

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

**ENDS 231**

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**FALL 2007**

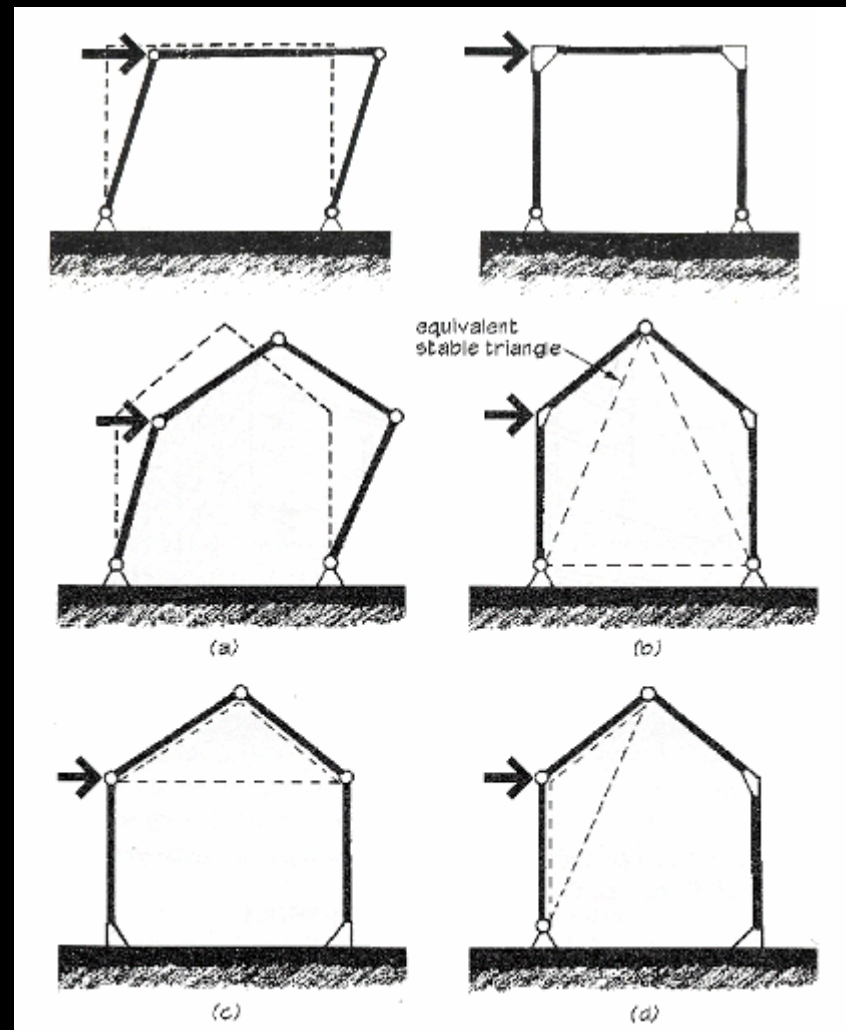
*lecture*  
**twenty seven**

**frames:  
rigid and braced**



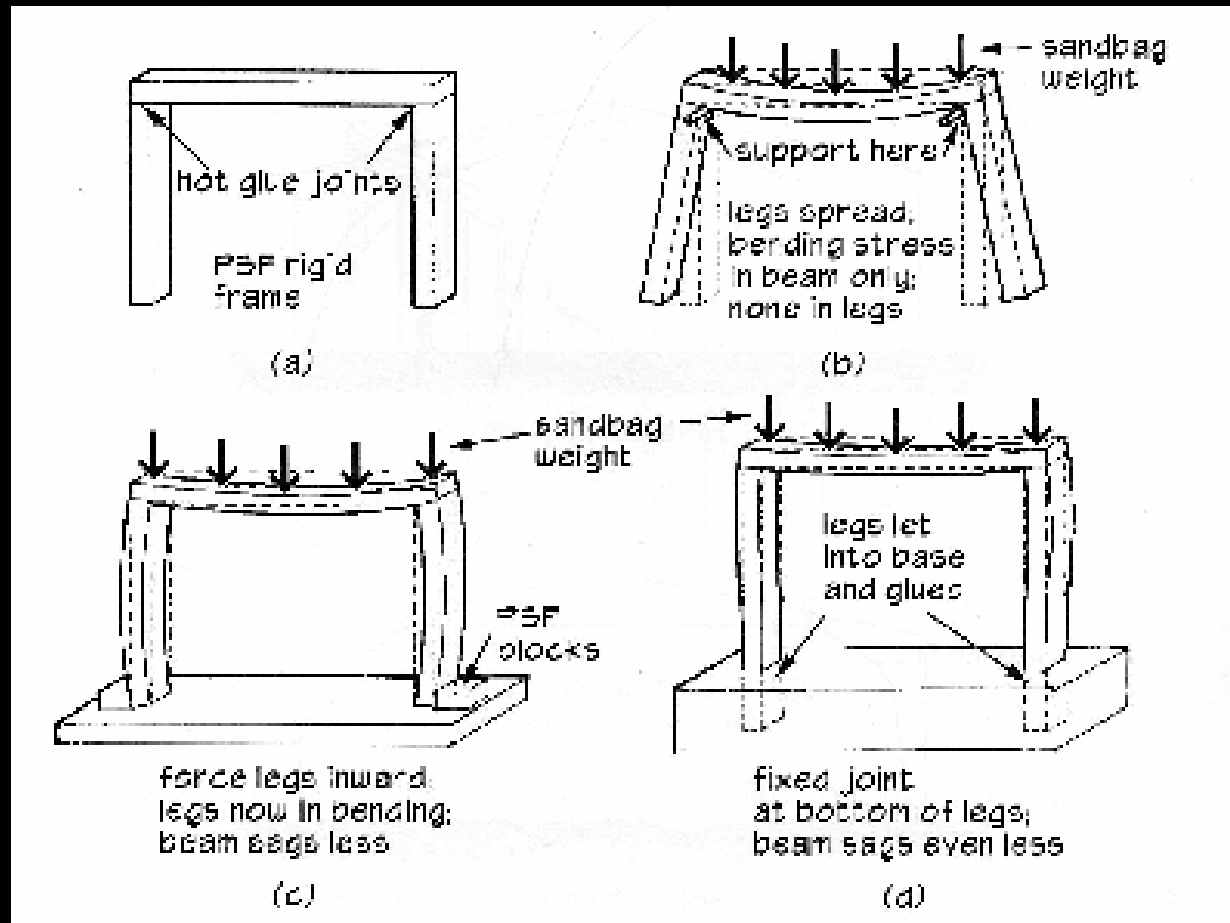
# Rigid Frames

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



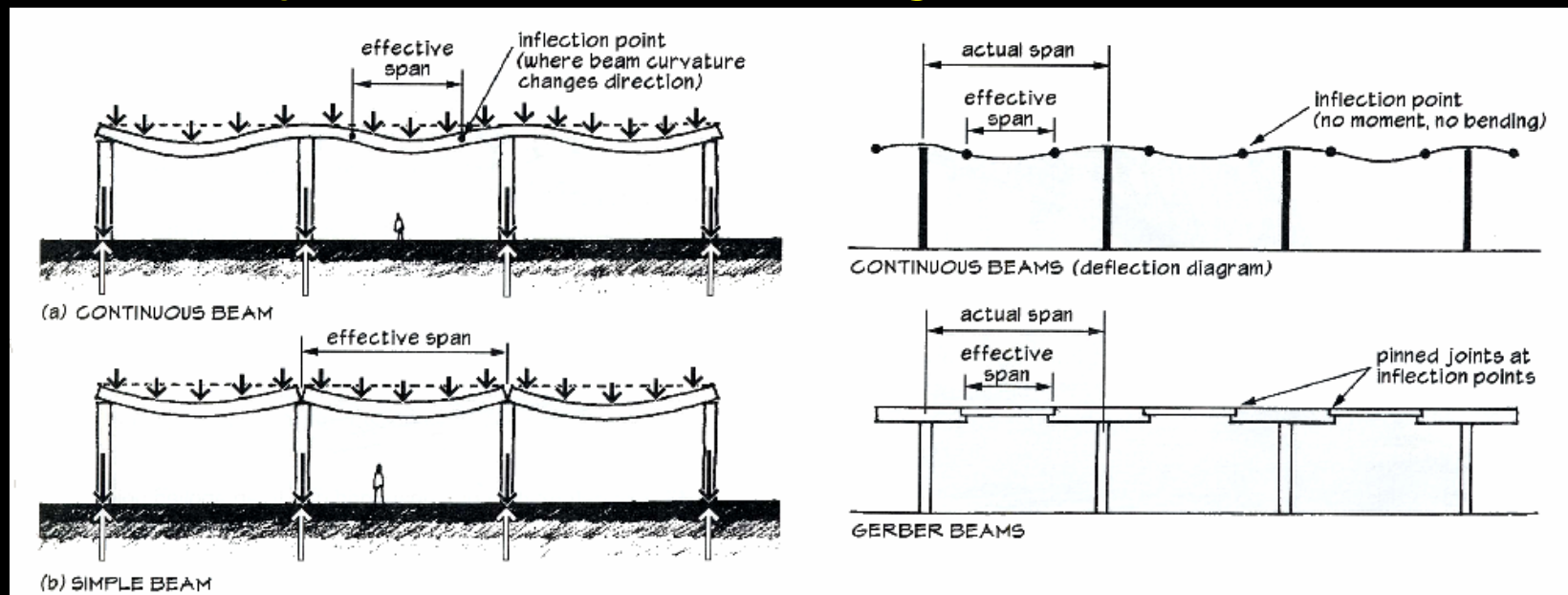
# Rigid Frames

- *behavior*



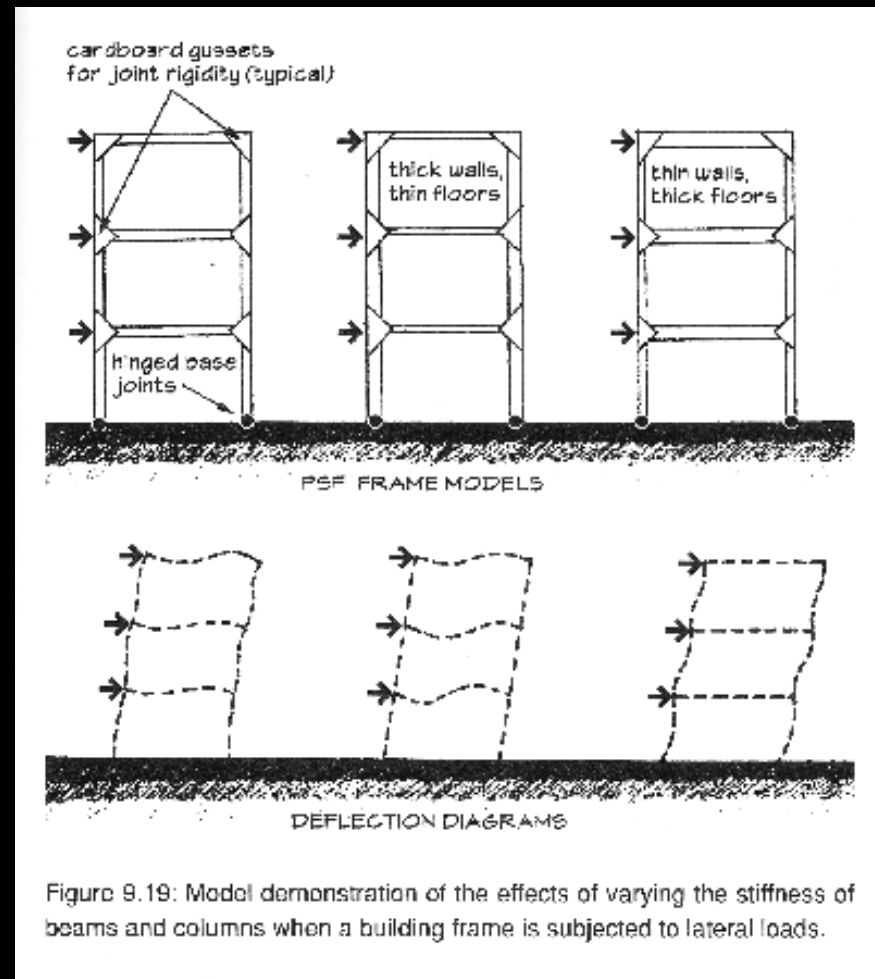
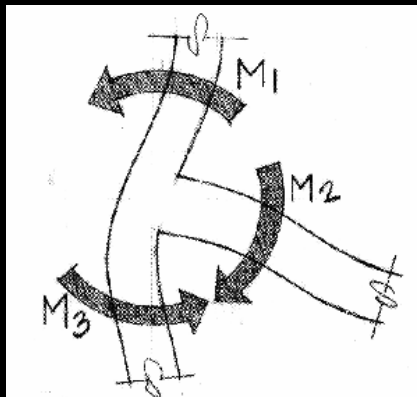
# Rigid Frames

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



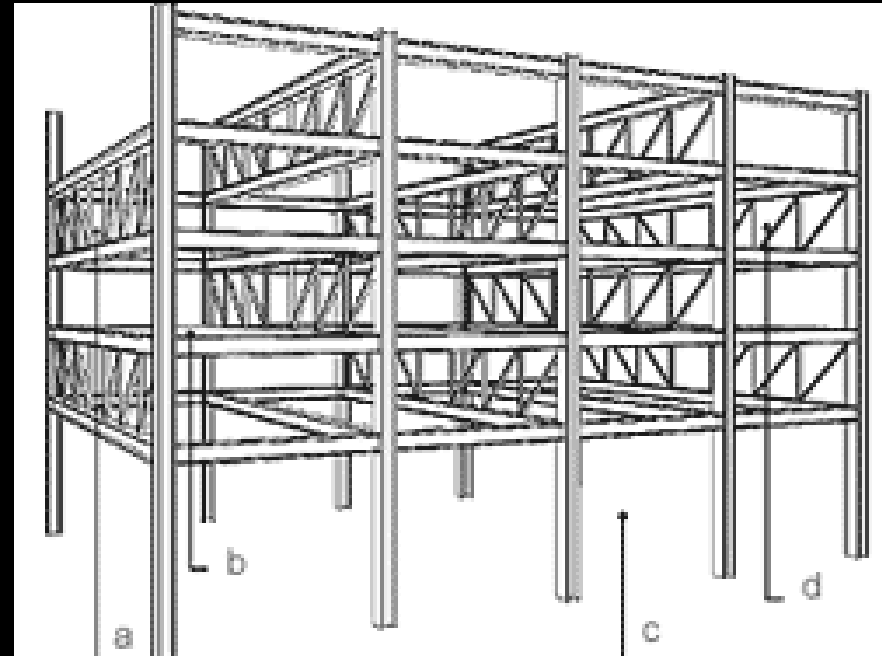
# Rigid Frames

- *resists lateral loadings*
- *shape depends on stiffness of beams and columns*
- *90° maintained*



# Rigid Frames

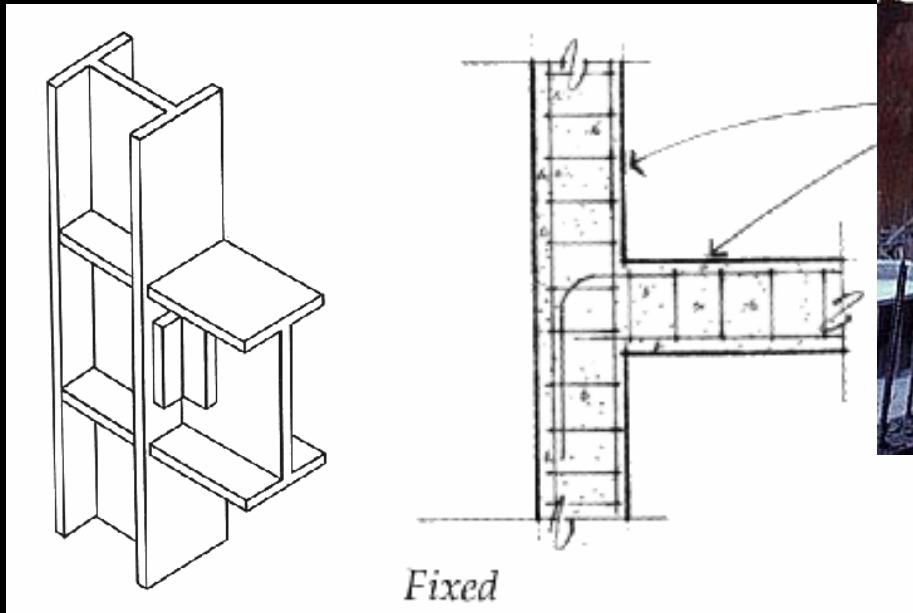
- *staggered truss*
  - *rigidity*
  - *clear stories*





# Rigid Frames

- *connections*
  - *steel*
  - *concrete*



# *Braced Frames*

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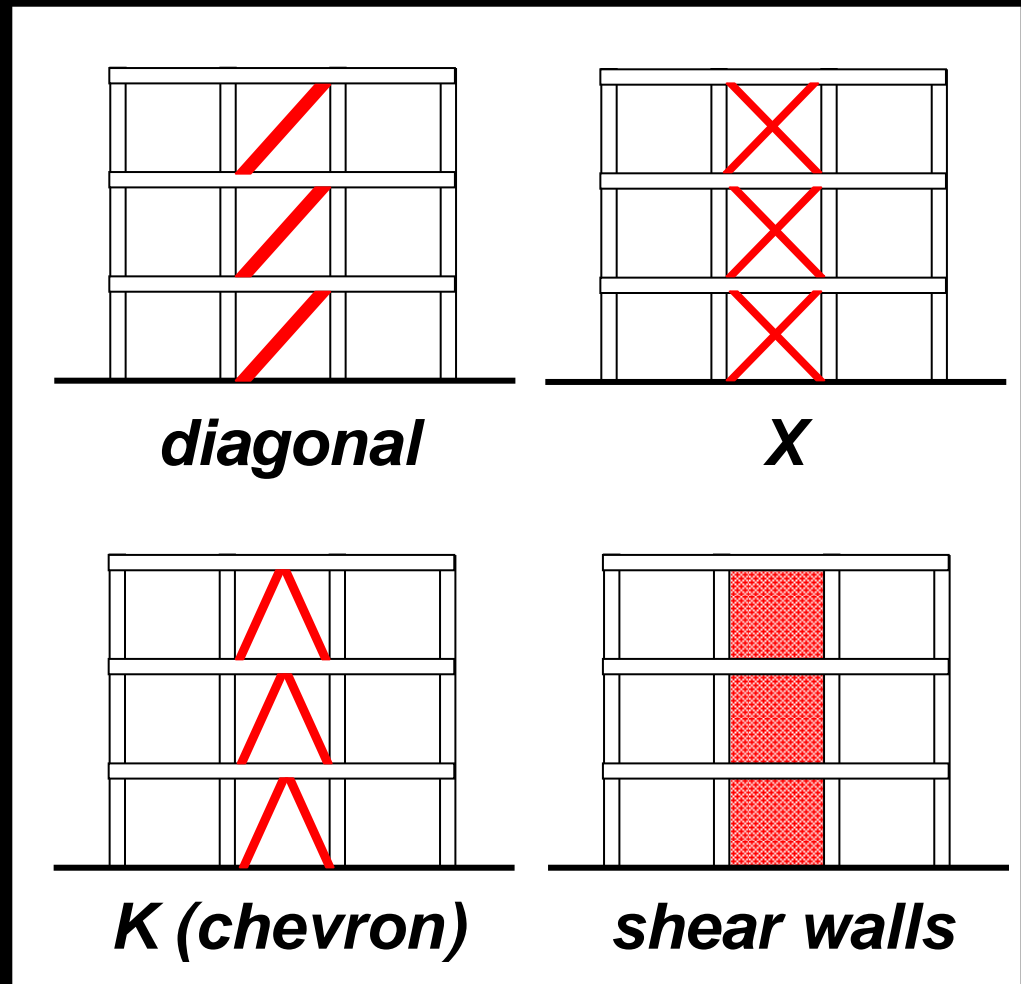
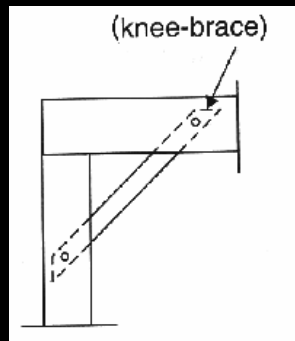
- *pin connections*
- *bracing to prevent lateral movements*





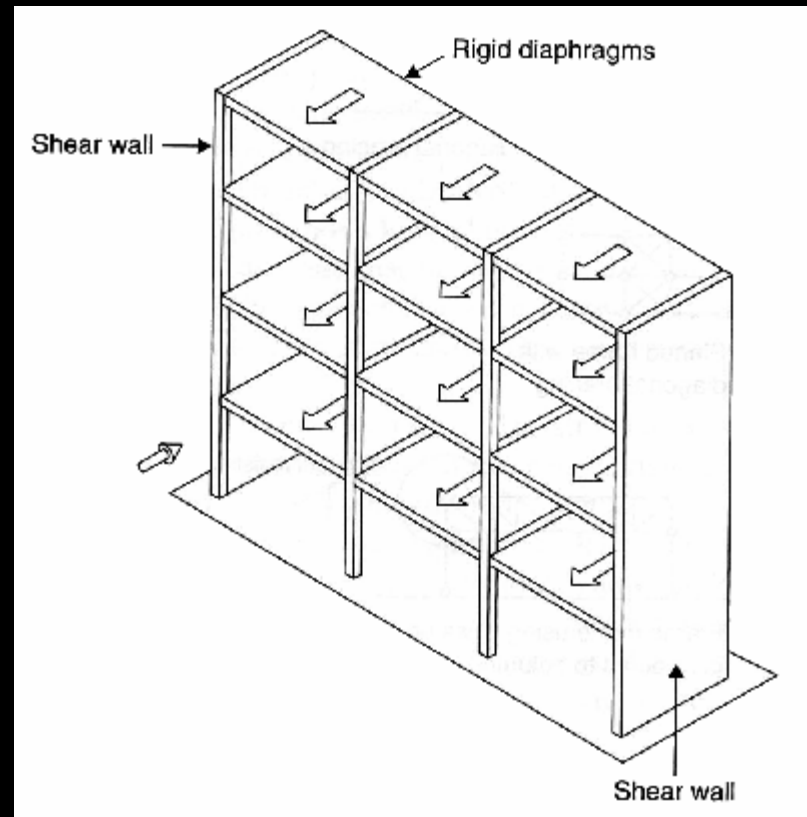
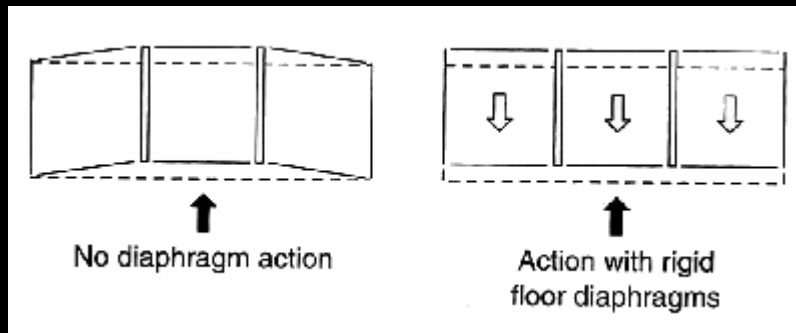
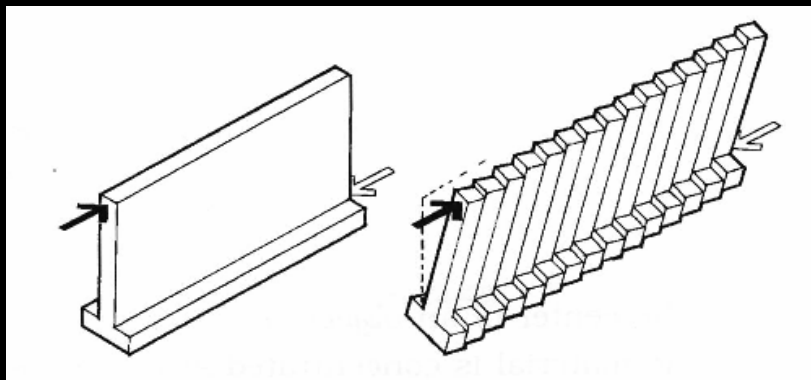
# Braced Frames

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



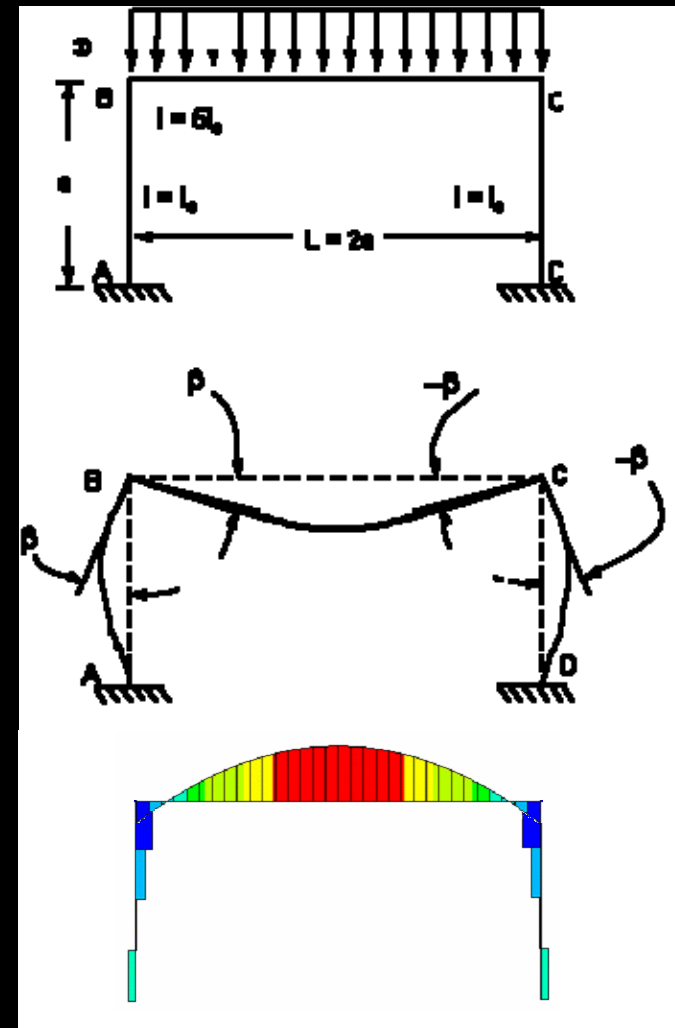
# Shear Walls

- resist lateral load in plane with wall



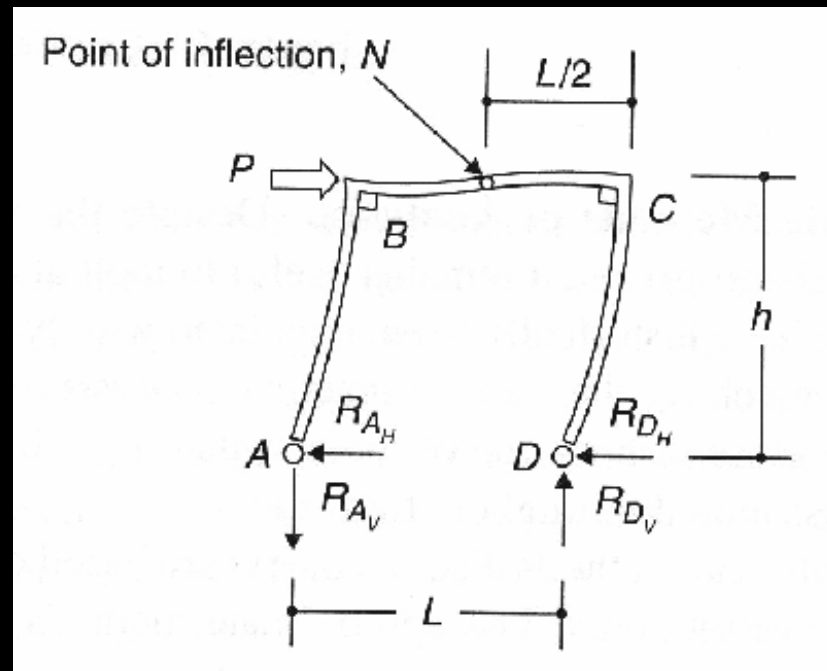
# Rigid Frame Analysis

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



# Rigid Frame Analysis

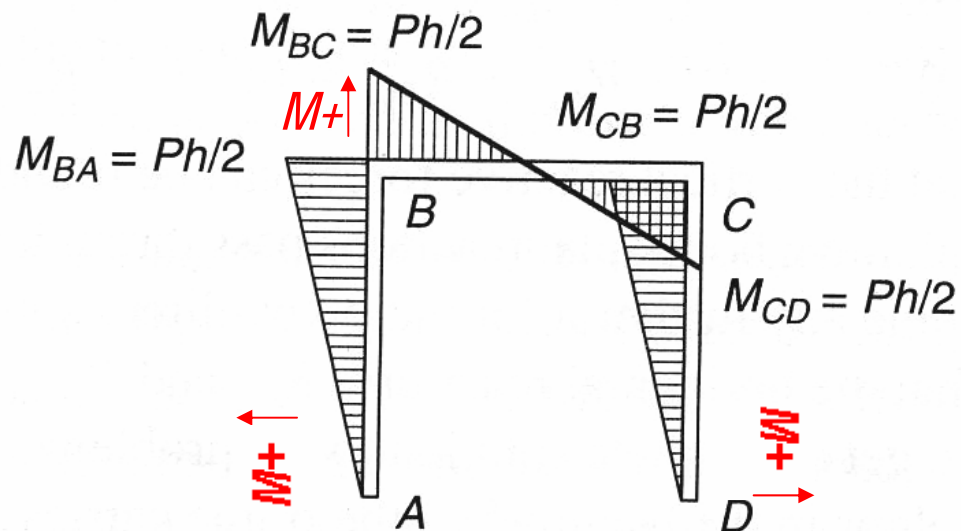
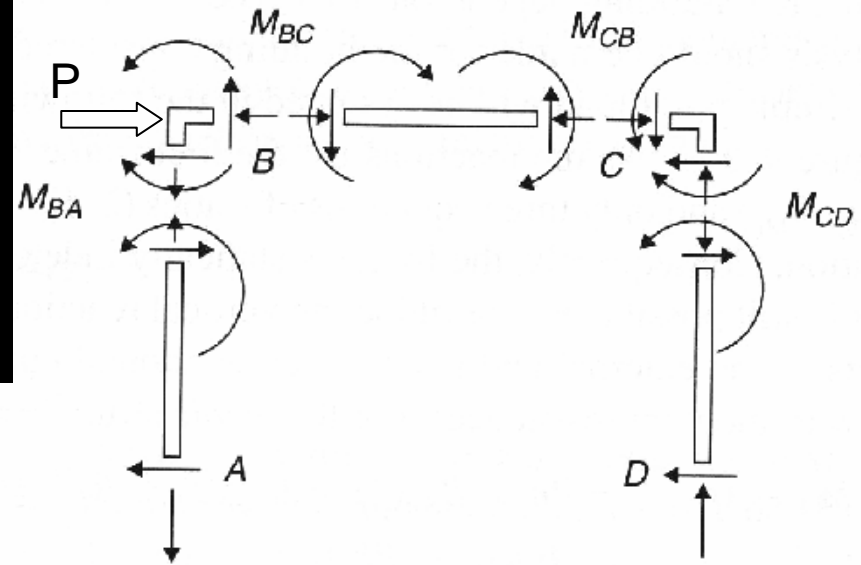
- need support reactions
- free body diagram each member
- end reactions are equal and opposite on next member
- “turn” member like beam
- draw  $V$  &  $M$



# Rigid Frame Analysis

## – FBD & M

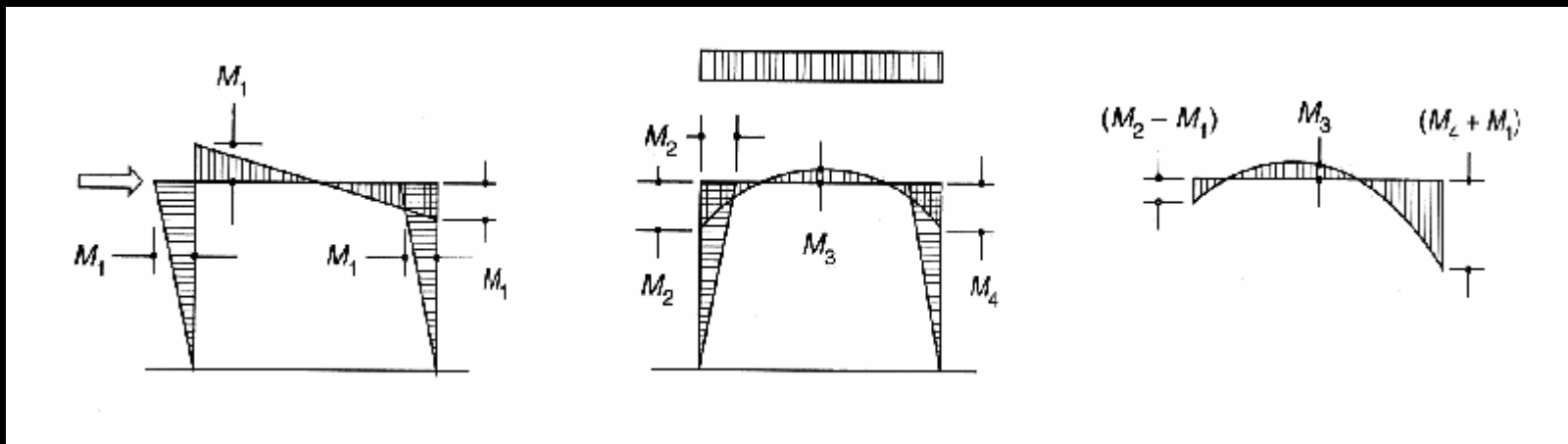
- opposite end reactions at joints





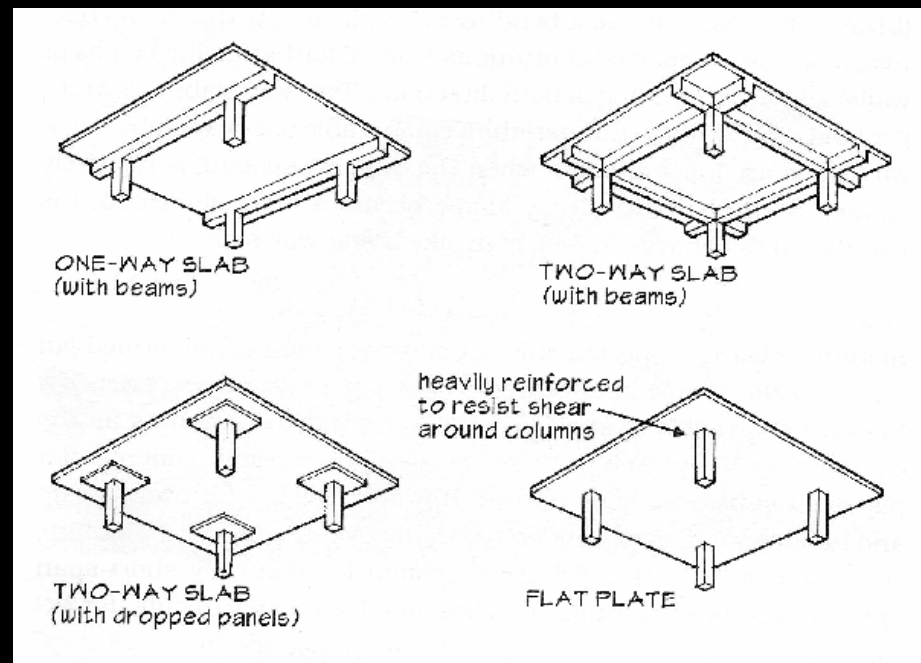
# Rigid Frame Design

- *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

