frames:
rigid and braced

ARCHITECTURAL STRUCTURES I:
STATICS AND STRENGTH OF MATERIALS
ENDS 231
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lecture twenty seven
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
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° 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
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

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

• loads and combinations
  – *usually uniformly distributed gravity loads*
  – *worst case for largest moments…*
  – *wind direction can increase moments*

![Diagram of rigid frame with labeled moments](image)
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