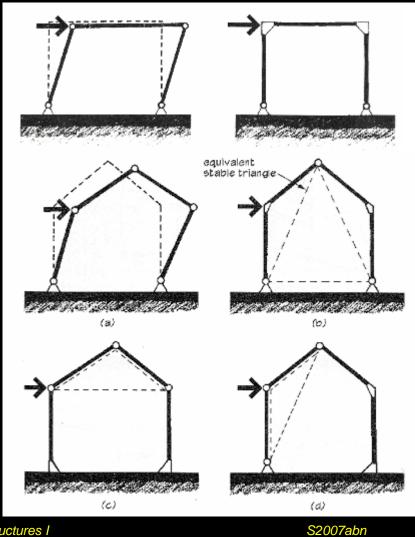
ARCHITECTURAL **S**TRUCTURES **I**: STATICS AND STRENGTH OF MATERIALS **ENDS 231 D**R. ANNE **N**ICHOLS SPRING 2007 In the formation of the frames: rigid and bra **Rigid Frames 1** Architectural Structures S2007abn

ENDS 231

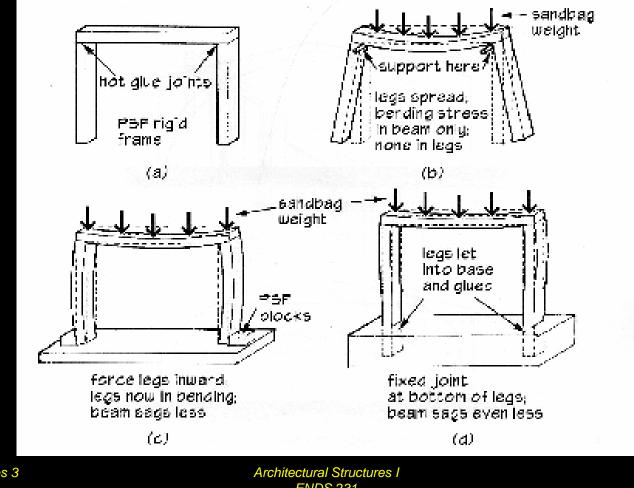
Lecture 27

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



Rigid Frames 2 Lecture 27 Architectural Structures I ENDS 231

• behavior

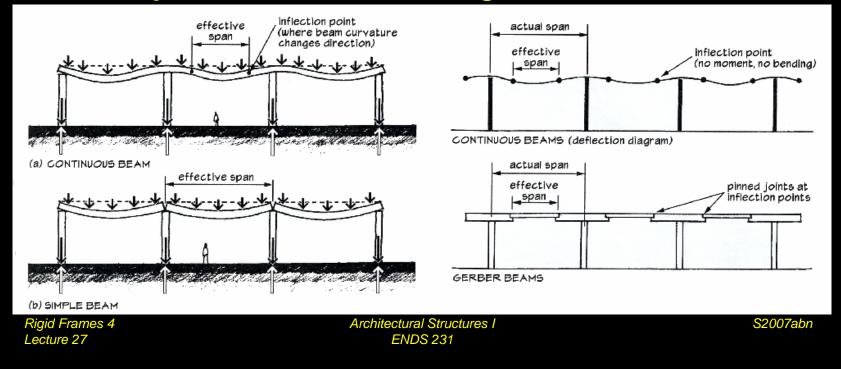


Rigid Frames 3 Lecture 27

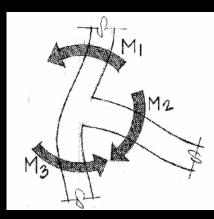
ENDS 231

- moments get redistributed
- deflections are smaller
- effective column lengths are shorter

- very sensitive to settling



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



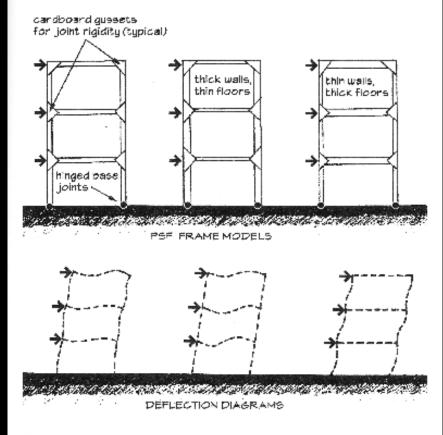


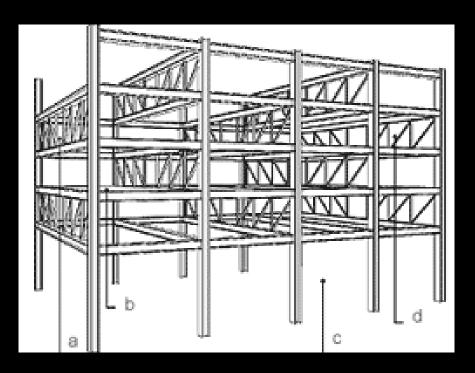
Figure 9.19: Model demonstration of the effects of varying the stiffness of beams and columns when a building frame is subjected to lateral loads.

Rigid Frames 5 Lecture 27 Architectural Structures I ENDS 231

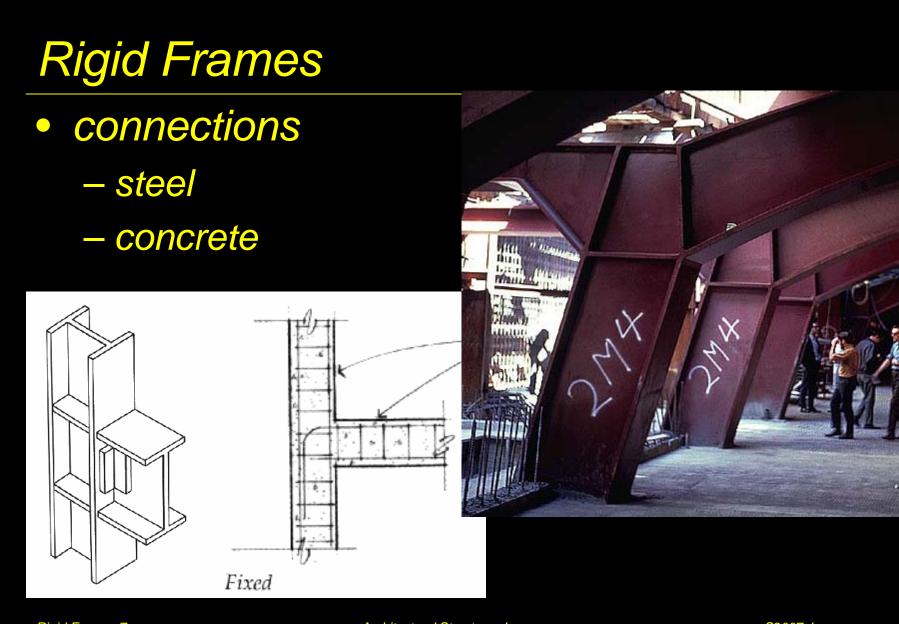
- staggered truss
 - rigidity
 - clear stories







Rigid Frames 6 Lecture 27 Architectural Structures I ENDS 231



Rigid Frames 7 Lecture 27 Architectural Structures I ENDS 231

Braced Frames

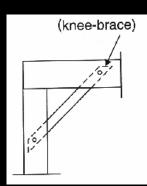
- pin connections
- bracing to prevent lateral movements

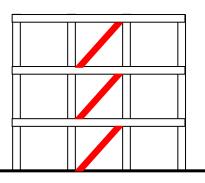


Rigid Frames 8 Lecture 27 Architectural Structures I ENDS 231

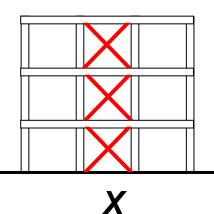
Braced Frames

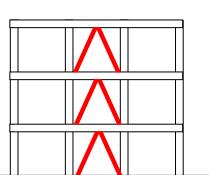
- types of bracing
 - knee-bracing
 - diagonal
 - -X
 - K or chevron– shear walls





diagonal





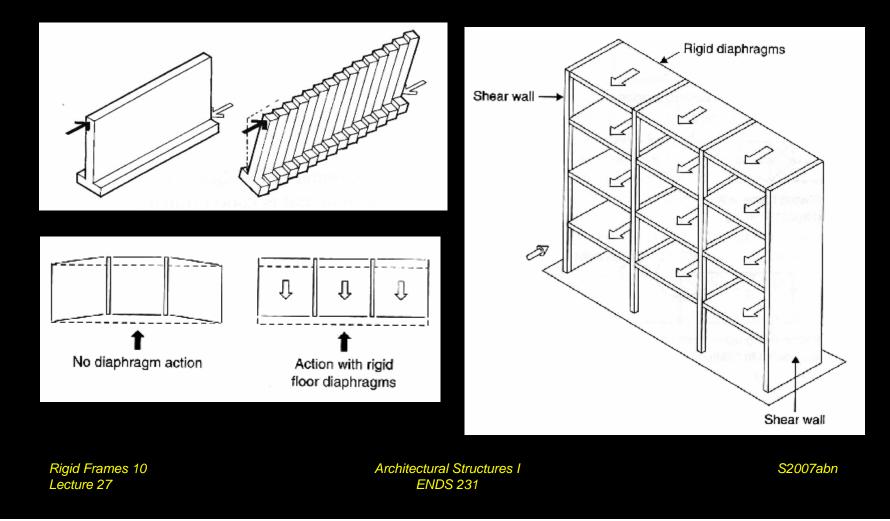
K (chevron)



Rigid Frames 9 Lecture 27 Architectural Structures I ENDS 231

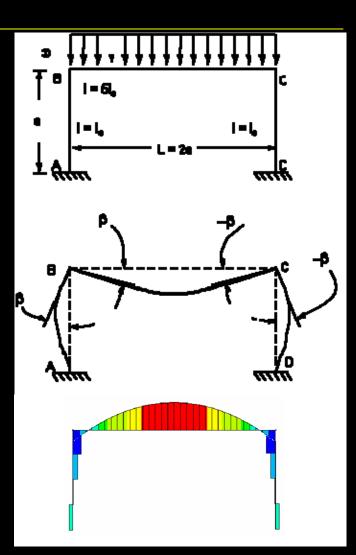
Shear Walls

• resist lateral load in plane with wall



Rigid Frame Analysis

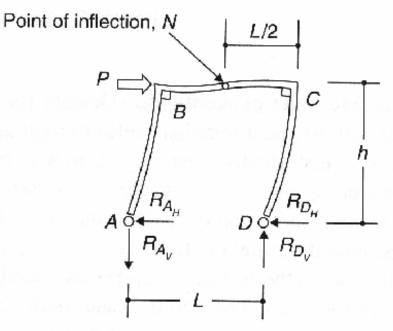
- members see
 - shear
 - axial force
 - bending
- V & M diagrams
 plot on "outside"



Architectural Structures I ENDS 231

Rigid Frame Analysis

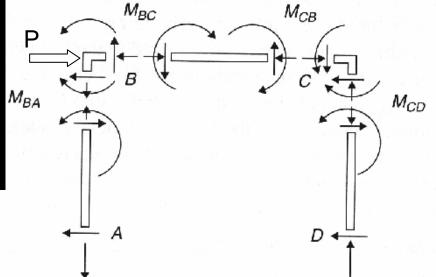
- need support reactions
- free body diagram each member
- end reactions are equal and opposite on next member
- *"turn" member like beam*
- draw V & M

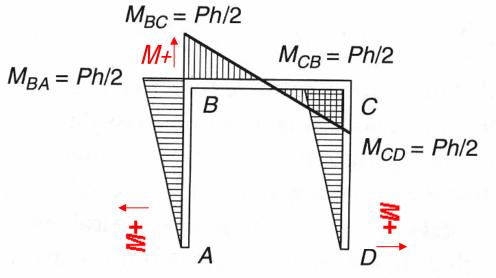


Rigid Frames 12 Lecture 27 Architectural Structures I ENDS 231



FBD & M
opposite end reactions at joints

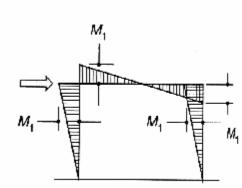


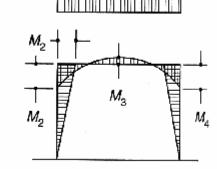


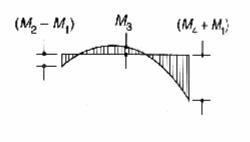
Rigid Frames 13 Lecture 27 Architectural Structures I ENDS 231

Rigid Frame Design

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



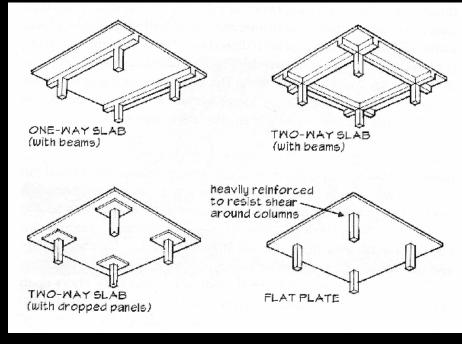




Rigid Frames 14 Lecture 27 Architectural Structures I ENDS 231

Rigid Frame Design

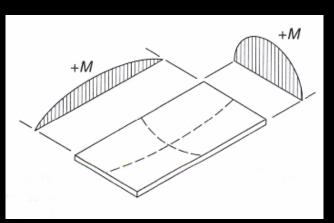
- frames & floors
 - rigid frame can have slab floors or slab with connecting beams
- other
 - slabs or plates on columns

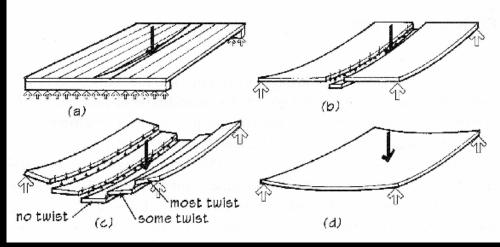


Rigid Frames 15 Lecture 27 Architectural Structures I ENDS 231

Rigid Frame Design

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





Rigid Frames 16 Lecture 27 Architectural Structures I ENDS 231