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EXAMPLE CALCULATIONS

For this and all other example problems the following data from the Canam United Steel Deck *Design Manual and Catalog of Steel Deck Products* will be used and are worked using LRFD methodology. A copy of the tables is provided in the Appendix and also shown on pages 42 and 43 of our *Design Manual and Catalog of Steel Deck Products.*

DECK TYPE - 2" Lok Floor Composite Floor Deck

GAGE - 20

YIELD STRESS - 40 ksi

STEEL DECK PROPERTIES:

I - 0.390 in^4/ft

S_p - 0.332 in^3/ft

S_n - 0.345 in^3/ft

A_s - 0.540 in^2/ft

ϕR_{be} - 800 lbs/ft

ϕR_{bi} - 1360 lbs/ft

ϕV_n - 2930 lbs/ft

w_{deck} - 1.8 psf

$w_{concrete}$ - 145 pcf

$n = E_s/E_c$ - 9

ϕR_{be} is the exterior web crippling capacity based on 2.5” bearing, a phi factor of 0.9 and a 10% increase for redistribution of load. ϕR_{bi} is the interior web crippling capacity based on 5” of bearing and a phi factor of 0.85.

Example Problems For Concentrated Loads

Example 2: Wall Load Parallel to Corrugations

For this example the following criteria apply:

Clear Span - 8 ft.

Slab Thickness - 4.5 in.

Composite Properties*:*

ϕM_{no} - 42.94 in.k

ϕM_{nf} - 57.78 in.k

w_{slab} - 42 psf

I_{av} - 6.3 in4/ft

ϕV_{nt} - 5970 lbs.

For this problem the previous slab system will be analyzed to assess its ability to carry an 8 in. CMU wall running parallel to the deck flutes. The wall is 10 feet high and runs the entire clear deck span (8 feet for this example). The wall is assumed to weigh 50 psf. For this problem there are studs present on beams @ 2’ o.c..

$b_m = b_2 + 2t_c + 2t_t$

t_c = 2.5 in. (thickness of concrete cover over the top of the deck)
t_t = 0 in. (thickness of any additional topping)
h = 4.5 in. (total thickness exclusive of topping)

b_m = 8 + 2(2.5) + 0 = 13 in.

ϕM_{nf} = 57.78 in.k ϕV_{nt} = 5970 lbs w_{slab} = 42 psf w_{deck} = 1.8 psf

$w_{DL} \approx$ 44 psf

Locate the load at the quarter point of the span of the wall to calculate b_e; x= l/4 = 24 in.

Single span case: $b_e = b_m + 2(1\text{-}x/l)x = 13 + 2(1 – 0.25)24 = 49$ in.

However $b_e \leq 8.9(t_c/h) = 8.9(2.5/4.5)12 = 59$ in.

Therefore b_e = 49 in.

W is the distribution parallel to the flutes. In this case, since the wall spans the entire distance between beams W = 96 in.

w_1 is the total unfactored (allowable) uniform load on the slab.

$\phi M = (1.6w_1 + 1.2w_{DL})l^2(12)/8 = (1.6w_1 + 1.2 \times 44)8^2(12)/8 = 57780$

Solving for w_1 yields: w_1 = 343 psf So the wall load is **O.K.**

The 10 foot high wall is dead load and 10 x 50 = 500 plf. The distributed wall load is:

500 x 12/49 = 122 psf < 343 psf

Solve for allowable live load that the composite slab can carry in addition to the wall load. Neglect the fact that simultaneous live load is not possible at the 8” wall width.

$57780 = (1.6w_1 + 1.2(44 + 122))8^2(12)/8$

Solving for w_1 yields w_1 = 252 psf

Since the typical code office load is 80 psf, the slab has an over capacity of 252 – 80 = 172 psf. Since the wall may transmit loads from an upper floor or roof, the live load surcharge could be:

(49 x 12)172/144 = 702 plf

Rigid walls, such as those made from concrete blocks will “arch”. If the designer wants to take advantage of arching he could use an appropriate model from a handbook.

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Check the adequacy of the SDI minimum wire mesh as transverse reinforcing. The weak direction moment is:

$M_{weak} = Pb_e/(15W)$

Consider that only the weight of the wall is distributing and there is no surcharge on the wall.

P = 500(8) = 4000 lbs

Hence;

M_{weak} = 4000(49)/(15 x 96) = 136 in lbs/in = 136(12) = 1632 in.lbs/ft

Assume the mesh is ½ in. above the deck so that d of the mesh is:

d = 2.5 – 0.5 = 2 in.

$a = A_sF_y / (0.85f'_cb)$

The F_y of the wire mesh is taken as 60 ksi and the minimum A_s = 0.028 in^2/ft and b = 12 in/ft.

a = 0.028(60000)/(0.85 x 3000 x 12) = 0.055 in.

The weak direction moment capacity is then:

ϕM_w = 0.9(0.028)(60000)(2 – 0.055/2) = 2982 in.lbs > 1.4 x 1632 = 2285 in.lbs **O.K.**

(1.4 load factor is used when only the dead load component is considered.)

If a surcharge is on the wall, additional or heavier mesh could be needed.

Check shear:

ϕV_{nt} = 5970 lbs

If the wall load plus 80 psf live is present, b_e for shear (load is at the quarter point) = b_m + (1 - x/l)x

b_e = 13 + 0.75(24) = 31 in.

$V_{applied}$ = (1.6 x 80 + 1.2(500 x 12/31 + 44))8/2 = 1652 lbs

or

$V_{applied}$ = 1.4(500 x 12/31 + 44))8/2 = 1330 lbs

5970 lbs > 1652 lbs **O.K.**

If there were a surcharge on the wall it would also need to be considered in the shear calculation.

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