for connections

### DC1 - Non-Composite Dead Loads

| Section Property | Deck k/ft | Stringer k/ft | Diaphragm k/ft | **Total Per Stringer Per Section** | |
|---|---|---|---|---|---|
| 1 | 0.95 | 0.218671007 | 0.013325714 | ***1.181996721*** | k/ft |
| 2 | 0.95 | 0.293064236 | 0.013325714 | ***1.25638995*** | k/ft |
| 3 | 0.95 | 0.356185764 | 0.013325714 | ***1.319511478*** | k/ft |
| 4 | 0.95 | 0.435538542 | 0.013325714 | ***1.398864256*** | k/ft |
| 5 | 0.95 | 0.462590625 | 0.013325714 | ***1.425916339*** | k/ft |

**Sum of Section Loads**

| |
|---|
| **87.467757** |
| **3.0127799** |
| **38.265833** |
| **12.589778** |
| **48.481156** |

***Overall DL Per Stringer : 1.2912742 k/ft***

**Note:**
Use as input for QuickBridge to apply load to bridge and calculate Moment and Shear Demand Envelopes.
See 'Raw Demand Loads' tab for results.

### DC2 - Composite Dead Loads

Using tributary areas: Dead loads due to curb, parapets, sidewalks and guardrails all are applied to exterior girders.

### DW - Wearing Surface Loads

DW is the same for each section property.

Unit Weight Asphalt: 0.14 k/ft^3

**DW Per Stringer:** ***0.186666667*** k/ft

**Note:**

Use as input for QuickBridge to apply load to bridge and calculate Moment and Shear Demand Envelopes. See 'Raw Demand Loads' tab for results.

## Live Load Analysis:

### Compute Live Load Distribution Factors

$K_g = n(I+Ae_g\text{^}2)$ $n = E_B/E_D$ 9.189067195 $E_D = 33000(w_c)\text{^}1.5*\text{sqrt}(f'_c)$ 3155.9243

**Note**: Use I and A of steel section property only.

### One Lane Loaded:

$g_{m1} = 0.06+(S/14)\text{^}0.4*(S/L)\text{^}0.3*(K_g/(12*l*t_s))\text{^}0.1$

$g_{v1} = 0.36+S/25$

***gv1 = 0.68***

### Two or More Lanes Loaded:

$g_{m2} = 0.075+(S/9.5)\text{^}0.6*(S/L)\text{^}0.2*(K_g/(12*l*ts))\text{^}0.1$

$g_{v2} = 0.2+(S/12)-(S/35)\text{^}2$

***gv2 = 0.8144218***

**Note**: gv is constant for entire member since it is based on girder spacing which is constant.

### Skew Correction Factor

Reduction of Load Distribution Factors for moment in longitudinal beams on skewed supports.

$M_{SCF} = 1-c_1(\tan\Theta)\text{^}1.5$

$c_1 = 0.25*(K_g/(12*L*t_s\text{^}3))\text{^}0.25*(S/L)\text{^}0.5$

| Section Property | $K_g$ in^4 | $g_{m1}$ | $g_{m2}$ | $c_1$ | $M_{SCF}$ | $g_m$ |
|---|---|---|---|---|---|---|
| 1 | 1156693.45 | 0.384991097 | 0.565601924 | 0.0545398 | 0.9327052 | 0.5275398 |
| 2 | 2008276.68 | 0.403425066 | 0.593429581 | 0.06260584 | 0.9227528 | 0.5475888 |
| 3 | 2071688.9 | 0.40449434 | 0.595043741 | 0.0630943 | 0.9221501 | 0.5487196 |
| 4 | 3030702.93 | 0.417852432 | 0.615208927 | 0.06938967 | 0.9143824 | 0.5625362 |
| 5 | 3069171.02 | 0.418304073 | 0.615890718 | 0.06960882 | 0.914112 | 0.5629931 |

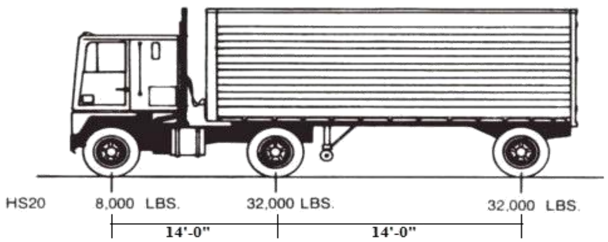
***Use maximum $g_m$ to be conservative, $g_m$ = 0.5629931***

***Use maximum $g_v$ to be conservative, $g_v$ = 0.8144218***

## Compute Live Load Effects:

Maximum moment effects are estimated to occur with the design live load centered on the span.

| | |
|---|---|
| *Design Lane Load =* | *0.64 k/ft* |
| *Design Truck Load =* | |




**Note:**

Use as input for QuickBridge to apply load to bridge and calculate Moment and Shear Demand Envelopes. See 'Raw Demand Loads' tab for results.

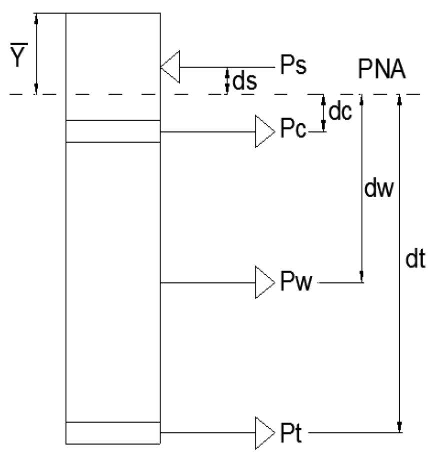
**Note:**

From hand calculations and Quick Bridge the Tandem Axles Moment did not control.

## Apply Distribution Factors and Impact Factor

Distribution factors and impact factors are applied to moment and shear demand envelopes on 'Strength I Limit State' and 'Service II Limit State' tabs.

## Compute Nominal Resistance of Sections:




$P_s = 0.85f'_c b_{eff} t_s =$ 2325.6 k

$c_{rb}$ = distance from top of slab to center of bottom layer of longitudinal reinforcing steel.

crb = 8.8125

crb/ts = 0.92763158

## Nominal Flexural Resistance, Mn:

**PNA lies in Web :**

$\bar{Y} = (D/2)[(P_t - P_c - P_s)/P_{w+1}]$

$M_p = (P_w/2D)*(\bar{Y}^2+(D-\bar{Y})^2)+[P_s d_s+P_c d_c+P_t d_t]$

**PNA lies in Top Flange :**

$\bar{Y} = (tc/2)[(Pw+P_t-P_s)/P_{c+1}]$

$M_p = (Pc/2tc)*(\bar{Y}^2+(tc-\bar{Y})^2)+[P_s d_s+P_w d_w+P_t d_t]$

**PNA lies in Concrete Deck :**

$\bar{Y} = (t_s)[(P_c+P_w+P_t)/P_s]$

$M_p = (\bar{Y}^2*Ps/2t_s)+[P_c d_c+P_w d_w+P_t d_t]$

If Dp < 0.1 Dt, then Mn = Mp

Otherwise, Mn = Mp(1.07-0.7*(Dp/Dt))

| | | | | If Pt+Pw>Pc+Ps PNA in Web | | If Pt+Pw+Pc>Ps PNA in Top Flange | | If Pc+Pw+Pt>(crb/ts)*Ps PNA in Deck | |
|---|---|---|---|---|---|---|---|---|---|
| Section Property | Pc = FyAc | Pw = FyAw | Pt = FyAt | Pt+Pw | Pc+Ps | Pc+Pw+Pt | Ps | Pc+Pw+Pt | ($c_{rb}/t_s$)*Ps |
| | k | k | k | k | k | k | k | k | k |
| 1 | 630 | 810 | 742.5 | 1552.5 | 2955.6 | 2182.5 | 2325.6 | 2182.5 | 2157.3 |
| 2 | 630 | 810 | 1485 | 2295 | 2955.6 | - | 2325.6 | - | - |
| 3 | 1260 | 810 | 1485 | 2295 | 3585.6 | - | 2325.6 | - | - |
| 4 | 1260 | 810 | 2277 | 3087 | 3585.6 | - | 2325.6 | - | - |
| 5 | 1530 | 810 | 2277 | 3087 | 3855.6 | - | 2325.6 | - | - |

| Section Property | Ȳ | dc | dw | dt | ds | ***Mp*** | Dp = Ȳ | 0.1$D_t$ = | ***Mn*** |
|---|---|---|---|---|---|---|---|---|---|
| | in | in | in | in | in | ***k-ft*** | in | 0.1$D_{comp}$ | ***k-ft*** |
| 1 | 8.91544118 | 1.022058824 | 31.45955882 | 61.9283088 | - | ***6819.7403*** | 8.9154412 | 7.13125 | ***6700.3026*** |
| 2 | 0.41625 | 0.02125 | 30.45875 | 61.39625 | 5.16625 | ***10666.482*** | 0.41625 | 7.225 | ***10666.482*** |
| 3 | 0.85375 | 0.02125 | 30.89625 | 61.83375 | 5.60375 | ***10869.395*** | 0.85375 | 7.3125 | ***10869.395*** |
| 4 | 1.40375 | -0.52875 | 30.34625 | 61.78375 | 6.15375 | ***15027.147*** | 1.40375 | 7.4125 | ***15027.147*** |
| 5 | 1.59125 | -0.52875 | 30.53375 | 61.97125 | 6.34125 | ***15133.516*** | 1.59125 | 7.45 | ***15133.516*** |

**Nominal Flexural Resistance with Repair Plate, Mn:**

| Plate Geometry | b | h | A |
|---|---|---|---|
| | 21 | 0.75 | 15.75 |

| New Section Property | At | y | Pc = FyAc | Pw = FyAw | Pt = FyAt | Pt+Pw | Pc+Ps | Pc+Pw+Pt | Ps |
|---|---|---|---|---|---|---|---|---|---|
| | in | in | k | k | k | k | k | k | k |
| 1 w/ pl | 36.375 | 0.84375 | 630 | 810 | 1309.5 | 2119.5 | 2955.6 | 2749.5 | 2325.6 |
| 2 w/ pl | 57 | 1.3125 | 630 | 810 | 2052 | 2862 | 2955.6 | 3492 | 2325.6 |
| 3 w/ pl | 57 | 1.3125 | 1260 | 810 | 2052 | 2862 | 3585.6 | 4122 | 2325.6 |

| New Section Property | $\bar{Y}$ | dc | dw | dt | ds | *Mp* | Dp = $\bar{Y}$ | $0.1D_t$ = | *Mn* |
|---|---|---|---|---|---|---|---|---|---|
| | in | in | in | in | in | *k-ft* | in | $0.1D_{comp}$ | *k-ft* |
| 1 w/ pl | 0.294375 | 0.143125 | 30.580625 | 61.049375 | 5.044375 | *8932.7187* | 0.294375 | 7.13125 | *9532.1973* |
| 2 w/ pl | 0.81 | -0.3725 | 30.065 | 61.0025 | 5.56 | *12674.425* | 0.81 | 7.225 | *13462.169* |
| 3 w/ pl | 1.2475 | -0.3725 | 30.5025 | 61.44 | 5.9975 | *12813.222* | 1.2475 | 7.3125 | *13557.133* |

**Nominal Shear Resistance, Vn:**

**Interior Panels:**

Vn = Vp[C+(0.87(1-C)/sqrt(1+(do/D)^2)]

*Vp = 0.58FyDtw = 469.8 k*

do = transverse stiffener spacing = 60 in

C = ratio of Shear Buckling to Shear Yield Strength

| Section Property | Is $(2D_{tw})/(b_{fc}t_{fc}+b_{ft}t_{ft})$ < 2.5 : |
|---|---|
| 1 | 1.18032787 |
| 2 | 0.76595745 |
| 3 | 0.59016393 < 2.5 |
| 4 | 0.45801527 |
| 5 | 0.42553191 |

| | | |
|---|---|---|
| C = 1.0 | if D/tw < 1.12sqrt(E*k/Fyw) : | 100.523076 |
| C = (1.12/(D/tw))*sqrt(E*k/Fyw) | if D/tw < 1.40sqrt(E*k/Fyw) : | 125.653845 |
| C = (1.57/(D/tw)^2)*(E*k/Fyw) | if D/tw > 1.40sqrt(E*k/Fyw) : | 125.653845 |

K = 5+5/(do/D)^2 = 10

D/tw = 160 Therefore: C = 0.4940321

*Vn = 378.32755 k*

**Exterior Panels:**

| | | | | |
|---|---|---|---|---|
| Vn = Vcr = CVp | | C = ratio of Shear Buckling to Shear Yield Strength | | |
| Vp = | 469.8 k | C = 1.0 | if D/tw < 1.12sqrt(E*k/Fyw) : | 158.940939 |
| do = | 30 in | C = (1.12/(D/tw))*sqrt(E*k/Fyw) | if D/tw < 1.40sqrt(E*k/Fyw) : | 198.676174 |
| K = | 25 | C = (1.57/(D/tw)^2)*(E*k/Fyw) | if D/tw > 1.40sqrt(E*k/Fyw) : | 198.676174 |

Therefore, C = 0.9933809

***Vn = 466.69033 k***

**Moment**

| Section Property | Location | MDC1 | MDW | MLL+IM | Capacity |
|---|---|---|---|---|---|
| | ft | k-ft | k-ft | k-ft | k-ft |
| 1 | 37 | 2625.15 | 380.545 | 3728.7543 | 6700.3026 |
| 2 | 37.5 | 2648.53125 | 383.934375 | 3760.9286 | 10666.482 |
| 3 | 52 | 3186.3 | 461.89 | 4482.6971 | 10869.395 |
| 4 | 56.5 | 3298.04625 | 478.088875 | 4623.6371 | 15027.147 |
| 5 | 90.5 | 3484.5 | 505.110375 | 4879.0286 | 15133.516 |

**Shear**

| Location of Stiffener Change | VDC1 | VDW | VLL+IM | Capacity |
|---|---|---|---|---|
| | k | k | k | k |
| End Panel (0 - 5'-0") | 94.815 | 13.7445 | 47.04 | 466.69033 |
| Interior Panel | 87.72 | 12.716 | 129.61714 | 378.32755 |

## General Load Rating Equation

RF = $(\varphi\varphi_c\varphi_s Rn-\gamma_{DC}DC-\gamma_{DW}DW)/(\gamma_L(LL+IM))$

### *Strength I Limit State*

| Inventory | | Operating | | Distribution Factors | | Impact Factor | |
|---|---|---|---|---|---|---|---|
| $\gamma_{DC}$ | 1.25 | $\gamma_{DC}$ | 1.25 | $g_m$ | 0.5629931 | IM | 1.33 |
| $\gamma_{DW}$ | 1.5 | $\gamma_{DW}$ | 1.5 | $g_v$ | 0.8144218 | | |
| $\gamma_{LL}$ | 1.75 | $\gamma_{LL}$ | 1.35 | | | | |

**Note**: See 'Strength I Limit State' tab for plots

#### Rating Factors

| Section Property | Moment | |
|---|---|---|
| | Inventory | Operating |
| 1 | 0.78 | 1.00 |
| 2 | 1.65 | 2.37 |
| 3 | 1.04 | 1.82 |
| 4 | 3.14 | 2.90 |
| 5 | 2.99 | 2.70 |
| Section Property | Shear | |
| | Inventory | Operating |
| End Panel | 4.89 | 6.33 |
| Interior Panel | 1.35 | 1.75 |

### *Service II Limit State*

| Inventory | | Operating | | Distribution Factors | | Impact Factor | |
|---|---|---|---|---|---|---|---|
| $\gamma_{DC}$ | 1 | $\gamma_{DC}$ | 1 | $g_m$ | 0.5629931 | IM | 1.33 |
| $\gamma_{LL}$ | 1.3 | $\gamma_{LL}$ | 1 | $g_v$ | 0.8144218 | | |

$f_R = 0.95 R_h F_{yf} =$ *34.2 ksi*

Rh : 1 for homogenuous sections

### Factored Live Load and Dead Load Stresses

| Section Property | Inventory | | Operating | |
|---|---|---|---|---|
| | $\gamma_{DC}f_{D}$ | $\gamma_{LL}f_{LL+IM}$ | $\gamma_{DC}f_{D}$ | $\gamma_{LL}f_{LL+IM}$ |
| 1 | 24.5641678 | 19.34330812 | 24.56416775 | 14.8794678 |
| 2 | 14.4699843 | 11.42163852 | 14.46998434 | 8.78587579 |
| 3 | 16.2038193 | 13.38813447 | 16.20381927 | 10.298565 |
| 4 | 11.7515246 | 9.646406308 | 11.75152463 | 7.42031254 |
| 5 | 12.1740226 | 10.10443554 | 12.17402257 | 7.77264272 |

### Rating Factors

| Section Property | Moment | |
|---|---|---|
| | Inventory | Operating |
| 1 | 0.4981481 | 0.647592534 |
| 2 | 1.72742428 | 2.245651559 |
| 3 | 1.34418882 | 1.747445472 |
| 4 | 2.32713351 | 3.025273564 |
| 5 | 2.17983254 | 2.833782308 |

## Summary of Rating Factor for Interior Girders

*Moment*

| **Section Property** | **Strength I Limit State** | | **Service II Limit State** | |
|---|---|---|---|---|
| | **Inventory** | **Operating** | **Inventory** | **Operating** |
| 1 | *0.78* | *1.00* | *0.50* | *0.65* |
| 2 | *1.65* | *2.37* | *1.73* | *2.25* |
| 3 | *1.04* | *1.82* | *1.34* | *1.75* |
| 4 | *3.14* | *2.90* | *2.33* | *3.03* |
| 5 | *2.99* | *2.70* | *2.18* | *2.83* |

*Shear*

| **Location** | **Inventory** | **Operating** |
|---|---|---|
| End Panels | *4.89* | *6.33* |
| Interior Panels | *1.35* | *1.75* |

| Interior Girders | **Strength I Limit State** | | **Service II Limit State** | |
|---|---|---|---|---|
| | Inventory | Operating | Inventory | Operating |
| Moment RF | *0.78* | *1.00* | *0.50* | *0.65* |
| Shear RF | *1.35* | *1.75* | - | - |