Introduction to Masonry

- Clay Masonry
- Concrete Masonry
- Autoclaved Aerated Concrete (AAC)

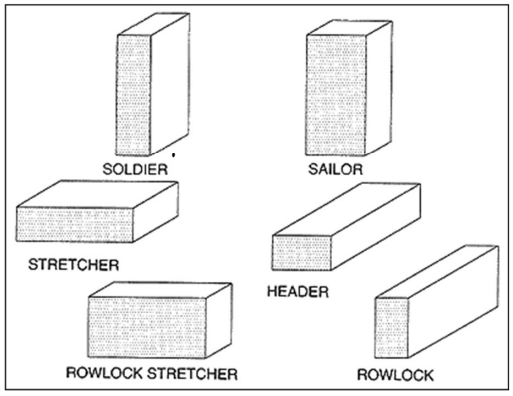
Höchst Entrance Hall, Frankfurt
Arch: Peter Behrens, 1920-24
Photo: Eva Kröcher

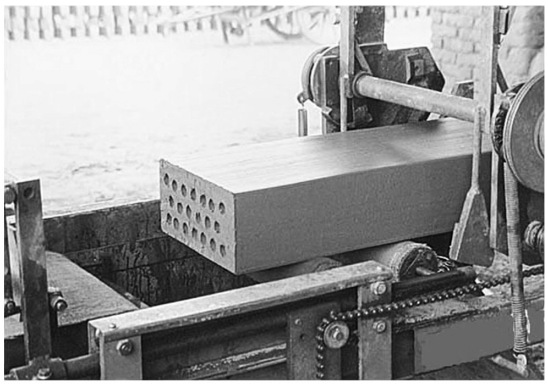
Clay Brick

- Molded
  or
- Extruded
- Cored – adds stability, strength
  cored < 25% > hollow
- Fired (2000° F)

- Sizes – use 3/8" mortar bed

- Six ways to position in wall:

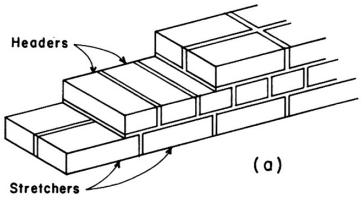


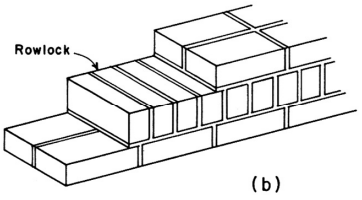


3/8" Mortar Joint Between Bricks (Most Common)

BRICK TYPE	SPECIFIED SIZE D X H X L (INCHES)	NOMINAL SIZE D X H X L	VERTICAL COURSE
Standard	3 5/8 x 2 1/4 x 8	Not modular	3 courses = 8"
Modular	3 5/8 x 2 1/4 x 7 5/8	4 x 2 2/3 x 8	3 courses = 8"
Norman	3 5/8 x 2 1/4 x 11 5/8	4 x 2 2/3 x 12	3 courses = 8"
Roman	3 5/8 x 1 5/8 x 11 5/8	4 x 2 x 12	1 course = 2"
Jumbo	3 5/8 x 2 3/4 x 8	4 x 3 x 8	1 course = 3"
Economy	3 5/8 x 3 5/8 x 7 5/8	4 x 4 x 8	1 course = 4"
Engineer	3 5/8 x 2 13/16 x 7 5/8	4 x 3 1/5 x 8	5 courses = 16"
King	2 3/4 x 2 5/8 x 9 5/8	Not modular	5 courses = 16"
Queen	2 3/4 x 2 3/4 x 7 5/8	Not modular	5 courses = 16"
Utility	3 5/8 x 3 5/8 x 11 5/8	4 x 4 x 12	1 course = 4"

Clay Brick





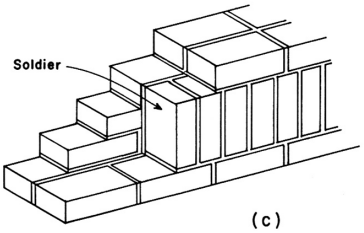
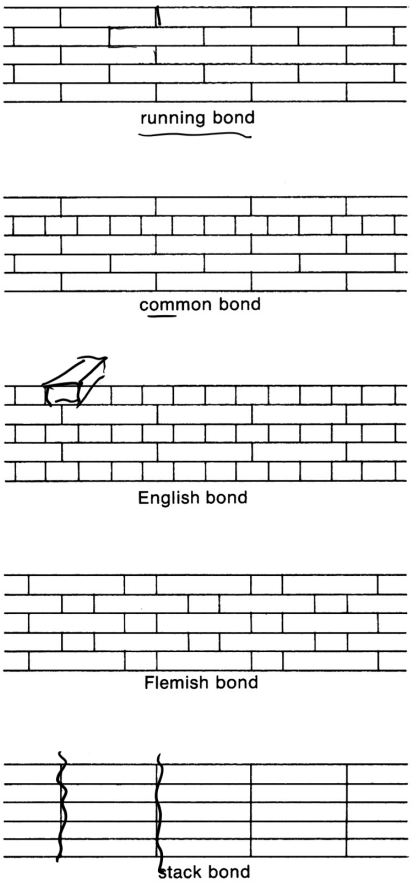
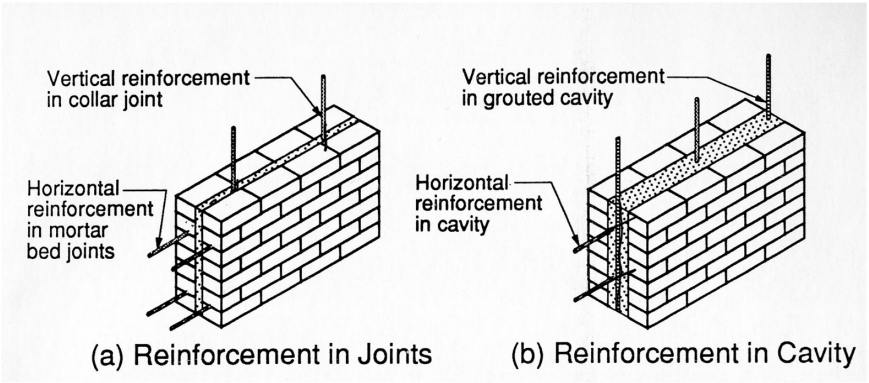
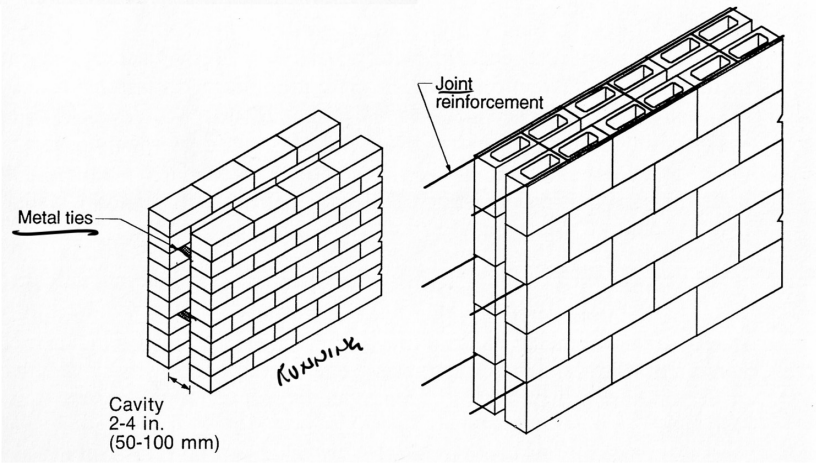


FIGURE 4.2. Ordinary positions for bricks.

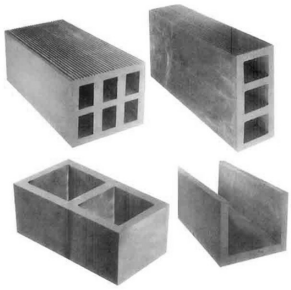


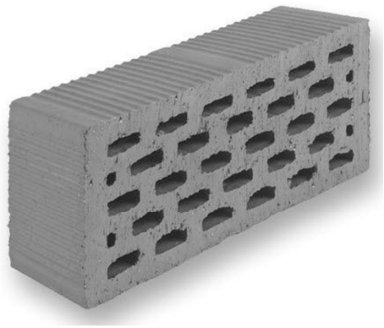
Cavity Walls



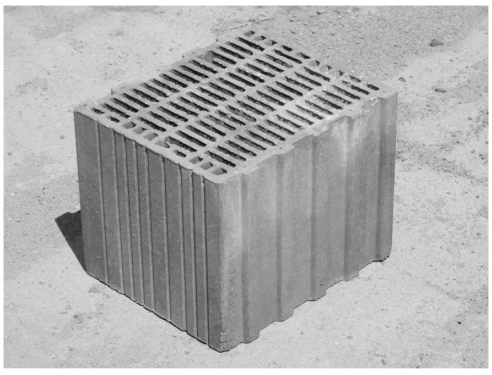


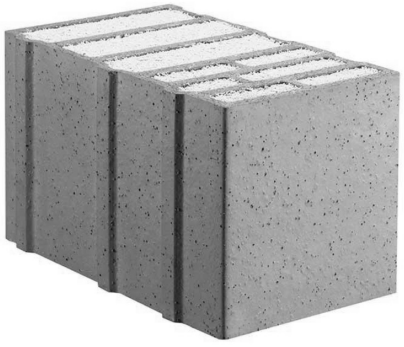
Clay Tile

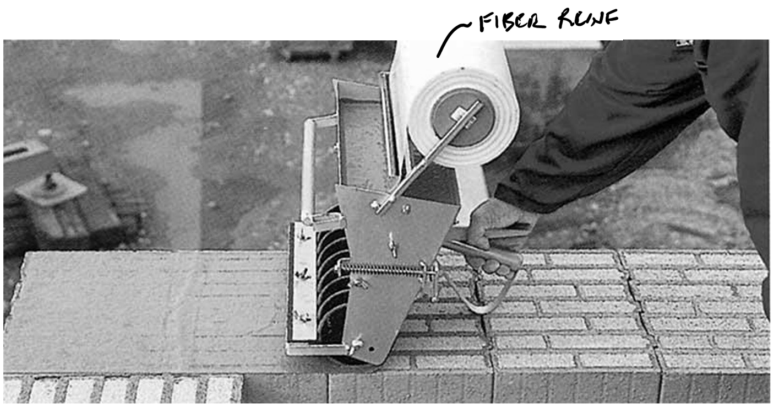




Insulated Clay Tile



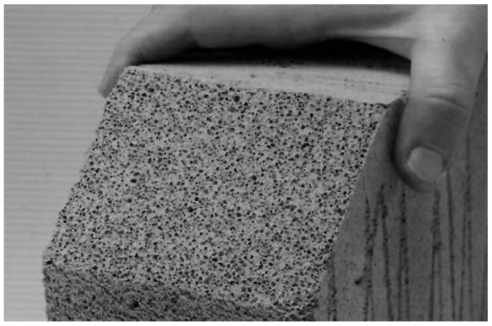


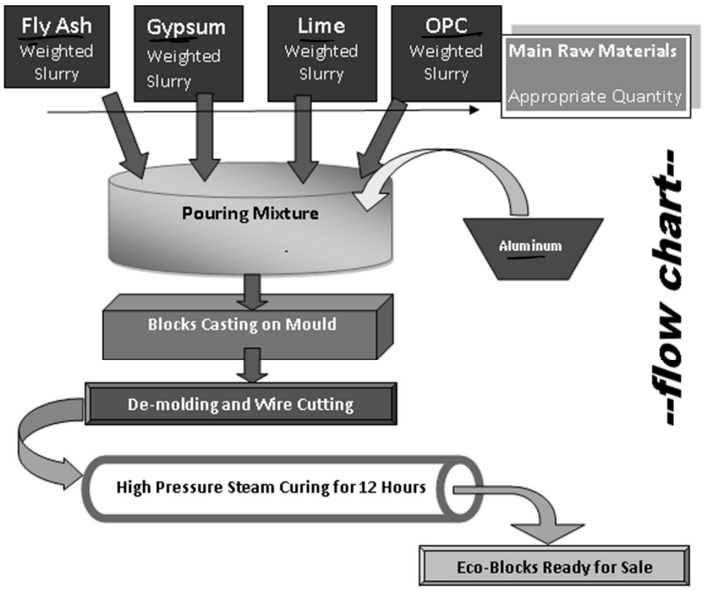


Ziegelindustrie International https://www.zi-online.info/en/index.html

Autoclaved Aeriated Concrete
(AAC)

Used predominately in Europe
Developed by Dr. Johan Axel Eriksson in
mid- 1920s in Sweden as "Ytong"
since 1943, Hebel blocks in Germany
Current largest production in China
Lighter weight
Better insulation value
Better fire resistance
Better moisture transmission
Larger blocks for faster erection
Can be shaped on site





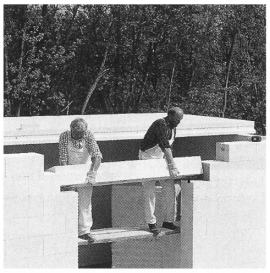
Autoclaved Aeriated Concrete
(AAC)

Density – 20 to 50 PCF (floats)

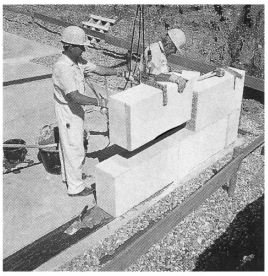
Compressive strength – 300 to 900 PSI

Allowable Shear Stress – 8 to 22 PSI

Thermal Resistance - 0.8 to 1.25 R/ IN



LARGE

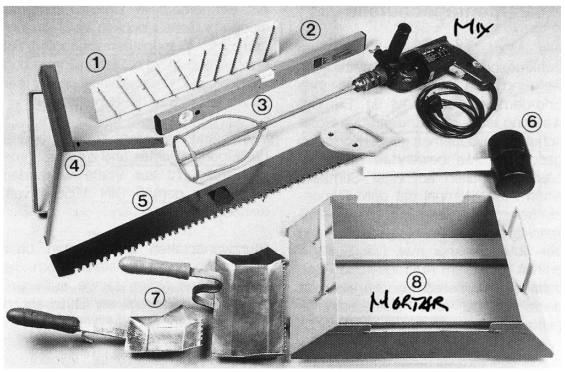


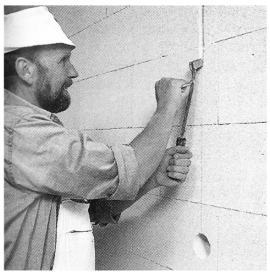
Autoclaved Aeriated Concrete
(AAC)

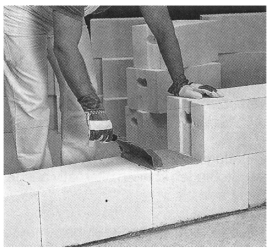
Easily shaped on site

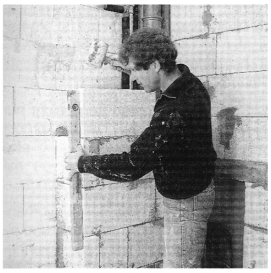
Thin mortar bed – 1/8” (1mm to 3mm)

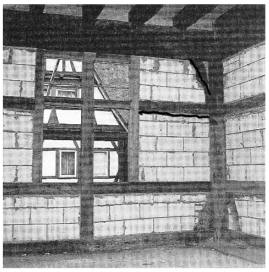
Tools for placement (below)

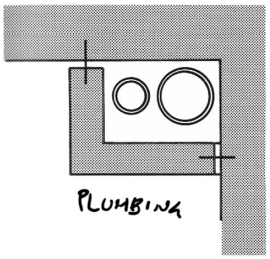








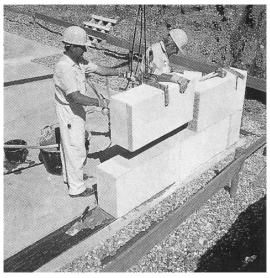


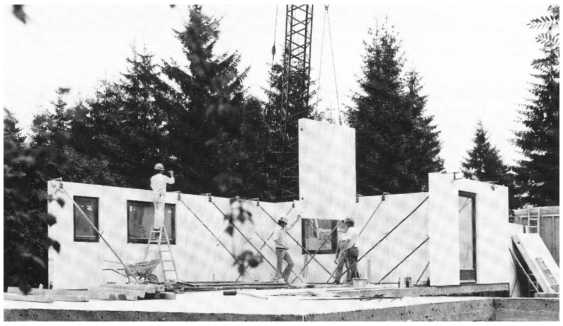


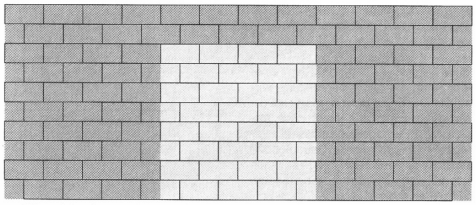
Autoclaved Aeriated Concrete
(AAC)

Larger blocks so faster layup – e.g. 8”x8”x24”

Panel layup with onsite crane

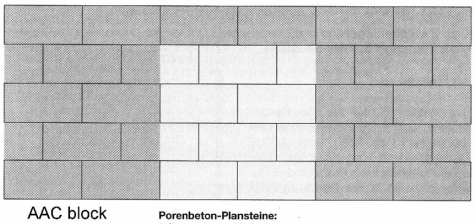






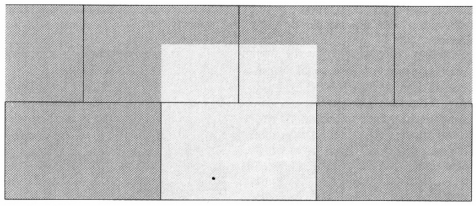
Clay block
32 blocks / m2
9.4” x 4.4”

Konventionelles Mauerwerk:
32 Steine 2 DF/3 DF für 1 m² Wand;
Steinmaß 240 mm x 113 mm x d



AAC block
8 blocks / m2
19.6” x 9.8”

Porenbeton-Plansteine:
8 Steine pro 1 m² Wand;
Steinmaß 499 mm x 249 mm x d



AAC panel
1.6 panels / m2
39.3” x 24.5”

Porenbeton-Planelemente:
1,6 Steine pro 1 m² Wand;
Steinmaß 999 mm x 623 mm x d

Autoclaved Aeriated Concrete
(AAC)

Finish with stucco

Abb. 2.4.4-1
Anbringen der Sockelabschluß- und Eckschutzschiene zur Sicherung der Mauerwerkskanten

Abb. 2.4.4-2
Auftrag des Grundputzes von Hand

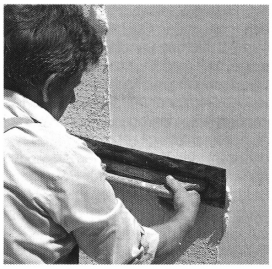


Abb. 2.4.4-3
Auftrag der Deckschicht

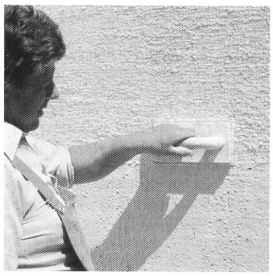


Abb. 2.4.4-4
Verreiben der Putzoberfläche mit Filzbrett oder Schwammscheibe

Member Types

Compression members based on proportions.

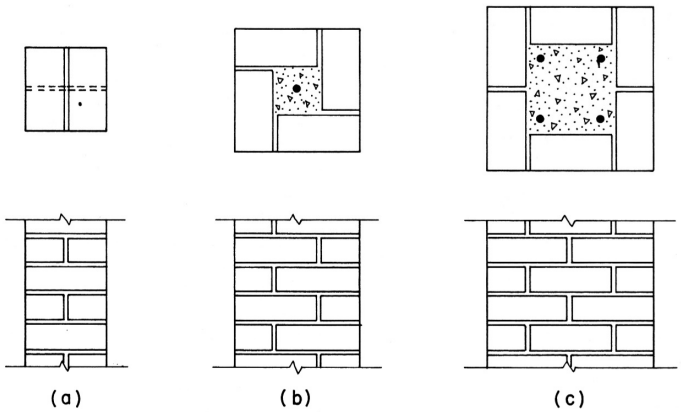


FIGURE 4.12. Forms of brick columns.

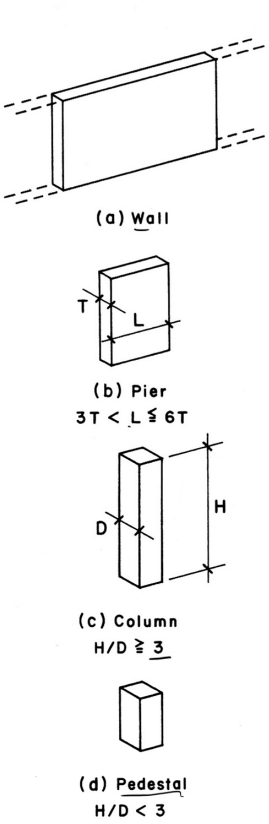
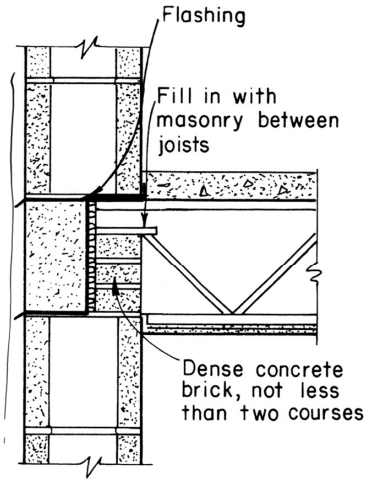


FIGURE 4.6. Classification of vertical compression members.

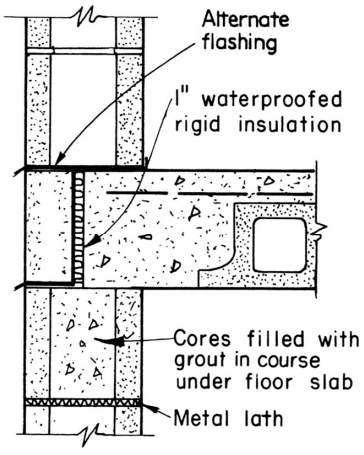
Concrete Masonry Units (CMU) wall construction

Member Details

Floor / Column details.



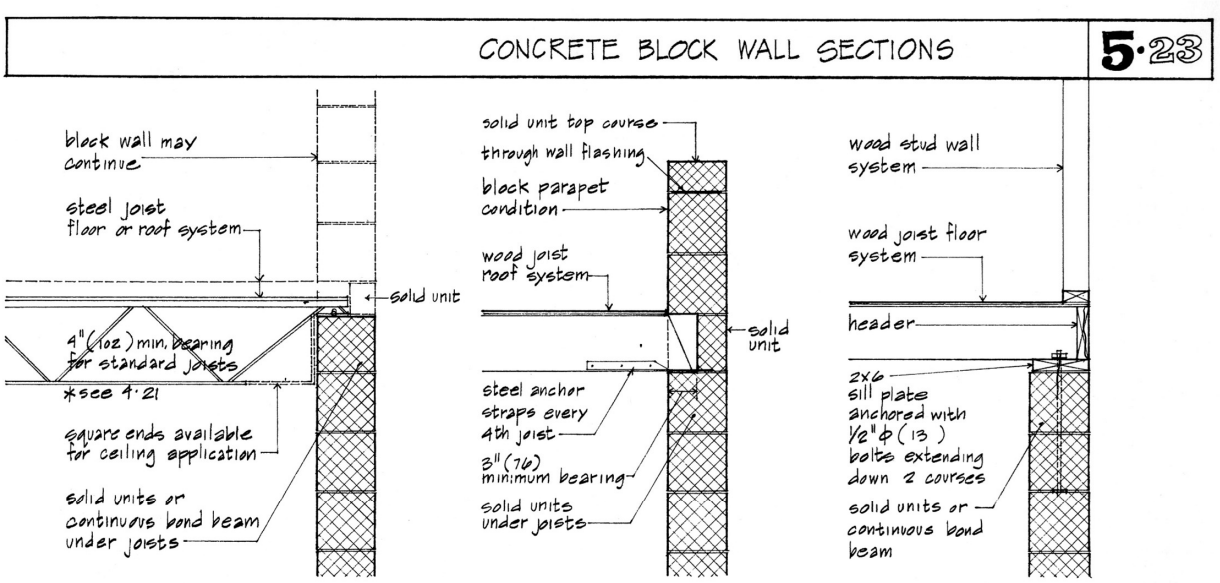
(a) Bar joist floor



(b) Soffit block joist floor

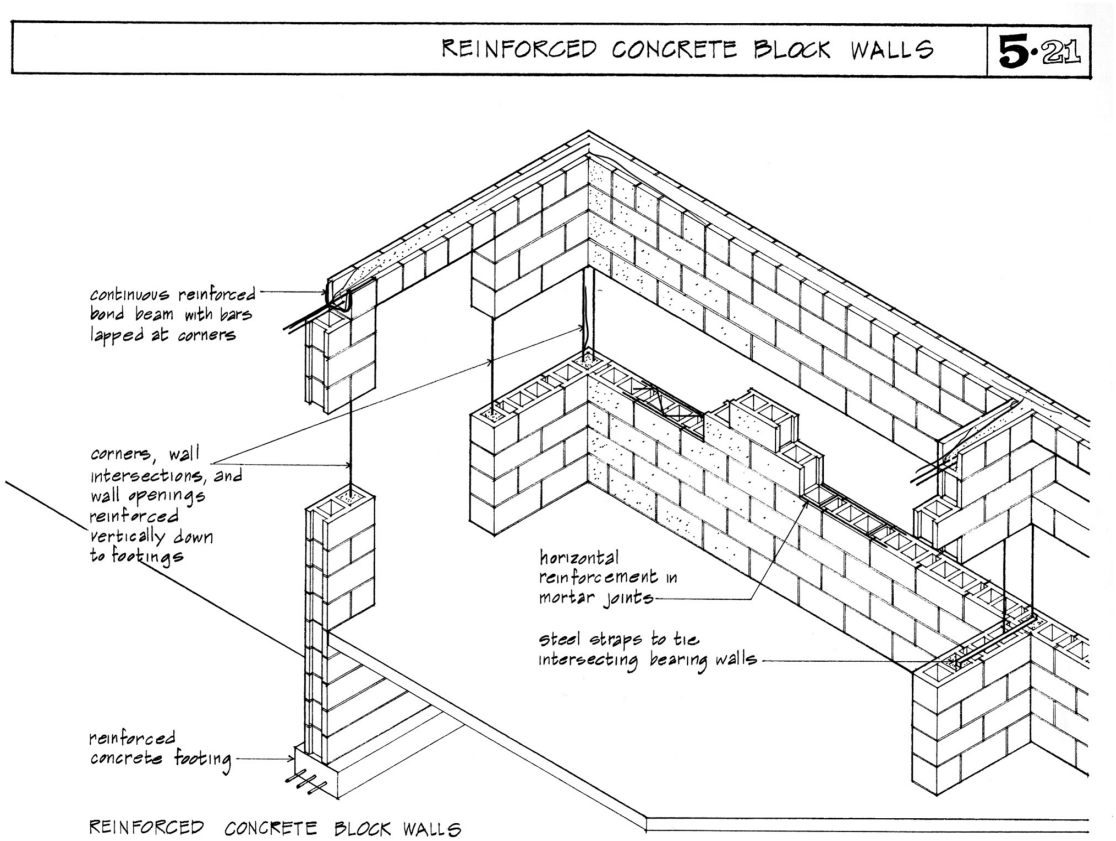
Concrete Masonry Units (CMU)

- wall sections



These wall sections are not intended to be complete. They exclude floor, wall, and ceiling finishes, trim, etc. They attempt to illustrate how various floor and roof systems are supported by a concrete block bearing wall. The above-grade wall is literally an extension of the concrete block foundation wall system. Note that the edges of floor and roof planes are not visible from the exterior except at the top of the concrete block wall. All vertical dimensions should be modular, especially is the block is left exposed as the wall finish

Concrete Masonry Units (CMU)



When concrete block walls are subjected to lateral forces such as caused by wind, earth pressure below grade, and earthquakes, they may be reinforced as illustrated above.

Concrete Masonry Units
(CMU)

- Cast (molds)
- Dried
- Autoclaved

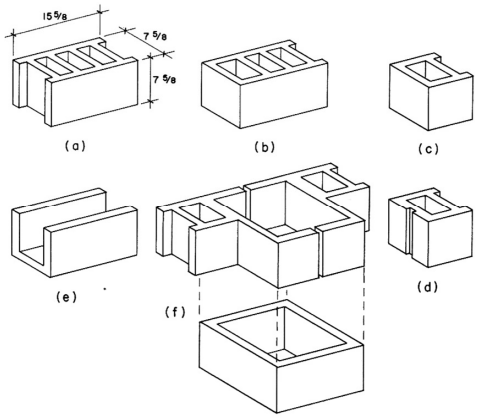
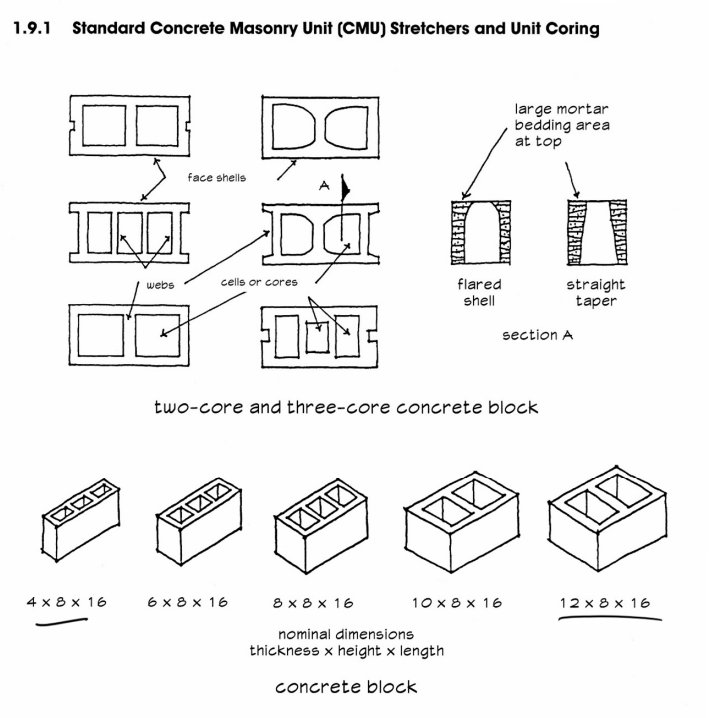
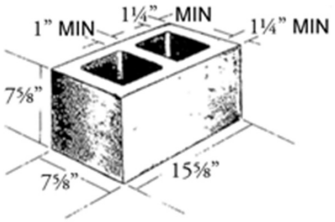


FIGURE 5.1. Forms of CMUs for unreinforced construction.



Concrete Masonry Units
(CMU)

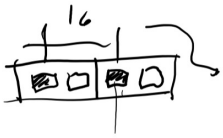
- Geometric Properties
- NCMA TEK 14-1B
- Radius of gyration, r = $\sqrt{\frac{I}{A}}$



8-inch (203-mm) Single Wythe Walls, 1¼ in. (32 mm) Face Shells (standard)

Horizontal Section Properties (Masonry Spanning Vertically)

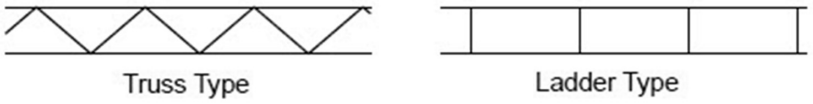
Unit	Grout spacing (in.)	Mortar bedding	Net cross-sectional properties[A] A_n (in.²/ft)	I_n (in.⁴/ft)	S_n (in.³/ft)
Hollow	No grout	Face shell	30.0	308.7	81.0
Hollow	No grout	Full	41.5	334.0	87.6
100% solid/solidly grouted		Full	91.5	443.3	116.3
Hollow	16	Face shell	62.0	378.6	99.3
Hollow	24	Face shell	51.3	355.3	93.2
Hollow	32	Face shell	46.0	343.7	90.1
Hollow	40	Face shell	42.8	336.7	88.3
Hollow	48	Face shell	40.7	332.0	87.1
Hollow	72	Face shell	37.1	324.3	85.0
Hollow	96	Face shell	35.3	320.4	84.0
Hollow	120	Face shell	34.3	318.0	83.4



Concrete Masonry Units
(CMU)

- Reinforcing

Joint Reinforcing

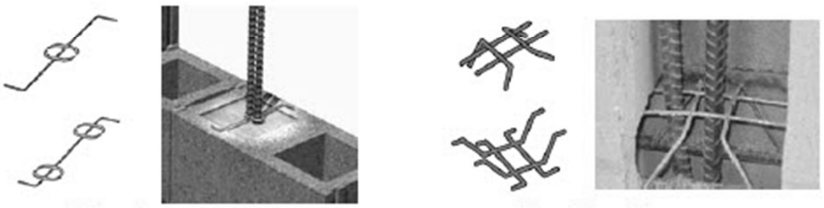


4.5 Horizontal reinforcement required for masonry not laid in running bond of $0.00028A_g$, placed at a maximum spacing of 48 in. o.c. in horizontal mortar joints or in bond beams.

$0.00028(7.625)(16) = 0.034 in^2$ Use 9 gage (W1.7) at 16 in. o.c.

W1.7 wire
dia. = 0.147 in
area = 0.017 in^2
2x wire = 0.034 in^2

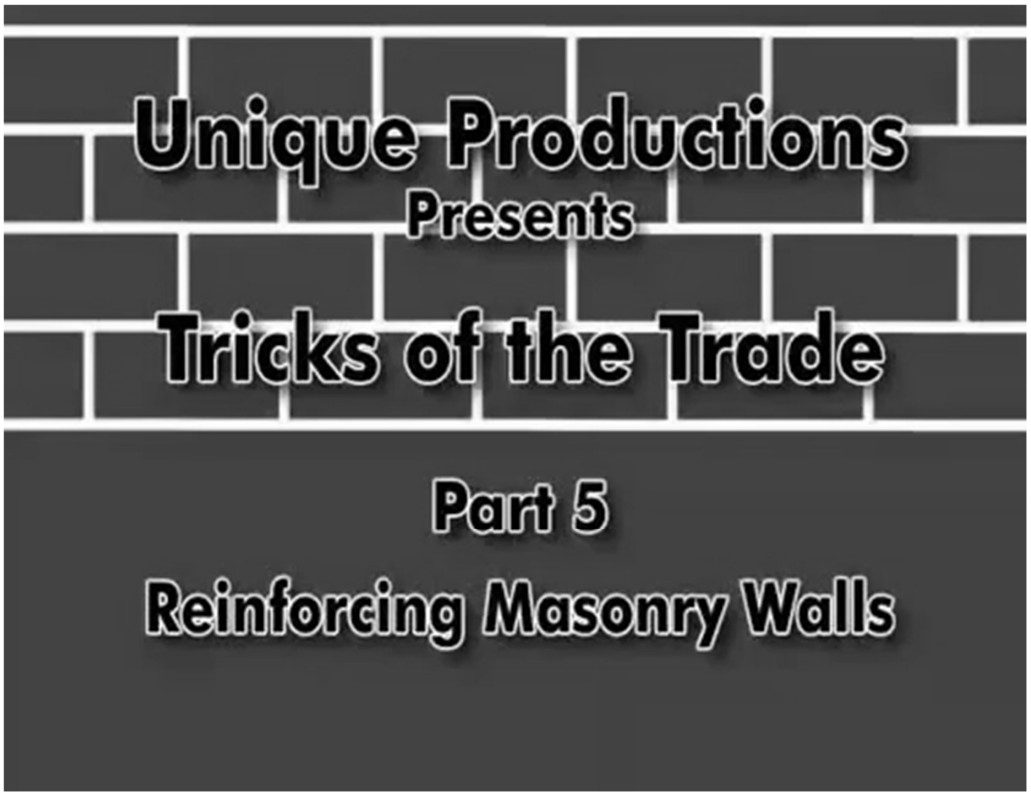
Rebar Positioners



Placed in mortar joints Placed in cells

Concrete Masonry Units 8

Concrete Masonry Construction



Mortar Types

Types M, S, N, O

The following mortar designations took effect in the mid–1950's:

M a **S** o **N** w **O** r **K**

strongest weakest

Table 2-3. Guide to the Selection of Mortar Type*

Location	Building segment	Mortar type	
		Recommended	Alternative
Exterior, above grade	Load-bearing walls	N	S or M
	Non-load-bearing walls	O**	N or S
	Parapet walls	N	S
Exterior, at or below grade	Foundation walls, retaining walls, manholes, sewers, pavements, walks, and patios	S†	M or N†
Interior	Load-bearing walls	N	S or M
	Non-load-bearing partitions	O	N

*Adapted from ASTM C270. This table does not provide for specialized mortar uses, such as chimney, reinforced masonry, and acid-resistant mortars.
**Type O mortar is recommended for use where the masonry is unlikely to be frozen when saturated or unlikely to be subjected to high winds or other significant lateral loads. Type N or S mortar should be used in other cases.
†Masonry exposed to weather in a nominally horizontal surface is extremely vulnerable to weathering. Mortar for such masonry should be selected with due caution.

Note: For tuckpointing mortar, see "Tuckpointing," Chapter 9.

Relative Parts by Volume

mortar type	Portland cement	lime	sand
M	1	$^1/_4$	$3^1/_2$
S	1	$^1/_2$	$4^1/_2$
N	1	1	6
O	1	2	9

sum should equal 1/3 of sand volume
(assuming that sand has void ratio of 1 in 3)

Mortar Types

Type M, S, N, O

Slump is higher than cast concrete based on workability

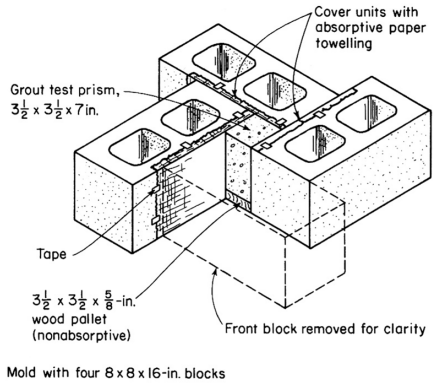


Fig. 2-29. ASTM C1019 method of using masonry units to form a prism for compression-testing of masonry grout.

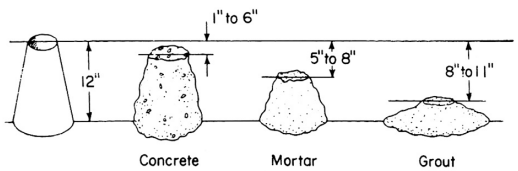
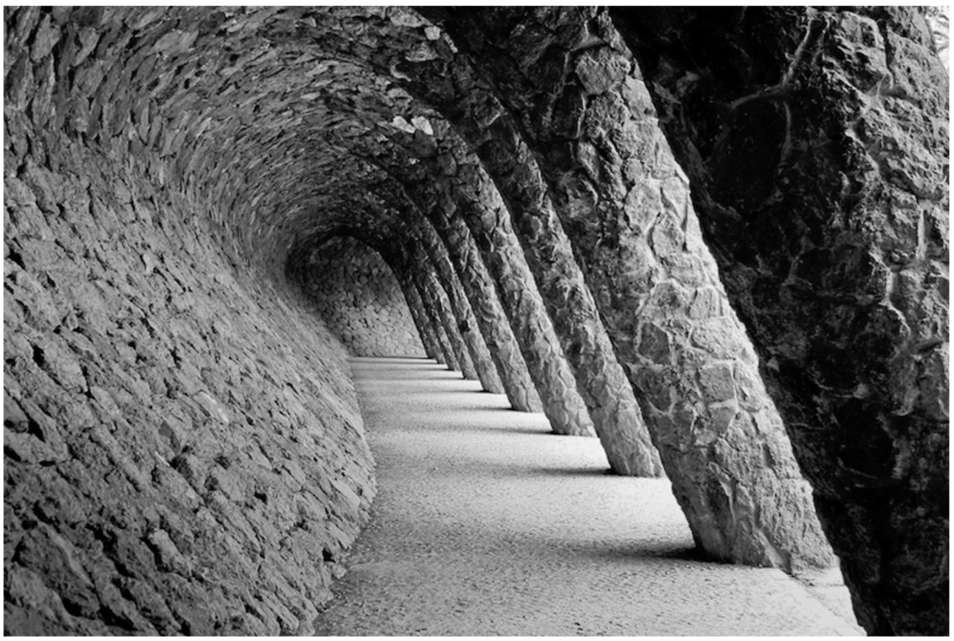


Fig. 2-27. Slump test comparison of concrete, mortar, and masonry grout.

Art Nueveau

Catalonian

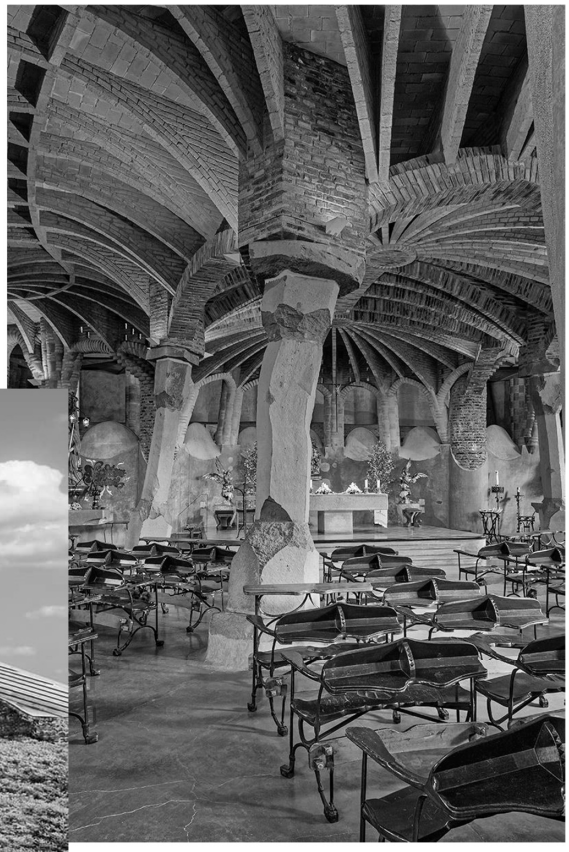
- Antonio Gaudi 1852 - 1926
- Catalonian Art Nouveau
- Park Guell



Art Nueveau

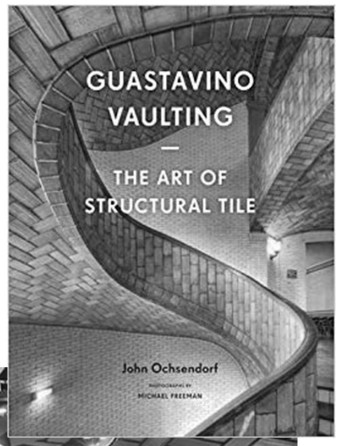
Catalonian

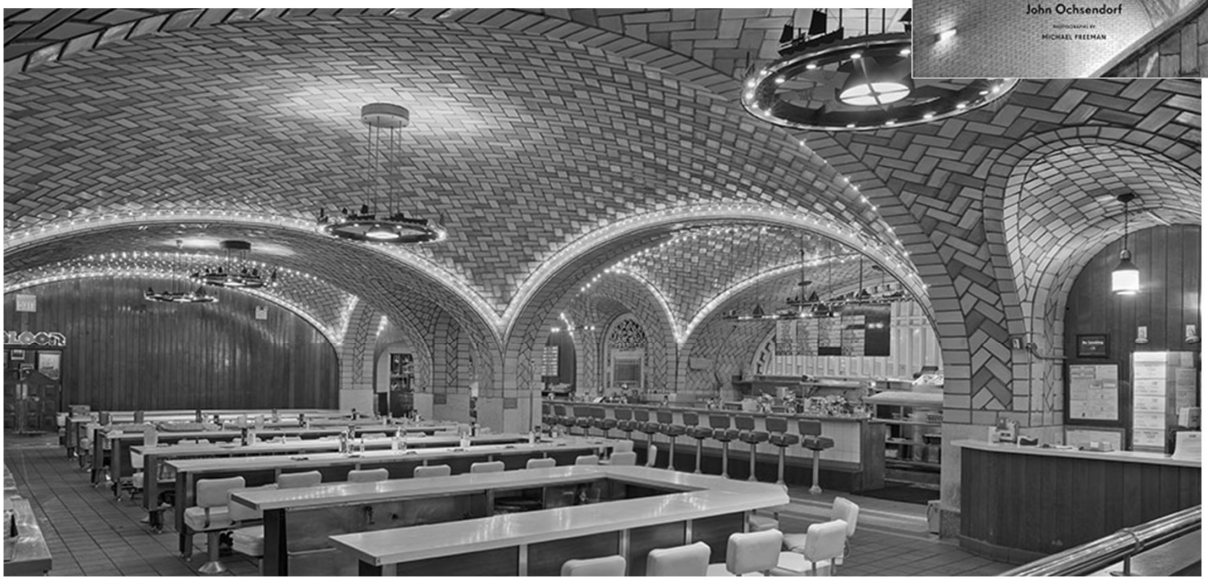
- Antonio Gaudi 1852 - 1926
- Catalonian Art Nouveau
- Crypt at Colonia Guell



Guastavino Vaulting

- Guastavino Co. 1885 – 1962
- Started in Boston





Guastavino Vaulting

- Guastavino Co. 1885 – 1962
- Detroit Train Station