DHANBAD INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF CIVIL ENGINEERING

SUBJECT: CONSTRUCTION MATERIALS

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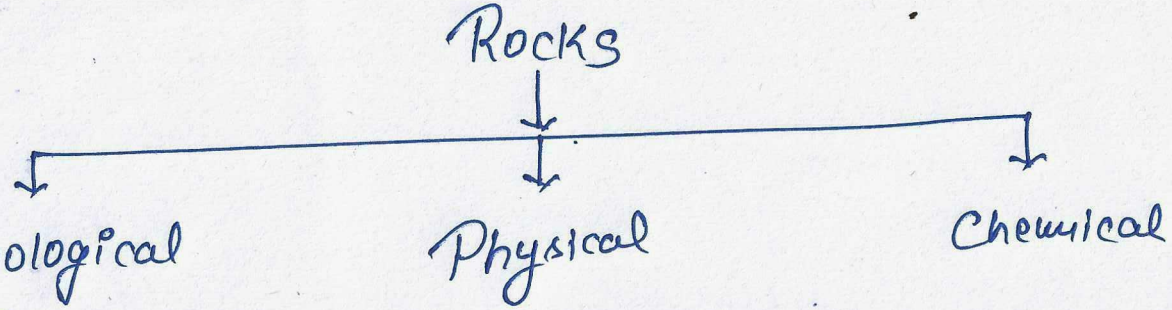
Rocks:- Rocks may be defined as the portion of the earth's crust having no definite shape and structure.

Almost all rocks have a definite chemical composition and are made up of minerals and organic matter some of rock forming minerals as follows:- Quartz, felspar, mica, dolouite etc.

Classification of Rocks :- The Rocks can be Classified on the basis of the following.



On the basis of Geological Classification :-

(a) Igneous Rock :- It is also known as primary unstratified eruptive rock of volcanic origin and are formed as result of solidification of molten mass lying below or over the surface of the earth.

Eg:- Granite, Rhyolite, Syenite, Andesite, Gabbro, peridolite, feldspar, mefic Rock.

⟹ Igneous Rocks are classified as below:—

[Cooling location]

Intrusive

Magma Earth के अंदर

Set (solid)

Eg - Diorite, Gabbro, granite, pegmatite, Syenite

- Plutonic Rock → Deep depth पर सेट (↓)
  - Eg - Granite
  - Structure → ↓ course grained
- Hypabyssal Rock → Shallow depth पर सेट (↓)
  - Eg - Daloxite
  - ↓ Fine Grained

Extrusive

magma earth surface में सेट (solid)

Eg :- Basalt, trap, Andesite, Decite, pumice, Rhyolite Soria, Tuff, Dolerite.

Volcanic Rock में main (Basalt, trap) आते है।

Structure (volcanic Rock) ↓ extreme fined.

(b) Sedimentary Rock :— These are known as aques or stratified rocks the various weathering agencies is air, water, sun, gravity, ice etc. breakus up the surface of the earth leading to the formation of these rocks, the properties of these rocks are very considerable depending upon the nature of sediment & types of bond b/w them.

Eg:- Sand stone, Lime stone, Gypsum, Chalk, Diatomite, Shale, gravel, laterite, liguite, calcite, Coal etc.

(c) Metamorphic Rock :— These are formed when igneous or sedimentary Rocks as a result of action of the earth movement, temperature & liquid preasure etc.

Eg- Marble, Quartzite, slate, Genissis, etc.

Note :— Shole (sedimentary) ⟶ Slate (metamorphic)

Lime stone ⟶ Marble

Granite ⟶ Genesis

Sand stone ⟶ Quartzize,

Qualities of Good Building Stones :— Desirable properties of Good Building Stones :-

(a) Compressive Strength :— Should Not be less than 100 MPa.

(b) Appearance :— Proper appearance and colour should be uniform.

(c) Durable :- Stone should be durable in weathering condition. Alternate wetting & Drying, freezing & thawing.

(d) Hardness :- Hard — If Hardness value is greater than 17.

Medium Hard — Hardness value is b/w 14 — 17.

Poor or less hard — If hardness value is less than 14.

Note :— For Road Work Stone Should not be used is hardness coefficient is below 17.

(e) Toughness Test :- High toughness → > 19

Moderate toughness → 13 — 19

Poor toughness → < 13

(f) Percentage of weir :- Percentage of weir should Not be more than 3%.

(G) Specific Gravity :- 2.7 (2.4 – 2.7)

(H) Water absorption Capacity :- A Good building stone water absorption capacity should not be more than 5% of the weight of stone or a stone should be rejected if water absorption exceed 10% of the weight of stone.

(I) Fire resistance Capacity :- Stone should be fire resistant (It can be staud up to 800°C)

Note :- (i) Compacted saud stone has high standard of fire resistance.

(ii) Quartz have most weather resistance capacity.

(J) Porosity & Absorption :-

→ It depends on the minerals cooling time and structural formation.

→ Permissible water absorption for different stones are as follows :-

Saud stone → 10
Lime stone → 10
Granite → 1
Trap → 1

Shale → 10
Gniss → 1
Slate → 1

Properties of Stones :—

1. Hardness
2. Porosity
3. Density
4. Specific Gravity
5. Strength
6. Toughness
7. Seasoning
8. Appearance
9. Workability
10. Durability.

- Fire Resistance
- Resistance
- Texture.
- Water absorption
- Structure

Quarrying of Stone's :— The only operation involved in the production of natural stone is termed as Quarrying process.

→ While selecting Quarrying following point's must be consider.

(a) Availability of sufficient stones Quantity of desired Quality.

(b) Proper transportation facilities.

(c) Availability of cheap labour and area-vail for dumping of refuse.

(d) Problem of penetration of rain water.

Quarrying can be done by following method :—

1. Excavation.
2. Wedging.
3. Heating.
4. Blasting.

Quarrying By the method of Blasting :—

In blasting following tools are used :-

(i) Jumper → It is used to stone in a suitable hole.

(ii) Scrapping Spoom → It is used for fine stone to out from Rock.

(iii) Priming needle → In the hole primary needle is provided.

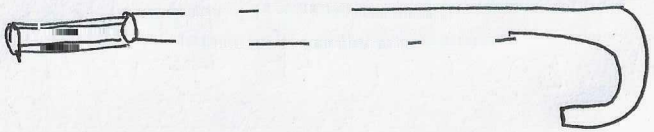
(iv) Tempering Rod → To compact the needle in the Rock.

In blasting following matterials are used :—

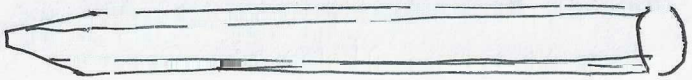
(i) Detonators's → Made of copper, cylindrical shape, filled with 6-9 gram of mercury having dia 6m & length 25mm. One end is closed and another end has fuse to fire.

(ii) Explosive → It is a form of Gun powder, Dynamite blasting powder Gun cottom, blasting Gelatine, coxdite gelethne, liquid oxygen etc. Explosive of blasting used in Kilogram.

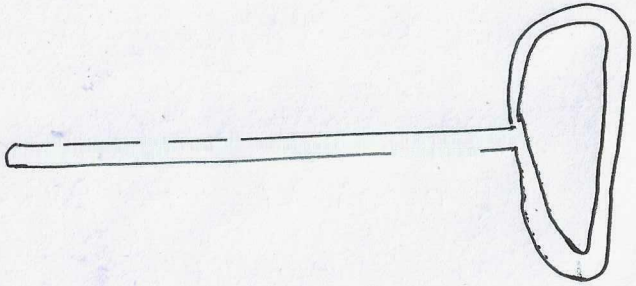
{Blasting powder in N = (Line of Least Resistance in cm)^2 x 1.50.}



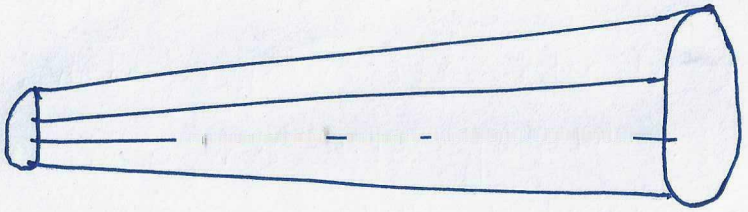
Scrapping spoon



Tamper



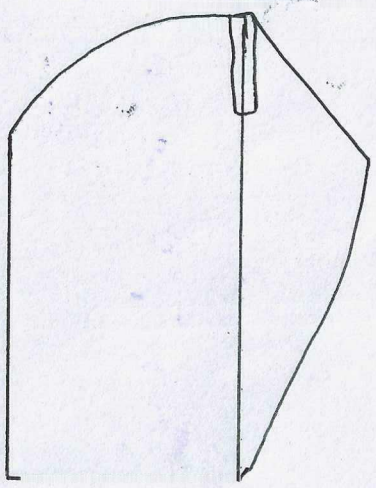
Perimring needle



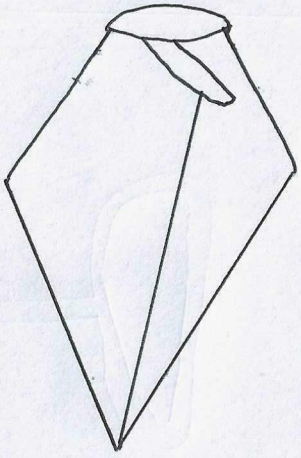
Tamping Bar

Quarrying By the method of Wedging :— In this method if Rock surface contains cracks or fissures, the steel wedges or points are driven through such cracks by means of hammers. The blocks of stones are then shifted and they are removed with the help of suitable instruments. → A plug is conical steel wedge.

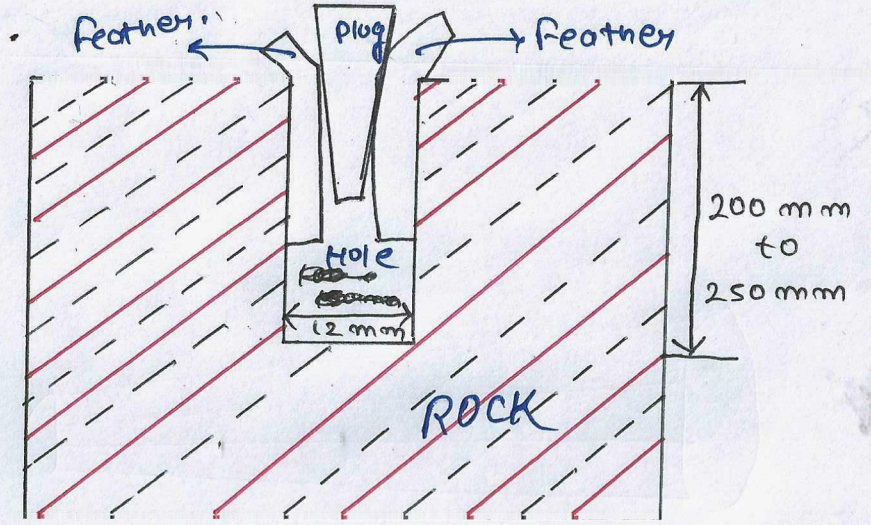
→ A feather is a flat steel wedge with its upper end slightly curved.



Steel Wedge



Steel point



Plug and feathers

Deterioration of Stone's :- The Stones with exposed are acted upon by various atmospheric and external agencies so as to cause their deterioration. Following are the causes of decay of Stones.

1. Alternate wetness and drying.
2. Frost.
3. Impurities in atmosphere.
4. Living Organisms.
5. moments of chemicals.
6. Nature of mortar.

→ It is found that stones subjected to such alternate wetness and drawing wear out Quickly.

→ In hill station's or very cold places, the moisture present in the atmosphere is deposited in the pores of Stones.

→ The atmosphere contains various impurities which have adverse effects.

→ Some living organisms like worm's and bacteria act upon stones and deteriote them.

Preservation of Stones :—

① It is essential to prevent in its decay

② Different types of stones required different treatement for its preser.

③ In General stone should be made dry with help of blow lamp and then a coating of perejin, linsed oil, light paint etc is applied over surface.

④ This make a protective layer over the stone.

⑤ However this periodic and not permanent.

⑥ When treatement is done with linsed oil, it is boiled and applied in three coats over the stone.

Note:— In Industrial town stones are preserved by application of Solution of Barium hydrate also termed as 'BARYTA'

$[Ba(OH)_2] \longrightarrow Ba(OH)_2 + CaSO_4 = BaSO_4 + Ca(OH)_2$

→ Here baryta react's $CaSO_4$ deposits on stone and form insoluble barium sulphate and calcium hydroxide.

→ $Ca(OH)_2$ absorbs CO_2 from air to form $CaCO_3$ precepetate.

$$[Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 \downarrow$$

Properties of Sand :- Following are the properties of Good Sand.

→ It should be chemically inert.
→ It should be clean & coarse.
→ Usually 3–4% clay is permitted
→ It should contain sharp, angular, coarse & durable grain's.
→ It should not contain's salt which attract moisture from the atmosphe.
→ It should be well graded
→ It should pass BIS No 480 mesh sieve & should not pass BIS No 15 mesh seive.
→ The fineness modulus of sand should be b/w 2 and 3.

Classification of Coarse aggregate according to Size:-

Coarse aggregate generally defined as materials retained on a 4.75 mm (or 3/16 inch) sieve are classified by size into categories like fine gravel (4.75 to 8 mm) medium gravel (8 to 16 mm) and coarse gravel (16 – 30 mm).

Crused Stones:- Rock that has been crushed to a desired size.

Cobbles → 64 mm – 256 mm.

Boulders → > 256 mm.

Size Rauge:- 4.7 — 9.5 mm
9.5 mm — 13.2 mm
13.2 mm — 19 mm
19 mm — 37.5 mm
37.5 mm — 75 mm

Note:- Coarse aggregate can also be classified by shape rounded, irregular, angular, flaky, or elongated.

It is term used to indicate the paste form by addition of water in specified proportion in mixture of binding material, fine agg, coarse agg & admixture (if required).

Building material + Fine agg + Course agg + Admixture + water = concrete.

- Building material → Cement, lime, Gypsum
- Fine agg → Surkhi clay
- Course agg → Gravel

Note :- $1 m^3$ of wet Concrete = $1.53 m^3$ of dry Concrete.

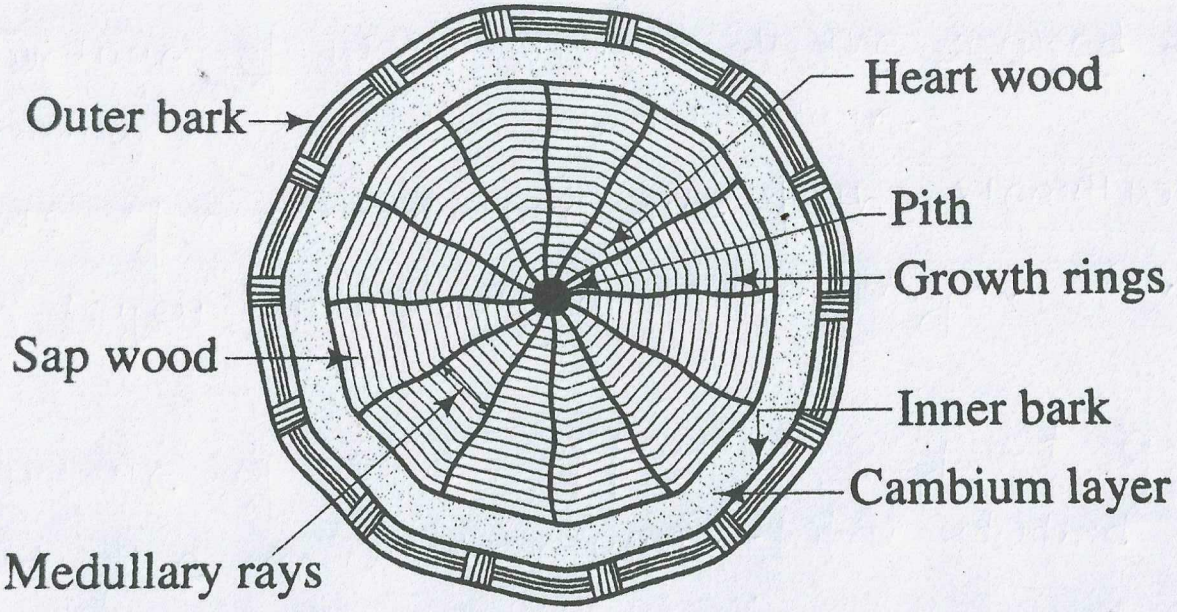
Date - 15/04/25.

Structure of timber :- From the visibility aspect, the structure of a tree can be devided into two categories :-

(1) Macrostructure (2) Microstructure.

→ The structure of wood visible to the naked eye or at a small magnification is called macrostructure.
Components of macrostructure are pith, Heart wood, Sap wood, cambium layer inner bark, modular rays. etc.

→ The Structure of wood apparent only at great magnifications is called the microstructure. When studied under a microscope it, becomes evident that wood consists of living & dead cells of various sizes & shapes.



Cross-section of an exogenous tree

FIG. 9-1

Properties of Good Timber :— In general, the quality of timber depends on the following factor's :—

1. Environmental conditions.
2. Maturity of the tree
3. Method of Seasoning
4. Nature of Soil
5. Process of preservation
6. Time of felling.

Following are the characterics of Good timber.

→ Appearance → Hard & shining appearance.

→ Colour → Dark colour

→ Defects → Serious Defects such as dead, knots, flaws, shakes etc.

→ Durability → A good timber should be durable.

→ Fibres — The timber should have straight fibres.

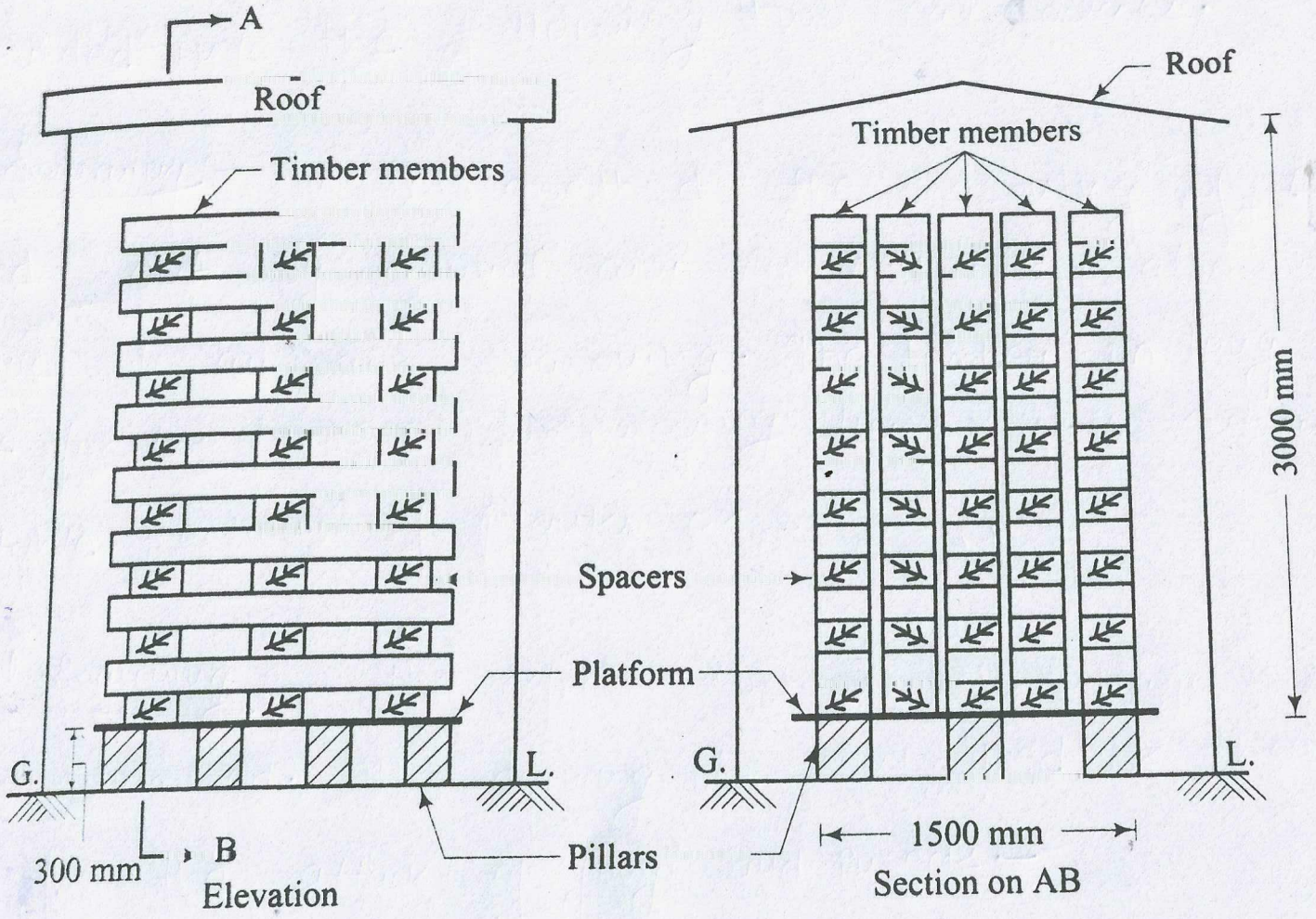
Method's of Seasoning :- The methods of seasoning can broadly be devided into the following two categories.

(a) Natural Seasoning :- In this method the seasoning of timber is carried out by natural air and heuse it is also sometimes reffered to as air seasoning. The timber in long form is not usually fit for the process of seasoning Hence it is cut and shown into suitable sections of planks or S

(b) Axitificial Seasoning :- The defects such as shrinkage, cracking & warping are minimized. The driving is controlled & there as practically no chances for the attack of fungi and insects —

→ The drying of different surfaces is even & uniform.

→ It is considerably reduces the period of seasoning.



Horizontal stack for air seasoning

FIG. 9-3

Defects in Timber :- The defects occuring in timber are grouped into foollowing five division.

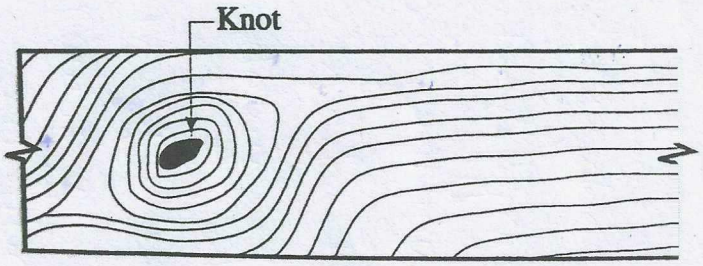
(1) Defects due to conversion :- During the process of converting timber to the commercial form, the following defects may occur. such as chip mark, Diagonal grain, Torn grain, Wane etc.

(2) Defects due to fungi :- The fungi are minute microscopic plant organisms. They attack timber only when the following two conditions are satisfied Simultaneously.

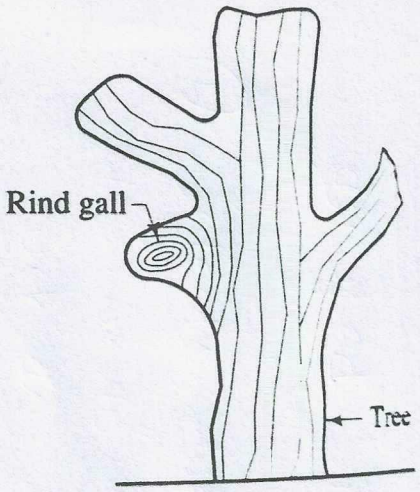
(3) Defects due to Insects :- Insects which are usually responsible for the decay of timber.

(4) Defects due to natural forces :- The main natural forces responsible for causing deflects in timber are two namely, abnormal growth and rupture of tissues.

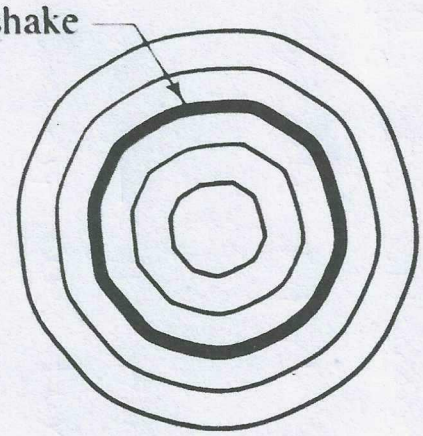
(5) Defects due to seasoning :- Defects occur in the seasoning process of wood.



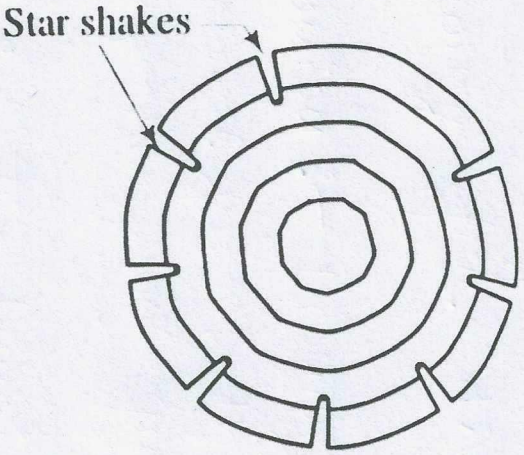
Knot
FIG. 9-8



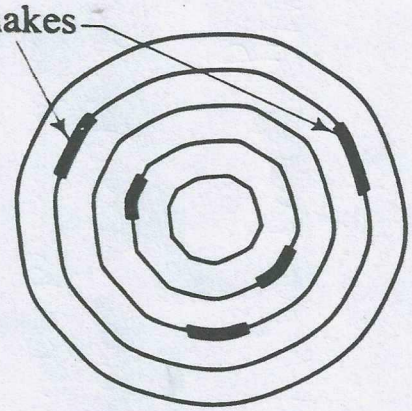
Rind gall
FIG. 9-9



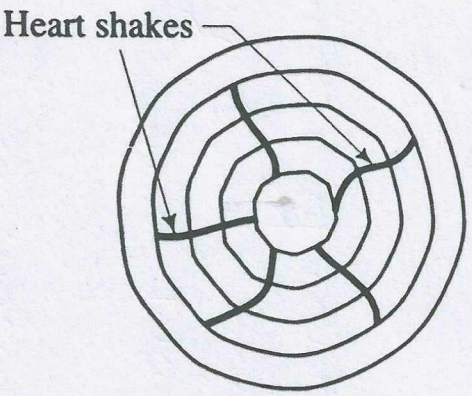
Ring shakes
FIG. 9-12



Star shakes
FIG. 9-13



Cup shakes
FIG. 9-10



Heart shakes
FIG. 9-11

Uses of Bamboo in Construction :—

① Structural Elements :- Bamboo can be used for walls, floors, ceilings, roof frames, & even foundations.

② Reinforcement :— It is used as a reinforcing material in concrete and masonary, enhancing their strength & earthquake resistance.

③ Scaffolding :— Bamboo is a traditional and cost-effective material for scaffolding on construction sites.

④ Fencing & Privacy Screen :- Bamboo is used for creating fences & privacy screen.

⑤ Flooring :— It is sustainable & durable alternative to traditional hardwood flooring.

⑥ Doors and Windows :— It is used in construction of doors & windows. providing a durable & ecofriendly option.

Asphalt :- It is a construction materials which is used in road & pavement construction, where it is acts as a binding materials.

Uses :- (1) Road construction.
(2) Water proofing
(3) Other Application
(4) Bitumin as binder.
(5) Asphalt concrete.

THE END

IMPORTANT QUESTION

1.Identify rocks based on geology of its origin

2.Explain the requirements and characteristics of stones

3.Explain the methods of Quarrying of stones

4.Explain the methods of deterioration of stones

5. Explain the methods of preservation of stones

6. Mention the properties of sand and its uses

7.Explain the classification of Coarse aggregate according to size

9. Explain the structure and properties of timber

10.Apply the use of Bamboo in construction.

MCQ-QUESTION

1. Which of the following is an igneous rock?
A. Marble
B. Granite
C. Slate
D. Limestone
✅ **Correct Answer: B. Granite**

2. Which rock is metamorphic in nature?
A. Basalt
B. Shale
C. Quartzite
D. Sandstone
✅ **Correct Answer: C. Quartzite**

3. The main constituent of limestone is:
A. Silica
B. Calcium Carbonate
C. Aluminum Oxide
D. Iron Oxide
✅ **Correct Answer: B. Calcium Carbonate**

4. Which type of rock is formed by the cooling of molten magma?
A. Sedimentary
B. Metamorphic
C. Igneous
D. Organic
✅ **Correct Answer: C. Igneous**

5. Slate is obtained by the metamorphism of:
A. Granite
B. Limestone
C. Shale
D. Sandstone
✅ **Correct Answer: C. Shale**

6. Which rock is most suitable for road metal?
A. Marble
B. Granite
C. Basalt
D. Sandstone
✅ **Correct Answer: C. Basalt**

7. Which of the following rocks is sedimentary in nature?
A. Gneiss
B. Limestone
C. Marble
D. Granite
✅ **Correct Answer: B. Limestone**

8. The durability of a building stone depends mostly on:
A. Color
B. Chemical composition
C. Texture
D. Hardness
✅ **Correct Answer: B. Chemical composition**

1. Which of the following stones is commonly used for flooring and paving?
A. Basalt
B. Granite
C. Slate
D. Quartzite
✅ **Correct Answer: C. Slate**

2. The stone which can be split into thin sheets is:
A. Granite
B. Slate
C. Marble
D. Limestone
✅ **Correct Answer: B. Slate**

3. Which stone is mainly composed of calcium carbonate?
A. Granite
B. Limestone
C. Slate
D. Basalt
✅ **Correct Answer: B. Limestone**

4. The hardest and most durable stone used in building construction is:
A. Marble
B. Granite
C. Sandstone
D. Shale
✅ **Correct Answer: B. Granite**

5. Which of the following stones is metamorphic?
A. Sandstone
B. Marble
C. Limestone
D. Shale
✅ **Correct Answer: B. Marble**

6. The stone suitable for making sculptures and decorative items is:
A. Basalt
B. Marble
C. Slate
D. Quartzite
✅ **Correct Answer: B. Marble**

7. What is the chief use of laterite stone in construction?
A. Foundation work
B. Decorative purposes
C. Road metal
D. Wall construction
✅ **Correct Answer: D. Wall construction**

8. A good building stone should not absorb water more than:
A. 10% by weight
B. 15% by weight
C. 20% by weight
D. 5% by weight
✅ **Correct Answer: D. 5% by weight**

9. Which test is used to check the toughness of stones?
A. Attrition test
B. Crushing test
C. Impact test
D. Water absorption test
✅ **Correct Answer: C. Impact test**

10. Sandstone is mainly composed of:
A. Quartz
B. Mica
C. Feldspar
D. Calcite
✅ **Correct Answer: A. Quartz**