

ARCHITECTURAL STRUCTURES I:  
 STATICS AND STRENGTH OF MATERIALS

ENDS 231

DR. ANNE NICHOLS

SPRING 2007

lecture  
 twenty seven

frames:  
 rigid and braced



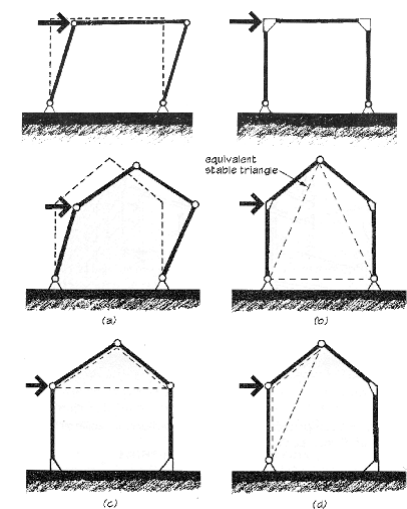
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Rigid Frames

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



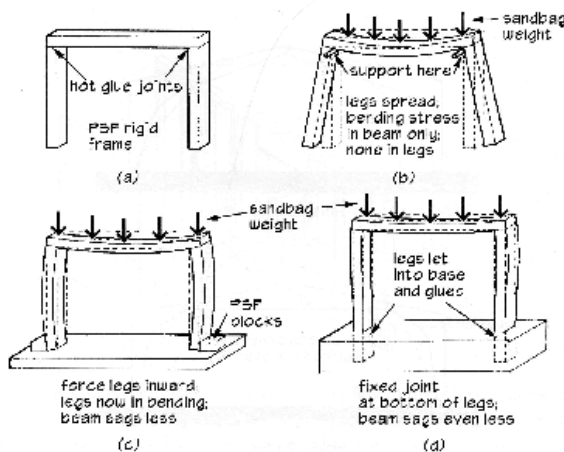
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Rigid Frames

- behavior



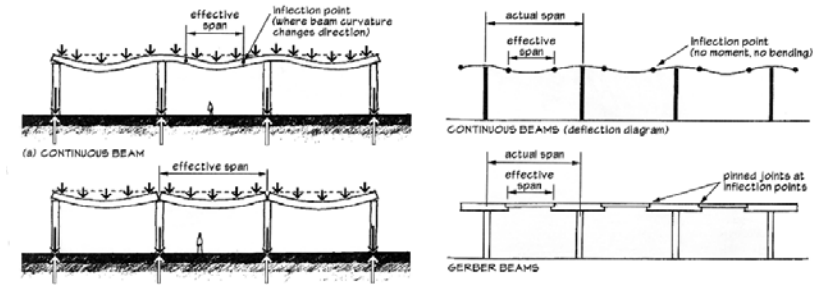
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Rigid Frames

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



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## Rigid Frames

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

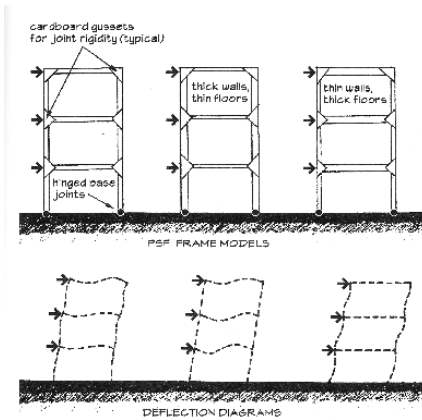
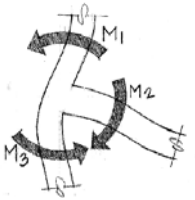


Figure 9.19: Modal demonstration of the effects of varying the stiffness of beams and columns when a building frame is subjected to lateral loads.

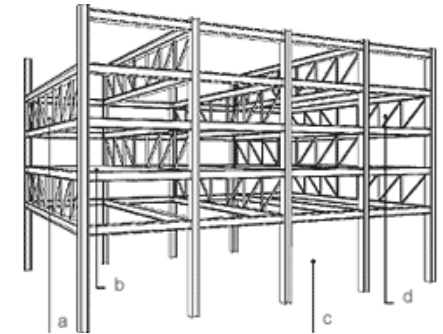
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## Rigid Frames

- staggered truss
  - rigidity
  - clear stories



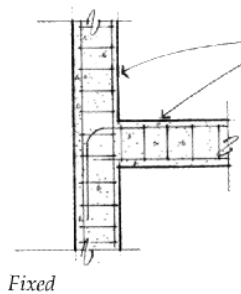
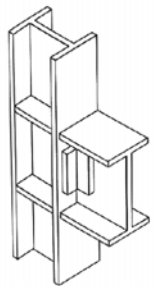
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## Rigid Frames

- connections
  - steel
  - concrete



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## Braced Frames

- pin connections
- bracing to prevent lateral movements



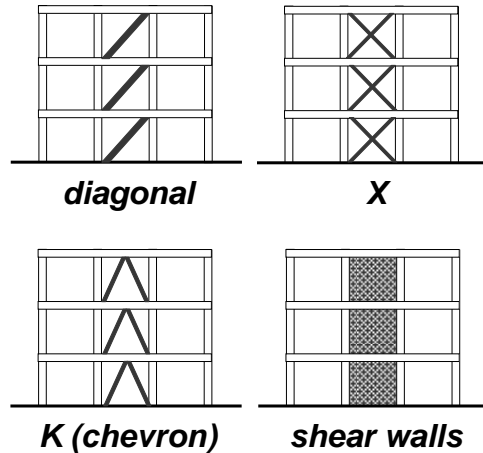
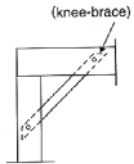
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## Braced Frames

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



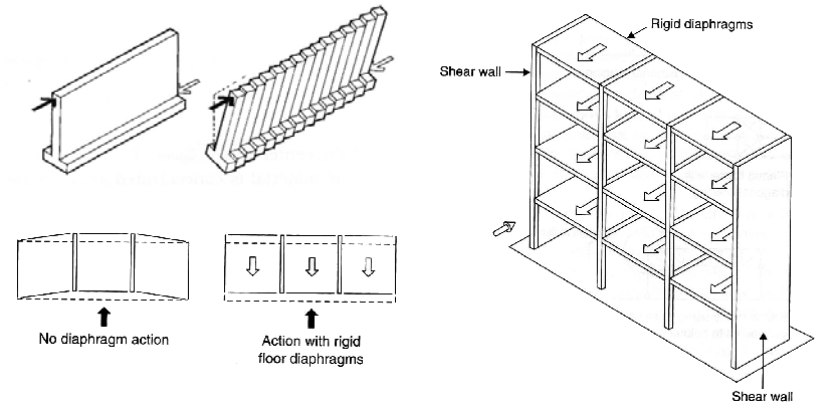
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## Shear Walls

- resist lateral load in plane with wall



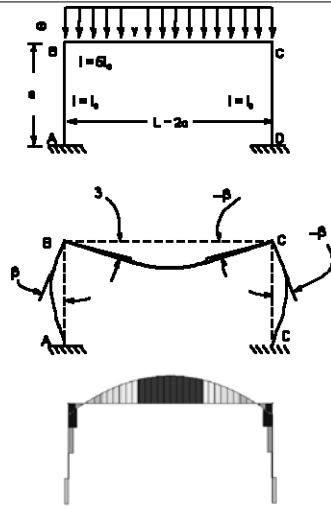
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## Rigid Frame Analysis

- members see
  - shear
  - axial force
  - bending
- V & M diagrams
  - plot on "outside"



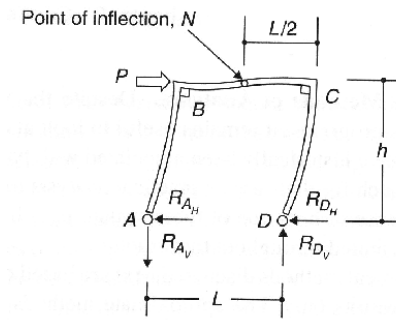
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## Rigid Frame Analysis

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



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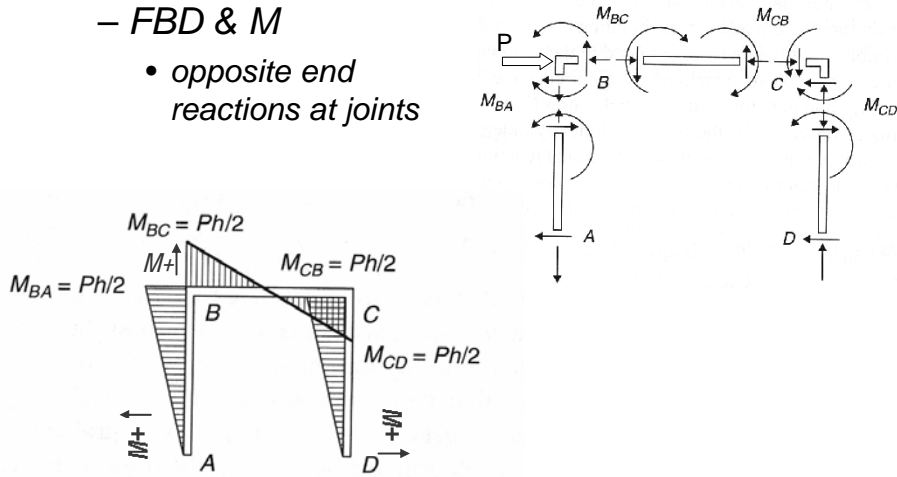
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# Rigid Frame Analysis

## - FBD & M

- opposite end reactions at joints



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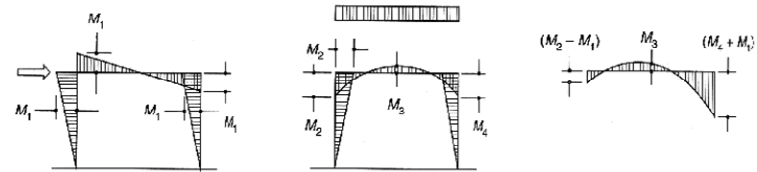
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# Rigid Frame Design

## • loads and combinations

- usually uniformly distributed gravity loads
- worst case for largest moments...
- wind direction can increase moments



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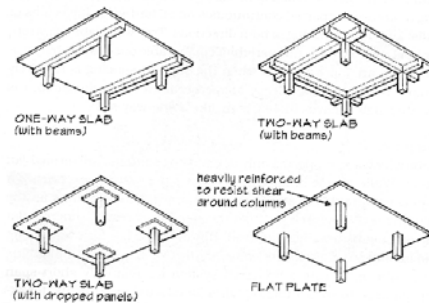
# Rigid Frame Design

## • frames & floors

- rigid frame can have slab floors or slab with connecting beams

## • other

- slabs or plates on columns



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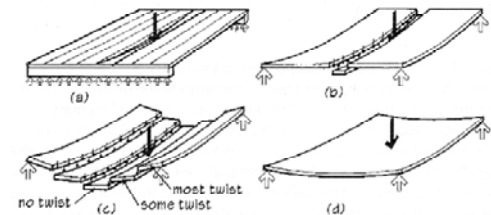
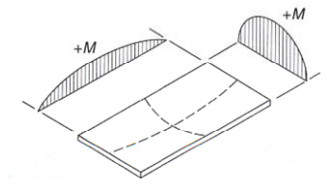
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# Rigid Frame Design

## • floors – plates & slabs

- one-way behavior
  - side ratio > 1.5
  - “strip” beam
- two-way behavior
  - more complex



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