

**ARCHITECTURAL STRUCTURES I:
STATICS AND STRENGTH OF MATERIALS**

ENDS 231

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SPRING 2008

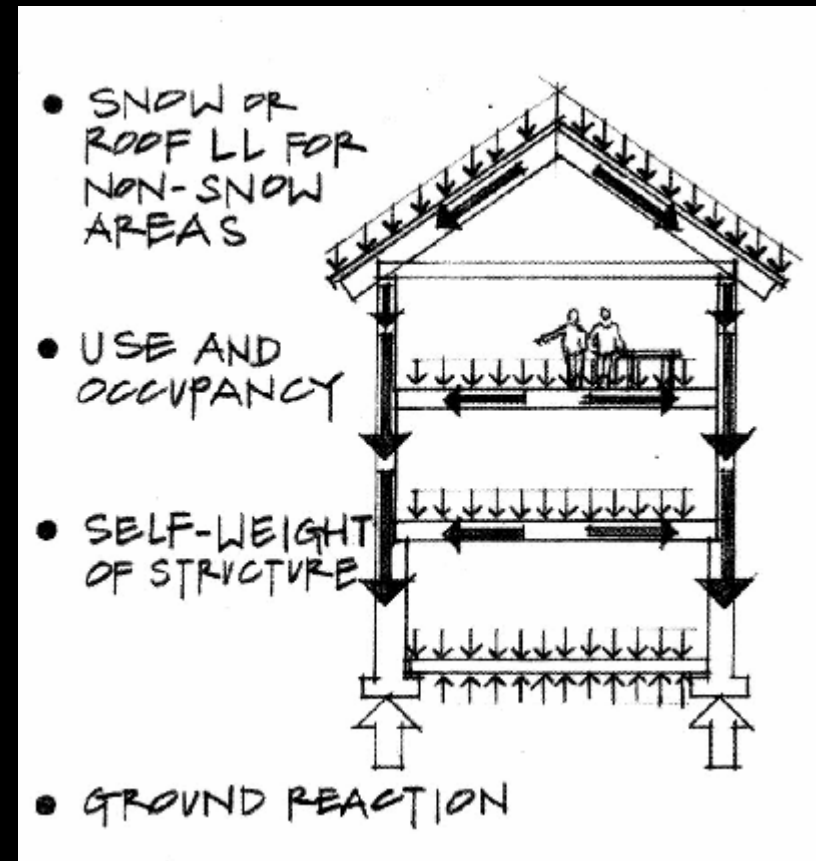
lecture
ten

**load tracing
and types**



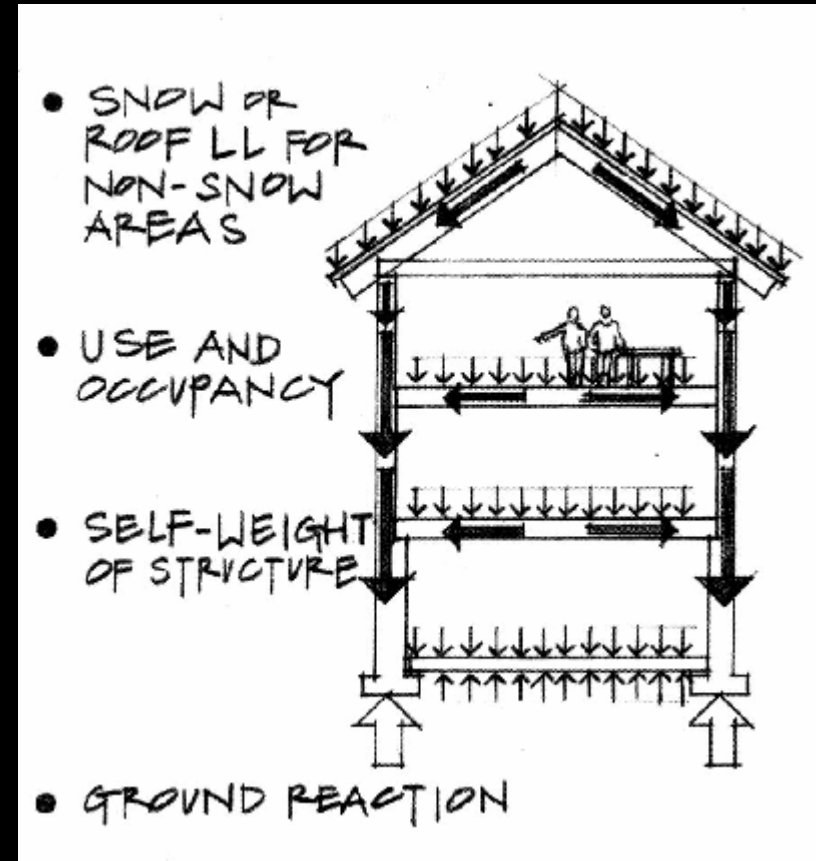
Structural Loads

- gravity acts on mass ($F=m*g$)
- force of mass
 - acts at a point
 - ie. joist on beam
 - acts along a “line”
 - ie. floor on a beam
 - acts over an area
 - ie. people, books, snow on roof or floor

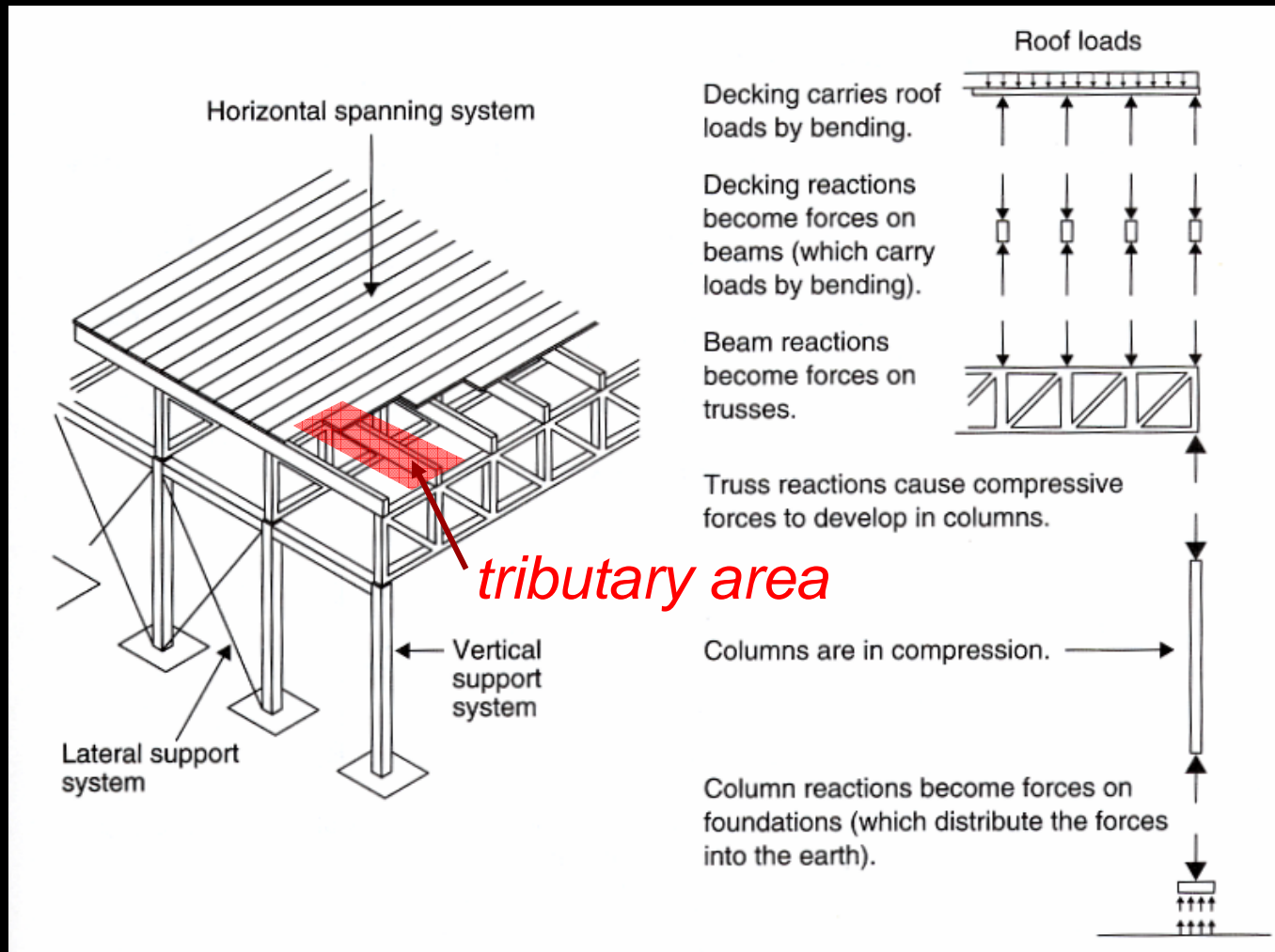


Load Tracing

- *how loads are transferred*
 - *usually starts at top*
 - *distributed by supports as actions*
 - *distributed by tributary areas*



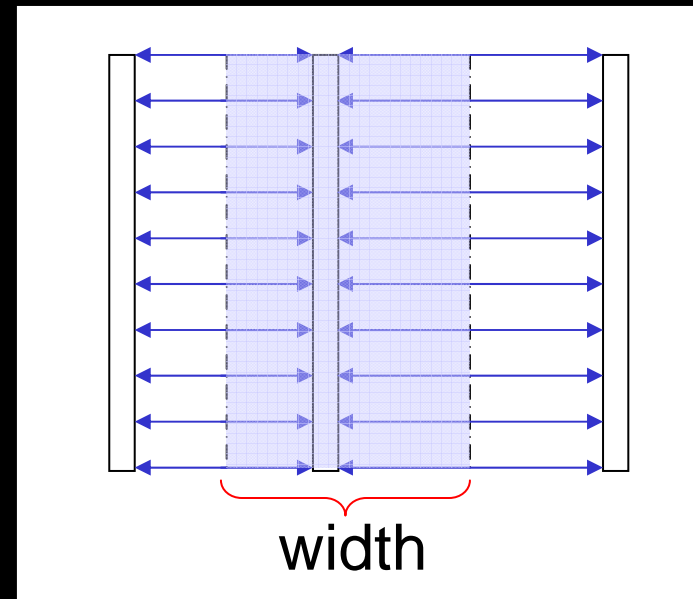
Load Tracing



Load Tracing

- *tributary load*
 - *think of water flow*
 - *“concentrates” load of area into center*

$$w = \left(\frac{\text{load}}{\text{area}} \right) \times (\text{tributary width})$$



Load Tracing



Patcenter
Rogers 1986

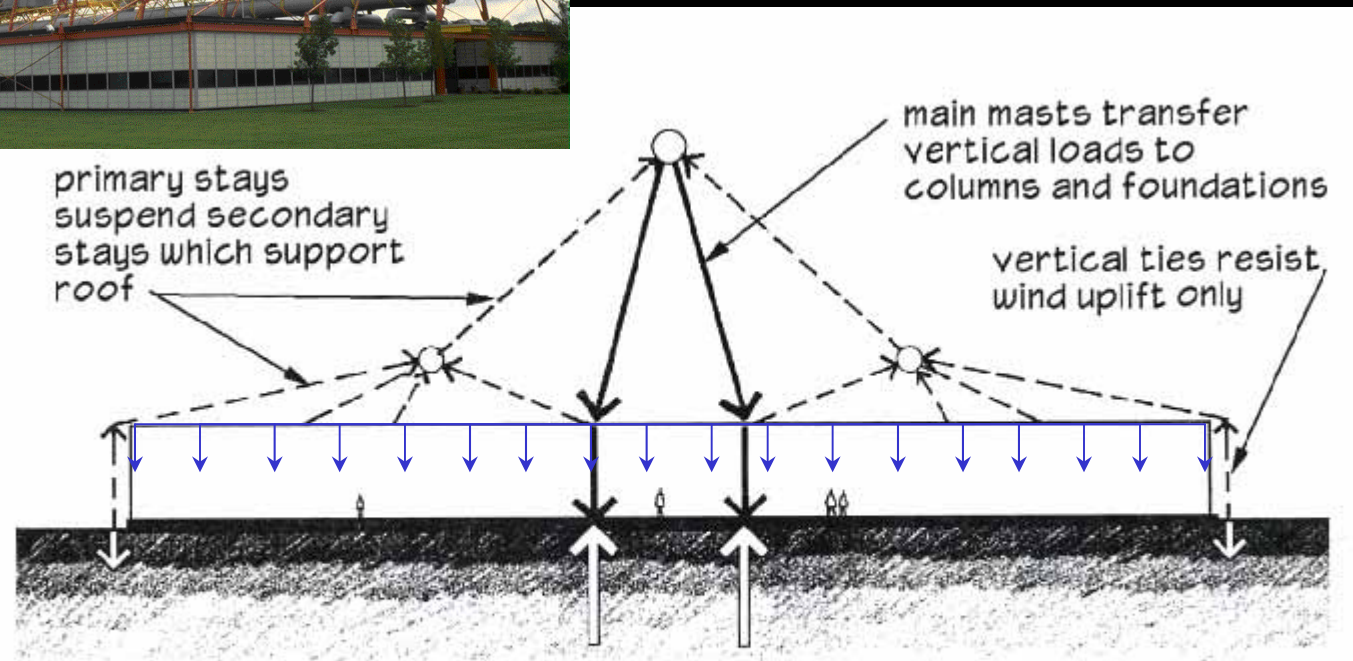


Figure 3.5: Patcenter, load path diagram.

Load Tracing



Alamillo Bridge Calatrava 1992

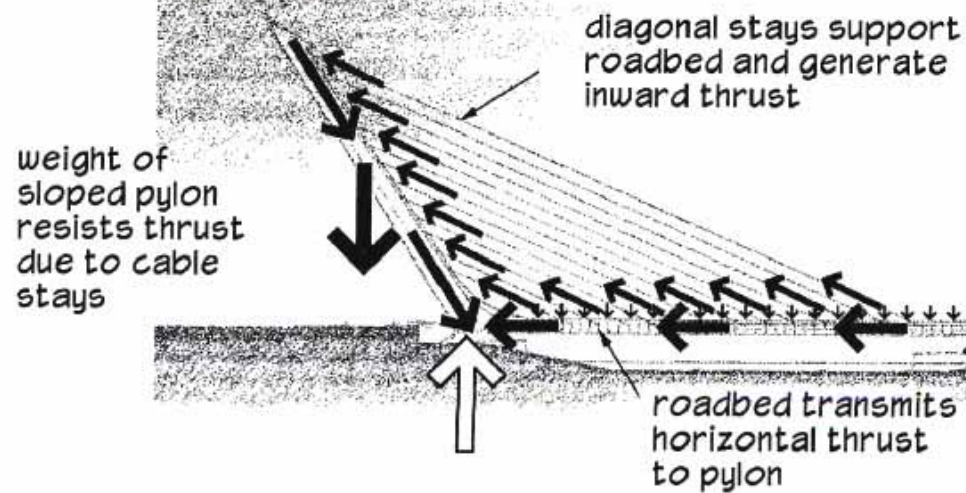
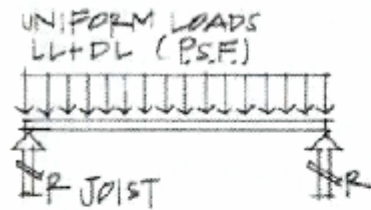
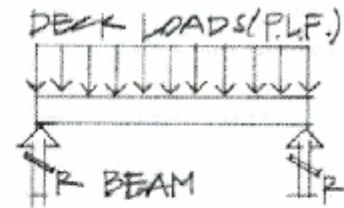


Figure 3.12: Alamillo bridge, load path diagram.

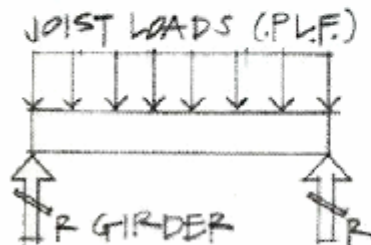
Load Paths



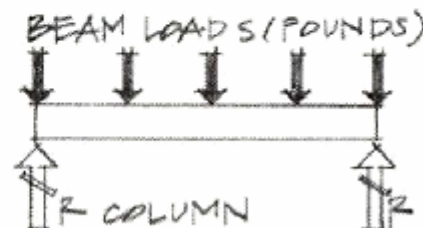
(a) FBD—decking.



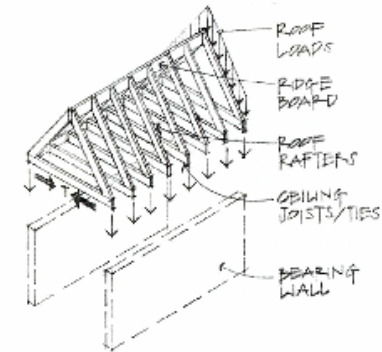
(b) FBD—joists.



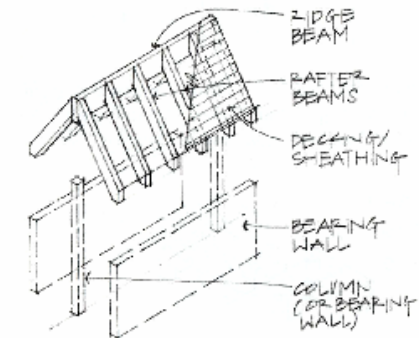
(c) FBD—beams.



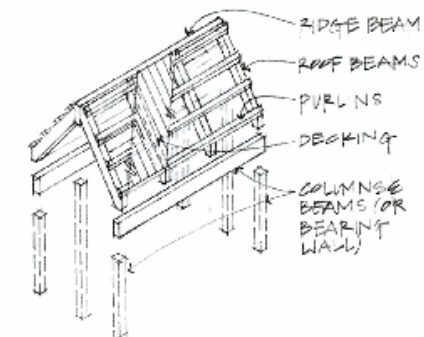
(d) FBD—girder.



(a)



(c)



Load Paths

- *wall systems*

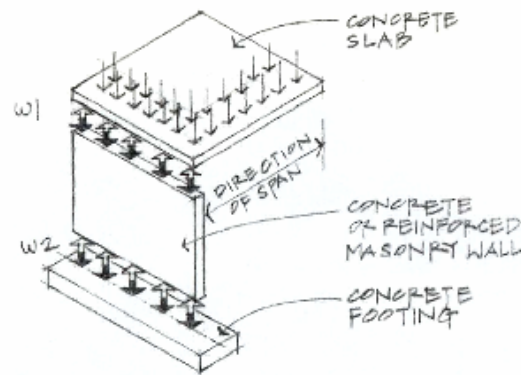


Figure 4.12 Uniform wall load from a slab.

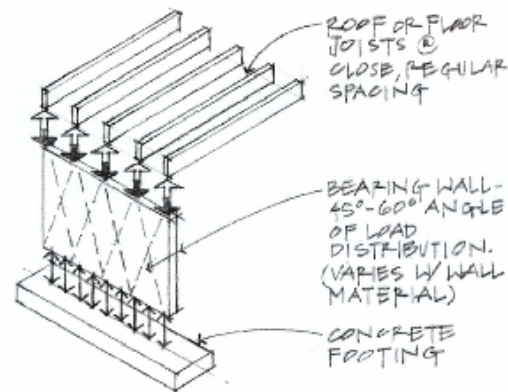


Figure 4.13 Uniform wall load from rafters and joists.

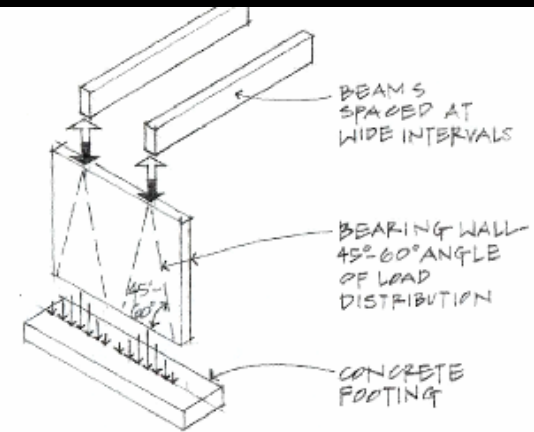


Figure 4.14 Concentrated loads from widely spaced beams.

Load Paths

- openings & pilasters

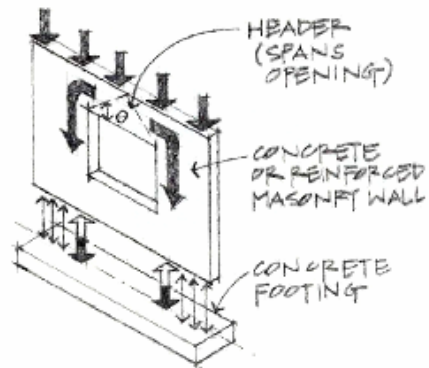


Figure 4.15 Arching over wall openings.

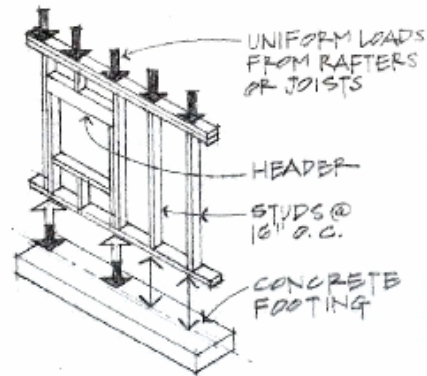


Figure 4.16 Stud wall with a window opening.

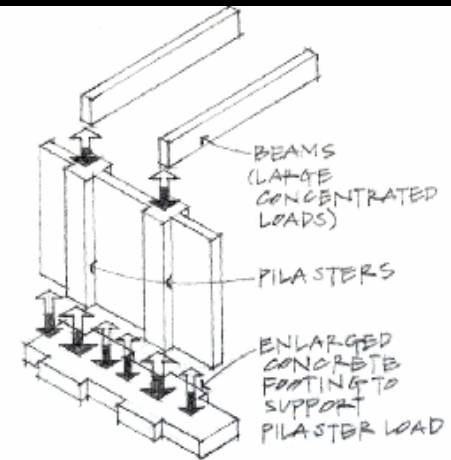


Figure 4.17 Pilasters supporting concentrated beam loads.

Load Paths

- foundations

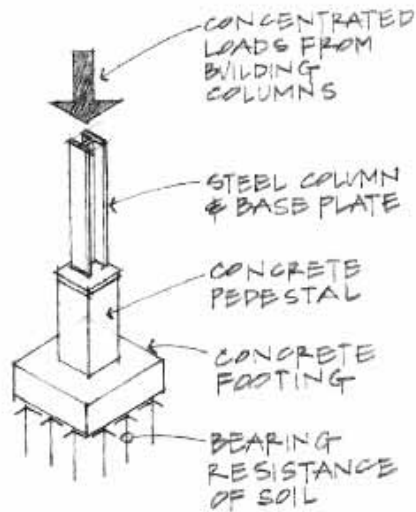


Figure 4.24 Spread footing.

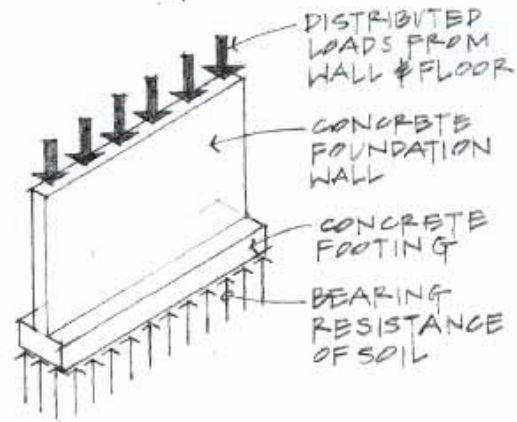


Figure 4.25 Wall footing.

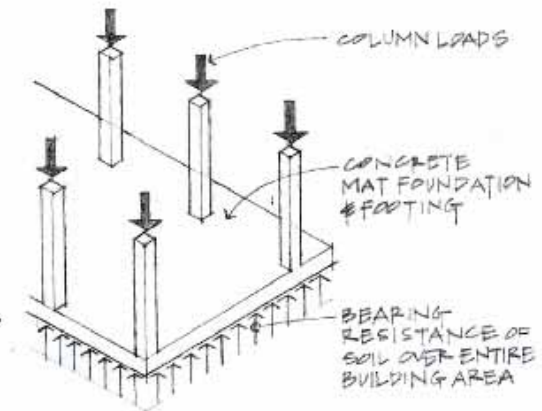


Figure 4.26 Mat or raft foundation.

Load Paths

- *deep foundations*

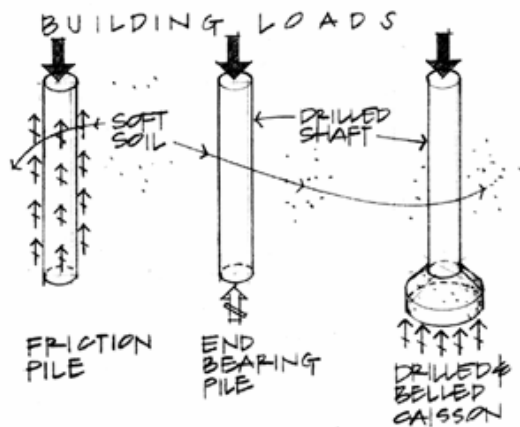


Figure 4.27 Pile foundations.

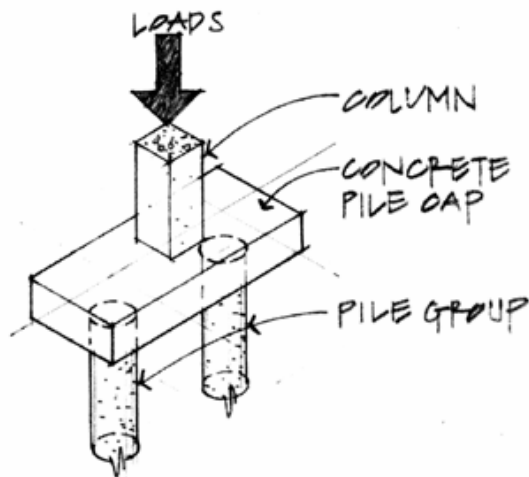


Figure 4.28 Pile cap on one pile group.

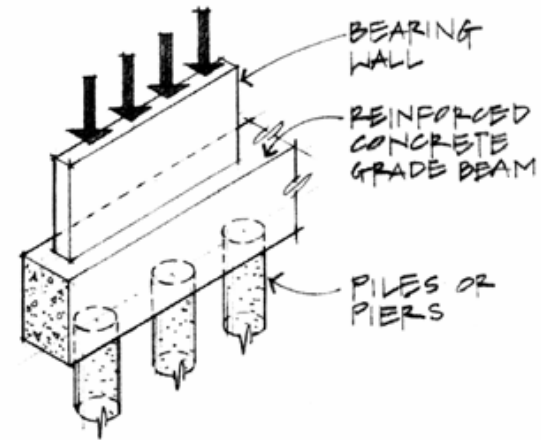
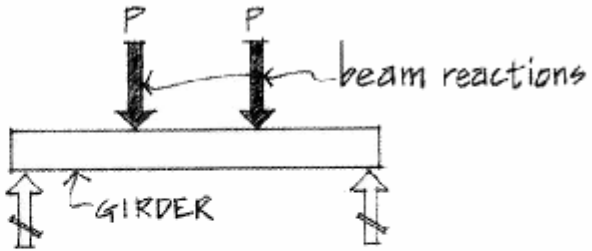
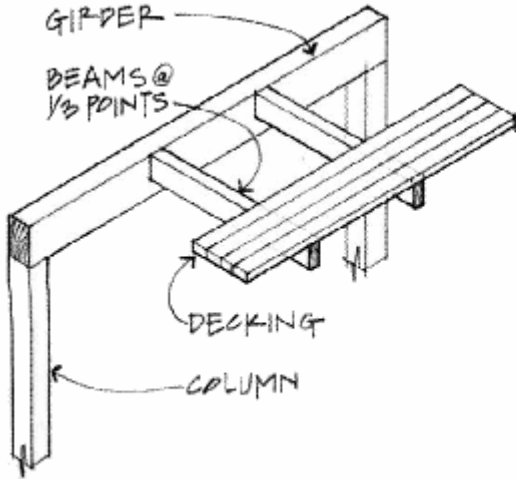
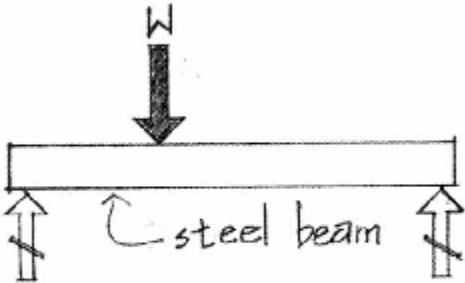
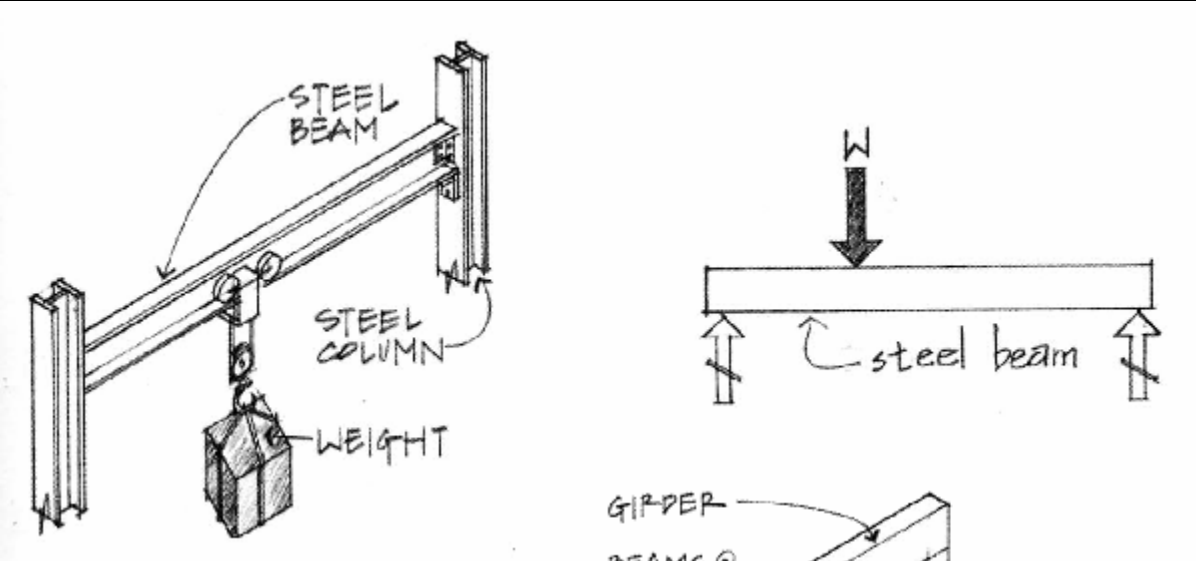
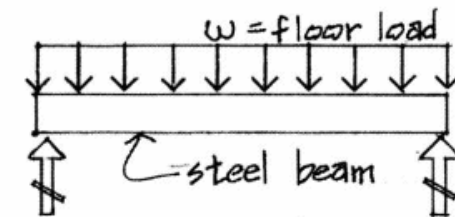
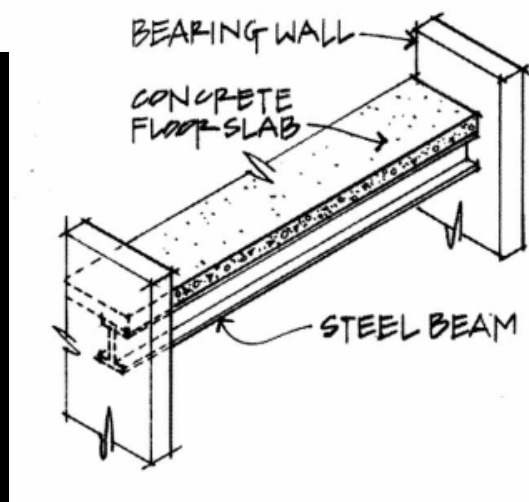
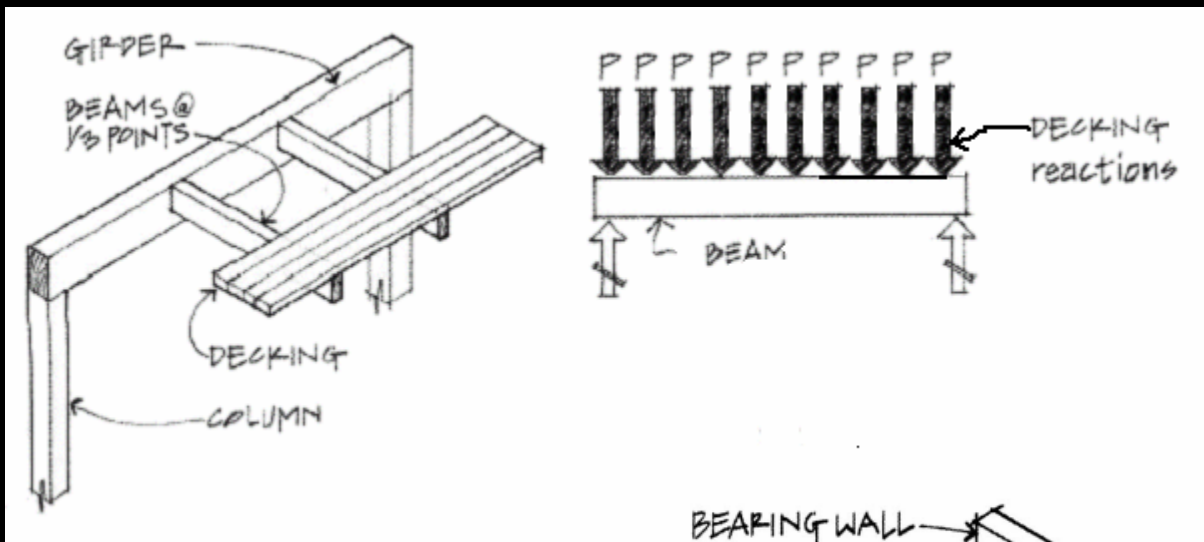


Figure 4.29 Grade beam supporting a bearing wall.

Concentrated Loads



Distributed Loads



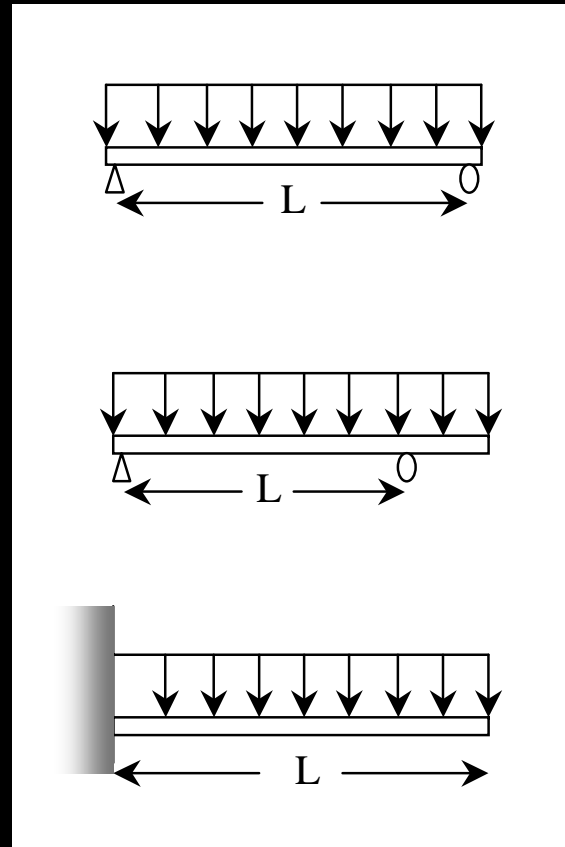
Distributed Loads

- *statically determinate beam supports*

- *simple*

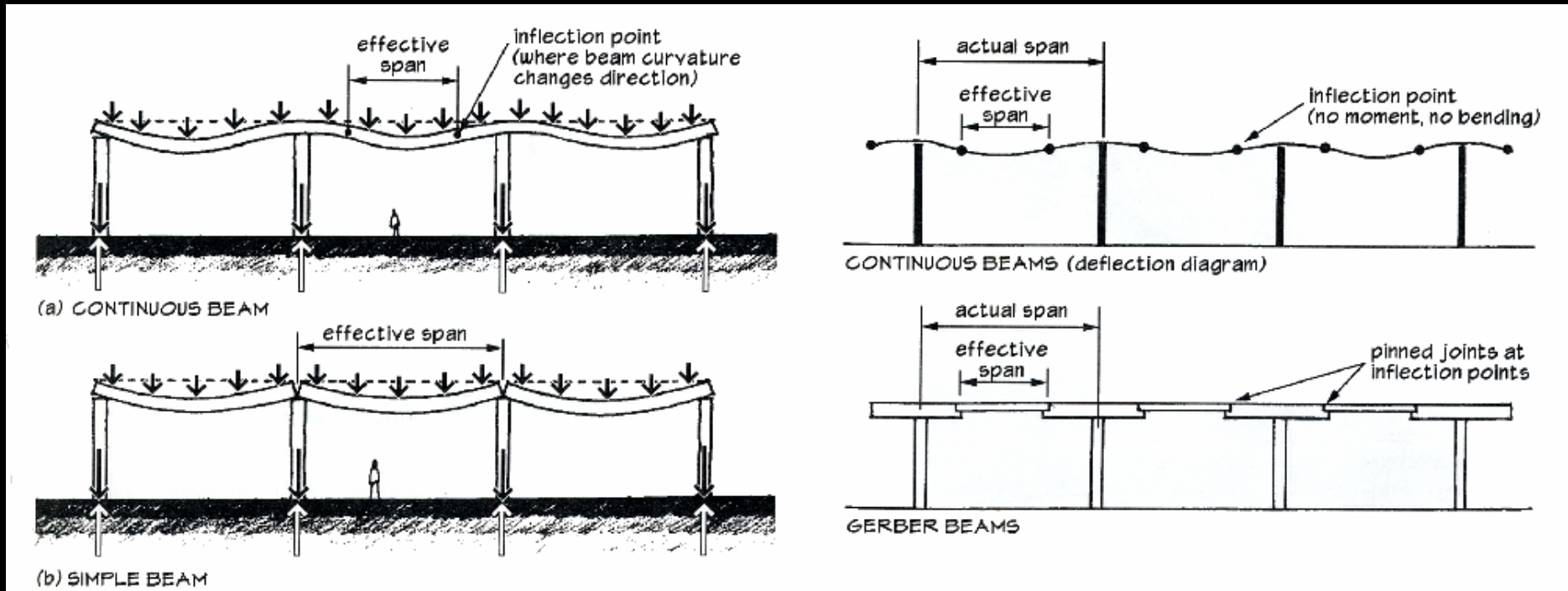
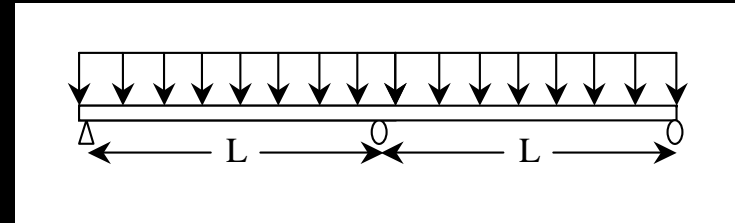
- *overhang*

- *cantilever*



Distributed Loads

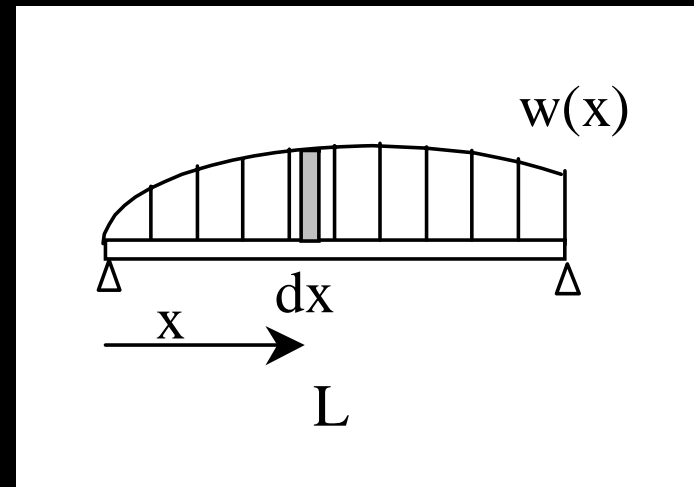
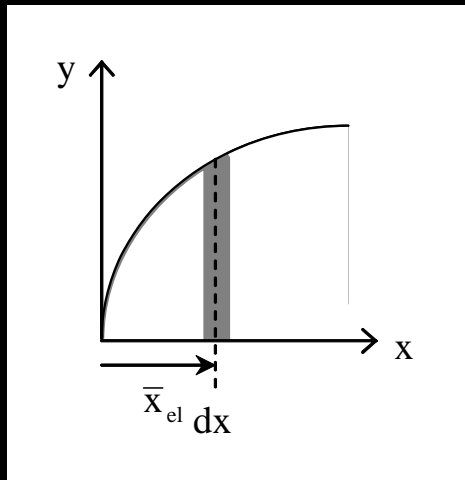
- *continuous beams*
 - *statically indeterminate*
 - *floors*



Equivalent Force Systems

- *replace forces by resultant*
- *place resultant where $M = 0$*
- *using calculus and area centroids*

$$W = \int_0^L w dx = \int dA_{\text{loading}} = A_{\text{loading}}$$



Area Centroids

- *Table 7.1 – pg. 242*

Centroids of Common Shapes of Areas and Lines			
Shape		\bar{x}	\bar{y}
Triangular area		$\frac{b}{3}$	$\frac{h}{3}$
Quarter-circular area		$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$
Semicircular area		0	$\frac{4r}{3\pi}$
Semiparabolic area		$\frac{3a}{8}$	$\frac{3h}{5}$
Parabolic area		0	$\frac{3h}{5}$

Load Areas

- *area is width x “height” of load*
- *w is load per unit length*
- *W is total load*

