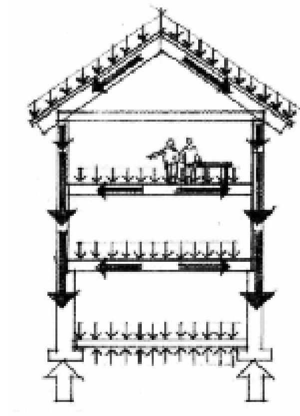
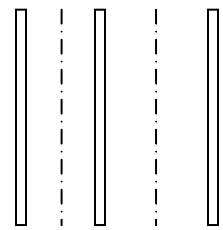
Loads – Tracing, Concentrated and Distributed

Load Tracing



- LOAD TRACING is the term used to describe how the loads on and in the structure are transferred through the members (*load paths)* to the foundation, and ultimately supported by the ground.

- It is a sequence of **actions**, NOT reactions. Reactions in statically determinate members (using FBD's) can be solved for to determine the actions on the next member in the hierarchy.



plan

- The *tributary area* is a loaded area that contributes to the load on the member supporting that area, *ex.* the area from the center between two beams to the center of the next two beams for the full span is the load on the center beam

- The *tributary load* on the member is found by **concentrating (or consolidating)** the load into the center.

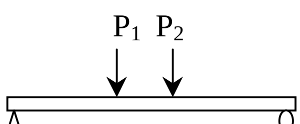
$$w = (\frac{load}{area})x(tributary\ width)$$

where:

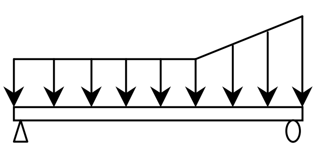
w = distributed load in units of load/length

Support Conditions & Loading

- Types of loads:
  - Concentrated – single load at one point
  - Distributed – loading spread over a distance or area

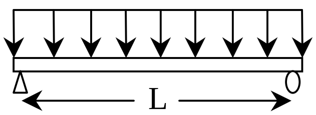


concentrated

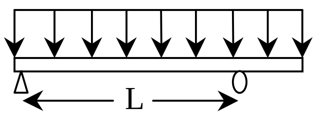


distributed

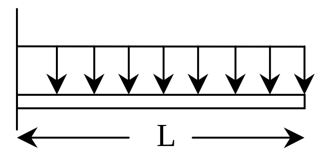
- Types of supports:
  - statically determinate
    (number of unknowns ≤ number of equilibrium equations)



simply supported
(most common)

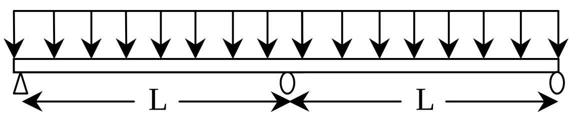


overhang



cantilever

  - Statically indeterminate:

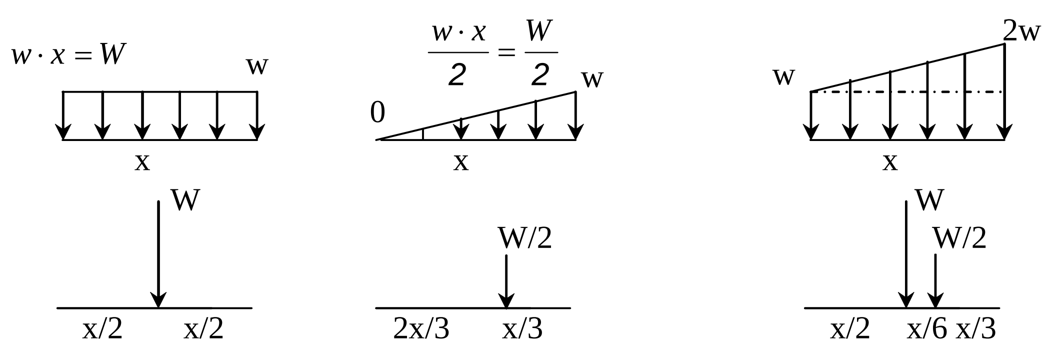


continuous
(most common case when $L_1=L_2$)

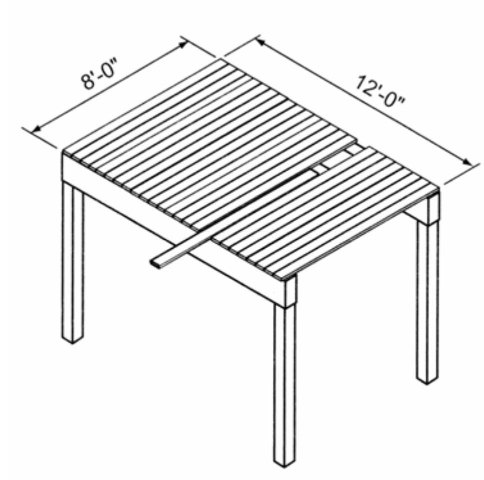
Distributed Loads

Distributed loads may be replaced by concentrated loads acting through the balance/center of the distribution or *load area*: THIS IS AN **EQUIVALENT** FORCE SYSTEM.

- *w* is the symbol used to describe the *load* per unit **length**.
- W is the symbol used to describe the *total load*.



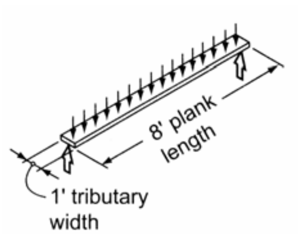
Example 1 (pg 168)

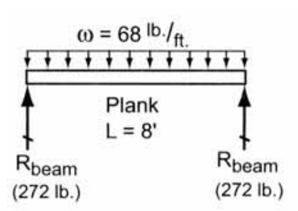


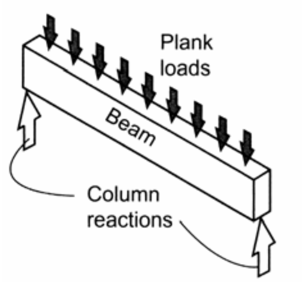
Example Problem 5.2

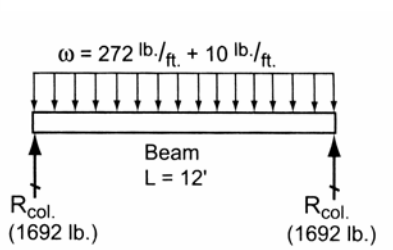
In the single-bay, post-and-beam deck illustrated, planks typically are available in nominal widths of 4" or 6", but for the purposes of analysis it is permissible to assume a unit width equal to one foot. Determine the plank, beam, and column reactions.

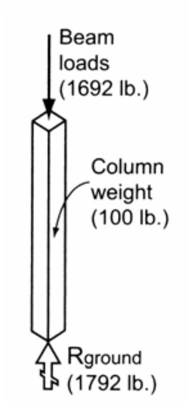
The loads are: 60 lb/ft^2 live load, 8 lb/ft^2 dead load, 10 lb/ft self weight of 12' beams, and 100 lb self weight of columns.











Example 2

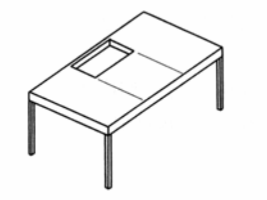
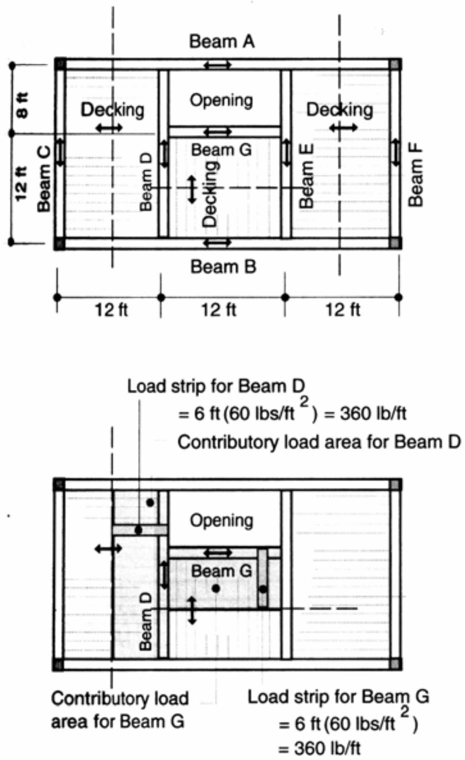


Figure 3.1

EXAMPLE

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.

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



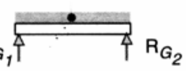
Live and dead load

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

Beam G carries distributed loads only

Find reactions for Beam G

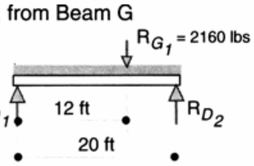
$w = 6\ \text{ft}(60\ \text{lbs/ft}^2) = 360\ \text{lb/ft}$



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

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

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



$\Sigma M_{D_1} = 0$

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

$R_{D_1} = 4896\ \text{lb}$

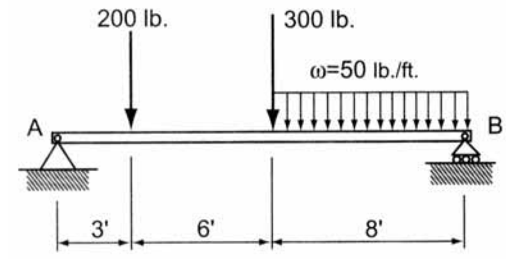
$\Sigma F_y = 0$

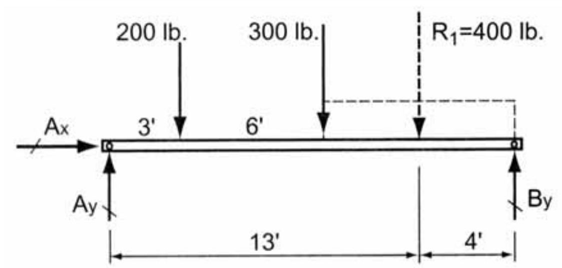
$R_{D_1} + R_{D_2} = (360\ \text{lb/ft})(20\ \text{ft}) + 2160\ \text{lb}$

$R_{D_2} = 4464\ \text{lb}$

FIGURE 3.15 Load modeling and reaction determination.

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.





Example 3 (pg 70)

Example Problem 3.12—Simple Beam

A simple beam supports two concentrated loads and a uniformly distributed load over 8 ft. of the span. See Figure 3.40. Construct a FBD of the beam and solve for the support reactions at ***A*** and ***B***.

Example 4 (pg 71)

Example Problem 3.13—Overhang Beam (Figure 3.41)

A single overhang beam supports a uniformly distributed load over an 8-ft. section and a triangular distribution over the remaining 12 ft. Draw the appropriate FBD and solve for the support reactions at ***A*** and ***B***.