ELEMENTS OF ARCHITECTURAL STRUCTURES:

FORM, BEHAVIOR, AND DESIGN

ARCH 614

DR. ANNE NICHOLS

SPRING 2014
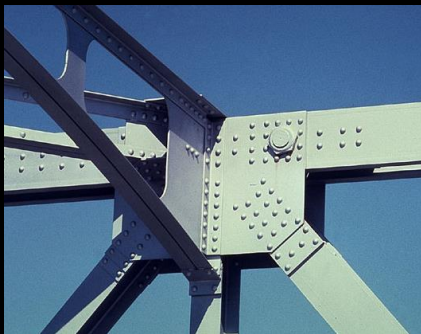
lecture
seventeen

steel construction:
trusses, decks & plate girders

Iron & Steel Trusses

- *cast iron*
  - *18th century*
  - *chain links*
- *wrought-iron*
- *rivets*

http:// nisee.berkeley.edu/godden

Truss Connections

- *gusset plates*

- *bolts*

- *welds*

http://courses.civil.ualberta.ca

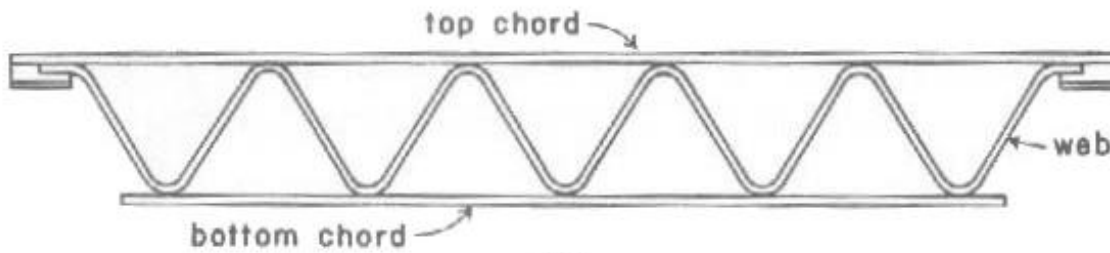*(AISC - Steel Structures of the Everyday)*

Trusses

- *require lateral bracing*
- *consider buckling*
- *indeterminate trusses*
  - *extra members*
  - *solvable with statics*
    - *cables can't hold compression*
  - *displacement methods*
    - *elastic elongation*
  - *too few members, unstable*

One Maritime Plaza, SOM 1964

Manufactured Trusses

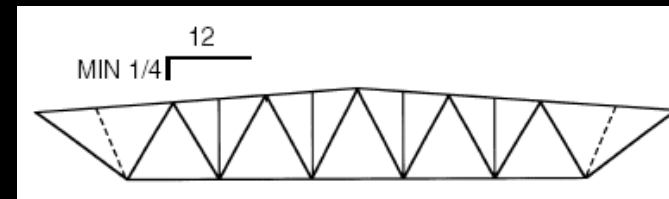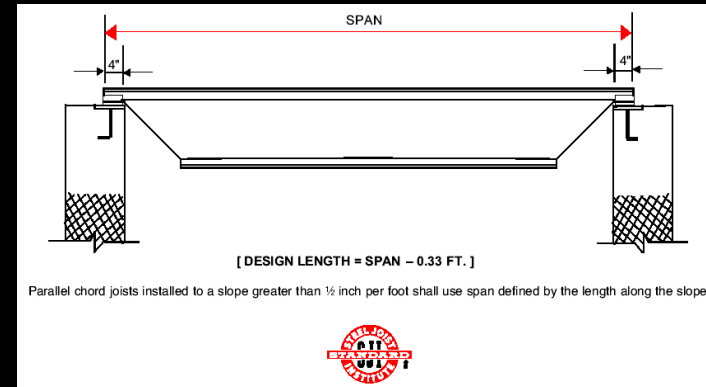- *open web joists*

- *parallel chord*

top chord

web

bottom chord

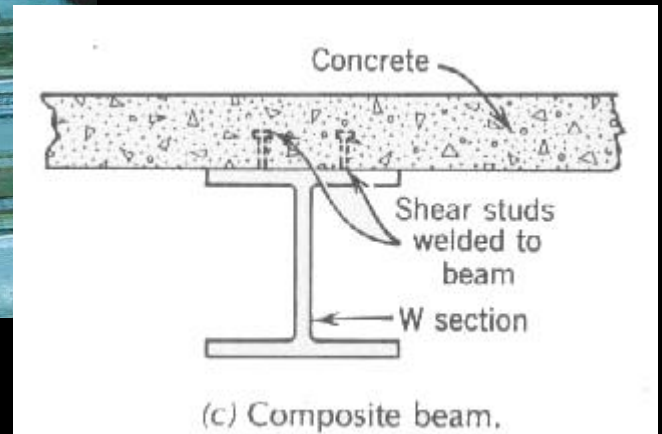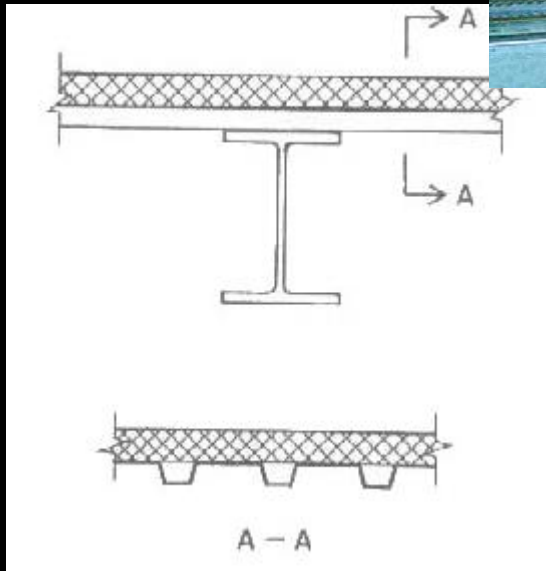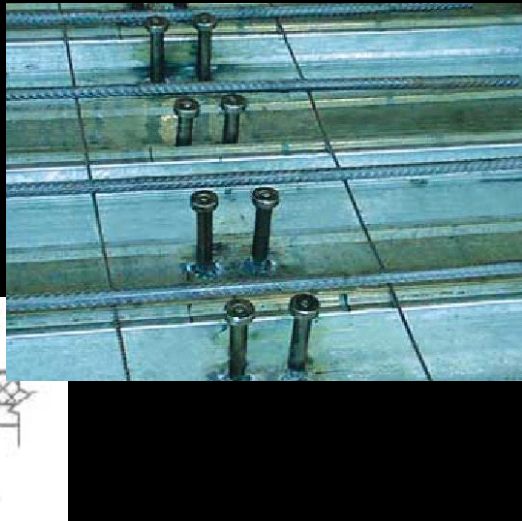(c) SECTION THRU JOISTS SHOWING FLANGE TYPES

Open Web Joists

- ### SJI: www.steeljoist.com

- ### Vulcraft: www.vulcraft.com

  - #### K Series (Standard)
    - 8-30" deep, spans 8-50 ft

  - #### LH Series (Long span)
    - 18-48" deep, spans 25-96 ft

  - #### DLH (Deep Long Spans)
    - 52-72" deep, spans 89-144 ft

  - #### SLH (Long spans with high strength steel)
    - pitched top chord
    - 80-120" deep, spans 111-240 ft

SPAN

4"   4"

[DESIGN LENGTH = SPAN − 0.33 FT.]

Parallel chord joists installed to a slope greater than ½ inch per foot shall use span defined by the length along the slope.

12
MIN 1/4

Decks

- *sheet steel*

- *composite*

Concrete

Shear studs welded to beam

W section

(c) Composite beam.

A — A

B — B

(b)
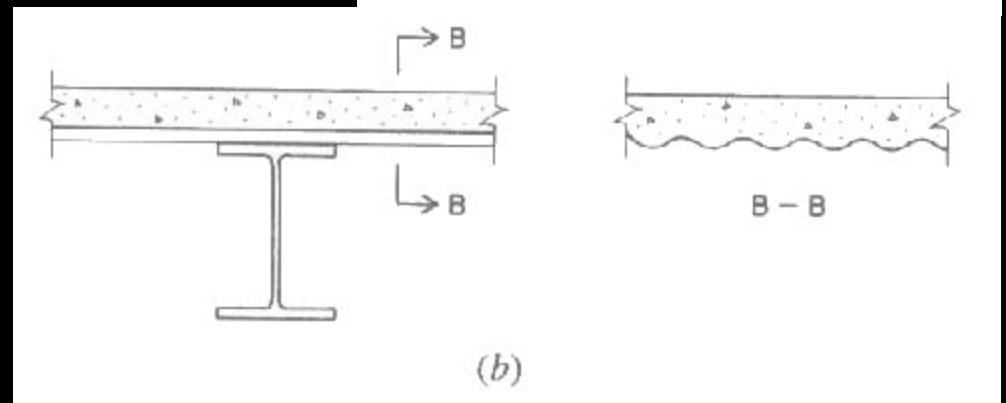
Plate Girders

- *welds*

- *web stiffeners*

http:// nisee.berkeley.edu/godden

plate web

angle stiffeners

thicker flange
in center where
moment is greatest

stiffeners
at end
where
shear is
greatest
and at
support

PLATE
GIRDER

BOX
GIRDER

stiffeners to prevent lateral buckling
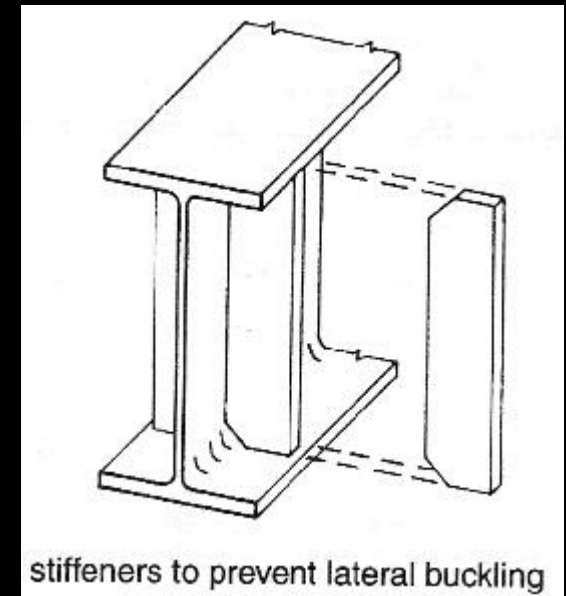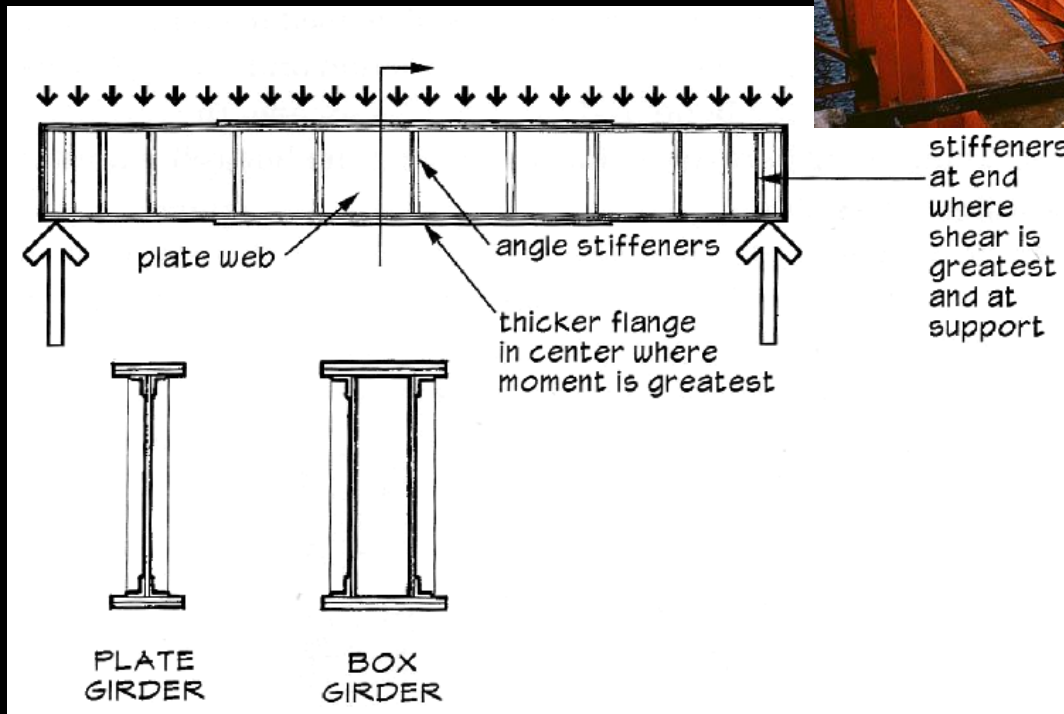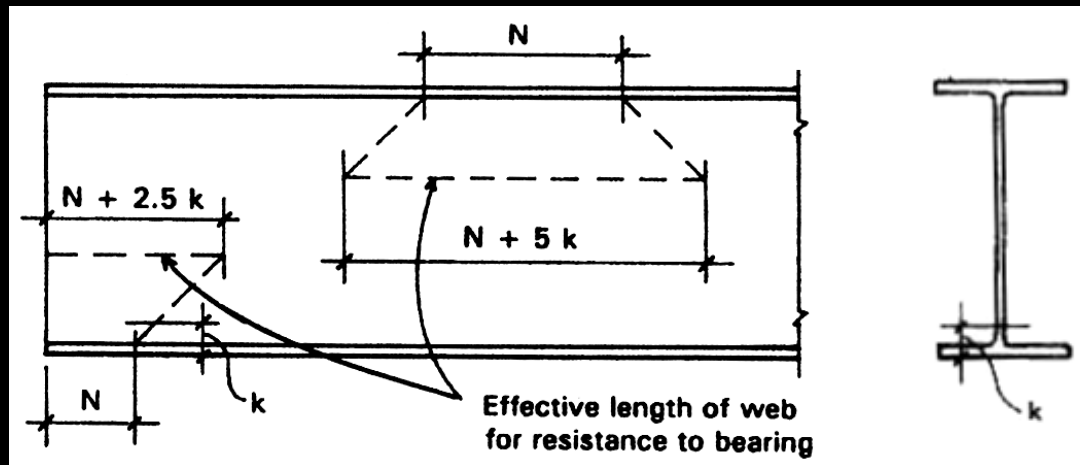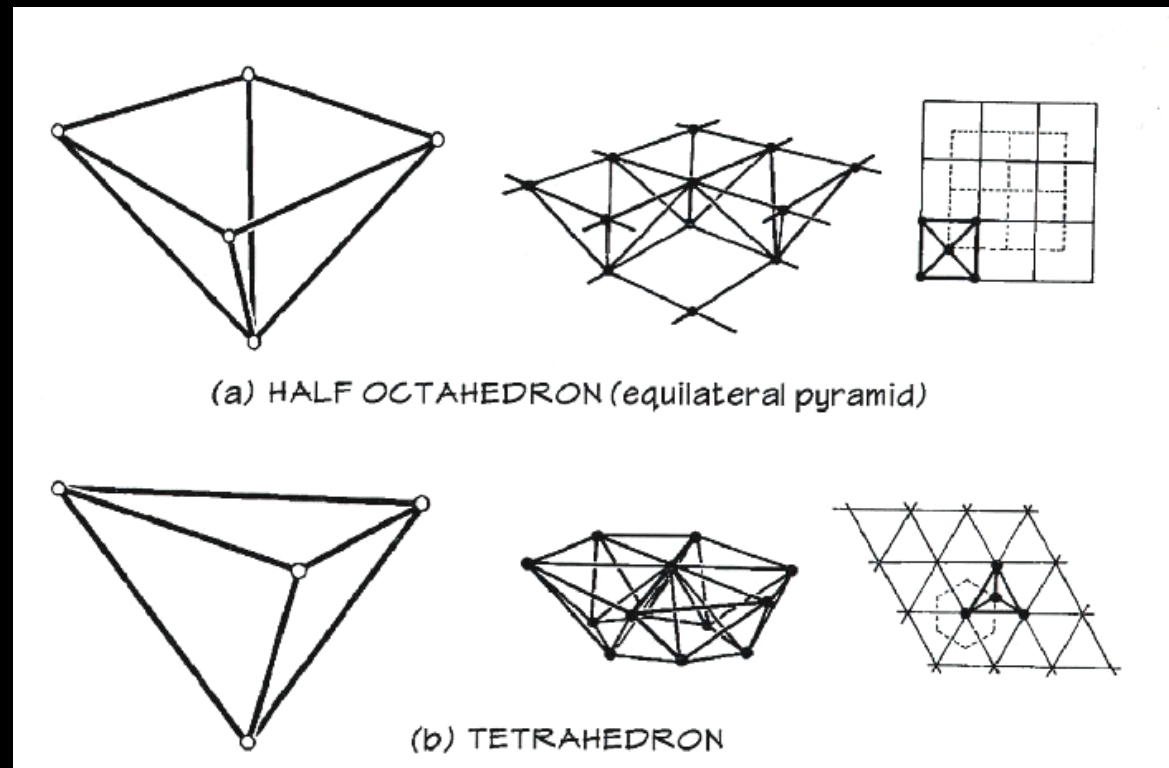
Web Bearing

- *max loads*

$$P_{n(max-end)} = (N + 2.5k)F_y t_w$$

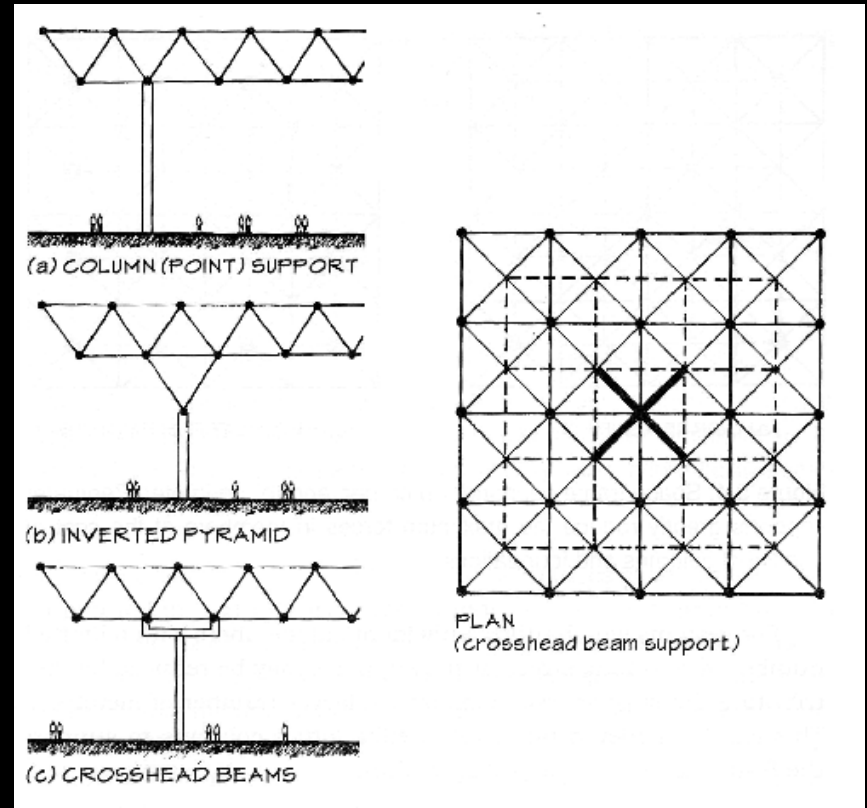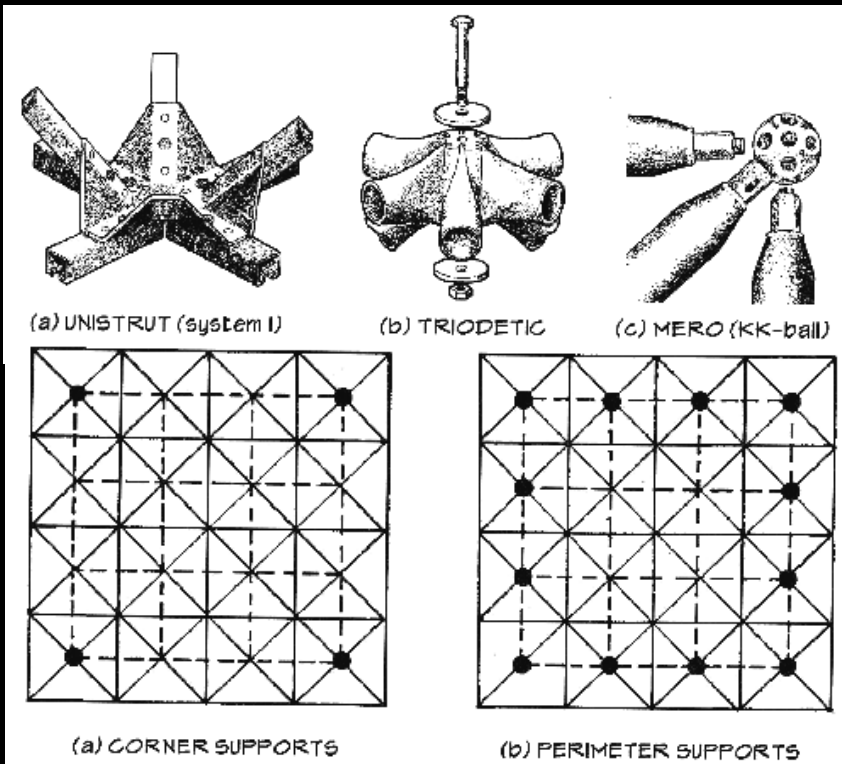$$P_{n(max-interior)} = (N + 5k)F_{yw} t_w$$

Space Trusses

- *3D with 2 force bodies and pins*
  - *pyramid*
    - *tetrahedron*
- *"frames" have fixed joints*
- *layers*
- *40's*

(a) HALF OCTAHEDRON (equilateral pyramid)

(b) TETRAHEDRON

Space Trusses

- *connections*

- *supports*

Space Trusses

Space Trusses

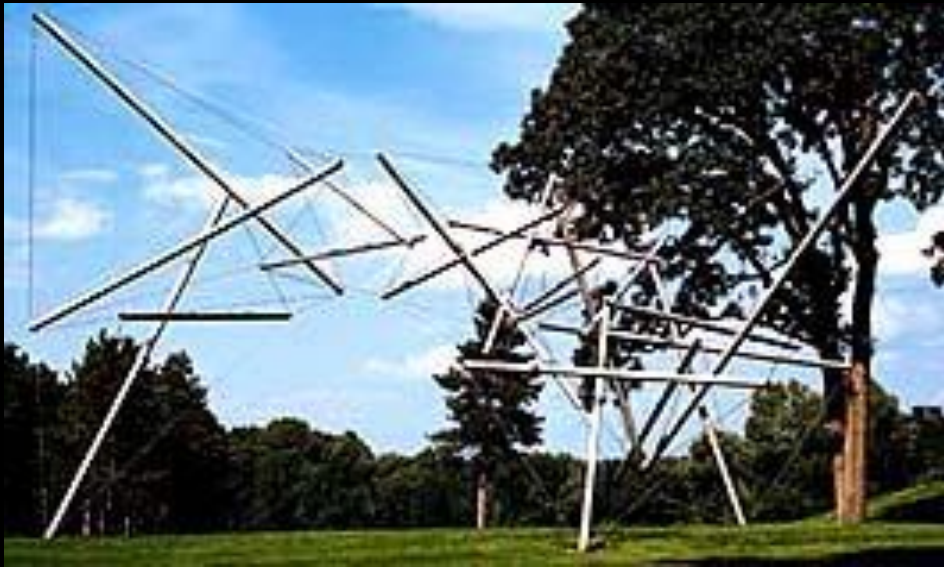

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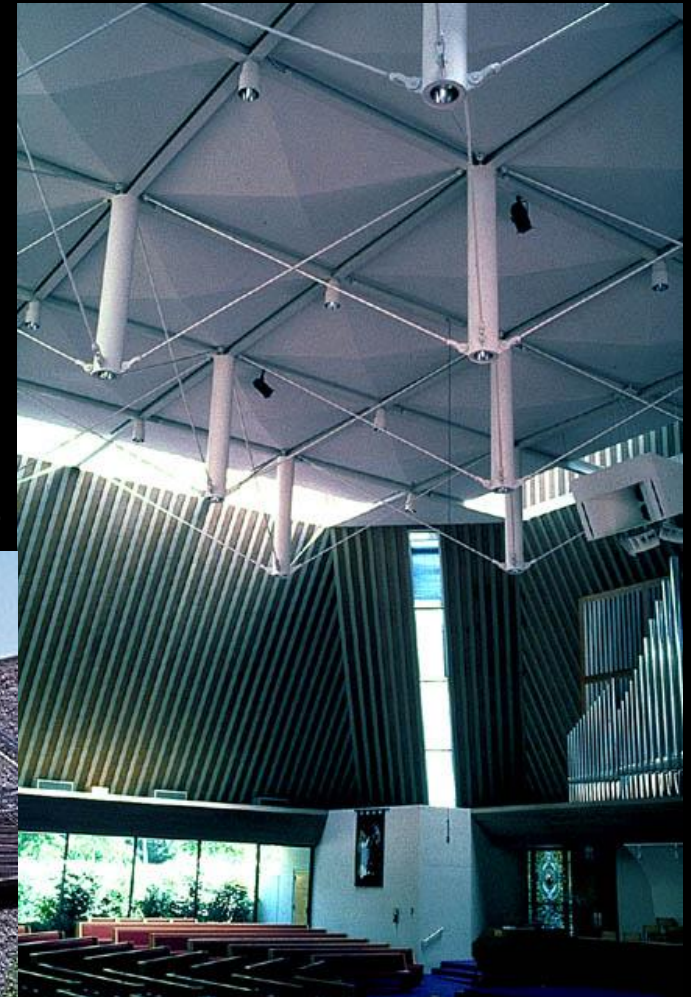
Tensegrities

- *3D frame*

- *discontinuous struts*
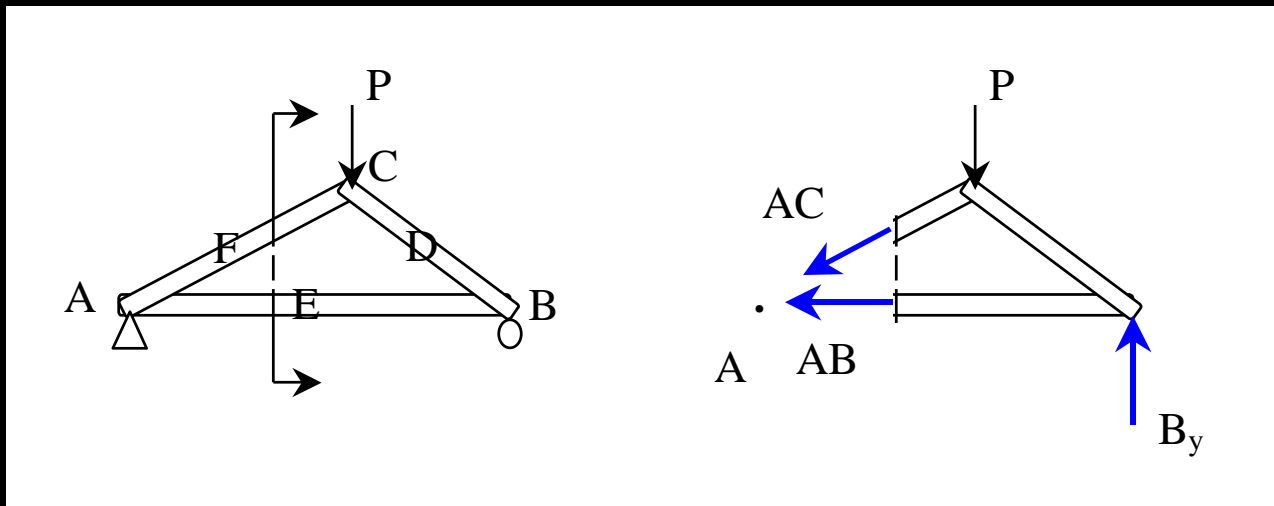
- *continuous cables*

Free Ride Home – Kenneth Snelson

Method of Sections

- *relies on internal forces being in equilibrium on a section*

- *cut to expose <u>3 or less</u> members*

- *coplanar forces $\rightarrow \sum M = 0$ too*

Method of Sections

- *joints on or off the section are good to sum moments*

- *quick for few members*

- *not always obvious where to cut or sum*