Design Step 5.2

DEAD LOAD CALCULATION

Calculate the dead load of the bridge superstructure components for the controlling interior girder. Values for the exterior girder have also been included for reference. The girder, slab, haunch, and exterior diaphragm loads are applied to the noncomposite section; the parapets and future wearing surface are applied to the composite section.

Interior girder

Girder weight

$DC_{girder\ (I)} = A_g(\gamma_{girder})$

where:

A_g = beam cross-sectional area (in^2)
= 1,085 in^2

γ = unit weight of beam concrete (kcf)
= 0.150 kcf

$DC_{girder\ (I)}$ = (1,085/144)(0.150)
= 1.13 k/ft/girder

Deck slab weight

The total thickness of the slab is used in calculating the weight.

Girder spacing = 9.667 ft.
Slab thickness = 8 in.

$DC_{slab\ (I)}$ = 9.667(8/12)(0.150)
= 0.967 k/ft/girder

Exterior girder

Girder weight

$DC_{girder\ (E)}$ = 1.13 k/ft/girder

Deck slab weight

Slab width = overhang width + ½ girder spacing
= 3.521 + ½(9.667)
= 8.35 ft.

Slab thickness = 8 in.

$DC_{slab\ (E)}$ = 8.35(8/12)(0.150)
= 0.835 k/ft/girder

Haunch weight

Width = 42 in.
Thickness = 4 in.

DC_{haunch} = [42(4)/144](0.150)
= 0.175 k/ft/girder

Notice that the haunch weight in this example is assumed as a uniform load along the full length of the beam. This results in a conservative design as the haunch typically have a variable thickness that decreases toward the middle of the span length. Many jurisdictions calculate the haunch load effects assuming the haunch thickness to vary parabolically along the length of the beam. The location of the minimum thickness varies depending on the grade of the roadway surface at bridge location and the presence of a vertical curve. The use of either approach is acceptable and the difference in load effects is typically negligible. However, when analyzing existing bridges, it may be necessary to use the variable haunch thickness in the analysis to accurately represent the existing situation

Concrete diaphragm weight
A concrete diaphragm is placed at one-half the noncomposite span length.

Location of the diaphragms:
Span 1 = 54.5 ft. from centerline of end bearing
Span 2 = 55.5 ft. from centerline of pier

For this example, arbitrarily assume that the thickness of the diaphragm is 10 in. The diaphragm spans from beam to beam minus the web thickness and has a depth equal to the distance from the top of the beam to the bottom of the web. Therefore, the concentrated load to be applied at the locations above is:

$DC_{diaphragm}$ = 0.15(10/12)[9.667 – (8/12)](72 – 18)/12
= 5.0625 k/girder

The exterior girder only resists half of this loading.

Parapet weight
According to the S4.6.2.2.1, the parapet weight may be distributed equally to all girders in the cross section.

Parapet cross-sectional area = 4.33 ft^2

$DC_{parapet}$ = 4.33(0.150) = 0.650 k/ft
= 0.650/6 girders
= 0.108 k/ft/girder for one parapet

Therefore, the effect of two parapets yields:

$DC_{parapet}$ = 0.216 k/ft per girder

Future wearing surface

Interior girder

Weight/ft^2 = 0.030 k/ft^2
Width = 9.667 ft.

$DW_{FWS\ (I)}$ = 0.030(9.667)
= 0.290 k/ft/girder

Exterior Girder

Weight/ft^2 = 0.030 k/ft^2
Width = slab width – parapet width
= 8.35 – 1.6875
= 6.663 ft.

$DW_{FWS\ (E)}$ = 0.030(6.663)
= 0.200 k/ft/girder

Notice that some jurisdictions divide the weight of the future wearing surface equally between all girders (i.e. apply a uniform load of 0.26 k/ft to all girders). Article S4.6.2.2.1 states that permanent loads of and on the deck may be distributed uniformly among the beams. This method would also be acceptable and would minimally change the moments and shears given in the tables in Design Step 5.3.