UNIT: 1

Stones: it is the natural, hard substance formed from minerals and earth minerals which are present in rock.

Classification of Stones:

(i) Geological

(ii) Chemical

(iii)Physical

1

(i) Geological classification:

1. Igneous Rocks
2. Sedimentary Rocks
3. Metamorphic Rocks

1. Igneous rocks:

Igneous rocks are formed as a result of solidification of molten mass lying below or above the earth's surface. The rocks formed by cooling of magma are called igneous rocks.

(i) Deep seated plutonic rock: if magma solidifies below earth surface. Ex: Granite

(ii) Hybabyssal rock: if magma solidifies at relatively smaller depth. Ex: Dolerite

(iii) Volcanic rocks: due to pouring of magma at earths surface. Ex: Basalt

2

2. Sedimentary rocks: formed due to the deposition of products of weathering on pre existing rocks. These rocks also called stratified rocks.

(i) Residual deposits

(ii) Sedimentary deposits

(iii) Organic deposits

(iv) Chemical deposits

3. Metamorphic rocks: These rocks are formed by the change in character of pre-existing rocks. The igneous or sedimentary rocks are changed in character when they subjected to great heat and pressure. The process of change is known as metamorphism.

3

(ii) Physical classification:

Based on general structure of rocks

(a) Stratified rocks: these rocks show distinct layers along which the rocks can be split.

Ex: Sandstone, limestone

4

b) Unstratified Rocks: These rocks cannot split into different layers

Ex: Granite

5

(c) Foliated rocks: foliated rocks have a tendency to split up only in a definite direction. Most of the metamorphic rocks have a foliated structure.

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(iii) **Chemical classification:**

(a) Silicious rocks: major constituent is silica (SiO_2) i.e. sand. These rocks are hard and durable.

Ex: Granite, Basalt

(b) Argillaceous rocks: major constituent is argil or clay. These are dense and compact. These are hard and durable but brittle.

Ex: slates and laterites

(c) Calcareous: Major constituent is lime.

Ex: limestone's and marbles

7

Properties of good building stones:

(a) Crushing Strength: For a good structural stone, the crushing strength should be greater than 100 N/mm^3 .

(b) Appearance: The stones which are to be used for face work should be decent in appearance and they should be capable of preserving their color uniformly for a long time.

(c) Durability: A good building stone should be durable. The various factors contributing to durability of a stone are its chemical composition, texture, resistance to atmospheric and other influences, location in structure, etc.

(d) Hardness: it should be enough strong and hard to withstand all the stresses applied due to seismic forces, wind loads, and a load of the superstructure.

8

(e) Absorption and porosity:

stones should not be porous and not allow rainwater or any type of acidic water to pass through it. It is impermeable to any type of liquid. Also, the stone must not show any absorption characteristics for liquid.

(f) Seasoning: The stones should be well seasoned before putting into use. The stones obtained fresh from a quarry contain some moisture which is known as the quarry sap. The presence of this moisture makes the stone soft. Hence the stones quarried freshly are easy to work.

9

METHODS OF QUARRYING:

- Excavating
- Wedging
- Heating
- Blasting

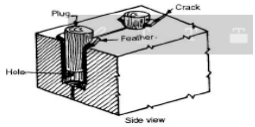
1

EXCAVATING:

Stones buried in earth or under loose overburden are excavated with pick axes, crow bars, chisels, hammers, etc.

WEDGING:

This method of quarrying is suitable for costly, soft and stratified rocks such as sandstone, limestone, laterite, marble and slate.



2

- About 10–15 cm deep holes, at around 10 cm spacing, are made vertically in the rock. Steel pins and wedges or plugs (conical wedges) and feathers (flat wedges) as shown in Fig. are inserted in them.
- These plugs are then struck simultaneously with sledge hammer. The rock slab splits along the lines of least resistance through holes.
- In case of soft rocks, dry wooden pegs are hammered in the holes and water is poured over them. The pegs being wet swell and exert pressure causing the rocks to crack along the line of holes.

3

HEATING:

- This method is most suitable for quarrying small, thin and regular blocks of stones from rocks, such as granite and gneiss.
- A heap of fuel is piled and fired on the surface of rock in small area.
- The two consecutive layers of the rock separate because of uneven expansion of the two layers.
- The loosened rock portions are broken into pieces of desired size and are removed with the help of pick-axes and crow-bars.

4

BLASTING:

Explosives such as blasting powder, blasting cotton, dynamite and cordite are used. The operations involved are boring, charging, tamping and firing.

STEPS INVOLVED IN BLASTING:

(i) BORING:

Holes are drilled or bored in the rock to be dislodged. For vertical holes, jumper is used whereas for inclined or horizontal holes, boring bars are used. One person holds the jumper exactly in the place where hole is to be made. The other person strikes it up and down and rotates it simultaneously. Water is poured in the hole regularly during the operation to soften the rock and facilitate drilling.

5

CHARGING:

- The holes are dried completely and the required amount of charge is placed in the holes.
- For drying the holes, rag is tied in the scrapper and is moved in the hole from where it absorbs the moisture, if any.
- In case it is found that water is oozing into the hole, water tightness is ensured inside the hole.

6

TAMPING:

- After placing the charge in the hole, a greased priming needle, projecting a little outside the hole, is placed in the hole which is then filled up with damp clay or stone dust in layers tamped sufficiently with a braced tamping rod.
- The priming needle should be kept on rotating while tamping is going on. This is done so that the needle remains loose in the hole.
- The priming needle is then taken out and 60 to 75 per cent of space created by withdrawal of needle is filled with gun powder.
- A Bickford fuse, a small rope of cotton coated with tar, is placed just touching the needle. The other end of the fuse is kept of sufficient length so that the person igniting it can move away to a safe place.

7

FIRING:

Blasting powder and cordite are ignited by means of a fuse whereas gun cotton and dynamite are exploded by detonation.

8

PRECAUTIONS IN BLASTING:

- Blasting should not be carried out in late evening or early morning hours. The blasting hours should be made public and a siren should warn the workmen and nearby public timely to retire to a safe distance.
- The danger zone, an area of about 200 m radius, should be marked with red flags.
- First aid should be available.
- .The number of charges fired, the number of charges exploded and the misfires should be recorded.
- Explosives should be stored and handled carefully.
- Detonators and explosives should not be kept together.
- Cartridges should be handled with rubber or polythene gloves.
- A maximum of 10 bore holes are exploded at a time and that also successively and not simultaneously.

9

Dressing of stones:

The stones after being quarried are to be cut into suitable sizes with suitable surfaces. This process is known as the dressing of stones.

Purpose:

To make the transport from quarry easy and economical.

To get desired appearance from stonework.

To suit the requirements of stone masonry.

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BRICKS:

Bricks are obtained by Moulding clay in rectangular blocks of uniform size and then by drying and burning these blocks.

COMPOSITION OF GOOD BRICK:

1. **Alumina:** It is the chief constituent of every kind of clay. A good brick earth should contain 20% to 30% alumina. Alumina absorbs water and renders the clay plastic. If the content of alumina more than excessive it produces cracks in bricks on drying.
2. **Silica:** A good brick earth should contain 50% to 60% silica. It helps the brick to retain its shape, imparts durability. Excessive silica makes brick brittle and weak on burning.

1

3. Lime: A small quantity of lime in brick earth is desirable. Lime should present in a finely powder form not in lump form. If lumps of lime are present, they are converted into quick lime after burning. This quick lime causes splitting of bricks into pieces. Lime reduces the shrinkage on drying.

4. Oxides of iron: 5% to 6% oxides of iron desirable to good brick earth. The colour of the brick depends largely on oxides of iron present in the earth. It gives red colour to the bricks. Excessive oxides of iron makes bricks dark blue or blackish. Less quantity leads to yellow colour.

5. Magnesia: A small quantity of magnesia in bricks decreases shrinkage. Excessive magnesia leads to decay of bricks.

2

CHARACTERSTICS OF A GOOD BRICK:

- It should have sharp edges.
- Bricks should not break into pieces when dropped from height of 1m.
- Bricks shall not have crushing strength less than 55kg/cm^2.
- it should be free from cracks.
- Bricks should not change its volume when it is wetted.
- The colour of brick should be deep red.

3

MANFACTURING OF BRICKS:

1. Preparation of clay
2. Moulding
3. Drying
4. Burning

1. Preparation of clay:

(i) Unsoiling: To remove impurities of organic matter in top soil up to 20cm.

(ii) Digging: Clay is dugout and laid on leveled ground a little below the general surface.

(iii) Cleaning: Stone and vegetable matter removed.

(iv) Weathering: Cleaned earth is spread and exposed to atmosphere for few months.

4

(v) Blending: Mixing of clay, sand and any other material.

(vi) Tampering: Water is added to clay and it is kneaded.

2. Moulding:

(i) Hand Moulding

(ii) Machine Moulding

3. Drying:

Artificial drying

Circulation of air

Period for drying

5

4. Burning:

i. Clamp Burning

ii. Kiln Burning

6

TYPES OF TILES:

1. Roof tiles
2. Floor tiles
3. Pebble tiles
4. Ceiling tiles
5. Wall tiles

1

Roof tiles:

Roof tiles are designed mainly to keep out rain. These tiles are made up of clay or slate.

Flat tiles: these are simplest type which are laid in regular overlapping

2

Types of roof tiles:

Mangalore tiles

Allahabad tiles

Flemish tiles

Guna tiles

3

Mangalore pattern tiles:

They were originally manufactured at Mangalore but now they are manufactured on a large scale in Malabar, cochin, Mysore, MP etc.

These tiles are 2 types class AA and class A

Characteristics	Class AA	Class A
Maximum water absorption percent	19	24
Minimum breaking load (avg)	102	82

4

Allahabad tiles:

These tiles have two legs with a rounded top and are prepared with the help of mould.

5

FLEMISH TILES:

They are S shaped tiles and are prepared with the help of a mould

6

Guna tiles:

These are conical shaped hollow tapered burnt clay tiles. Their diameter at broader end is 10 cm inside where as narrower end 7.5 cm, the thickness of annular ring being 6mm. These tiles manufactured on the potter's wheel.

7

Flooring tiles:

These are commonly made up of ceramic or stones. Due to recent trends we are using rubber or glass tiles for floors as well.

8

Pebble tiles:

Pebble tiles are composite materials made up of marbles pebbles or pieces of natural stone in different sizes bounded together with a transparent white or colored resin.

9

Ceiling tiles:

These tiles are used to cover the ceilings of rooms.

Ex:

Suspended ceilings

Acoustic ceilings

Decorative ceiling tile

10

Wall tiles:

The concept behind wall tiles is decorating the interior of a home.

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CHARACTERSTICS OF GOOD TILE:

- Uniform colour
- Properly burnt
- Free from cracks, flaws, bends
- Hard and durable
- Proper shape and size
- Even and compact structure
- Clear ringing sound

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STANDARD TESTS FOR TILES AS PER CODE:

Transverse strength test
Water absorption test
Impact value test
Breaking strength test

13

Transverse strength test(IS:2690):

Consists of applying load along the Centre line at right angles to the length of the tile(which has been immersed in water for 24 hours) supported on rounded edges of wood bearers. Six tiles are tested and average breaking strength is taken as transverse strength. The rate of loading is kept uniform at 450-550 N/min.

Flexural strength(N/mm^2) = 15WS/bt^2

Where W = breaking load
S = span in mm(3/4 of tile length)
b, t = width and thickness respectively

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Water absorption test:

Six tiles are dried in oven at 105-110 degree Celsius and cooled at rom temperature. They are then immersed in water for 24 hours. Therefore these are wiped dry and weighted.

Absorption in (%) = (W2-W1/W1)*100

Where W1 = weight of dry specimen
W2 = weight of immersed specimen

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Impact value test:

the apparatus for impact test consists of an upright stand fixed to a heavy base. A steel ball 35mm in diameter and 170g in weight is held in jaws of clamp fixed to the stand. Three specimen tiles oven dried at a temperature 100-110 degree Celsius till they attain a constant weight and then allowed to cool at room temperature.

The specimen tile is placed horizontally with its face upwards over a 25mm thick rubber sheet. The tile is adjusted that the ball when released falls vertically on the center of the tile. The steel ball is first released from a height of 75mm. Then the height of specimen is raised in steps of 75mm until test specimen breaks. The maximum height of release of test ball is reported.

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Breaking strength test(IS:1464):

A sample of 6 tiles used for test. The tiles are soaked in water for 24 hours. The 2 longitudinal edges of the tiles are kept, in the normal position, over two strips of 25mm thick rubber sheet placed on the table of testing machine. A 75×100×300 mm block is placed over the ridge of the tile and a load at the rate of 2.7kN/min applied on the bock. The breaking load of individual tile is noted. It is divided by the length of tile. The result are reported in N/mm.

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Manufacturing of tiles:

1) Preparation of clay
2) Moulding
3) Drying
4) Burning.

1) Preparation of clay:

- The selected clay is taken and free from any impurity such as grit, pebbles, etc. such clay is then pressed and turned into fine powder in pug mills. For high-quality edges, a large amount of pure water is added to crushed clay and it is mixed well into the tank.
- The mixture is then allowed to stand quietly. Coarse heavy particles settle in the bottom of the tank. The fine particles are taken into other bins and the water is allowed to dry.
- The best clay used after such a process for making tiles, a mixture of ground glass and pottery ware can be added to the edges of the clay to make the edges harder and intrusive.

1

2) Moulding:

- The clay is placed in molds that represent the type or shape the tile is to be created. Molding can be done with the help of wood molds or mechanical means or by a potter's wheel. Wood molds should be made from well-spiced wood. The clay is pressed in such molds. And when the soil is removed from the mold the edges are ready to dry.
- Care should be taken to preserve the shape of the edges when removing molds. Molding involves the provision of machinery with the help of mechanical means and clay is pressed into such machines to obtain the desired section and edges of shapes.
- The molding method of the potter's wheel is similar to the method used by the potter in making pottery. This method is adopted when the tile is circular while on the wheel. However, it may have a diameter along with it.

2

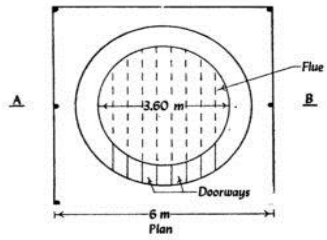
3) Drying:

- The edges, as they come out of the mold, lay flat on top of the appropriate number. Thus different piles are formed. After about 2 days, irregular [edges rare due to warping is fixed with Fiat wood mallet.
- They are only lifted when the edges are hardened by hand. The edges and undersides are swatched. They are attached to the edge of the shade to dry for about two days.
- The tiles are drying in the shade and the sun and rain prevent the edges from cracking and warping.

3

4) Burning:

Tiles are then burnt in kilns. A typical kiln for accommodating about 30000 to 40000 tiles as shown in fig.



Circular kiln for burning tiles

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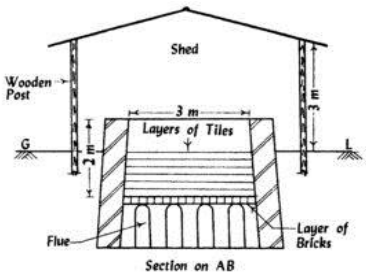

Section on AB

5

- It is circular in shape and is protected by a shed. A layer of tiles is laid flat on the rows of long. Burning is affected if firing wood is placed in.
- These flues. Bricks are arranged in such a way that the open spaces between them remain. On top of the bricklayer, the dried edges are placed over the edge layer by layer. Closing the vents is affected by the brickwork in the soil. The top of the nest is loose in the layer of old edges.
- Heat control is important to achieve good results. The fire is initially quiet. It removes moisture. It is then raised to about 800. C. It is let loose for about 6 hours and raised to white heat again, bringing the temperature to 1300. C. This temperature is maintained constant for 3 hours.

6

- The process of loosening the fire for 6 hours and then increasing the temperature to white heat is repeated. White heat is maintained for 4 hours. Finally, the flues are filled with fuel and the doors are closed with brickwork in the mud. The kiln then gradually allows cooling. It takes about 72 hours to complete the process of burning the tiles.
- The edges are removed from the nest. Underburned tiles are sorted and placed on top of the nests to burn the edges.

7