

Contemporary Masonry

- walls
- columns and pilasters
- beams and lintels
- prestress

Monadnock Building
Chicago 1891 – 1893
Burnham & Root



Monadnock Building

- Chicago
- 1891 – 1893
- Burnham & Root



High Rise

Walls – thrust line calculation

- Sum moments at sections to find axis

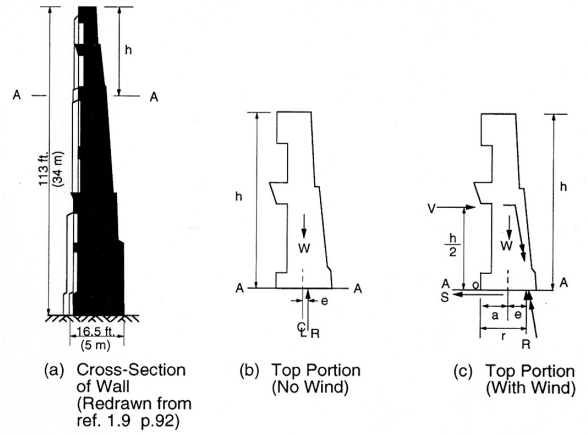


Figure 1.8 Equilibrium of mud brick wall at Palace of Ctesiphon (c. A.D. 550).

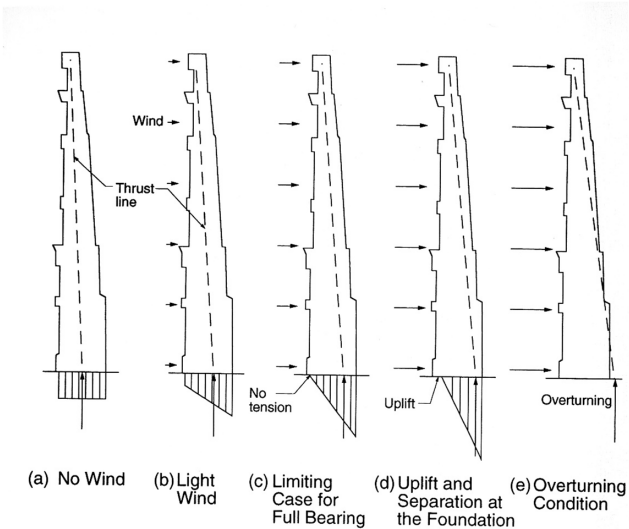
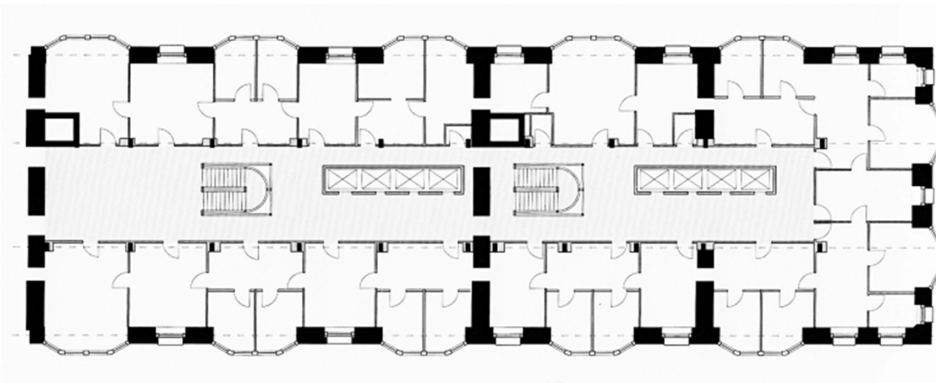


Figure 1.9 Stability of wall under increasing wind force.

Monadnock Building

Burnham & Root
1892, Chicago
215 ft., 16 stories



Modern Multistory Masonry

- Reinforced cavity wall
- Tied to slab
- Diaphragm action

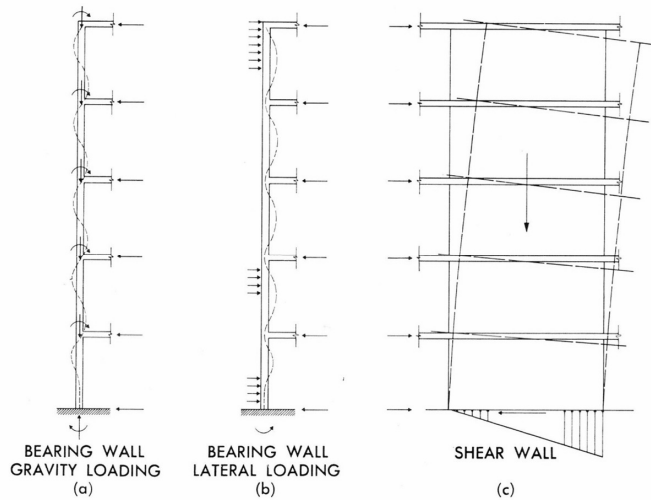


Figure 17.1 16-story loadbearing brick masonry building, Biel, Switzerland. (Courtesy of Brick Institute of America.)

Modern Multistory Masonry

- Reinforced cavity wall
- Tied to slab
- Diaphragm action

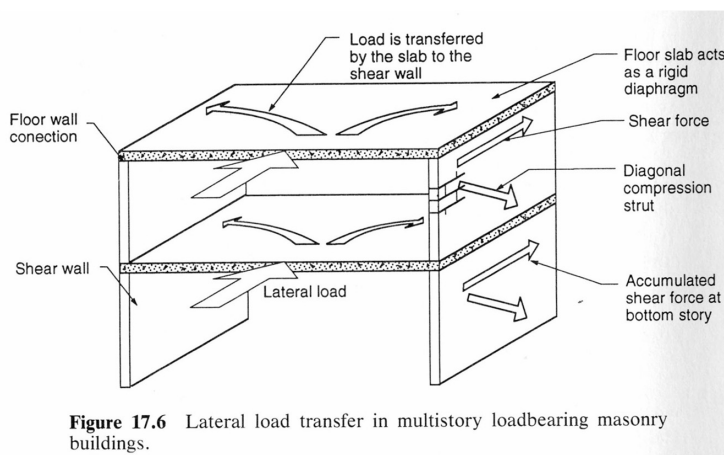
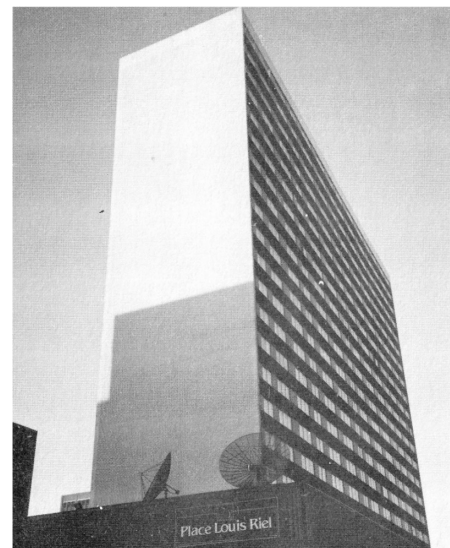


Figure 17.6 Lateral load transfer in multistory loadbearing masonry buildings.



24 story loadbearing reinforced 8" block Holiday Towers North apartment building. Winnipeg, Canada. 1973

Unique Productions Presents Tricks of the Trade Part 5 Reinforcing Masonry Walls

Wall Construction

- Single wythe

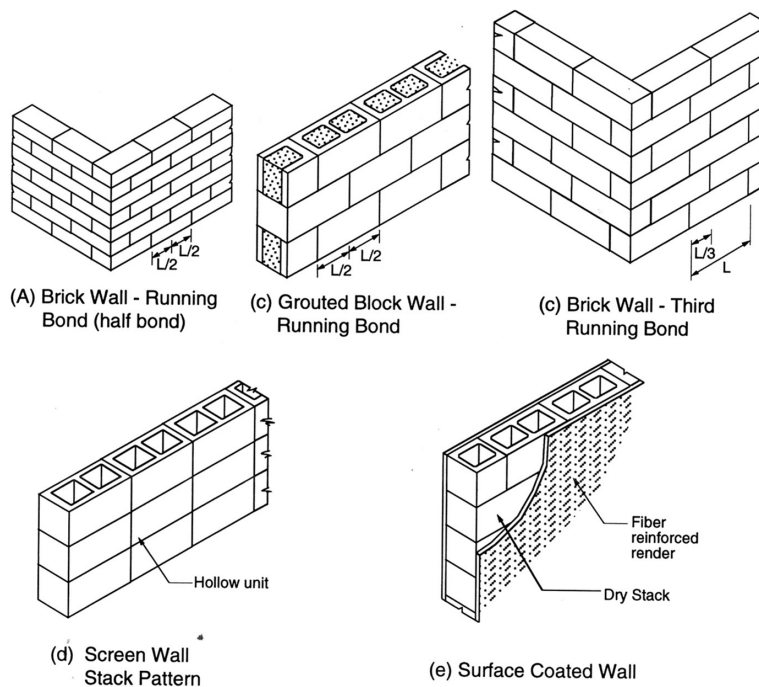
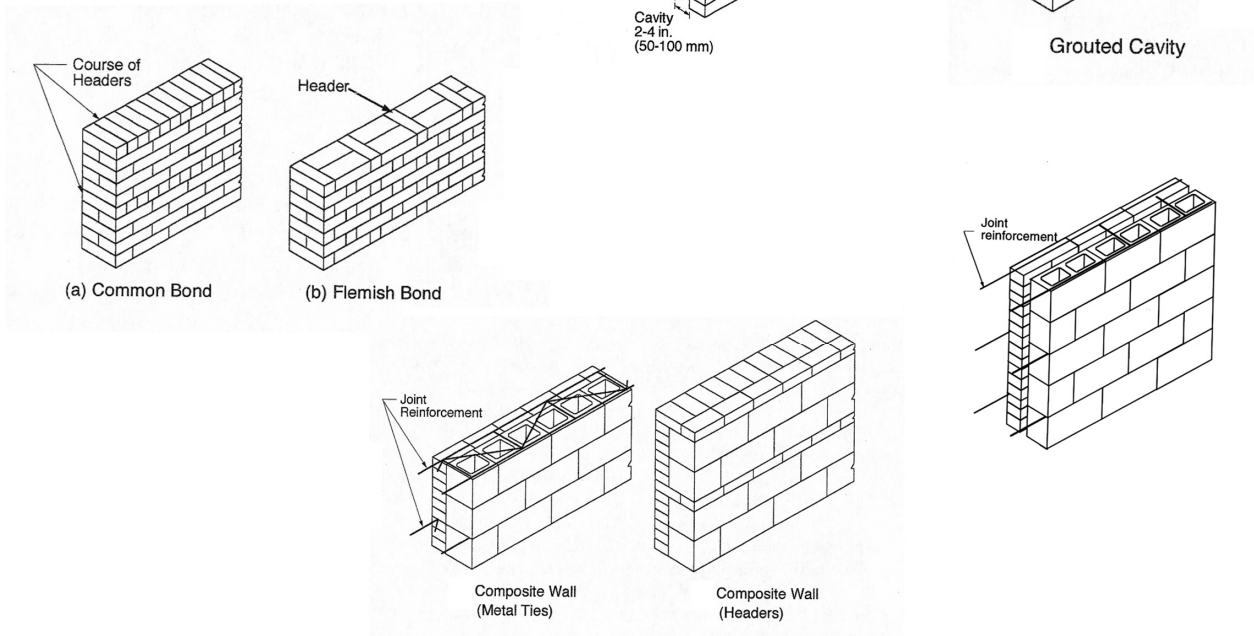


Figure 2.1 Single-wythe walls.

Wall Construction

Double wythe

- solid
- cavity – hollow or filled
- composite



Wall Construction

reinforced walls

- vertical
- horizontal

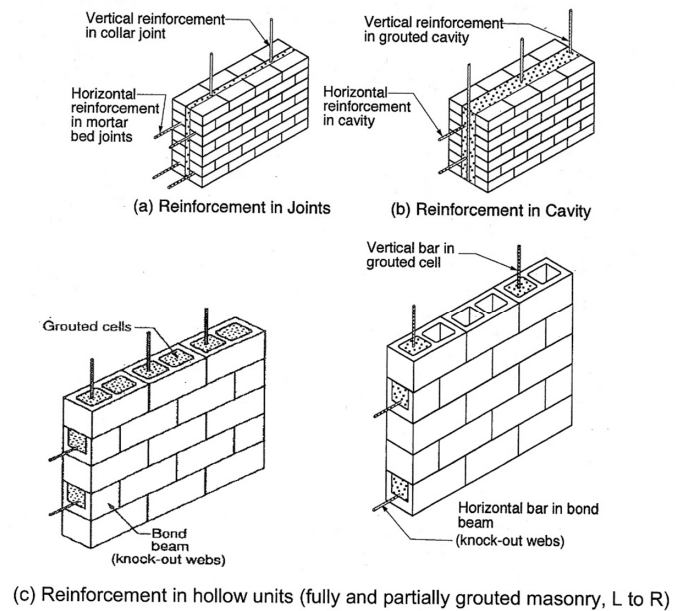


Figure 2.3 Examples of reinforced walls

Wall Construction

veneer

- adhered
- tied – to masonry or studs

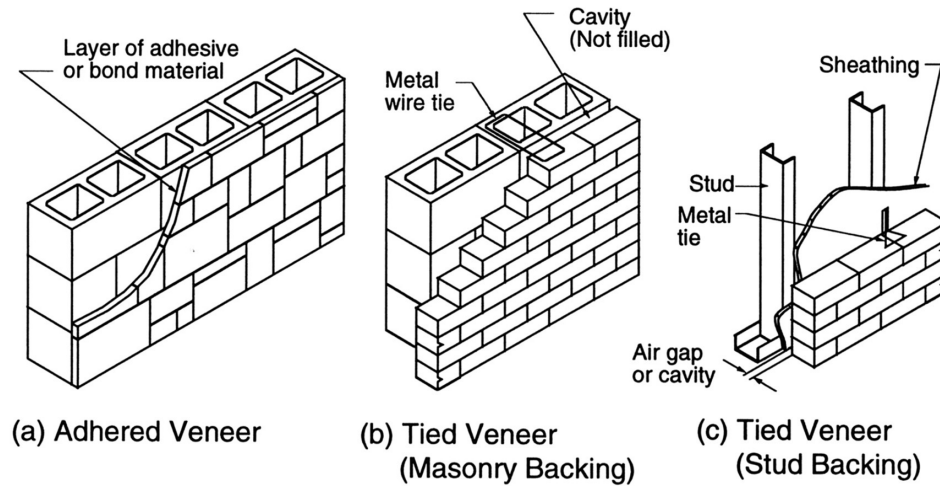


Figure 2.5 Veneer walls.

Wall Construction

diaphragm

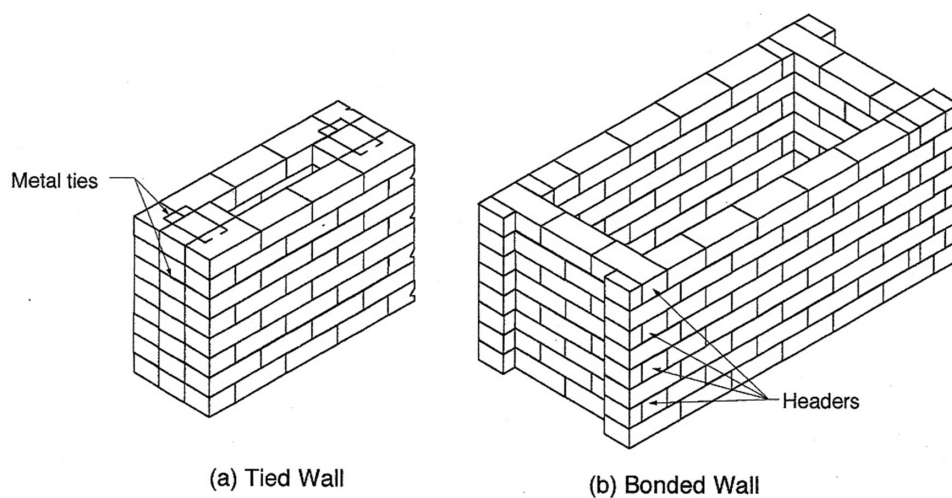


Figure 2.6 Diaphragm walls.

Columns and Pilasters

(by TSM 402 5.3 and 5.4)

- lateral support spacing (h) = $99 r_{\min}$
 $r = 0.288675 t$ (rectangle)
 $h/r < 99$
- $t_{\min} = 8''$
- fully grouted
- $A_s \min = 0.0025 A_n$
- $A_s \max = 0.04 A_n$
- min bars = 4

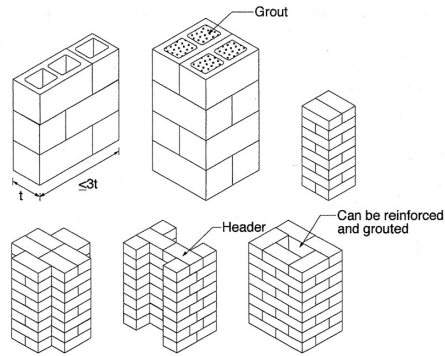
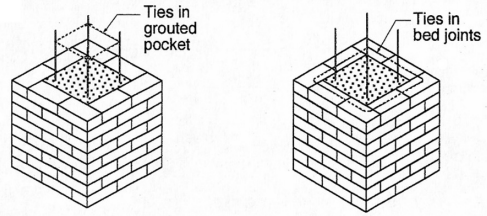
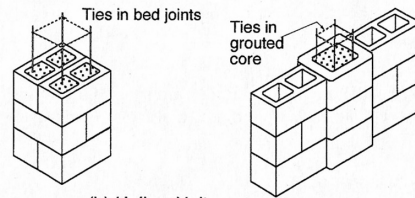


Figure 2.7 Columns.



(a) Solid or Cored Units



(b) Hollow Units

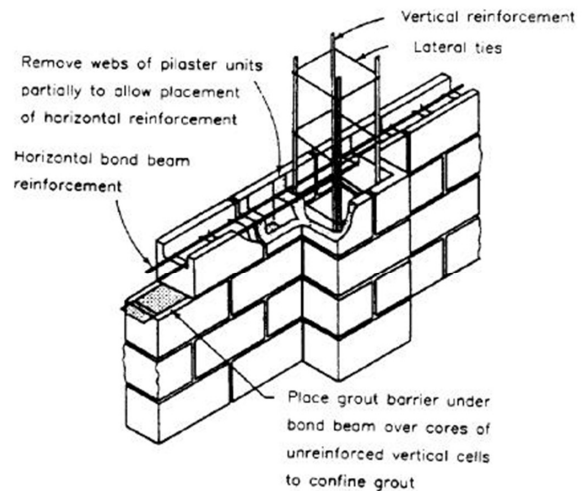
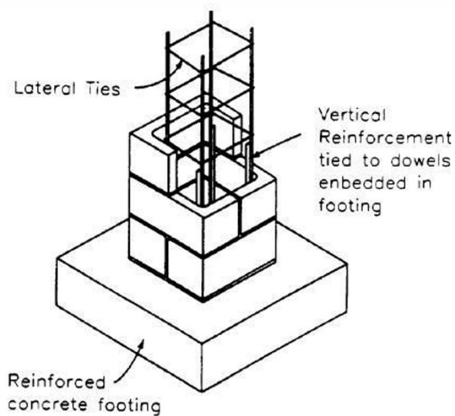
Figure 2.9 Column and pilaster reinforcement.

Columns and Pilasters

(by TSM 402)

Ties

- min. $\frac{1}{4}''$ dia.
- vertical spacing
 - 16 x longitudinal bar dia.
 - 48 x tie dia.
 - least dim. of column



U. S. ARMY CORPS OF ENGINEERS

Columns and Pilasters

- pilasters
- project from one or both sides
- carry lateral and vertical loads

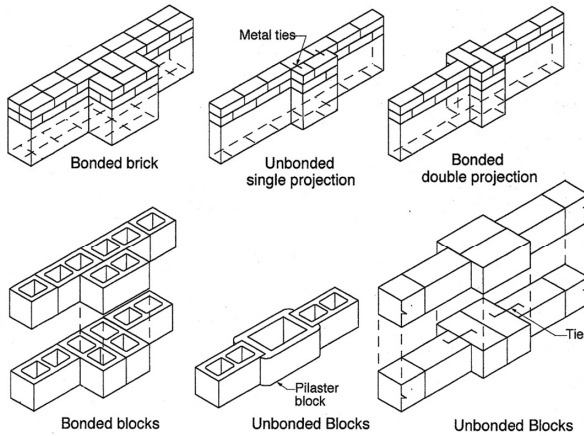


Figure 2.8 Pilasters.

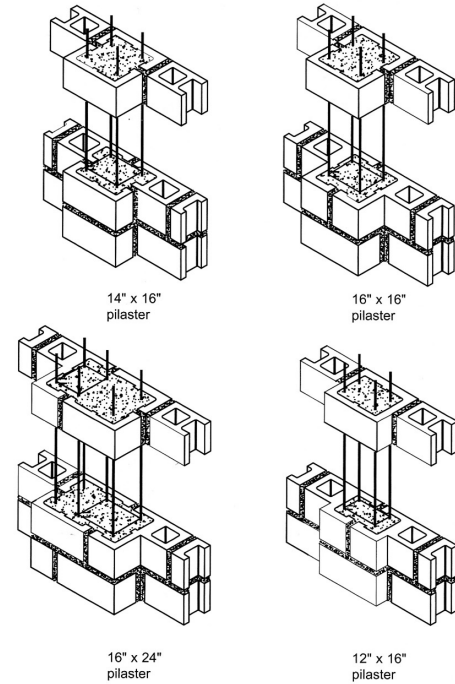


Figure 4.25 Pilaster details.

Beams and Lintels

- solid
- hollow

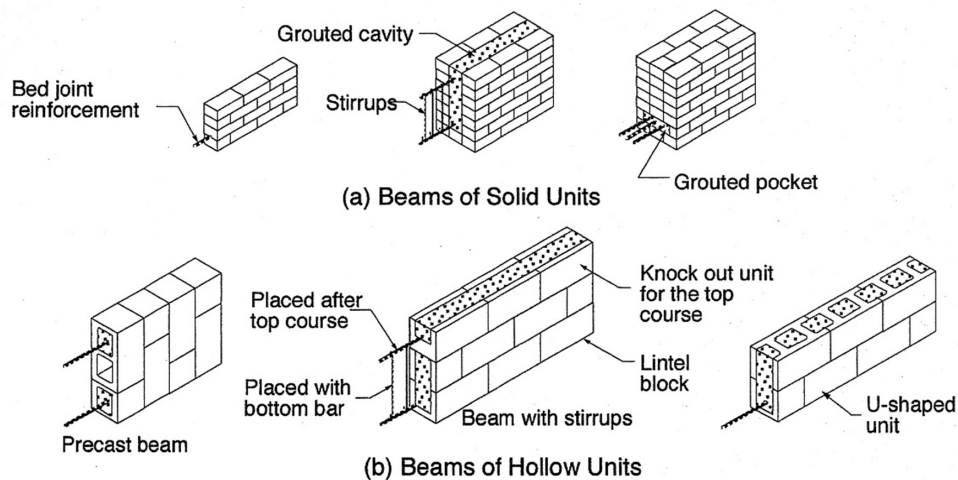


Figure 2.10 Reinforced masonry beams and lintels.

Single-Story Buildings

- compression
- bending
- shear

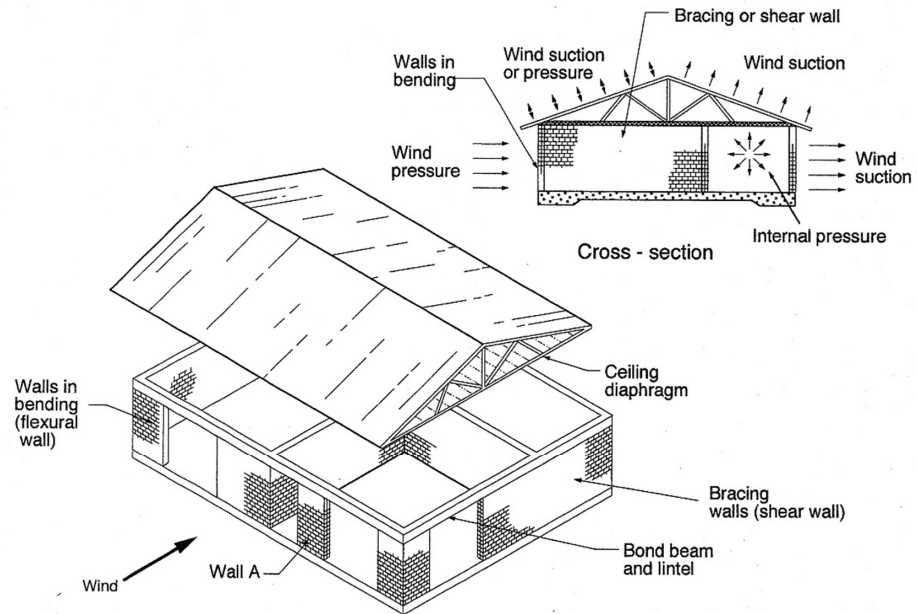


Figure 2.11 Structural action of a single-story structure.

Multi-Story Buildings

- compression
- bending
- shear

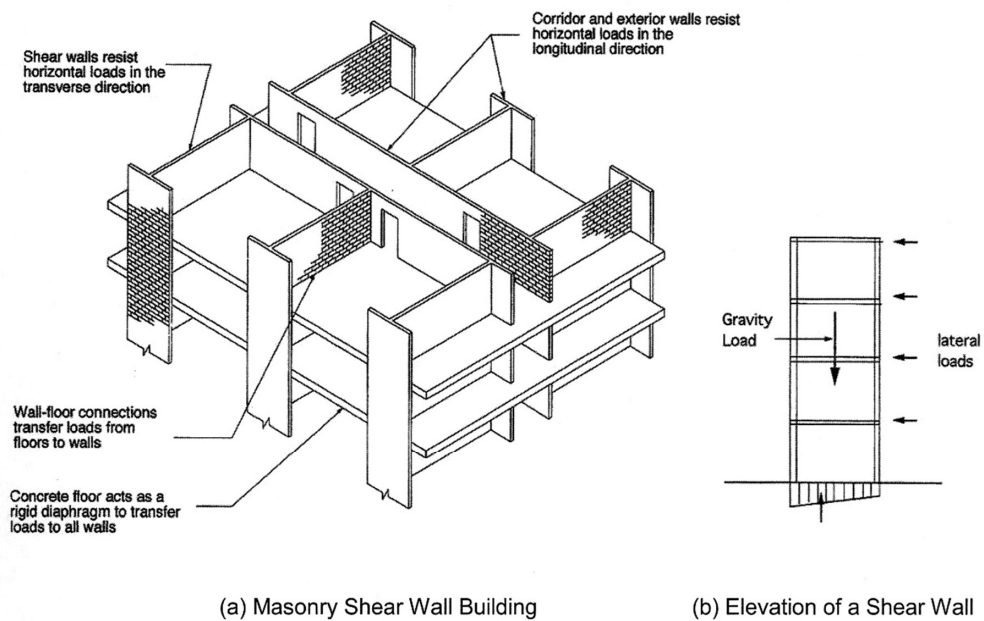


Figure 2.12 Lateral load resistance of masonry shear wall system.

Multi-Story Buildings

- thrust lines in walls
- unreinforced
- if center of force is outside of the kern, then tension occurs
- this is magnified by bending in thin walls

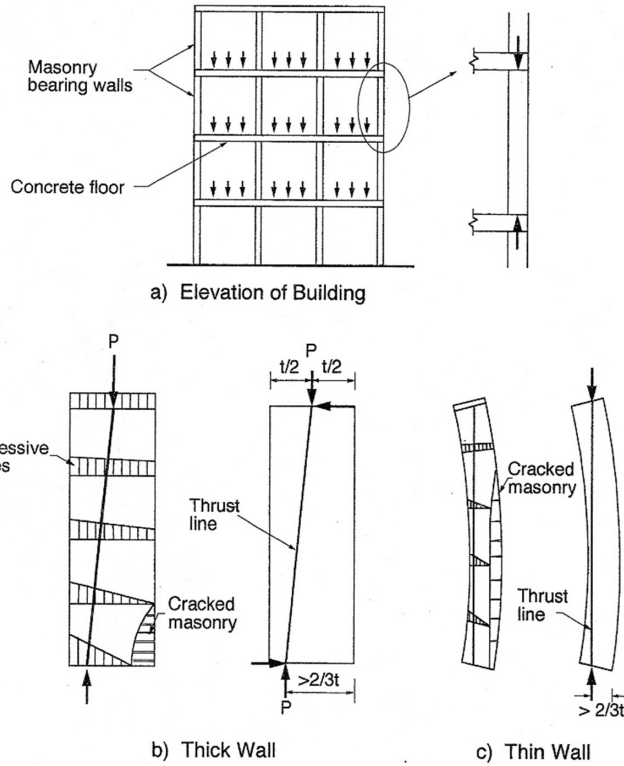


Figure 2.14 Thrust lines in unreinforced masonry walls.

Multi-Story Buildings

- thrust lines in walls
- finding thrust line at center
- sum moments at center c
- find e
- if e is within the kern of the wall then all is in compression
- this assumes minimal bending deformation

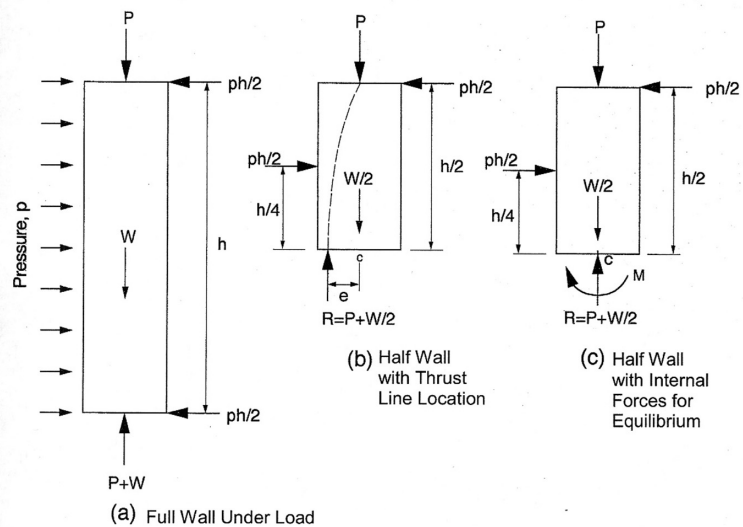


Figure 2.15 Masonry walls under axial load and lateral wind pressure.

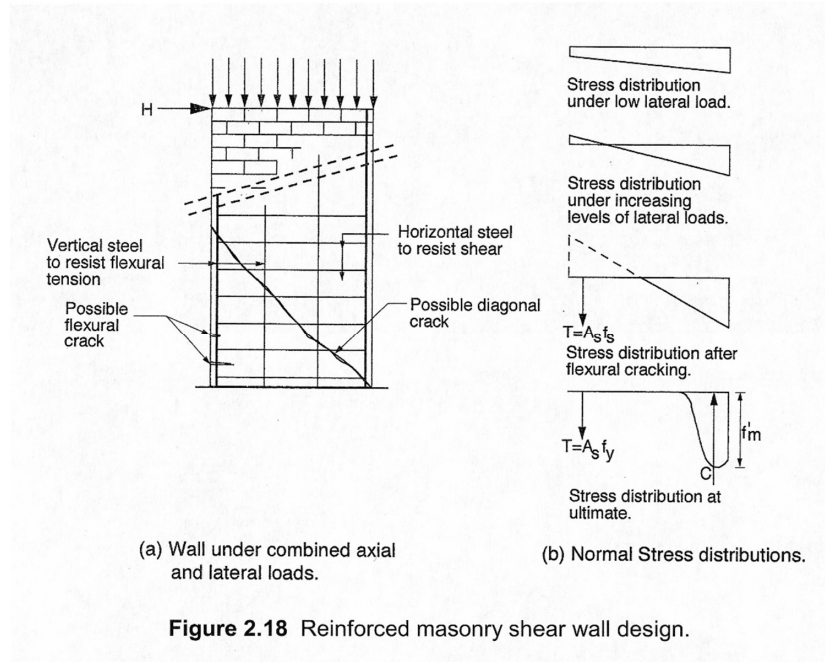
$$R \cdot e = \frac{ph}{2} \cdot \frac{h}{2} - \frac{ph}{2} \cdot \frac{h}{4}$$

$$e = \frac{ph^2}{8R} = \frac{ph^2}{8} \left(\frac{1}{P+W/2} \right)$$

Multi-Story Buildings

Shear Walls

- failure modes
- compression
- tension
- shear



Prestressed Masonry

- raises compressive stress
- used in Gothic (without steel)
- steel placed on centroid
- no need for grout
- creep ~ 2 to 3 times initial elastic deformation

