Frames: Rigid and Braced
Rigid Frames

- **rigid** frames have no pins
- frame is all one body
- joints transfer moments and shear
- typically statically indeterminate
- types
  - portal
  - gable
Rigid Frames

• behavior

![Diagram of Rigid Frames]

- PSP rigid frame
- sandbag weight
- legs spread, bending stress in beam on y; none in legs
- force legs inward; legs now in bending; beam sags less
- fixed joint at bottom of legs; beam sags even less
Rigid Frames

- moments get redistributed
- deflections are smaller
- effective column lengths are shorter
- very sensitive to settling
Rigid Frames

- resists lateral loadings
- shape depends on stiffness of beams and columns
- $90^\circ$ maintained
Rigid Frames

• staggered truss
  – rigidity
  – clear stories
Rigid Frames

- connections
  - steel
  - concrete
Braced Frames

• *pin connections*

• *bracing to prevent lateral movements*
Braced Frames

- types of bracing
  - knee-bracing
  - diagonal
  - X
  - K or chevron
  - shear walls
Shear Walls

- resist lateral load in plane with wall

No diaphragm action

Action with rigid floor diaphragms

Rigid Frames 10
Lecture 27

Shear wall
Rigid Frame Analysis

- members see
  - shear
  - axial force
  - bending
- V & M diagrams
  - plot on “outside”
Rigid Frame Analysis

- need support reactions
- free body diagram each member
- end reactions are equal and opposite on next member
- “turn” member like beam
- draw V & M
Rigid Frame Analysis

- FBD & M
  - opposite end reactions at joints

![Diagram of rigid frame analysis]

\[
M_{BA} = Ph/2, \quad M_{BC} = Ph/2, \quad M_{CB} = Ph/2, \quad M_{CD} = Ph/2
\]
Rigid Frame Design

- loads and combinations
  - usually uniformly distributed gravity loads
  - worst case for largest moments...
  - wind direction can increase moments
Rigid Frame Design

- frames & floors
  - rigid frame can have slab floors or slab with connecting beams
- other
  - slabs or plates on columns
Rigid Frame Design

- floors – plates & slabs
  - one-way behavior
    - side ratio > 1.5
    - “strip” beam
  - two-way behavior
    - more complex