ARCHITECTURAL STRUCTURES I:
STATICS AND STRENGTH OF MATERIALS
ENDS 231
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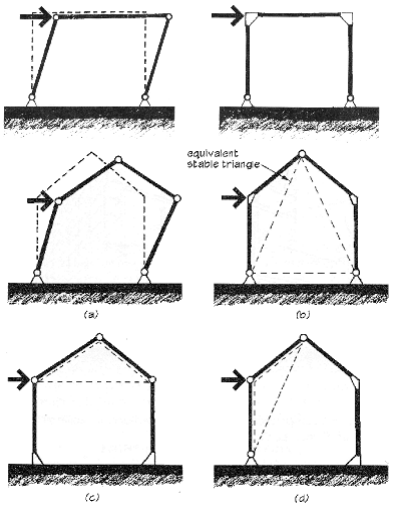
SPRING 2008

lecture
twenty seven

frames:
rigid and braced

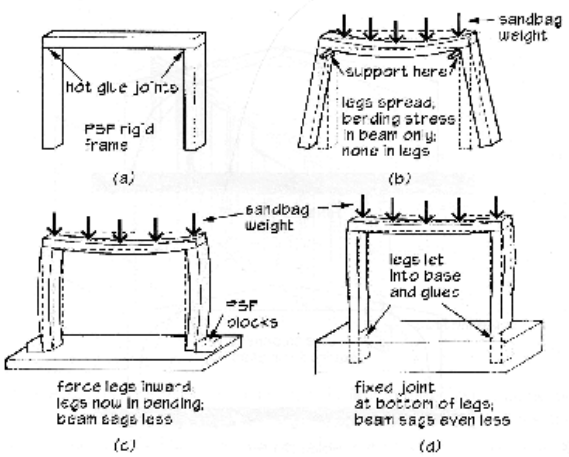
Rigid Frames

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



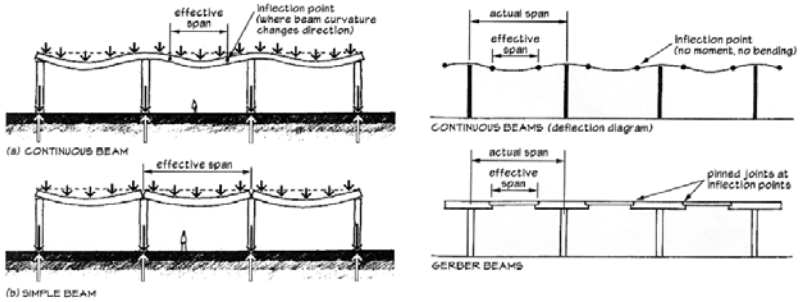
Rigid Frames

- *behavior*



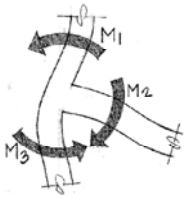
Rigid Frames

- *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*



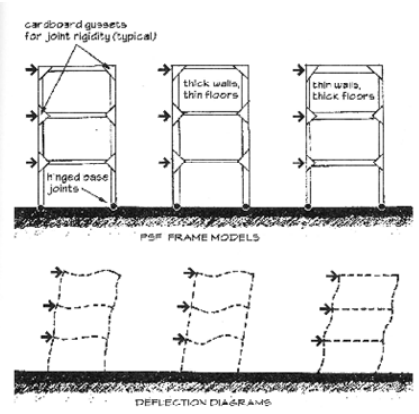
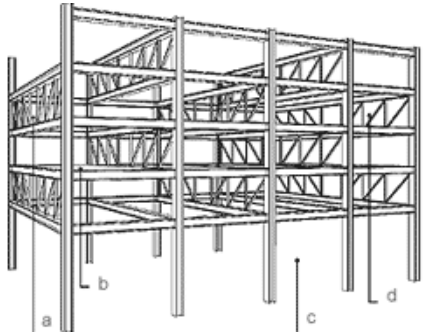


Figure 9.19: Model demonstration of the effects of varying the stiffness of beams and columns when a building frame is subjected to lateral loads.

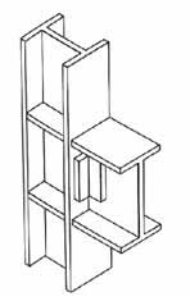
Rigid Frames

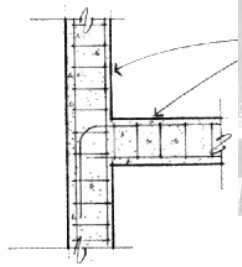
- *staggered truss*
  - *rigidity*
  - *clear stories*



Rigid Frames

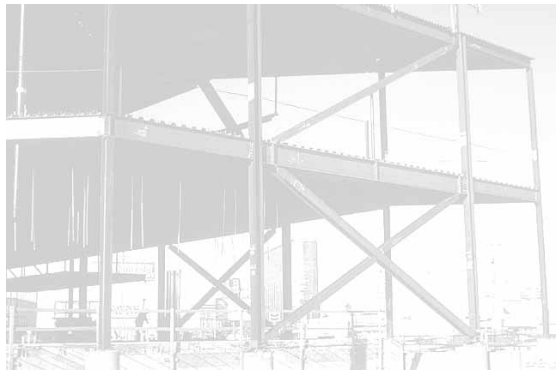
- *connections*
  - *steel*
  - *concrete*





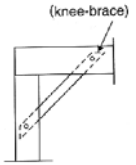
Braced Frames

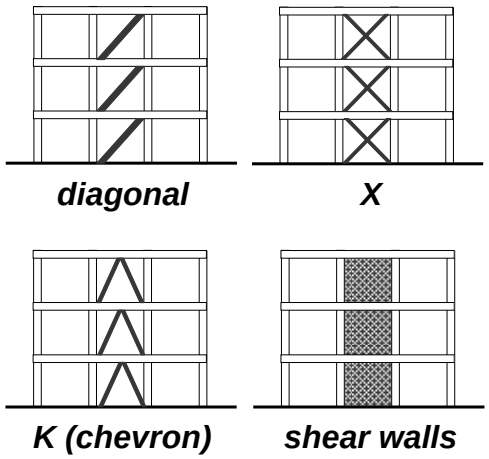
- *pin connections*
- *bracing to prevent lateral movements*



Braced Frames

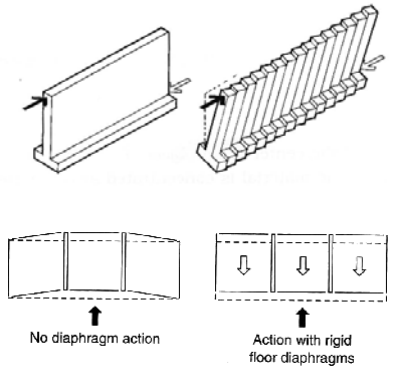
- *types of bracing*
  - *knee-bracing*
  - *diagonal*
  - *X*
  - *K or chevron*
  - *shear walls*

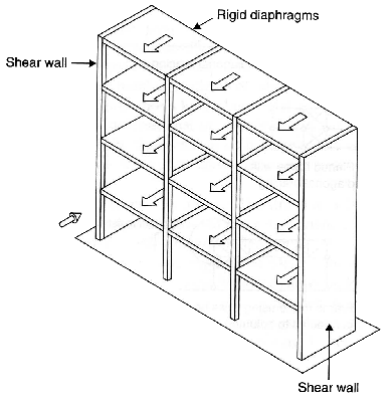




Shear Walls

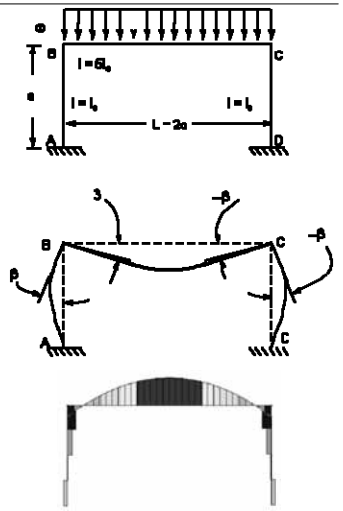
- *resist lateral load in plane with wall*





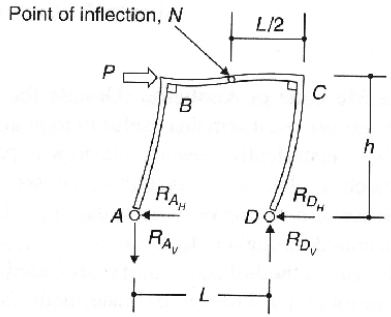
Rigid Frame Analysis

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



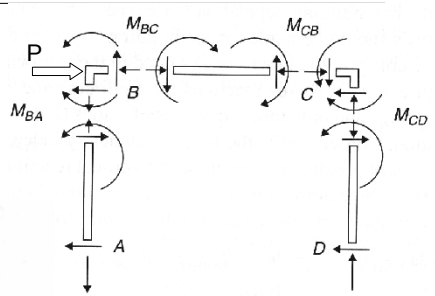
Rigid Frame Analysis

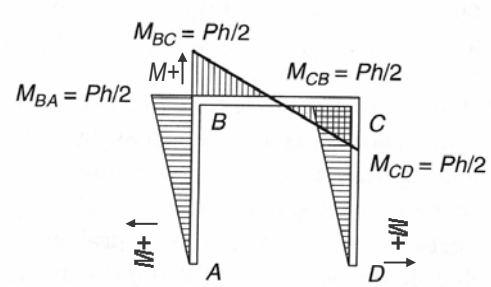
- *need support reactions*
- *free body diagram each member*
- *end reactions are equal and opposite on next member*
- *"turn" member like beam*
- *draw V & M*



Rigid Frame Analysis

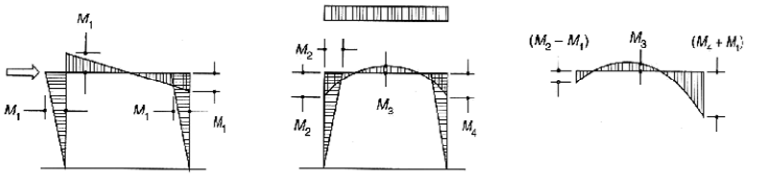
- *FBD & M*
  - *opposite end reactions at joints*





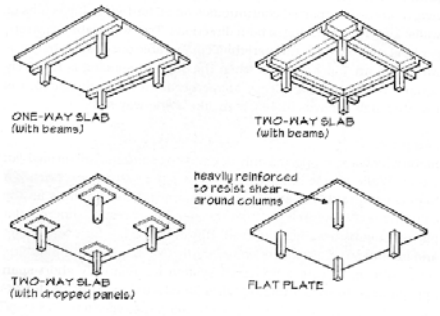
Rigid Frame Design

- *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*