CANAM
Solutions + Service
Manufacturers of USD United Steel Deck products.

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 1: Point Load

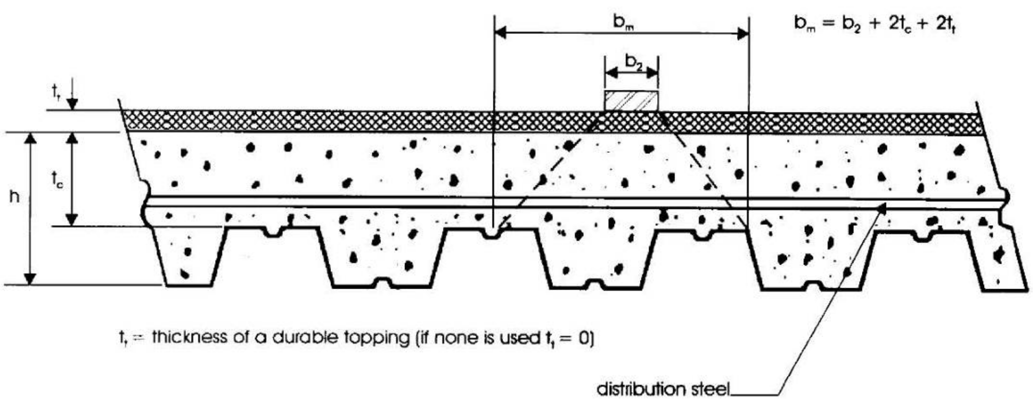
This problem is designed to demonstrate how to check the ability of a composite slab to carry a 3000 lb point load over an area of 4.5" x 4.5" occurring anywhere in the span. This problem is consistent with the requirements of the 2006 International Building Code for garages storing vehicles accommodating not more than nine passengers.

There will be no other live load acting simultaneously, and there is no negative bending reinforcement present over the supports, therefore we assume a single span condition.

For this example the following criteria apply:

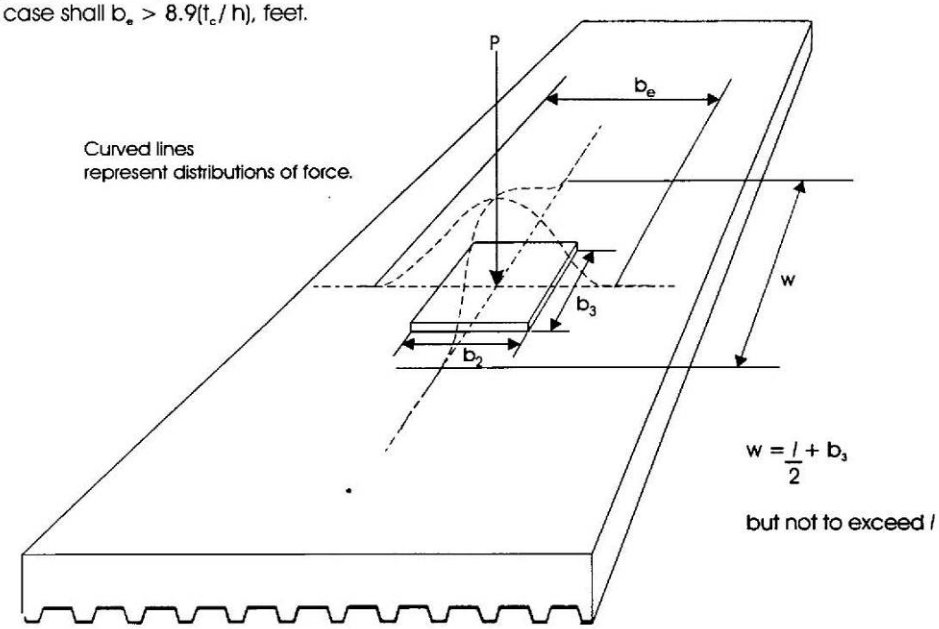
Clear Span - 9 ft. -- Maximum Unshored Span is 9.67 ft
Slab Thickness - 4.5 in.
Composite Properties*:*

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.



$b_m = b_2 + 2t_c + 2t_t$

single span bending: $b_e = b_m + 2(1 - x / l)x$; where x is the location of the load.
continuous span bending: $b_e = b_m + 4/3\ (1 - x / l)x$
shear: $b_e = b_m + (1 - x / l)x$
but in no case shall $b_e > 8.9(t_c / h)$, feet.



weak axis Moment $= \dfrac{Pb_e}{15w}$

Figure 1

$b_2 = b_3 = 4.5$ in.

$b_m = b_2 + 2t_c + 2t_t$

$t_t = 0$ in.
$t_c = 2.5$ in.
$h = 4.5$ in.

t_c = Thickness of concrete cover over the top of the deck
t_t = Thickness of any additional topping
h = Total thickness exclusive of topping

$b_m = 4.5 + 2(2.5) + 0 = 9.5$ in.

For moment and for determining the distribution steel, put the load in the center of the span.

$b_e = b_m + 2(1\text{-}x/l)x$; where x is the location of the load $x = l/2$

$b_e = 9.5 + 2(1\text{-}54/108)54 = 63.5$ in. ; However $b_e < 8.9(t_c/h)$ in feet

$8.9(2.5/4.5)(12) = 59$ in. therefore $b_e = 59$ in.

Check vertical shear : Put the load one slab depth away from the beam; x=h

$b_{ve} = b_m + (1\text{-}x/l)x = 9.5 + (1\text{-}4.5/108)4.5 = 13.8 < 59$

For Moment $b_e = 59$ in.
For Shear $b_{ve} = 13.8$ in.

Live load moment (per foot of width) = Pl/4 = (1.6)(3000)(9/4)(12/59)(12)/1000

Pl/4 = 26.36 in.k ; 1.6 is the load factor and 12/59 is the distribution factor

w_{total} = Total dead load = $w_{slab} + w_{deck} = 42 + 1.8 = 43.8 \cong 44$ psf; 1.2 is the load factor.

Dead load moment = $w_{total}l^2/8 = 1.2(44)(9)^2(12)/8000 = 6.42$ in.k

26.36 + 6.42 = 32.78 in.k

ϕM_{no} ; Factored resisting moment when studs are not present on the beams

$\phi M_{no} = 42.94$ in.k > 32.78 in.k **O.K.**

V = 1.6(3000)(12/13.8) + 1.2(44)(9)/2 = 4412 lbs

$\phi V_{nt} = 5970$ lbs > 4412 lbs **O.K.**

CANAM
Solutions + Service
Manufacturers of USD United Steel Deck products.

Find the required distribution steel (welded wire mesh)

M_2 = Weak direction moment = $Pb_e/15W$

W = l/2 + b_3 = 54 + 4.5 = 58.5 in. < 108 in.

M_2 = 1.6(3000)(59)(12)/(15 x 58.5) = 3873 in.lbs/ft

Assume the wire mesh is located 1/2"above top of deck; d = 4.5-2-0.5 = 2 in.

$M_n = A_sF_y(2-a/2)$; A_s is the area per foot of the wire mesh which has an F_y of 60 ksi. If the bars are being investigated, the F_y would have to be adjusted accordingly.

$a = A_sF_y/0.85f'_cb$; b = 12 in.
Assume A_s is the area of 6x6w2.0x2.0 mesh. A_s= 0.04in^2/ft.
6x6w1.4x1.4 mesh is the ANSI/SDI and ASCE minimum.

a = 0.040(60000)/(0.85 x 3000 x 12) = 0.078 in.

NOTE: ϕ = 0.9 in ACI but SDI uses 0.85

ϕM_{weak} = 0.85(0.040)(60000)(2-0.078/2) = 4000 in.lbs/ft

4000 > 3873 **O.K.** 6x6w2.0x2.0 mesh is sufficient.

Check Deflection under concentrated load:

I_{av} = 6.3 in^4/ft Put load in center of span and use concentrated load coefficients.

$y = Pl^3/48EI$; P = 3000(12)/59 = 610 lbs

y = 610(9)^3(1728)/(48 x 29.5x10^6 x 6.3) = 0.086 in.

0.086 in. ≅ l/1250 ; Should be **O.K.**

CANAM
Solutions + Service
Manufacturers of USD United Steel Deck products.