Examples: Load Tracing and Factored Loads

EXAMPLE 1 (pg. 109 with additions)

Assume that the average dead plus live load on the structure shown in Figure 3.15 is 60 lbs/ft^2. **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!*

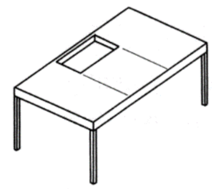
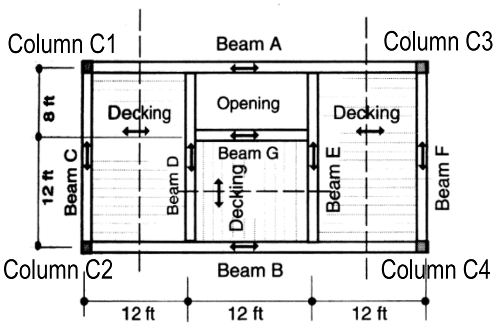


Figure 3.1

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



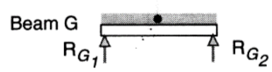
Live and dead load

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

Beam G carries distributed loads only

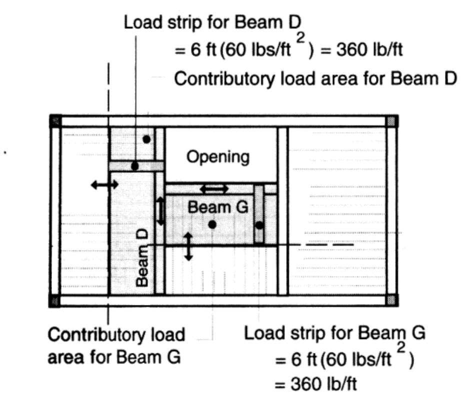
Find reactions for Beam G

$w = 6$ ft(60 lbs/ft^2) = 360 lb/ft

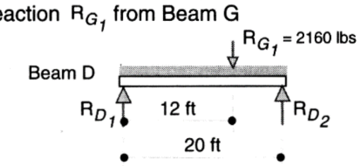


$R_{G_1} = wL/2 = (360\text{ lb/ft})(12\text{ ft})/2 = 2160$ lbs

$R_{G_2} = wL/2 = (360\text{ lb/ft})(12\text{ ft})/2 = 2160$ lbs



Beam D (and E) carries both distributed loads and the reaction R_{G_1} from Beam G



$\Sigma M_{D_1} = 0$

$-(12\text{ ft})(2160\text{ lb}) - (360\text{ lb/ft})(20\text{ ft})(20\text{ ft}/2) + 20R_{D_2} = 0$

$R_{D_2} = 4896\text{ lb} = R_{E2}$

$\Sigma F_y = 0$

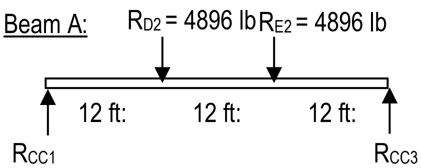
$R_{D_1} + R_{D_2} = (360\text{ lb/ft})(20\text{ ft}) + 2160\text{ lb}$

$R_{D_1} = 4464\text{ lb} = R_{E1}$

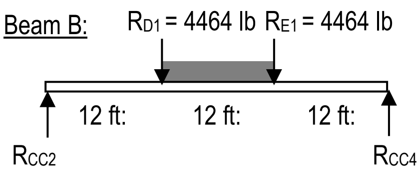
FIGURE 3.15 Load modeling and reaction determination.

Example 1 (*continued*)

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.



By symmetry; $R_{CC1} = R_{CC3}$ = (4893 lb + 4896 lb)/2 = 4896 lb



By symmetry; $R_{CC2} = R_{CC4}$ = (4464 lb + 4464 lb)/2 + (6 ft)(60 lb/ft^2)(12 ft)/2 = 6624 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 ft)(60 lb/ft^2)(20 ft)/2 = 3600 lb

Columns:

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:

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

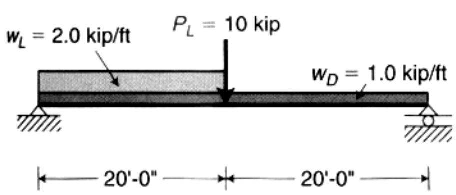


FIGURE 2–16 Example 2–4 (service loads).

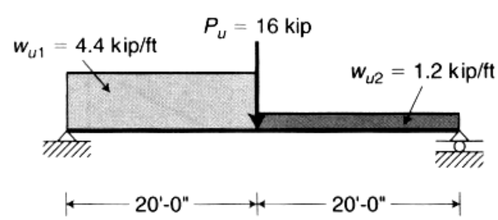


FIGURE 2–17 Example 2–4 (factored loads).

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.