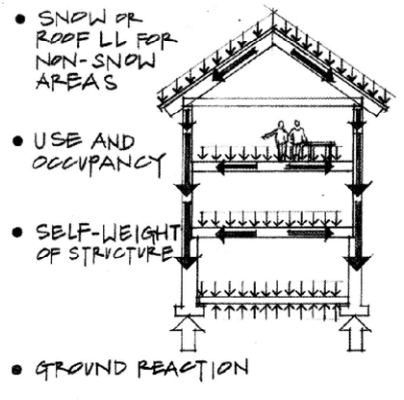
ARCHITECTURAL STRUCTURES I:
STATICS AND STRENGTH OF MATERIALS
ENDS 231
DR. ANNE NICHOLS
SUMMER 2006

lecture
nine

load tracing and types

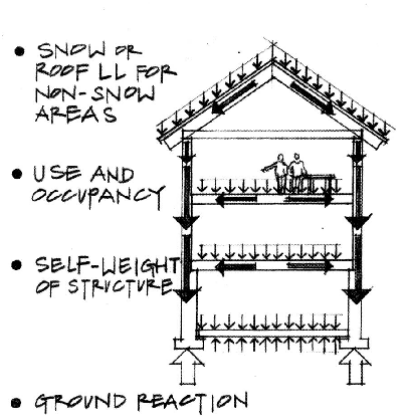
Structural Loads

- *gravity acts on mass (F=m·g)*
- *forces*
  - *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*

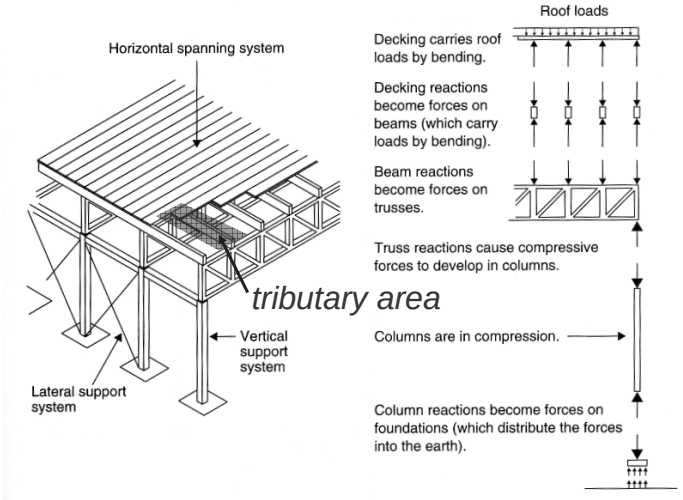


Load Tracing

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

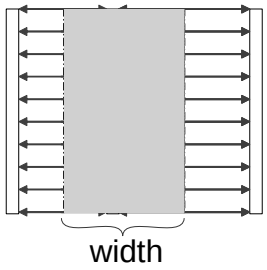


Load Tracing



Load Tracing

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



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

Load Tracing

Patcenter
Rogers 1986

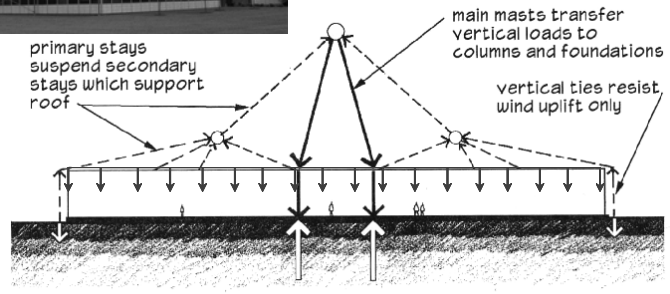


Figure 3.5: Patcenter, load path diagram.

Load Tracing

Alamillo Bridge
Calatrava 1992

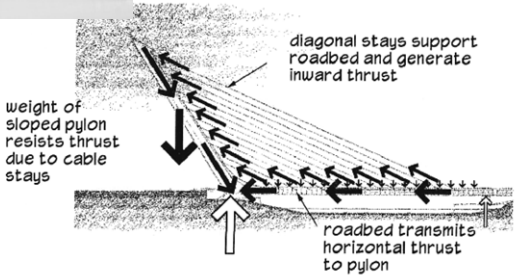
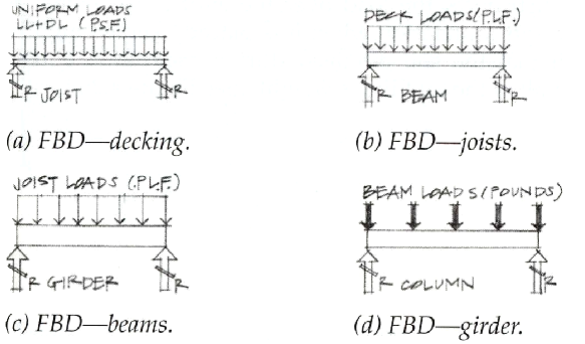
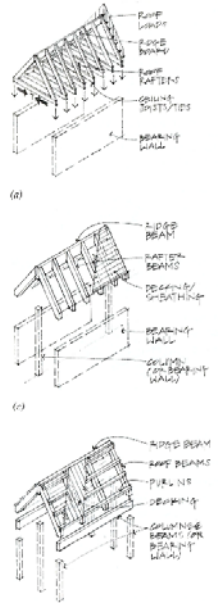


Figure 3.12: Alamillo bridge, load path diagram.

Load Paths





Load Paths

- *wall systems*

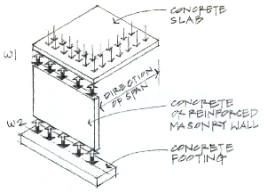


Figure 4.12 Uniform wall load from a slab.

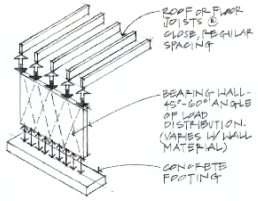


Figure 4.13 Uniform wall load from rafters and joists.

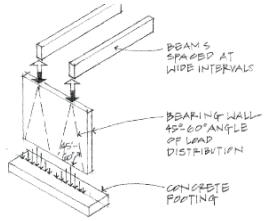


Figure 4.14 Concentrated loads from widely spaced beams.

Load Paths

- *openings & pilasters*

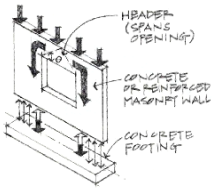


Figure 4.15 Arching over wall openings.

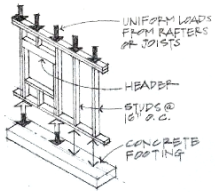


Figure 4.16 Stud wall with a window opening.

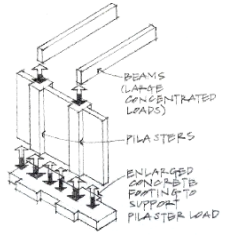


Figure 4.17 Pilasters supporting concentrated beam loads.

Load Paths

- *foundations*

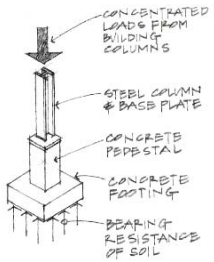


Figure 4.24 Spread footing.

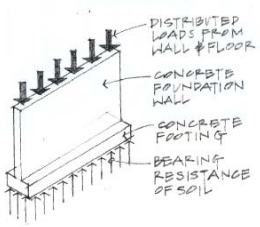


Figure 4.25 Wall footing.

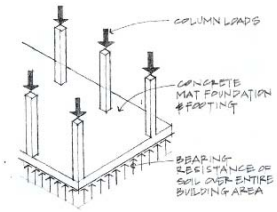


Figure 4.26 Mat or raft foundation.

Load Paths

- *deep foundations*

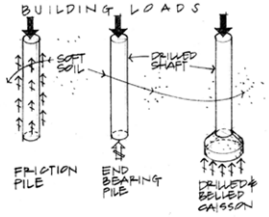


Figure 4.27 Pile foundations.

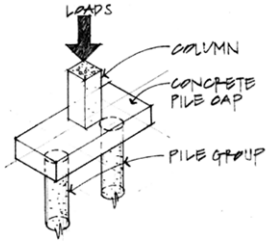


Figure 4.28 Pile cap on one pile group.

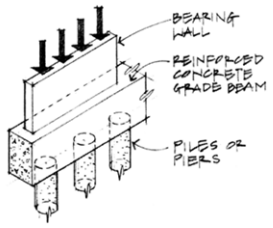
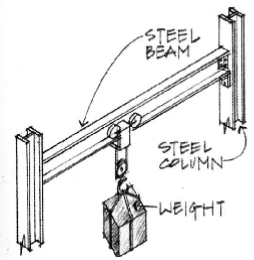
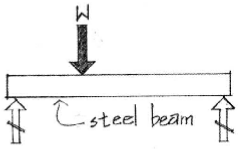
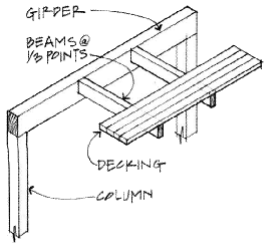


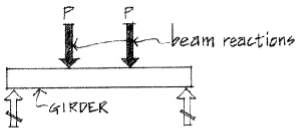
Figure 4.29 Grade beam supporting a bearing wall.

Concentrated Loads

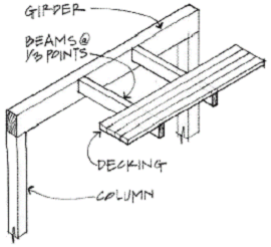


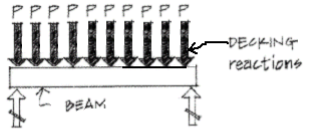


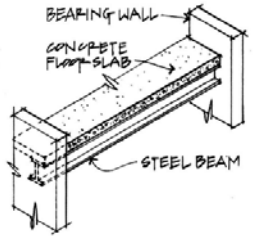


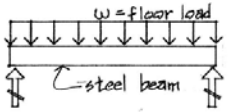


Distributed Loads



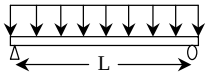


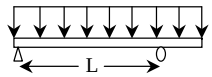


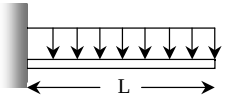


Distributed Loads

- *statically determinate beam supports*
  - *simple*
  - *overhang*
  - *cantilever*

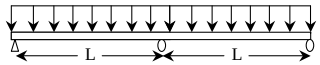


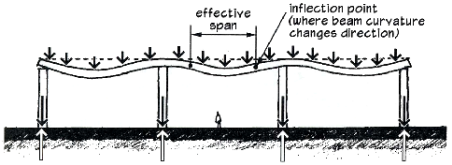


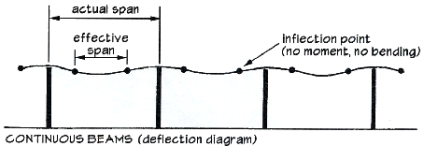


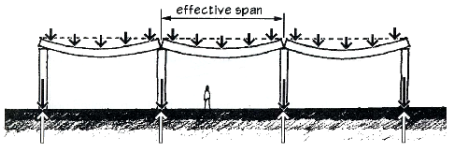
Distributed Loads

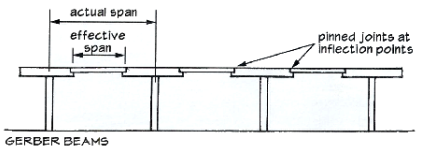
- *continuous beams*
  - *statically indeterminate*
  - *floors*







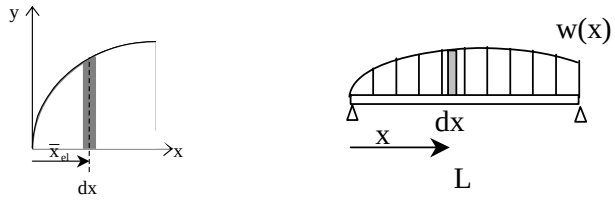




Equivalent Force Systems

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

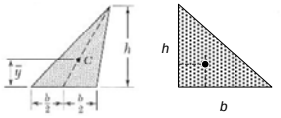
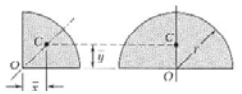
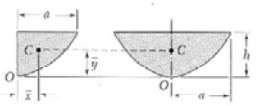
$$W = \int_0^L w\,dx = \int dA_{loading} = A_{loading}$$



Area Centroids

- *Table 7.1 – pg. 242*

Centroids of Common Shapes of Areas and Lines

Shape		$\bar{x}$	$\bar{y}$
Triangular area		$\frac{b}{3}$ *right triangle only*	$\frac{h}{3}$
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*