

Examples: Load Tracing and Factored Loads

EXAMPLE (pg. 129 with corrections and additions)

Assume that the average dead plus live load on the structure shown in Figure 3.15 is 60 lbs/ft². Determine the reactions for Beam D. This is the same structure as shown in Figure 3.1.

^ E, B and A Assuming all beams are weightless!

Solution:

Note carefully the directions of the decking span. Beam D carries floor loads from the decking to the left (see the contributory area and load strip), but not to the right, since the

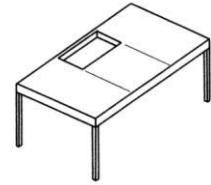
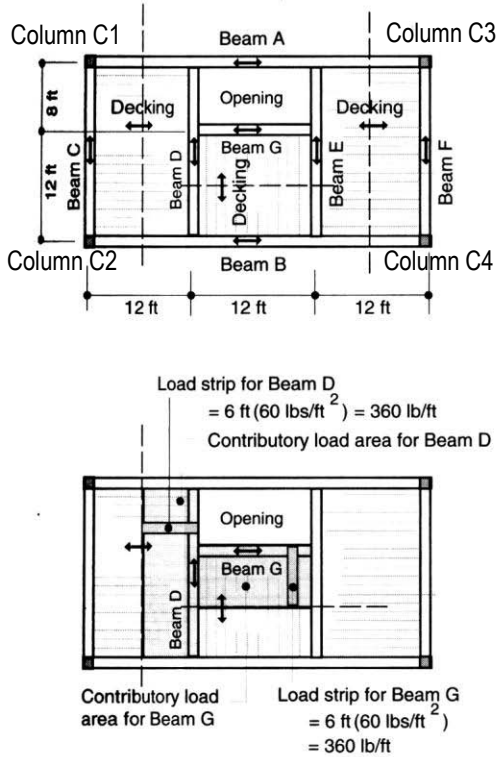


Figure 3.1



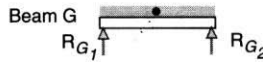
Live and dead load

Assume $w_{DL+LL} = 60 \text{ lbs/ft}^2$

Beam G carries distributed loads only

Find reactions for Beam G

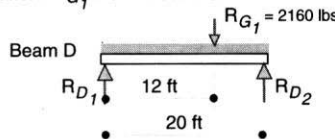
$W = 6 \text{ ft} (60 \text{ lbs/ft}^2) = 360 \text{ lb/ft}$



$R_{G1} = wL/2 = (360 \text{ lb/ft})(12 \text{ ft})/2 = 2160 \text{ lbs}$

$R_{G2} = wL/2 = (360 \text{ lb/ft})(12 \text{ ft})/2 = 2160 \text{ lbs}$

Beam D (and E) carries both distributed loads and the reaction R_{G1} from Beam G



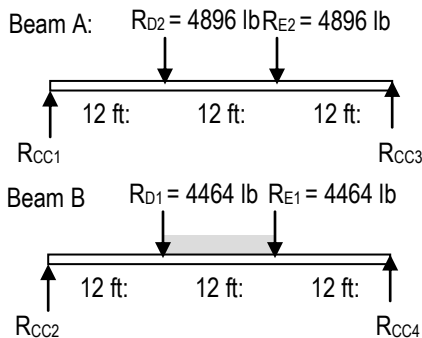
$\Sigma M_{D1} = 0$
 $-(12 \text{ ft})(2160 \text{ lb}) - (360 \text{ lb/ft})(20 \text{ ft})(20 \text{ ft}/2) + 20 R_{D2} = 0$

$R_{D2} = 4896 \text{ lb} = R_{E2}$

$\Sigma F_y = 0$
 $R_{D1} + R_{D2} = (360 \text{ lb/ft})(20 \text{ ft}) + 2160 \text{ lb}$

$R_{D1} = 4464 \text{ lb} = R_{E1}$

FIGURE 3.15 Load modeling and reaction determination.



By symmetry; $R_{C1} = R_{C3} = (4893 \text{ lb} + 4896 \text{ lb})/2 = 4896 \text{ lb}$

By symmetry; $R_{C2} = R_{C4} = (4464 \text{ lb} + 4464 \text{ lb})/2 + (6 \text{ ft})(60 \text{ lb/ft}^2)(12 \text{ ft})/2 = 6624 \text{ lb}$

Additional loads are transferred to the column from the reactions on Beams C and F:

$R_{C1} = R_{C2} = R_{F1} = R_{F2} = wL/2 = (6 \text{ ft})(60 \text{ lb/ft}^2)(20 \text{ ft})/2 = 3600 \text{ lb}$

center decking runs parallel to Beam D and is not carried by it. Beam D also picks up the end of Beam G and thus also “carries” the reactive force from Beam G. It is therefore necessary to analyze Beam G first to determine the magnitude of this force. The analysis appears in Figure 3.15. The reactive force from Beam G of 2160 lbs is then treated as a downward force acting on Beam D. The load model for Beam D thus consists of distributed forces from the decking plus the 2160-lb force. It is then analyzed by means of the equations of statics to obtain reactive forces of 4896 lbs and 4464 lbs at its ends.

- C1 = 4896 lb + 3600 lb = 8,496 lb
- C2 = 6624 lb + 3600 lb = 10,224 lb
- C3 = 4896 lb + 3600 lb = 8,496 lb
- C4 = 6624 lb + 3600 lb = 10,224 lb

Example 2

Determine the controlling load combinations(s) using AISC-LRFD for a building column subject to the following service or nominal (unfactored) axial compressive loads: $D = 30$ k, $L = 50$ k, $L_r = 10$ k, $W = 25$ k, $E = 40$ k

Using a spreadsheet analysis:

LRFD (ASCE-7)		FACTORED LOAD
$1.4D$		
$1.4D$	=	42 kips
$1.2D + 1.6L + 0.5(L_r \text{ or } S \text{ or } R)$		
$1.2D + 1.6L + 0.5L_r$	=	121
$1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (L \text{ or } 0.5W)$		
$1.2D + 1.6L_r + L$	=	102
$1.2D + 1.6L_r + 0.5W$	=	64.5
$1.2D + 1.6L_r - 0.5W$	=	39.5
$1.2D + 1.0W + L + 0.5(L_r \text{ or } S \text{ or } R)$		
$1.2D + 1.0W + L + 0.5L_r$	=	116
$1.2D - 1.0W + L + 0.5L_r$	=	66
$1.2D + 1.0E + L + 0.2S$		
$1.2D + 1.0E + L$	=	126
$1.2D - 1.0E + L$	=	46
$0.9D + 1.0W$		
$0.9D + 1.0W$	=	52
$0.9D - 1.0W$	=	2
$0.9D + 1.0E$		
$0.9D + 1.0E$	=	67
$0.9D - 1.0E$	=	-13
Critical Factored Load		126 kips (C) -13 kips (T)

Example 3

EXAMPLE 2-4

Determine factored loads for the beam shown in Figure 2-16.

Solution

For the left half of the beam:

$$w_{u1} = 1.2w_D + 1.6w_L$$

$$w_{u1} = 1.2 \times 1.0 + 1.6 \times 2.0 = 4.4 \text{ kip/ft}$$

For the right half of the beam:

$$w_{u2} = 1.2w_D + 1.6w_L$$

$$w_{u2} = 1.2 \times 1.0 + 1.6 \times 0 = 1.2 \text{ kip/ft}$$

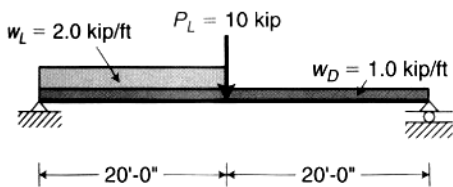


FIGURE 2-16 Example 2-4 (service loads).

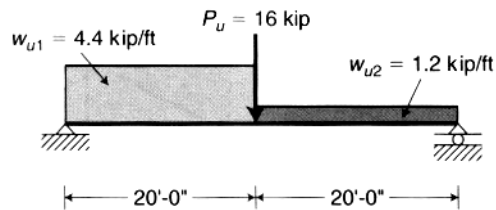


FIGURE 2-17 Example 2-4 (factored loads).

The concentrated load is a live load only:

$$P_u = 1.2P_D + 1.6P_L$$

$$P_u = 1.2 \times 0 + 1.6 \times 10 = 16 \text{ kip}$$

The factored loads on the beam are shown in Figure 2-17.