

BRICKS

Bricks are one of the oldest and most popular building materials. The reasons for bricks being very popular and widely used construction material are,

- Bricks are cheap
- Bricks are durable
- Bricks are easy to handle and work with

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Bricks can be defined as,

"Bricks are blocks of tampered clay molded to suitable shapes and sizes while it is still in plastic condition, dried in the sun and burnt, if desired so as to make them more strong, hard and durable."

Bricks are normally rectangular in shape and size is set so as to make it easy for workers to handle it. Bricks are usually available made up of three different materials,

- Burnt clay (Most common type in Pakistan)
- Mixture of sand and lime
- Portland cement concrete

The bricks made up of the last two types are usually called blocks and are available in sizes of following proportions,

Length of brick = 2 × width of brick + thickness of mortar

Height of brick = width of brick

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Commonly available size is, 19 × 9 × 9 cm and 19 × 9 × 4 cm.

The bricks made up of clay usually have the size, 9" × 4½" × 3". Weight of such brick is around 3.0 kg. An indent called frog, 1-2 cm deep. The size of frog should be 10 × 4 × 1 cm. The purpose of providing frog is to form a key for holding the mortar and therefore, the bricks are laid with frogs on top.

1 CLASSIFICATION OF BRICKS:

There are several categories to classify bricks. All those categories have been explained below.

1.1 ON FIELD PRACTICE:

Based upon the physical and mechanical properties the bricks are classified into four types such as, first class, second class, third class and fourth class.

a. First Class Bricks: (Fair faced first class bricks)

- These are thoroughly burnt and are of deep red, cherry or copper colour.

10. These bricks may have slight presence of efflorescence by its uses.

2. The surface should be smooth and rectangular, with parallel, sharp and straight edges and square corners.
3. These should be free from flaws, cracks and stones.
4. These should have uniform texture.
5. No impression should be left on the brick when a scratch is made by a finger nail.
6. The fractured surface of the brick should not show lumps of lime.
7. A metallic or ringing sound should come when two bricks are struck against each other.
8. Water absorption should be 12-15% of its dry weight when immersed in cold water for 24 hours.
9. The crushing strength of the brick should not be less than 10 N/mm². This limit varies with different Government organizations around the country.

Uses: First class bricks are recommended for pointing, exposed face work in masonry structures, flooring and reinforced brick work.

b. Second Class Bricks: (Non fair faced F.C.B)

These bricks are supposed to have the same requirements as the first class ones except that

- Small cracks and distortions are permitted.
- A little higher water absorption of about 16-20% of its dry weight is allowed.
- The crushing strength should not be less than 7.0 N/mm².

Uses: Second class bricks are recommended for all important or unimportant hidden masonry works and centering of reinforced brick and reinforced cement concrete (RCC) structures.

c. Third Class Bricks: (Second class bricks)

- These bricks are under burnt.
- They are soft and light-colored.
- They produce a dull sound when struck against each other.
- Water absorption is about 25 per cent of dry weight.

Uses: It is used for building temporary structures.

d. Fourth Class Bricks: (Over burnt bricks)

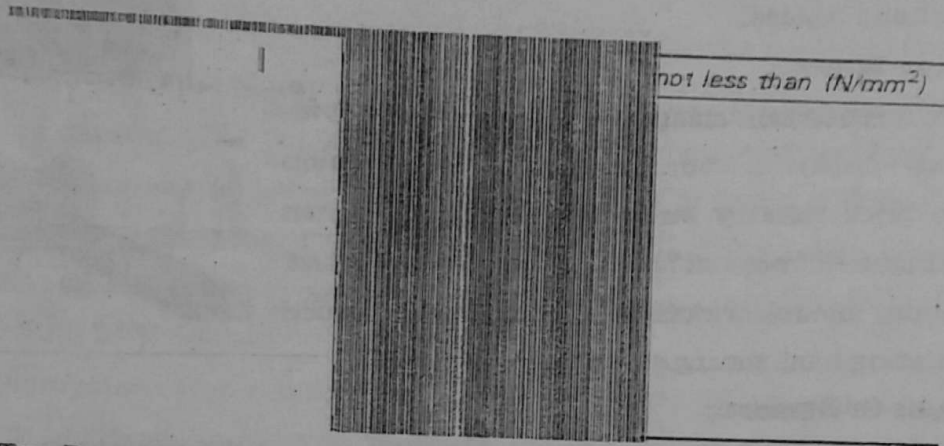
- These bricks are over burnt.
- Badly distorted in size and shape.
- Brittle in nature.
- Have more strength due to over heating

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Uses: The ballast of such bricks is used for foundation and floors in lime concrete and road metal.

1.2 ON STRENGTH:

On the basis of strength the bricks have been subdivided into the following categories (IS 1077).



1.3 ON THE BASIS OF USE:

On the basis of use the bricks have been classified into the following three types,

a. Common Bricks:

This is a general multi-purpose unit manufactured economically without special reference to appearance. These may vary greatly in strength and durability and are used for filling, backing and in walls where appearance is of no consequence.

b. Facing Bricks:

These are made primarily with a view to have good appearance, either of color or texture or both. These are durable under severe exposure and are used in fronts of building walls for which a pleasing appearance is desired.

c. Engineering Bricks:

These are strong, impermeable, smooth, table molded, hard and conform to defined limits of absorption and strength. These are used for all load bearing structures.

1.4 ON THE BASIS OF FINISH:

On the basis of finish the bricks have been classified into the following two types,

a. Sand Faced Bricks:

This type has textured surface manufactured by sprinkling sand on the inner surfaces of the mould.

b. Rustic Bricks:

This type has mechanically textured finish, varying in pattern.

1.5 ON THE BASIS OF MANUFACTURE:

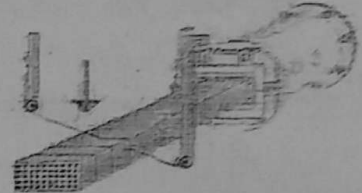
On the basis of manufacture the bricks have been classified into the following two types,

a. Hand Made Bricks:

These bricks are hand molded.

b. Machine Made Bricks:

Depending upon mechanical arrangement, bricks are known as wire-cut bricks—bricks cut from clay extruded in a column and cut off into brick sizes by wires; pressed bricks—when bricks are manufactured from stiff plastic or semi-dry clay and pressed into molds; molded bricks—when bricks are molded by machines imitating hand mixing.



1.6 ON THE BASIS OF BURNING:

On the basis of burning the bricks have been classified into the following three types,

a. Pale Bricks:

These are under burnt bricks obtained from outer portion of the kiln.

b. Body Bricks:

These are well burnt bricks occupying central portion of the kiln.

c. Arch Bricks:

These are over burnt also known as clinker bricks obtained from inner portion of the kiln.

1.7 ON THE BASIS OF TYPES:

On the basis of types the bricks have been classified into the following four types,

a. Solid Bricks:

Small holes not exceeding 25 per cent of the volume of the brick are permitted; alternatively, frogs not exceeding 20 per cent of the total volume are permitted.

b. Perforated Bricks:

Small holes may exceed 25 per cent of the total volume of the brick.

c. Hollow Bricks:

The total of holes, which need not be small, may exceed 25 per cent of the volume of the brick.

d. Cellular Bricks:

Holes closed at one end exceed 20 per cent of the volume.

CHARACTERISTICS OF GOOD BRICKS:

The characteristics of a good brick are,

- **Size and Shape:** The bricks should have uniform size and plane, rectangular surfaces with parallel sides and sharp straight edges.
- **Color:** The brick should have a uniform deep red or cherry color as indicative of uniformity in chemical composition and thoroughness in the burning of the brick.
- **Texture and Compactness:** The surfaces should not be too smooth to cause slipping of mortar. The brick should have precompact and uniform texture. A fractured surface should not show fissures, holes grits or lumps of lime.
- **Hardness and Soundness:** The brick should be so hard that when scratched by a finger nail no impression is made. When two bricks are struck together, a metallic sound should be produced.
- **Water Absorption:** Water Absorption should not exceed 20 per cent of its dry weight when kept immersed in water for 24 hours.
- **Crushing Strength:** Crushing strength should not be less than 10 N/mm^2 .
- **Brick Earth:** Brick earth should be free from stones, kankars, organic matter etc.

3 INGREDIENTS OF GOOD BRICK EARTH:

For the preparation of bricks, clay or other suitable earth is molded to the desired shape after subjecting it to several processes. After drying, it should not shrink and no crack should develop. Different ingredients present in the good quality brick earth have been shown in the figure below with their percentages.

Silica	50-60%	
Alumina	20-30%	
Lime	10%	
Magnesia	< 1%	} Less than 20%
Ferric oxide	< 7%	
Alkalis	< 10%	
Carbon dioxide		} Very small percentage
Sulphur trioxide		
Water		

4 FUNCTIONS OF VARIOUS INGREDIENTS:

The functions of different substances present in the brick earth have been explained below,

✓ 4.1 SILICA: 25-50%.

It enables the brick to retain its shape and imparts durability, prevents shrinkage and warping. Excess of silica makes the brick brittle and weak on burning.

✓ 4.2 ALUMINA: 20-30%.

Alumina absorbs water and renders the clay plastic. If alumina is present in excess of the specified quantity, it produces cracks in brick on drying.

✓ 4.3 LIME: 10%.

Normally lime is added less than 10%. The benefits are,

- ✓ Reduces the shrinkage on drying.
- ✓ Causes silica in clay to melt on burning and thus helps to bind it.
 - In carbonated form, lime lowers the fusion point.
 - ✓ Excess of lime causes the brick to melt and the brick lose its shape.
 - Red bricks are obtained on burning at considerably high temperature (more than 800°C) and buff-burning bricks are made by increasing the lime content.

✓ 4.4 MANGNESIA: 4-7%.

Mangnesia is rarely exceeding 1 per cent, affects the color and makes the brick yellow, in burning; it causes the clay to soften at slower rate than in most case is lime and reduces warping.

✓ 4.5 IRON: 2-7%.

Iron oxide constituting less than 7 per cent of clay, imparts the following properties:

- Gives red colour on burning when excess of oxygen is available and dark brown or even black colour when oxygen available is insufficient, however, excess of ferric oxide makes the brick dark blue.
- Improves impermeability and durability.
- Tends to lower the fusion point of the clay, especially if present as ferrous oxide.
- Gives strength and hardness.

5 HARMFUL SUBSTANCES IN BRICK EARTH:

The harmful substances present in the brick earth have been explained below,

5.1 LIME:

When a desirable amount of lime is present in the clay, it results in good bricks, but if in excess, it changes the colour of the brick from red to yellow. When lime is present in lumps, it absorbs moisture, swells and causes disintegration of the bricks. Therefore,

There should be present finely divided state and lumps, if any, should be removed in the beginning itself.

5.2 PEBBLES AND GRAVELS:

Pebbles and Gravels do not allow the clay to be mixed thoroughly and spoil the appearance of the brick. Bricks with pebbles and gravels may crack while working.

5.3 IRON PYRITES:

This tends to oxidize and decompose the brick during burning. The brick may split into pieces. Pyrites discolourise the bricks.

5.4 ALKALIS:

These form less than 10 per cent of the raw clay, are of great value as fluxes, especially when combined with silicates of alumina. These are mainly in the form of soda or potash. However, when present in excess, alkali makes the clay unsuitable for bricks. They melt the clay on burning and make the bricks unsymmetrical. When bricks come in contact with moisture, water is absorbed and the alkalis crystallize. On drying, the moisture evaporates, leaving behind grey or white powder deposits on the brick which spoil the appearance.

5.5 ORGANIC MATTER:

On burning green bricks, the organic matter gets charred and leave pores making the bricks porous; the water absorption is increased and the strength is reduced.

5.6 CARBONACEOUS MATERIALS:

Present in the form of bituminous matter or carbon greatly affects the color of raw clay. Unless proper precaution is taken to effect complete removal of such matter by oxidation, the brick is likely to have a black core.

5.7 SULPHUR:

Sulphur is usually found in clay as the sulphate of calcium, magnesium, sodium, potassium or iron, or as iron sulphide. Generally, the proportion is small. If, however, there is carbon in the clay and insufficient time is given during burning for proper oxidation of carbon and sulphur, the latter will cause the formation of a spongy, swollen structure in the brick and the brick will be discolored by white blotches.

5.8 WATER:

A large proportion of free water generally causes clay to shrink considerably during drying, whereas combined water causes shrinkage during burning. The use of water containing small quantities of magnesium or calcium carbonates, together with a sulphurous fuel often causes similar effects as those by sulphur.

BRICKS CM(B)

Bricks are blocks of tempered clay moulded to suitable shapes and sizes while it is still in plastic condition, dried under sun and then burnt to make them more strong, hard and durable. Brick is the more extensively used material of construction due to its local and cheap availability depending upon the nature of soil from which the bricks are made, the moulded finish and the quality of heating, the bricks are classified into various categories.

Sun dried Bricks

Properties and uses: These bricks after moulding are dried in the sun and used in the construction of temporary structure and should not be used at the places exposed to heavy rain.

First class bricks

- 1) These are sound, well burnt bricks of uniform color.
- 2) All the faces are uniform and smooth.
- 3) All the edges are sharp.
- 4) These are free from cracks or flaws.
- 5) A broken surface shows a uniform compact texture.
- 6) Scratch with finger nail leaves no mark.
- 7) These don't absorb more than 15% of ^{water} of their ~~total~~ weight.

of their wt. when kept immersed in water for 24 hrs.

3) Two first class bricks when struck with each other give a sharp metallic ringing sound.

a) These bricks may have slight presence of efflorescence by its uses.

b) These bricks are used for all sand works of permanent nature especially in the face work of structures not to be plastered but only pointed.

Non fair faced F.C.B

1) These are on hand as fair faced F.C.B

but may be somewhat irregular in shape and size

all other qualities are same as of Fair faced F.C.B.

2) These bricks are used for all sand works of permanent nature which are to be plastered.

Second class bricks:

These are little underburnt bricks and called soft bricks and these are inferior in properties to the first class bricks, therefore these are used in temporary or low cost single story structures.

Over burnt bricks:

These are over burnt bricks that being near the fire in the kiln get fired and lose their shape. But under the same time have more strength due to over heating.

These bricks may be used for inferior type of constructions or as brick ballast

Composition of Brick earth: A good brick earth should be such that when prepared with water it can be easily moulded, dried and burnt without cracking or warping. It should contain a small quantity of finely divided lime to help in binding the particles of brick together by melting the particles of sand. A little oxide of iron should also be present which would give the brick reddish brown color and act in the same manner as lime. A good brick earth should preferably conform to the following composition:

Clay (Alumina)	20-30% by wt.
Silt	20-35% "
Sand (Silica)	35-50 "

The total content of clay and silt should not as far as possible be less than 50% by wt.

Functions of constituents:

1) Silica or Sand: It is present either free as sand or in combination as silicate of Alumina. Silicate is infusible except at very high temp. but in the presence of alumina in nearly equal proportions and the oxide of iron, it fuses at lower temperatures.

Unlike silicate of alumina, its presence in clay produces hardness resistance to heat, durability and reduces shrinkage and warping. Excess of it makes the bricks brittle.

2) Alumina: It is tenacious finely green mineral component present in brick earth. It is plastic when wet and capable of being moulded to any shape. On drying it loses its plasticity and becomes hard, shrinks, warps and cracks. Burning causes the fusion of its constituents. Therefore making it homogeneous, harder and stronger.

3) Lime: When present in small quantities in finely divided state, it reduces shrinkage of bricks and acts as flux, causing silica to melt. It results in binding the particles of brick together, resulting in greater strength of brick. Excess of lime causes the brick to melt and lose its shape.

4) Magnesia: In the presence of iron, it gives a yellowish tint to the bricks. It should not be present in excess. However, the presence of small quantity with iron will give brick darker color. Total lime and magnesia in case of alluvial soils shall not be more than 1% and in other cases it will preferably not exceed 15%.

5) Oxides of iron: In the presence of silica and alumina, it helps the fusion of brick particles. Also it influences the color of bricks. It produces tint varying from light yellow to reddish brown depending upon the % of iron present in clay. Excess of it, makes the color dark blue. It should not be present in the form of iron pyrites.