Dead Loads

As per AASHTO LRFD Design Specification, the dead load on the girder is composed of

1. Self-Weight of the girder
2. Weight of Deck
3. Superimposed Dead Loads

Superimposed dead loads represent non-structural dead loads that remain permanently on the structure such as wearing surface, sidewalk, barriers and fences. *Figure 1* below shows the aforementioned dead load components for a typical highway bridge.

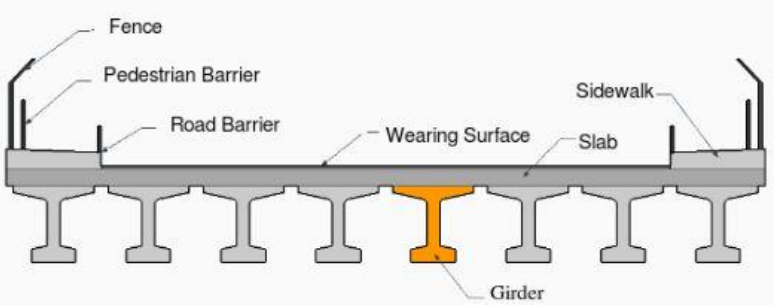

Figure 1: Dead load components for a typical highway bridge

The calculator outputs uniform load and the corresponding maximum moment for each component of the dead load. The bridge being considered in the calculator is a simply supported single span bridge. Therefore, the maximum moment due to dead loads occurs at the mid span.

1. Self-Weight of Girder

The inputs to the calculator are:

1. Area of Girder (A)
2. Unit Weight of Reinforced Concrete (γ)
3. Span Length (L)

Using the above mentioned inputs, the calculator outputs:

1. Uniform Girder Dead Load (W_{gDL})
2. Max. Moment of Girder Dead Load (M_{gDL})

Example (Using Test Data)

Given:

A = 550000 mm^2, γ = 25 kN/m^3, L = 30 m

The uniform load due to self-weight of the girder (W_{gDL}) can be calculated as follows:

$$W_{gDL} = \mathrm{A} * \gamma = (550000 \times 10^{-6})(25)$$

$$\boldsymbol{W_{gDL} = 13.75\ kN/m}$$

As mentioned previously, for simply supported girders the maximum moment occurs at mid-span. It can be calculated as follows

$$M_{gDL} = \frac{W_{gDL} * L^2}{8} = \frac{13.75 \times 30^2}{8}$$

$$\boldsymbol{M_{gDL} = 1546.88\ kN\ m}$$

2. Wet Weight of Slab

The inputs to the calculator are:

1. Unit Weight of Reinforced Concrete (γ)
2. Span Length (L)
3. Slab Thickness (t_s)
4. Girder Spacing (s)

Using the above mentioned inputs, the calculator outputs:

1. Uniform Wet Slab Dead Load (W_{slabw})
2. Max. Moment of Wet Slab (M_{slabw})

Example (Using Test Data)

Given:

γ = 25 kN/m^3, L = 30 m, t_s = 0.25 m, s = 1.35 m

$$W_{slabw} = t_s * s * \gamma = (0.25)(1.35)(25)$$

$$\boldsymbol{W_{slabw} = 8.44\ kN/m}$$

$$M_{slabw} = \frac{W_{slabw} * L^2}{8} = \frac{8.44\ \times 30^2}{8}$$

$$\boldsymbol{M_{gDL} = 949.5\ kN\ m}$$

3. Superimposed Dead Loads

Superimposed dead loads include:

1. Weight of Wearing Surface (w_{wear})
2. Weight of Barrier ($w_{barrier}$)
3. Weight of Sidewalk ($w_{sidewalk}$)
4. Weight of Facade (w_{facade})

Therefore, total superimposed dead load (W_{sdl}) can be expressed as:

$$W_{sdl} = w_{wear} + w_{barrier} + w_{sidewalk} + w_{facade}$$

The inputs to the calculator are:

1. Span Length (L)
2. Number of Girders (N_g)
3. Span Width (W)
4. Wearing Layer Thickness (t_w)
5. Avg. Side Walk Thickness (S_t)
6. Side Walk Width (S_w)
7. Unit Weight of Reinforced Concrete (γ)
8. Unit Weight of Wearing Layer Concrete (γ_w)

Using the above mentioned inputs, the calculator outputs:

1. Uniform Superimposed Dead Load (W_{sdl})
2. Max. Moment of Superimposed Dead Load (M_{sdl})

Example (Using Test Data)

Given:

L = 30m, N_g = 9, W = 12m, t_w = 0.05m, S_t = 0.25, S_w = 3m, γ = 25 kN/m^3, γ_w = 22 kN/m^3

Weight of Wearing Surface:

$$Wearing\ Surface\ Width = \ Span\ Width - 2 \times Sidewalk\ Width$$

$$Wearing\ Surface\ Width = W - (2 \times S_w) = 12 - (2 \times 3) = 6\ m$$

$$w_{wear} = \frac{Wearing\ Surface\ Width * t_w * \gamma_w}{N_g} = \frac{6 * 0.05 * 22}{9}$$

$$w_{wear} = 0.73\ kN/m$$

Weight of Barrier:

The uniform weight of each barrier is assumed to be 1 kN/m.

As shown in *Figure 1* there are a total of 2 pedestrian barriers and 2 road barriers. Therefore, the total barrier weight is 4 kN/m. Then,

$$w_{barrier} = \frac{Total\ Barrier\ Weight}{N_g} = \frac{4}{9} = 0.44\ kN/m$$

Weight of Sidewalk:

$$w_{sidewalk} = \frac{(2 * S_w) * S_t * \gamma}{N_g}$$

$$w_{sidewalk} = \frac{(2 \times 3) * 0.25 * 25}{9} = 4.17\ kN/m$$

Weight of Façade:

The total weight of façade is assumed to be 120 kN.

$$w_{facade} = \frac{120}{N_g * L} = \frac{120}{9 * 30}$$

$$w_{facade} = 0.44\ kN/m$$

$$W_{sdl} = w_{wear} + w_{barrier} + w_{sidewalk} + w_{facade}$$

$$W_{sdl} = 0.73 + 0.44 + 4.17 + 0.44$$

$$\boldsymbol{W_{sdl} = 5.78\ kN/m}$$

$$M_{sdl} = \frac{W_{sdl} * L^2}{8} = \frac{5.78 \times 30^2}{8}$$

$$\boldsymbol{M_{sdl} = 650.25\ kN\ m}$$

Summary of Results

Figure 2 below shows the inputs (test data) and the corresponding output from the calculator for each component of dead load.

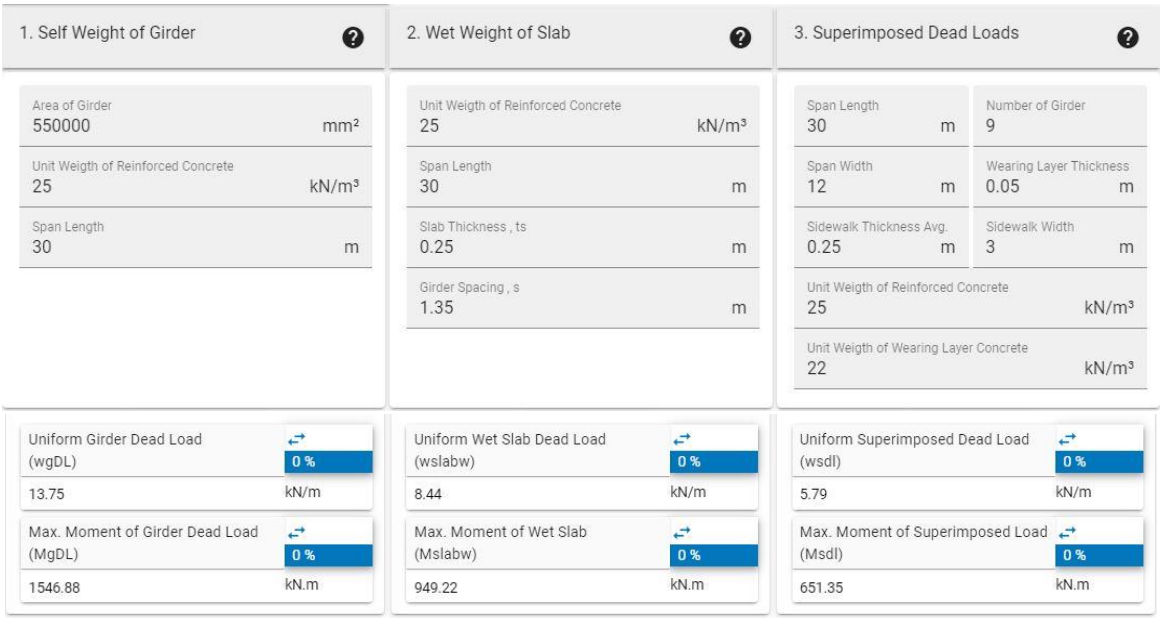

Figure 2: Calculator output for each component of dead load using test data

Results are summarized and errors are calculated in *Table 1* and *Table 2* below.

Table 1: Percentage error between hand calculations and calculator output for uniform load

Load Type	**Uniform Dead Load (kN/m)**		**Error (%)**
	Hand Calculations	Calculator	
Self-Weight of Girder	13.75	13.75	0.0
Wet Weight of Slab	8.44	8.44	0.0
Superimposed Dead Load	5.78	5.79	0.17

Table 2: Percentage error between hand calculations and calculator output for maximum moments

Load Type	**Max. Moment (kN m)**		**Error (%)**
	Hand Calculations	Calculator	
Self-Weight of Girder	1546.88	1546.88	0.0
Wet Weight of Slab	949.50	949.22	0.03
Superimposed Dead Load	650.25	651.35	0.17