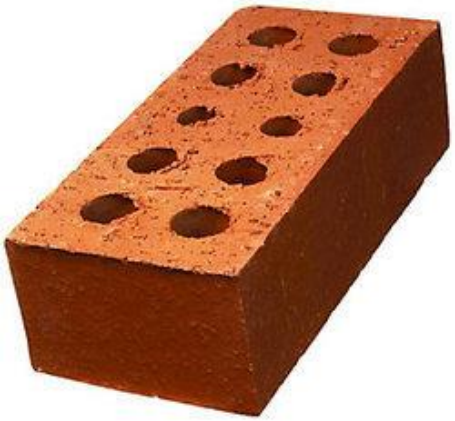
Bricks

Classification of bricks according to constituent raw material:

1. Clay bricks
2. Lime - sand bricks
3. Concrete bricks



1. Clay bricks: الطابوق الطيني

1.1 Raw materials: المواد الخام

a. Alumina

Alumina is main constituent of every clay. In absence of sand, pure clay will develop cracks due to shrinkage on drying and burning. A good clay bricks should contain about 20% of alumina.

b. Silica

Free silica (sand), if added to clay in suitable proportion makes hard and prevents it from Warping and shrinkage on drying. Silica, if present in greater proportion, makes a brick brittle. Both silica and alumina should be in free form.

c. Lime

Lime should be present in small quantities in the brick earth. Lime prevents shrinkage of raw bricks. It helps fusion of sand at the kiln temperature. This fused sand will bind the bricks particles fast.

d. Iron oxide

A small quantity of oxide of iron (5-6%) is desirable. It helps the fusion of sand like lime. It gives red colure to burn bricks. Excess of iron oxide

imparts dark blue or blackish colure to brick, while, a lower percentage of iron oxide makes, the brick yellow in colure. Iron oxide makes the bricks hard and strong.

e. Magnesia

A small amount of magnesia helps to decrease the shrinkage of bricks. This gives a yellow tint to the bricks. But excess of magnesia is not desirable as it tends to produce the decay of bricks.

1.2- Composition of good clay brick:

A good clay brick should contain the following:

1.Clay or alumina - Al_2O- 20%

2.Sand or silica - SiO_2 - 60%

3. Remaining ingredients, such as:

-Lime
-Iron oxide
-Magnesia
-Manganese

} **20%**

3.1- Harmful ingredients in clay bricks:

a. Excess of lime:

Excess of lime makes the colure of the brick yellow instead of red and when the brick contact with water, lime will begin to slake generates heat and expands. Due to this, stresses will be produced, which will result in producing cracks in bricks.

b. Iron pyrites

These will decompose and oxide the clay during the burning of bricks. After oxidation a black discoloration will be produced on the bricks, making it look ugly.

c.Pebbles:

The presence of pebbles, girt, gravel etc. will be undesirable because they prevent the clay from being mixed well. They prevent the manufacture of smooth and regular, standard bricks. They also spoil the appearance of the bricks,

d. Organic matter:

This includes leaves, twigs, roots, grass, bones of animals, etc. These if present and burnt along with bricks, produced empty pockets or pores and will be porous bricks.

e. Alkalis (MgO, K_2O):

• It lowers the fusion temperature and molts bricks.

• Changes the shape of bricks or get twisted.

• These salts have hygroscopic action, they absorb moisture, present in the atmosphere and keep brick damp which is harmful for health and decays the structure.

$MgO + H_2O \longrightarrow Mg(OH)$

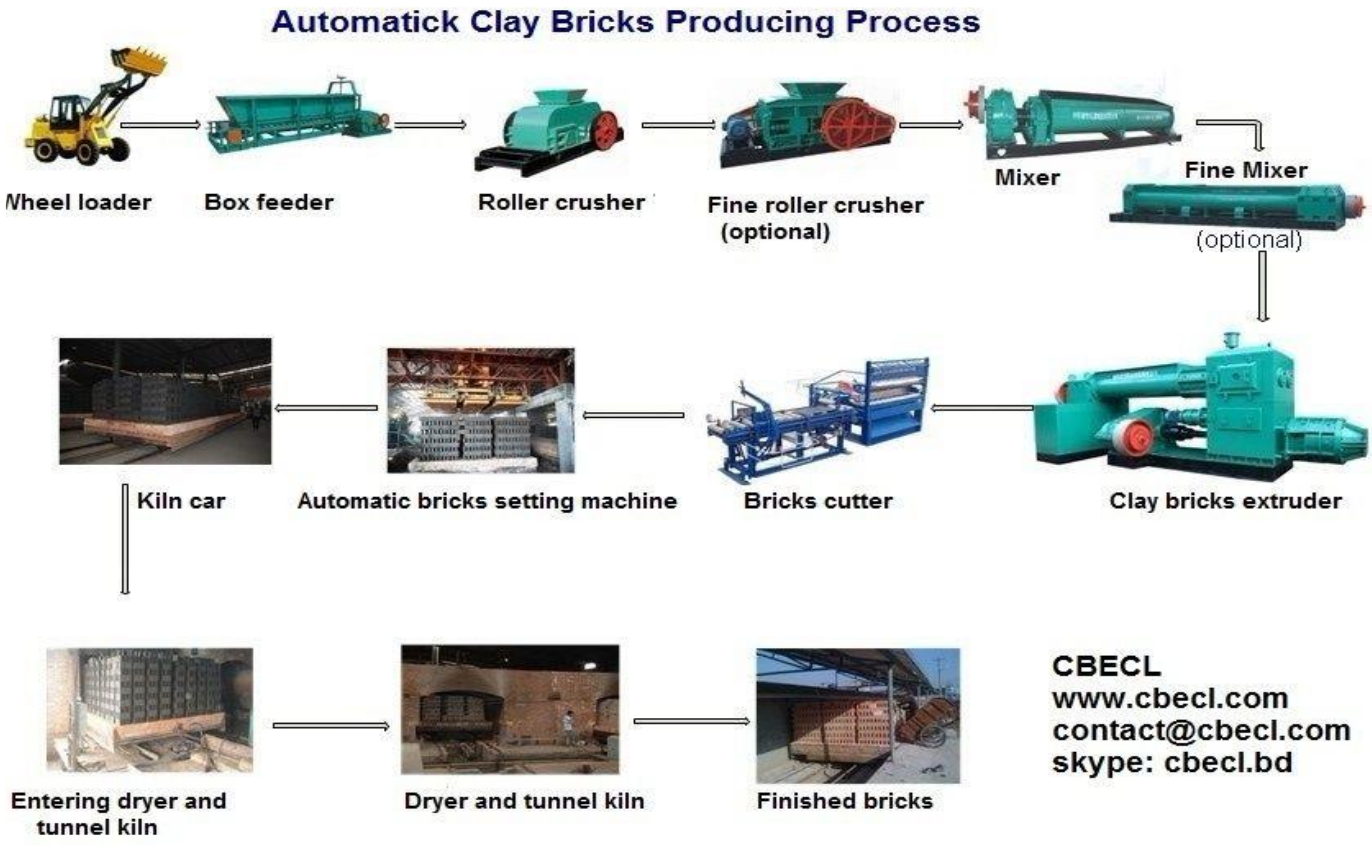
$K_2O + H_2O \longrightarrow 2KOH$

f. Salts:

Salts such as sodium sulphate cause efflorescence,

1.4 Manufacture of bricks:

Manufacture of clay bricks involves the following operation:



1.4.1 Preparation of clay:

a. Removal of loose soil:

The top layer of loose disintegrated soil up to about 20 cm depth has to be removed as this contains a lot of impurities,

b. Digging, spreading and cleaning:

Now the earth has to be dug up. For small quantity, digging may be done manually. For large scale work, it may be done by machine.

c. Weathering

The earth is left to weather for a few weeks, this is necessary to increase the plasticity of soil and improves its quantity.

b. blending:

This is to mixing the clay, after making it loose and adding any required ingredients to the top of the heap.

e. Tempering:

This is necessary to make the clay fully consistent, and fit for molding into raw bricks by adding the required amount of Water to make it plastic.

1.4.2 Molding

Molds required for making a brick are made of rectangular blocks slightly large in size (10% larger than the burnt bricks). It is done to allow for the shrinkage of the molded brick on drying and burning. The molding is improved by the following process:

a. Dry press process:

In this method, a small amount of water is mixed with clay as to form a damp powder, with plunger machines, this powder is compressed in the mold, in the form of bricks. Such bricks are directly buried, no drying is needed, but care is to be taken during burning where the temperature should be raised gradually.

b. Stiff mud process:

In this process the clay is only sufficiently moist to process the required coherence under moderate pressure, which results in economy of time in drying and fuel in burning. Such clay is forced to come out of any opening having dimensions equal to length of bricks, by means of a wire. Hence these are also known as Wire cut bricks.

c. Soft mud process:

This process is used where the clay is too wet, there for, it must be dried before molding, Bricks are molded under pressure in a soft mud brick machine, which tempers the clay in its pigging chamber, sands or Wets the molds, presses the clay into 4 to 9 molds at a time, strikes of the excess clay, bumps the molds uniformly and dumps the bricks into a pallet. The pallets of bricks are carried away to the dryer as fast as made.

1.4.3 Drying:

As wet clay bricks come from different brick machine they contain 7-50% moisture depend on molding process. Most of the free water is removed in the drying process and the remaining moisture during the burning process. It is desirable to dry clay with moist air, reducing the drying rate to the point where diffusion of water to the surface can keep up with the Vaporization at the surface. The average time necessary for drying clay brick is about 3 days, and the temperature required is from 38°C to 149 ºC.

1.4.4 Burning:

The burning of clay in a kiln requires an average time of 3 to 4 days. The process of burning may be divided into the following stages:

a. Water smoking:

During this period which remove most of the Water in the clay under temperature ranging from 125°C to 175 °C.

b. Dehydration:

Dehydration consists of expelling chemically combined water by breaking down the clay molecules. It begins at about 425 °C and complete at about 750 °C.

e. Oxidation:

Oxidation begins during the dehydration stage. All combustible matter is consumed ،carbon is eliminated, the fluxing materials are changed to oxides ،and sulfur is removed.

1.5- Classification of clay bricks in accordance with Iraqi Standard No. 25 /1988:

Bricks used in construction works are classified into three grades:

Grade A: Intended for use in building construction and footing subjected to loads and exposed to sever abrasion by weathering action.

Grade B: Intended for use in building construction subjected to loads and not exposed to sever abrasion by weathering action, such as exterior walls not exposed to penetration of water.

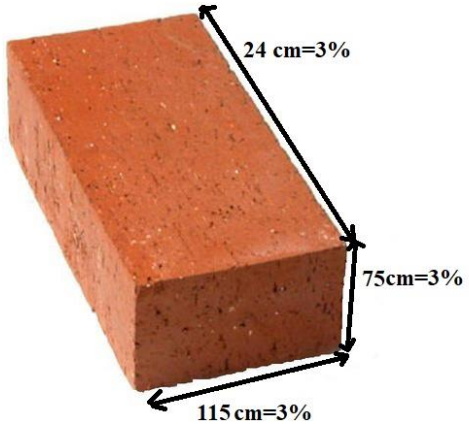
Grade C: Intended for use in building construction not subjected to loading such as interior masonry Walls and partitions, not exposed to sever abrasion by weathering action.

Appearance:

A good brick should be rectangular in shape with smooth and even surfaces. They shall be free from cracks and flows and nodules of free line.

Dimensions:

A good brick shall have standard dimensions as shown below:



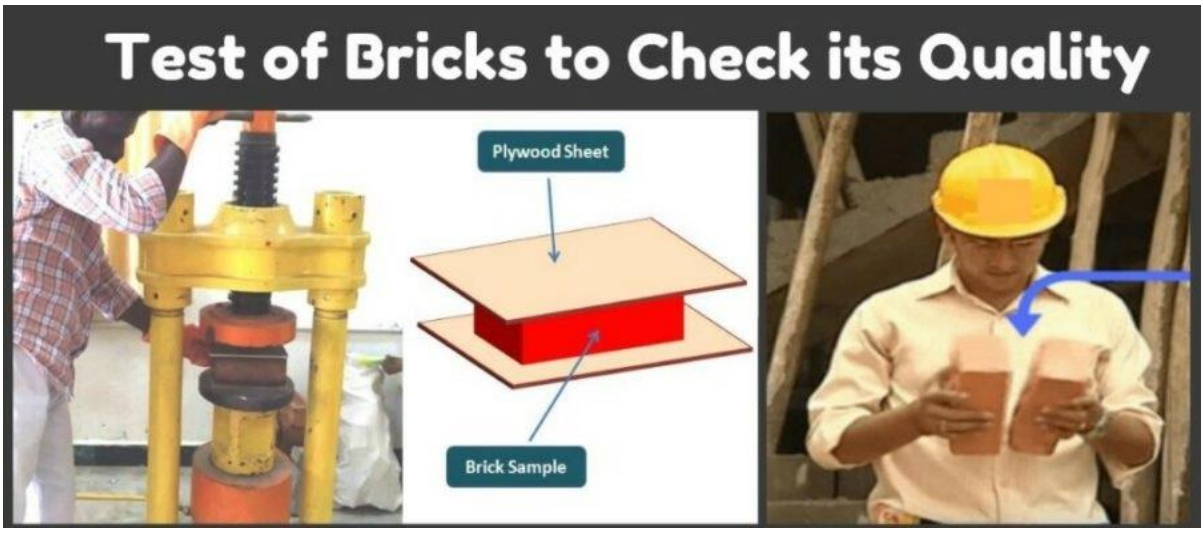
1.6 Properties of bricks:

The raw materials and the manner and degree of burning influence the physical properties greatly and therefore wide ranges in values are to be expected for each property.

1.6.1 Compressive strength:

The test is carried out in accordance with Iraqi Standard No. 24, The brick placed between two plywood sheets and carefully centered between plates of the compression testing machine. The load shall be applied at a uniform rate until failure occurs.

Compressive strength = Load at failure/ Cross Sectional area subjected to load



1.6.2 Water absorption: أمتصاص الماء

The absorption of water by brick is often considered to be indicative of probable durability. The test also provides a means of checking on the consistency of the bricks produced by one factory. In this test the specimen shall be dried to constant weight in a ventilated oven at 110°C to 115 °C for about 48 hours. Next the specimen shall be completely immersed in leaf water for 24 hours. Each specimen shall then be removed, the surface Water wiped off with a damp cloth and the specimen weight.

Water absorption = {(W2-W1)/W1} *100%

Where W2: Weight of brick after 24 hours in water

W1: Weight of dry brick

1.6.3 Efflorescence: التزهر

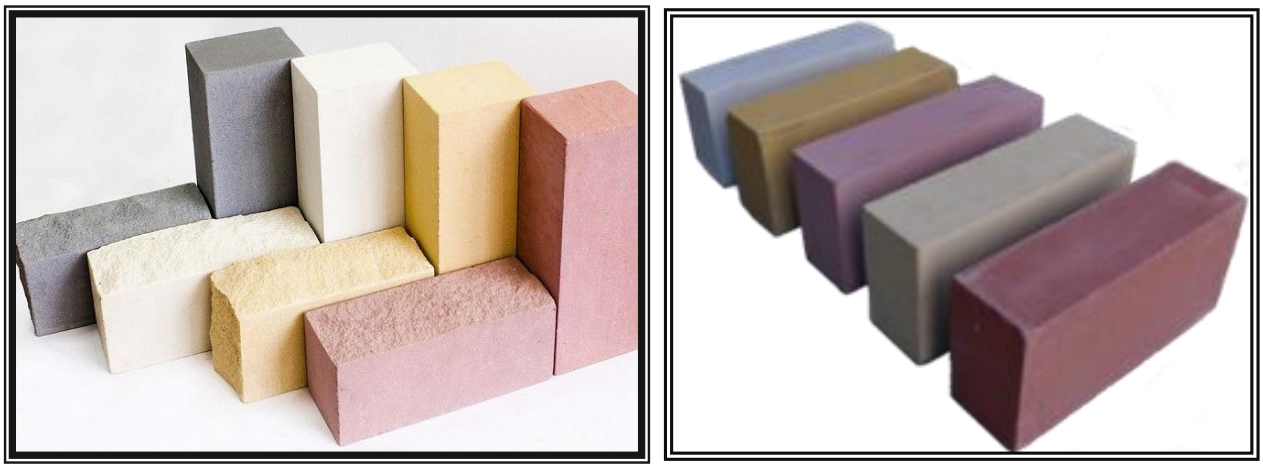
Soluble salts, if present in bricks, will cause efflorescence on the surface of bricks. Efflorescence test is carried out in accordance with Iraqi Standard No.24.The test is very useful for comparing samples of bricks from different sources, such as when we want to test bricks from several different factories at One time. In this test take a representative sample of 10 bricks and place them on end in the pan containing distilled water to a depth of 2.5 cm for 7 days. Allow the bricks to dry for 3 more days in similar pan not containing Water.

- ❖ Nil - No efflorescence visible.
- ❖ Slight-A thin deposit of salts on less than 10%of the area of the brick.
- ❖ Moderate-A heavier deposit of salts covering between 10-50% of the area of the brick, but no powdering or flaking of the surface.
- ❖ Heavy - A heavy deposit of salts covering more than 50% of the area, but no powdering or flaking of the surface.
- ❖ Serious 8 heavy deposit of salts and some powdering and flaking of the surface.

Compressive strength, water absorption and efflorescence according to Iraqi, standard No. 25/1988:

Grade	Eflorescence	Maximum compressive strength N/mm2		Maximum water absorption %	
		For one brick	Average for 10 brick	For one brick	Average for 10 brick
A	**Slight**	**16**	**18**	**22**	**20**
B	**Slight**	**11**	**13**	**26**	**24**
C		**7**	**9**	**28**	**28**

2. Sand - Lime bricks:



2.1 Raw materials:

The raw materials required for manufacture of sand - lime bricks are as follow:

2.1.1 Sand

The sand used in sand - line brick should meet the physical and chemical requirements of Iraqi Standard No. 572:

a. Contain not less than 70% silica.

b. Well graded between 0.005 - 0.5 mm.

c.Free from impurities such as Organic matter, rock، minerals and soluble.

d. The percentage of clay not more than 10%

e. Iron compounds not more than 1.5%.

f. Gypsum content not more than 1%.

g. (CaO + MgO) not more than 5%.

2.1.2 Lime:

The lime used in sand lime brick should meet the requirements of Iraqi Standard No, 572:

a. Activity of lime shall not be less than 83%.

b. The percentage of lime retaining on 75 µm sieves should not be greater than 2%

2.1.3 Water:

Water used in sand lime brick should be fit for drinking .

2.1.4. Pigment:

To make colored sand lime bricks, suitable coloring pigment should be added in the mixture of sand and lime The Quantity of pigment Varies from 0.2 to 3% of the total weight of the brick.

2.2 Mix proportion:

The percentage of lime should be between 9- 15% of the weight of sand.

2.3 Manufacture:

a. Sand, lime and pigment are taken in suitable proportions and they are thoroughly mixed with a required quantity of water.

b. The material is the molded in the shape of the bricks under mechanical pressure (150-200 kg/cm).

c. Bricks are then place in closed chamber and subjected to saturated steam pressure of about 8.5-16 kg/cm^2 for 6 -12 hours to speed up the interaction between lime and sand. The process is known as autoclaving.

Properties of lime sand brick:

a. The raw materials of these bricks do not contain any soluble salt. Hence the trouble of efflorescence does not arise.

b. If plaster is to be provided on sand line bricks, the quantity required will be less as bricks are uniform in size and shape.

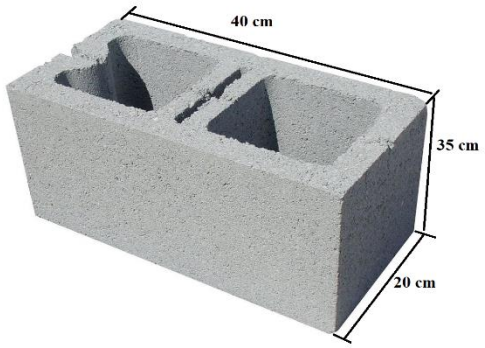
c. These bricks are hard and storing.

d. These bricks are uniform in colure and texture.

e. Sand lime bricks are used for ornamental work.

3. Concrete bricks:

These bricks are manufactured from Portland cement and aggregate for use in brick masonry. Typical aggregate include sand, gravel, Crushed stone and blast furnace slag. Mix proportion varies from 1:2:4 to 1:8:16 according to the required bearing capacity. These bricks are often made hollow for economical purposes and to reduce the Weight of the brick. The dimensions of the brick are as follow:



3.1 Uses:

Concrete bricks are widely used for construction purposes especially in areas where soils are not suitable for manufacture of clay bricks and may be used in the construction of bricks panels for light Weight structures and multistory formed structures.

3.2 Properties of concrete bricks:

a. The using of these bricks save time and effort as brick are light in weight and big in size.

b. These bricks give good bonding with plastering materials used in construction.

c. These bricks have accurate size and shape.

d. These bricks can produced with various bearing capacity according to the cement content and in their production.

e. The Weight of bricks can be controlled by varying the size of openings.

Questions and Answers of Lecture Five

1.Show the effect of the raw materials in the properties of Clay Bricks?

2.Show the effect of the (a. Alumina, b. Silica, c. Lime, d. Iron oxide and e. Magnesia) in the properties of Clay Bricks?

3.What are the main Composition of good clay brick? Show the effect of components in the properties of Clay Bricks?

4- What are the main Harmful ingredients in clay bricks? Show the effect of each them in the properties of Clay Bricks?

5- Explain the phases of Manufacture of Clay bricks?

6- Show the presence of water in the Clay Bricks body and Explain the stages of removed it from Clay Bricks body?

7- Show the Classification of clay bricks in accordance with Iraqi Standard No. 25 /1988? What are its grades, limitations and where to be used?

8- Show the Effect of Efflorescence in the durability of clay bricks and structures? What are the imitations accordance with Iraqi Standard No. 25 /1988?

9-What are the advantages and disadvantages of Clay Bricks?

10- Show the effect of the raw materials in the properties of Sand - Lime bricks?

11- What are the properties of Sand - Lime bricks?

12- What are the advantages and disadvantages of Sand - Lime bricks?

13-Compare between the Clay Bricks and Sand - Lime bricks?

14- Compare between the Clay Bricks and Concrete bricks?

15- What are the advantages and disadvantages of Concrete bricks?

16- What are the uses and Properties of concrete bricks?

17- Compare between the concrete bricks and Sand - Lime bricks?