

Cihan University Sulaymaniya
 Faculty of Engineering
 Architectural Engineering Department



Building Materials

Chapter Four (Masonry Work) (1- Blocks Work)

1st Grade- Fall Semester 2022-2023

Instructor: Diyari B. Hussein

Chapter Four Masonry Materials

Masonry Materials:

A mason is one who builds with bricks, stones, and blocks. Masonry is the part of a building or structure that is made from combining the masonry units: stone, block or brick, and mortar.

Types of Masonry Units:

- 1- Blocks Masonry
- 2- Bricks Masonry
- 3- Stones Masonry



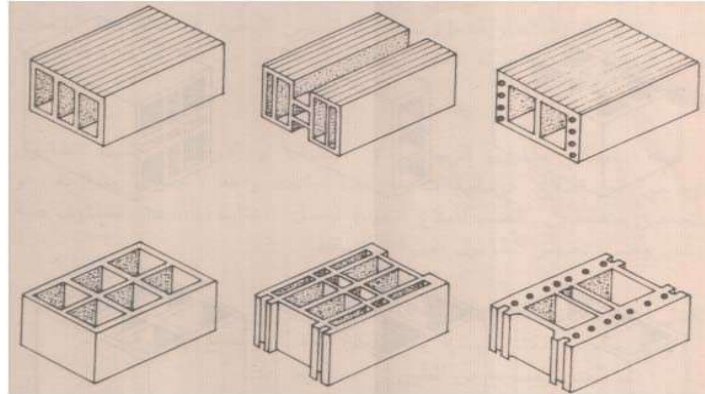
Block work

Block masonry

Types of Block according to material:

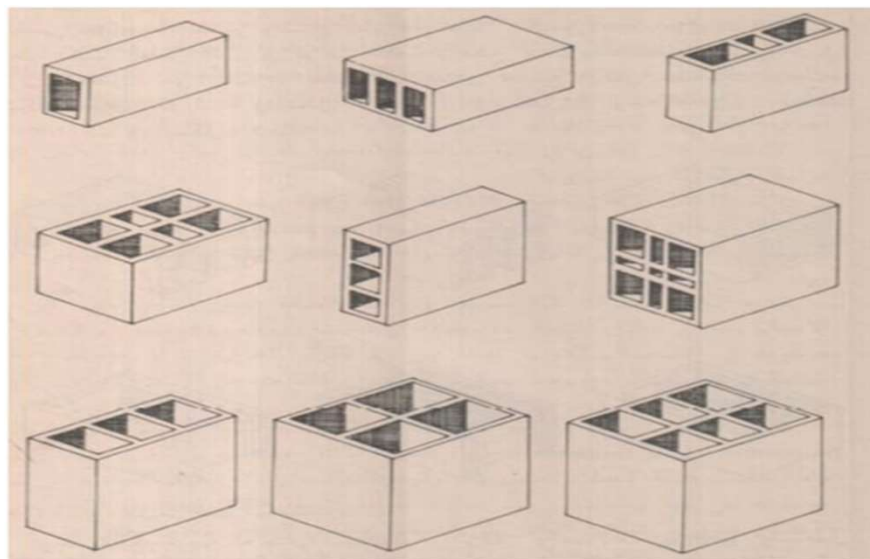
1- Clay block

facing clay tiles



Block work

Structural clay tiles



Block work

2- Concrete block

- A **concrete block** is one of several precast concrete products used in construction. A concrete block is primarily used as a building material in the construction of the walls. It is sometimes called a **concrete masonry unit** (CMU).
- Most concrete blocks have one or more hollow cavities, and their sides might be cast to produce a smooth surface. The first hollow concrete block was designed in 1890 by Harmon S. Palmer in the United States.
- The exterior dimensions for standard concrete masonry units are shown in Table 1.

• Table 1: Standard dimensions of CMU

Length, mm	Width, mm	Height, mm
400	200	200
400	200	150
300	200	150
300	150	150
300	200	100
300	150	100

Hint: The term precast refers to the fact that the blocks are formed and hardened before they are brought to the job site.

Block work

Raw materials used for production of CMU

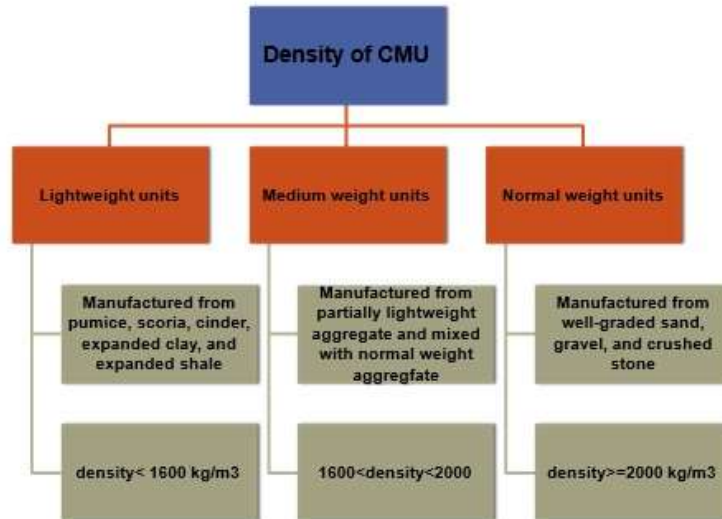
- The concrete commonly used to produce concrete blocks is a mixture of powdered Portland cement, water, sand, and gravel.
- In general, the concrete mixture used for blocks has a higher percentage of sand and a lower percentage of gravel and water than the concrete mixtures used for general construction purposes.
- Table 2: Mix proportion of concrete used for the production of concrete blocks

Item	Mix proportion	Value
1	Aggregate to cement ratio	6
2	Sand to gravel ratio	1.5
3	Maximum size of aggregate, mm	6-12
4	Fineness modulus of combined aggregate	2.9-3.6

Block work

Classification of concrete masonry units

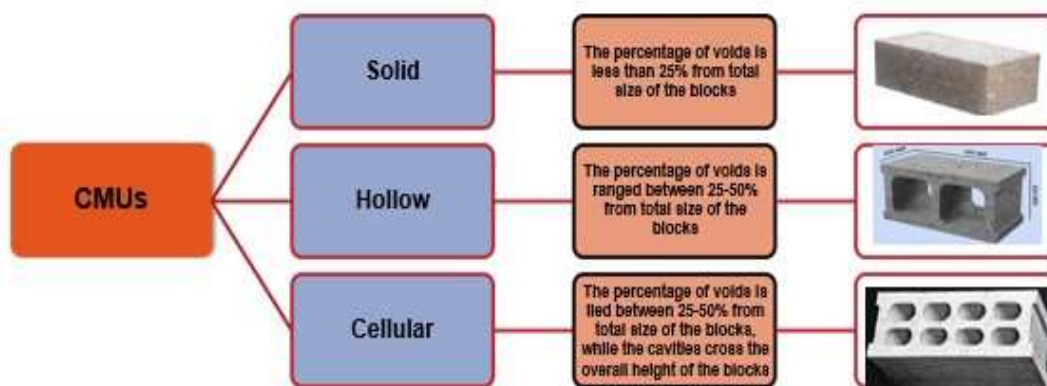
Concrete masonry units are classified based on density, as shown in the diagram.



Block work

Classification of concrete masonry units

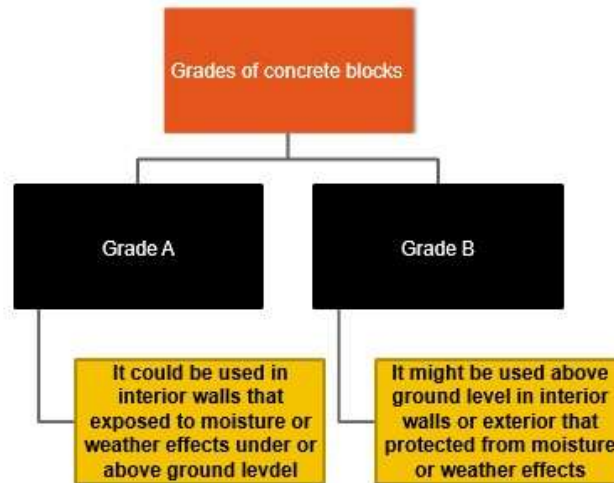
The classification of CMU is based on the percentage of cavities in the blocks.



Block work

Grades of Concrete Masonry Units CMUs

The concrete blocks are classified into two grades based on IQ.S 1077 in 1987 for load bearing concrete masonry units, as shown in the diagram.



Block work

Loaded concrete blocks

• Based on Iraqi Standard Specification No. 1077, the main requirements for concrete blocks used in load-bearing walls are as follows:

- Table 2: IQS for concrete blocks used in load-bearing walls

Type of block	Grade of block	strength based on gross area, MPa		Water absorption %
		One block	Average of 3 blocks	
Solid	A	11	13	10
	B	7	9	15
Hollow	A	6	7	15
	B	4.5	5	20

Block work

UnLoaded concrete blocks

- Based on Iraqi Standard Specification No. 1129, the main requirements for concrete blocks used in non-load-bearing walls are as follows:
- Table 3: IQS for concrete blocks used in non-load-bearing walls

Properties	For one block	Average of 3 blocks
Water absorption-%	22	18
Compressive strength based on net area, MPa	3.5	4.0

Block work

Wall Thickness

- The minimum wall thickness concerning the value of height or length of wall based on CPI 121 Specification, as shown in the table below:

Maximum height or length of wall*, m	Minimum thickness, mm
2.4	51
3.0	64
3.6	76
4.5	102
6.0	152
7.5	219

Hint : * whichever is greater

Block work

Concrete Block Manufacturing Process

- The concrete block manufacturing process has different steps based on the system that has been selected for producing them.
- The concrete block manufacturing process can be:
 - 1- manual
 - 2- semi- automatic
 - 3- automatic,
 - 4- full-automatic,depending on demand, country, and budget.

Block work

1- Manual Concrete Block Manufacturing Process

The manual method is the simplest and cheapest way. Just it needs the molds. The concrete is mixed manually and then poured into the concrete block molds. Usually, there is no vibration and high pressure in the manual method, so the quality of the concrete blocks is low.

Since the mortar is mixed manually, it could not achieve a certain ratio and each time it will be different and it will affect the quality of the final product. The manual method is also too slow since all the business is done by hand. This method is not suggested anymore since it does no't have any advantages and it is not industrial.



Block work

2- Semi-Automatic Concrete Block Manufacturing Process

In the semi-automatic concrete block manufacturing process, it needs a machine that produces the blocks. This machine is called a concrete block machine. It has molds installed in it and produces concrete blocks using pressure and vibration in the molds. The advantages of the semi-automatic concrete block manufacturing process are that the final product quality is higher than manual since it is produced using hydraulic pressure and vibration.

The disadvantage of this method is that the mixing process is still done manually, and the concrete ratio will be different each time. Also, pallets from the machine are delivered by hand carts and 3 workers are needed to handle the production, so it will need more workers compared to other production methods.



Block work

3- Automatic Concrete Block Manufacturing Process

The automatic concrete block manufacturing method is the most popular option based on our sales department. The mortar preparation in this method is done automatically so its mortar quality will be the same over time since the exact ratio is used. The production process is handled by robots as well and instead of three handcarts, one forklift is operated to handle the production. Cement is also stored in the cement silo and added automatically to the mixer. In this way, it can reduce the number of workers in the plant. Consider that an operator in this method operates the machine.



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4- Full-Automatic Concrete Block Manufacturing Process

The difference between automatic and full-automatic methods is that in the automatic method, it needs an operator to operate the machine, but in a Full-automatic concrete block machine, the machine operates automatically. This design is suitable for developed countries where labor cost is high, and the land is also expensive.



Block work

Manufacture of Concrete Block Units



Block work

Manufacture of Concrete Block Units



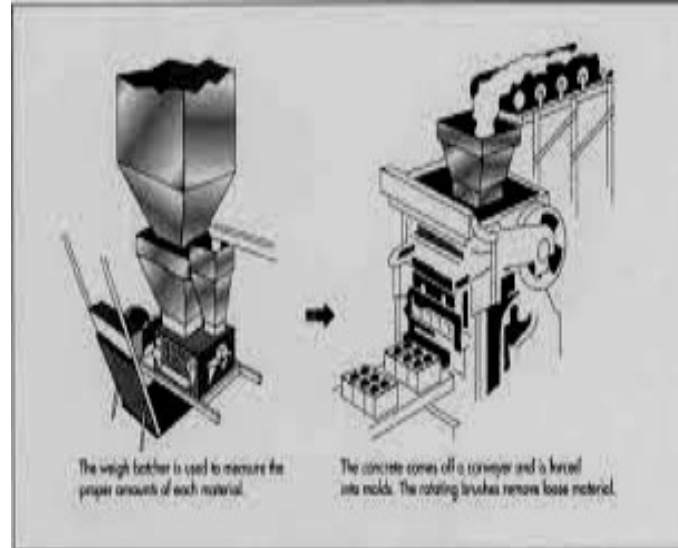
Block work

Manufacturing Process of Concrete Blocks

- The production of concrete blocks consists of four basic processes, as shown in the diagram below;



Block work Mixing



Block work Molding



Block work
Curing



Block work
Cubing



Block work

Type of blocks	Degree of exposure to environmental effect	Minimum compressive strength (MPa) on average gross area		
		Average of 3 units	One unit no less than	specification
1-Hollow units, load bearing	A-exposure to environmental effect	6.9	5.5	ASTM C90-75
	B- non-exposure to environmental effect	4.8	4.1	
2-Non-load bearing units (hollow or solid)	non-exposure to environmental effect	4.14	3.45	ASTM C129-75
3-Solid units, load bearing	A-exposure to environmental effect	12.42	10.35	ASTM C145-75
	B- non-exposure to environmental effect	8.28	6.90	

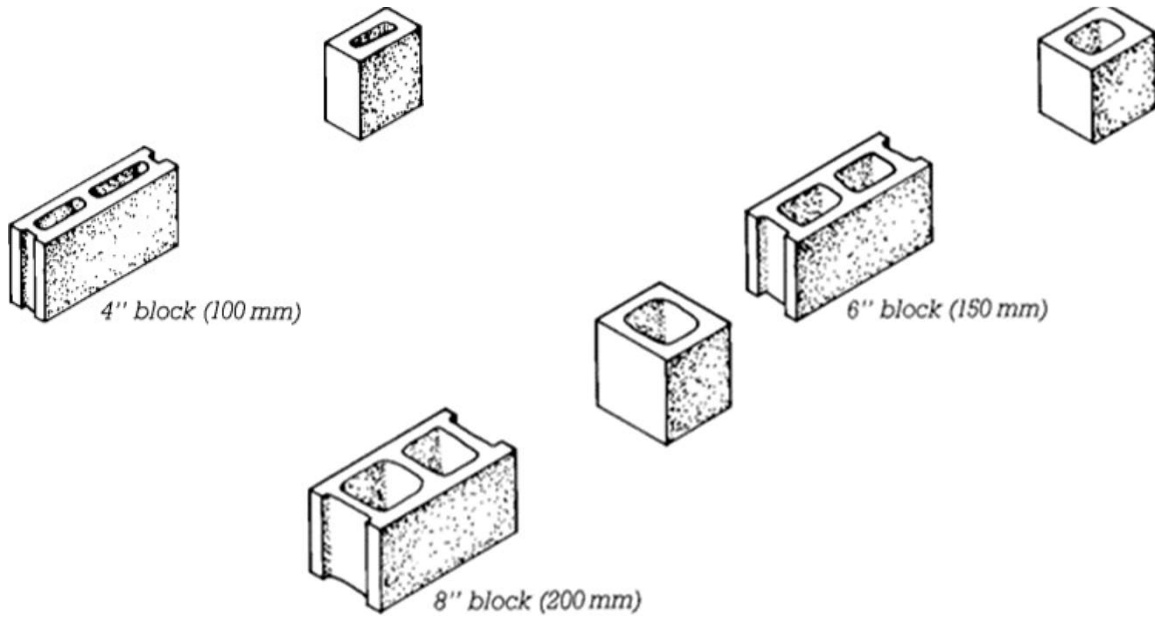
Block work

- 3- Glass block**
- 4- Gypsum block**
- 5- Cellular block**

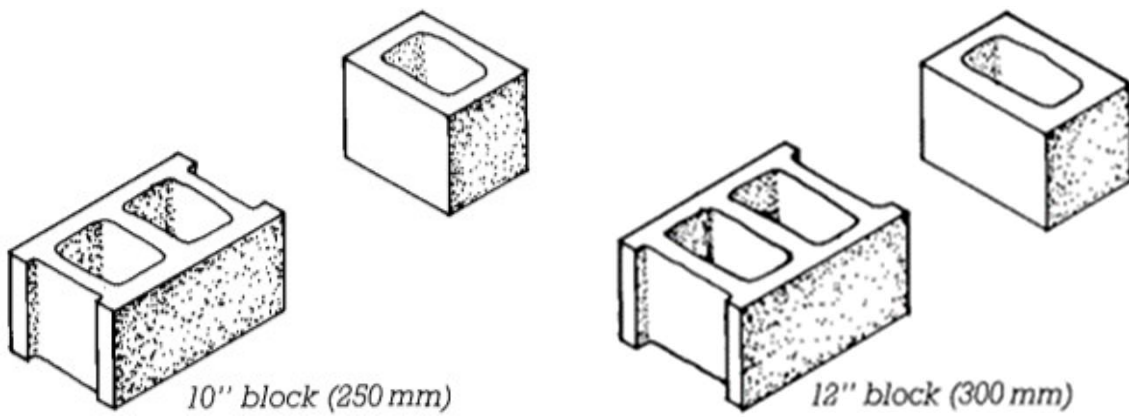
Concrete masonry units are made in a variety of sizes and shapes. They are also made with different densities of concrete, some of which use cinders, pumice, blast furnace slag, or expanded lightweight aggregates rather than crushed stone or gravel. Many colors and surface textures are available. Special shapes are relatively easy to produce if a sufficient number of units will be produced to amortize the expense of the mold.

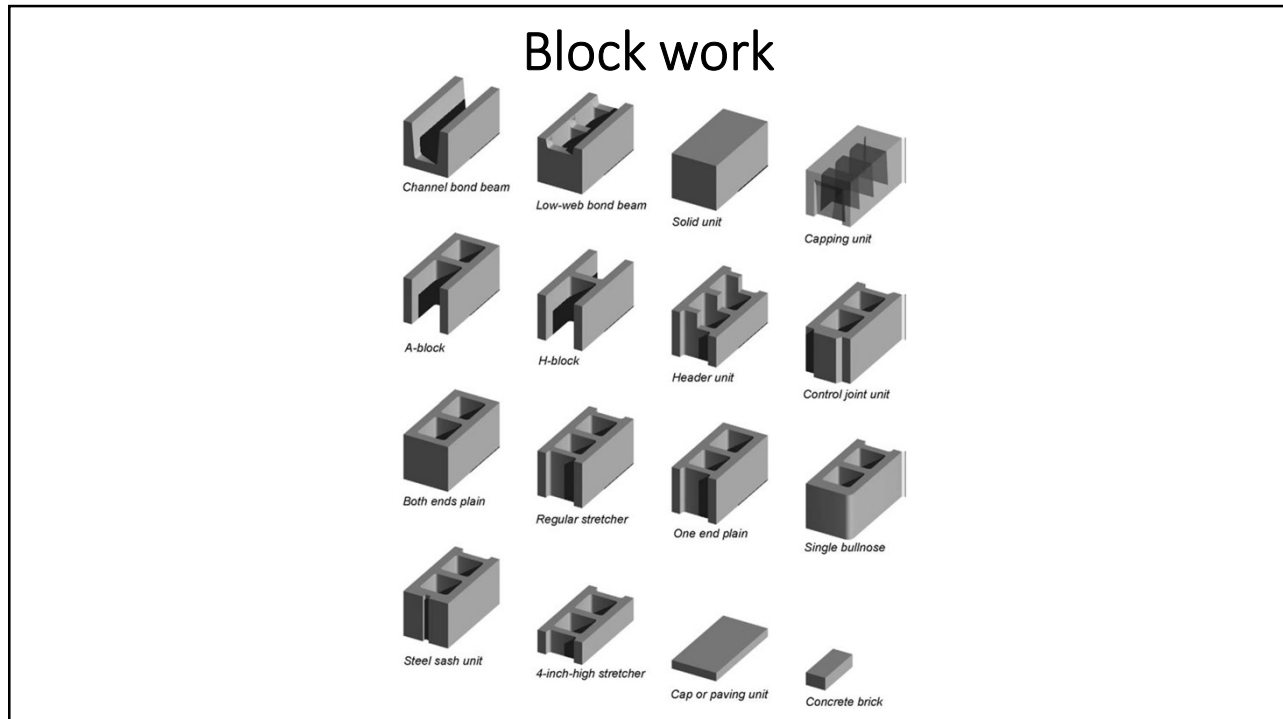
Figure below (Next Slide) is American standard concrete blocks and half-blocks. Each full block is nominally 8 inches (200 mm) high and 16 inches (400 mm) long.

Block work



Block work





Block work

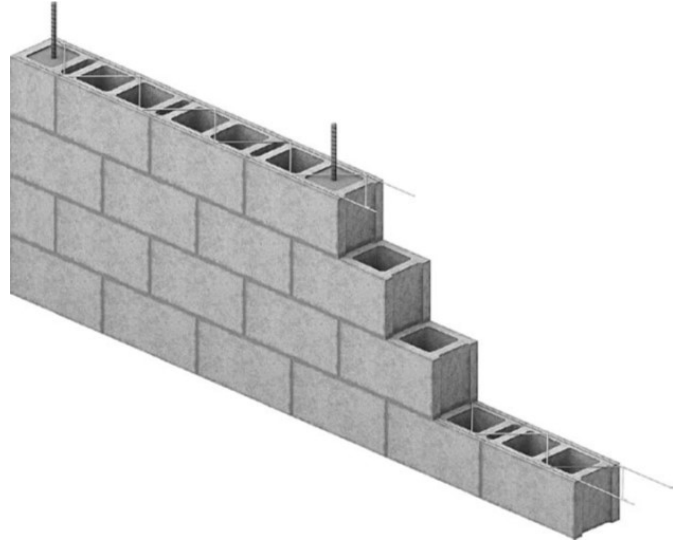
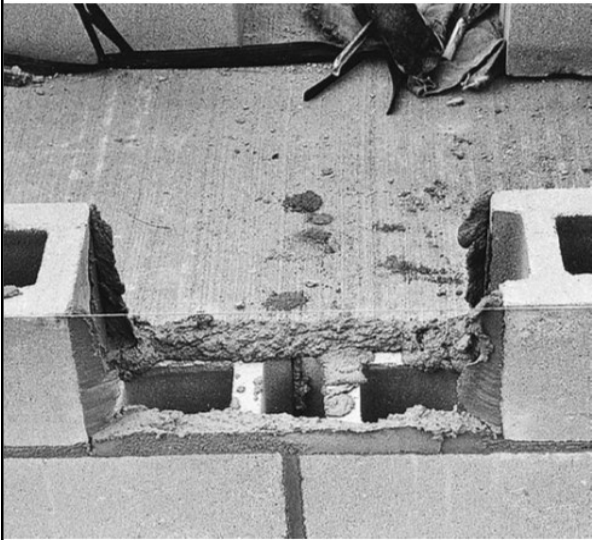
Laying Concrete Blocks

The mortar is identical to that used in brick walls, but in most walls only the face shells of the block are mortared, with the webs left unsupported.

Concrete masonry is often reinforced with steel to increase its loadbearing capacity, resistance to cracking, or resistance to seismic forces.

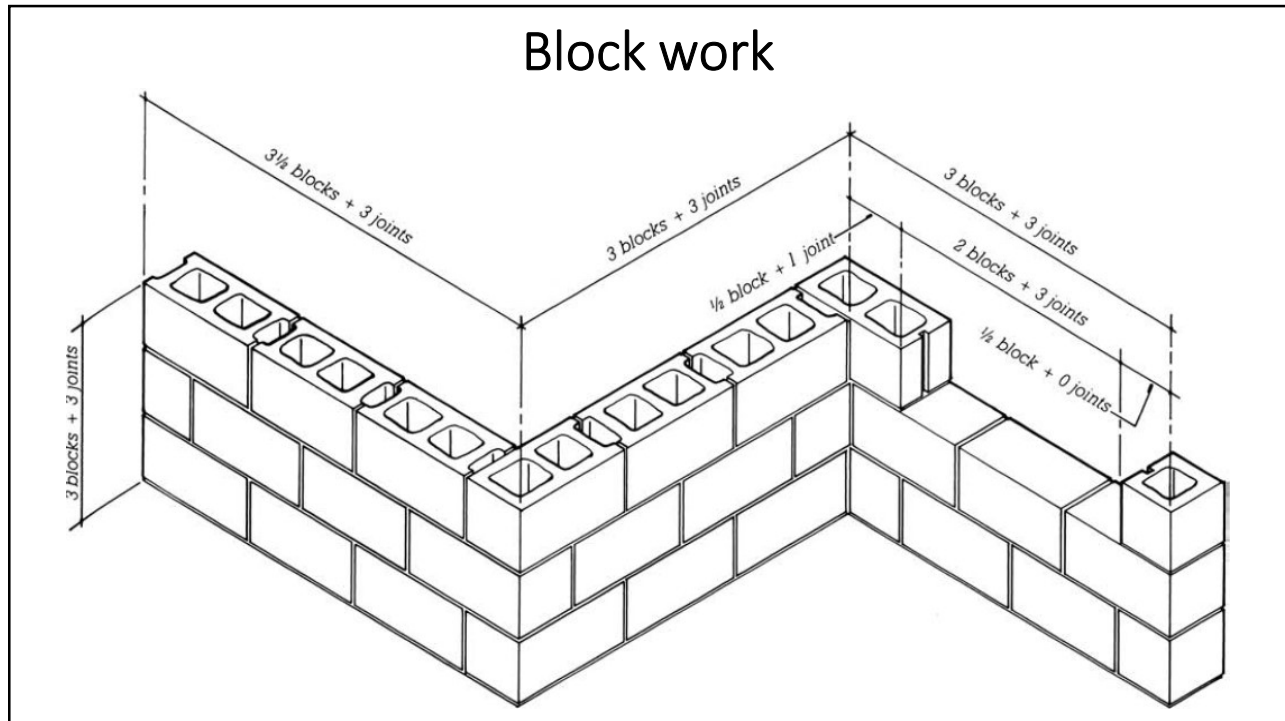
Horizontal reinforcing is usually inserted in the form of joint reinforcing, welded grids of small-diameter steel rods that are laid into the mortar bed joints at the desired vertical intervals

Block work



Block work

If stronger horizontal reinforcing is required, bond beam blocks or special blocks with channeled webs allow heavier reinforcing bars to be placed in the horizontal direction. The horizontal bars may be embedded in grout before the next course is laid, with the grout contained in the cores of the reinforced course by a strip of metal mesh that was previously laid into the bed joint beneath the course to bridge across the core openings. Alternatively, the horizontal bars may be grouted simultaneously with the vertical bars. Vertical block cores are easily reinforced by inserting bars and grouting, using either the low-lift or high-lift technique, as described. In most cases only those cores that contain reinforcing bars are grouted, but sometimes all the vertical cores are filled, whether or not they contain bars, for added strength.



Thank You