unit-1 Natural Construction Material

Stone

→ The Engineering structure are composed of Material those Material are known as Engineering Materials; and those materials are use for the construction of a building are known as building Materials.

→ Some properties Building construction such as :-

(i) Water Resistance
(ii) Strength
(iii) Durability
(iv) Temperature Resistance
(v) Pemeability
(vi) Appearance

* **Rock :-**

Classification of Rock :-

(i) Geological classification
(ii) Physical classification
(iii) Chemical classification

Geological classification :-

→ As for the geological classification the rock is classified into three categories :-

(i) Igneous Rock
(ii) Sedimentary Rock
(iii) Metamorphic Rock

Igneous Rock :-

→ The inside Part of the earth surface has high temperature, so as to cause generate hit by ordinary pressure.

→ The multen or pasty rocky Material is known

known as Magma. This magma occasionally trys to come out to the earth surface, through that cracks or weakest part of the earth surface.

→ That magma become hard offter application of atmosphere pressure by cooling slowly.

→ When that hot magma converted into cool material that material is known as Igneous Rock.

→ Igneous Rocks is classified into three categories :-

① Plutonic Rock
② Hypabysal Rock
③ Volcanic Rock

① Plutonic Rock :-

→ The Rock is from due to cooling of magma at the considerable depth of the earth surface.

→ Here the process of cooling is very slow and it forms coarsly grained cristalyne structure.

Ex :- granalite

② Hypabysal Rock :-

→ The Rock is form due to cooling of magma at reletably shallow depth of the earth surface.

→ Here the cooling process his slightly quick.

→ A forms finely grain cristalyne structure.

Ex :- Dolerite.

(iii) Volcanic Rock :-

→ The Rock is form due to cooling of magma on the earth surface.

→ Here the cooling process is very quick.

→ A forms extreme finely grain cristalyne structure.

Ex :- Basalt

* Use of stone :-

→ The following are the use of stone :-

(i) structure
(ii) face work
(iii) Paving
(iv) Basic Material
(v) Miscellaneous use

(i) Structure :-

→ The stones are used for foundation, wall, coloum, lintel, Arch, roof, floor, damp-proof curses etc. (DPC).

(ii) Face work :-

→ The stones are adopted to give messive appearance to the structure.

→ The walls are of brick and fashing is done in stone this is known as composite Masonary.

(iii) Basic Materials :-

→ The stones are dis-integrated and convert to form a basic materials such as stone, aggregate, hollow block etc.

(iv) Paving :-

→ Stones are used to cover of floor of the building is known as Paving.

→ Paving is also adopted on road and footpath.

(v) Miscellaneous use :-

→ Stones are also use for the ballast of the Railway tract metal for the bridge, abudment, Pier, Retaining work etc.

* Natural bed of stone :-

→ The stones are obtained from the Rock.

→ These rocks have a distinct plane of division along which stones can easily be split, this plane is known as natural bed of stone.

* Quabities of a good building Stone :- / Characteristics

(i) Appearance
(ii) Crushing strength
(iii) Durability
(iv) Facility of Dressing
(v) Fracture
(vi) Hardness
(vii) Percentage wear
(viii) Resistance to fire
(ix) Seasoning
(x) Specific Gravity
(xi) Texture
(xii) Toughness index
(xiii) water absoption
(xiv) weathering

(i) Appearance :-

→ The stones which are to be used for face work should be descent in appearance and they should be capable of preserving their colour uniformly for a long time.

→ The colour of the stone for facework should

be choosen by keeping in my the generals get-up surrounding area. It is prefer the light colour stone as compare to dreak colour stone because there is a chances of veriety to be aeftek easily by weathering agents.

→ A Good building stone should be of a uniform colour & free form types of whole & spots of other colour irregularities etc.

(II) Crushing Strength :-

→ For a good building stone the crushing strength should be greater then 100N/mm². The approximat value of crushing strength of difference strength of different stones are shown in below.

Rock	Stone	Crushing strength in N/mm²
Igneous	Basalt	150 - 185
	Diorite	90 - 150
	Granite	75 - 127
	Syenite	90 - 150
	Trap	330 - 380
Sedimentary	Laterite	1.80 - 3.10
	Lime stone	54
	Shale	0.20 - 0.60
Metamorphic	Gneiss	20.6 - 370
	Slate	75 - 207

(III) Durability :-

→ A Good building stone should be durable.

→ The various factors contributing to durability of a stone are chemical composition, Texture

Resistance to atmospheric, location of structure, etc.

→ following are the important atmospheric agency which effect the durability of stones.

(i) Alternate condition of heat & cold due to different temp.

(ii) Alternate condition of wetness & dryness due to rain & sunshine.

(iii) Chemical agencies such as dissolved gases in rain. ex:- acid rain.

(iv) Growth of different types of trees in the join between the stones.

(IV) Facility of Dressing :-

→ The stone should be such that they can be easily moulded, cut & dressed it is an important consideration from the economic point of view.

(V) Fracture :-

→ For a good building stone a fracture should be sharp, even, bright & clear.

(VI) Hardness :-

→ The co-efficient of hardness of a stone should be greater than 17.

→ If it is in between 14 to 17 than the stone is said to be medium hard.

→ If the stone is less than the stone is called poor & such stones are used in construction of road & railway Ballast.

(VII) Percentage wear :-

→ If the wear is more than 3% then the stone is not satisfactory.

→ If it is equal to 3% then the stone is just tolerable.
→ For a good building stone the wear should be equal & less then 3%.

(VIII) Resistance to fire :-
→ The failure of stone in case of fire is due to various regeion. such as rapid rise in temp sudden falling etc.
→ The lime stone can resist the fire up to 800°C.
→ Ex:- the free quartz suddenly expand at a temperature of 600°C centigrade.

(IX) Seasoning :-
→ The stones should be well seasoned before putting in to use.
→ Stones obtained some moisture in quarry site is known as quarry sap.
→ Presence of moisture in stone makes it soft.
→ The stone should be dry or seasoned before they are used in structure work.
→ The period of seasoning of stone is 6-12 month.

(X) Specific gravity :-
→ For a good building stone the specific gravity should be greater then 2.7.
→ The stone should have less porous and they can be used for various engineering application such as dam, retaining wall, road etc.

(XI) Texture :-
→ A Good building stone should have free from all types of Cracks Cravities, Patches etc.
→ The stone should be strong and durable.

(XII) Toughness Index :-

→ In impact test, the value of toughness index come bellow 13, then the stone is not tough.

→ If the value of thoughness index is in between 13-19 then the stone is said to be moderately.

→ If the value of toughness index is excid 19 then the toughness is said to be high.

(XIII) Water absorption :-

→ All the stones have less, or more porous. But a good building stone the percentage absorption by weight after 24 hrs should not excid 0.60.

→ The porous stone seriously effect the suriability of stone.

→ If the porous stone are used then the remains in the ~~proce~~ pores, then the stone can be easily disintegrate.

(XIV) Weathering :-

→ A Good building stone should posses better weathering quality.

→ It should be capable for with standing of various atmospheric agency such as wind, rain etc.

→ The best way to know the resisting power of a stone of other is to study the performance of building constructed with similar stone in same area in locality in same atmospheric condition.

* Stone Quarring :-

→ The process of taking out stones from natural bed of rock is known as stone quarring.

* Method of quarrying :-

(i) quarrying with hand tools.
(ii) quarrying with channelling mechine.
(iii) quarrying by Blasting.

(I) quarrying by hand tools :-

→ There are three different way for quarry by hand tools.

(i) Digging or
(ii) Hitting
(iii) Wedging

Digging or

→ In this method the stones are ext with the help of suitable instrument such as pick-axe, hammer, chisel etc.
→ This method is suitable for quarring on soft

~~Hitting~~ Heating :-

→ In this method the top surface of the rock is hitted.
→ It is ~~hitted~~ Heated by placing would pice with fuel and apply the fire.
→ After some hour due to unequal expansion the layer of the rock is separated out.
→ The part other or is than remove by using suitable instrument such as pick-axe.
→ quarrying by heating method can be applicable when surface of the rock should not have that much of irregular.

Wedging :-

→ If the natural cracks are absent on the rock then artificial crack should be formed.
→ A line of hole is drilled along the Rock surface.

→ The diameter of hole is 12mm. distance between to hole should be 100 to 150mm depth should be 200 to 250mm.

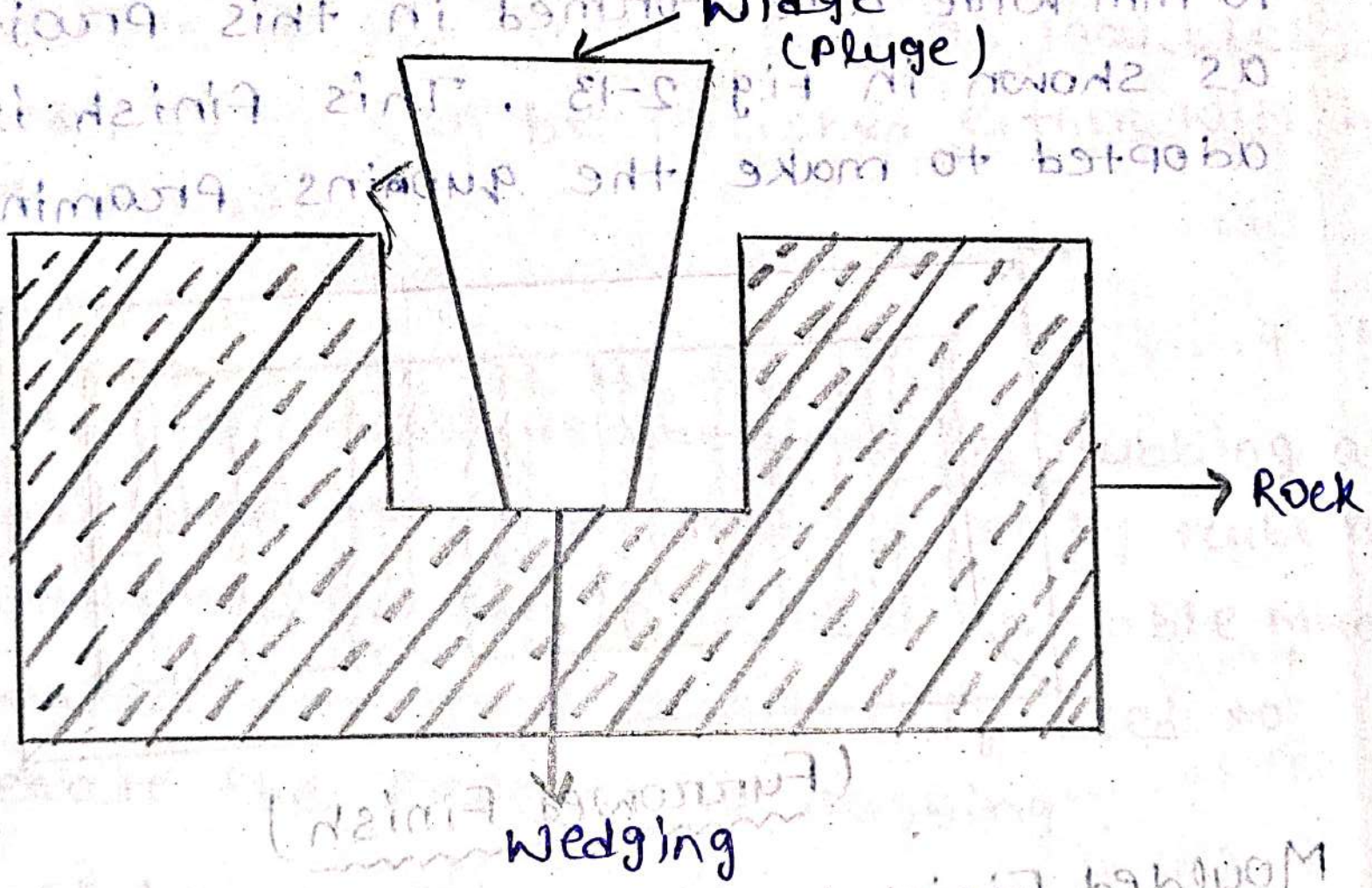
→ The pluge is in conical shape. two figure plate still plate which are curve at upper part.

→ The wedge is plate in between two figure.

→ The wedge is contuniously hammered for triven.

→ When the wedge is force by the hammered contineously them there a artificial crack in form bellow the hole.

* Wedging Figure



(11) quarrying by channeling Mechine :—

→ The channeling Mechine is opperated by Electricity.

→ This Mechine make a grooves rappidly having a length of 20M, width of 50 to 75 and 2.4 to 3.7 Meter depth.

Process :—

→ The channels are cut around the stone block which is to be remove.

→ The horizontal holes are drille.

→ wedges are driven into that hole.

→ quarrying by Blasting :—

→ This Method is use to convert the rock into the smaller pieces of stones.

→ This method is adopted for quarrying very hard stone.

→ which stone we obtain by blasting usually of small size and they are use for ballest in railway track, aggregate for concrete, Road Metal etc.

* Dressing of stones :-

1 Axed Finish :-

→ The surface of hard stones such as granite are dressed by means of an axe. such as finish is termed as an axed finish.

Chisel - draughted margins :-

→ In order to obtain uniform joints in stone work, the margins are placed which may be either squared or pitched or chamfered.

Circular Finish :-

→ In this type of finish, the surface of stone is made round or circular as in case of a column.

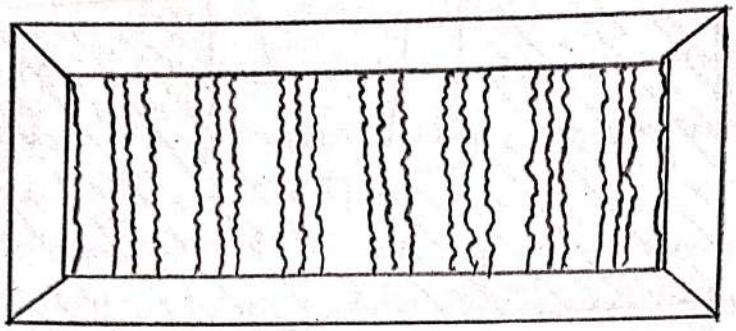
Dragged or Combed finish :-

→ In this type of Finish, a drag or a comb, which is a piece of steel with a number of teeth, is rubbed on the surface in all directions and surface.

Furrowed Finish :-

→ In this type of finish, margin of about 20mm width, is sunk on all the edges of stones and the central portion is made to project about 15mm.

A number of vertical or horizontal grooves about 10 mm wide are formed in this projected portion as shown in Fig 2-13. This finish is generally adopted to make the quoins prominent.



(Furrowed Finish)

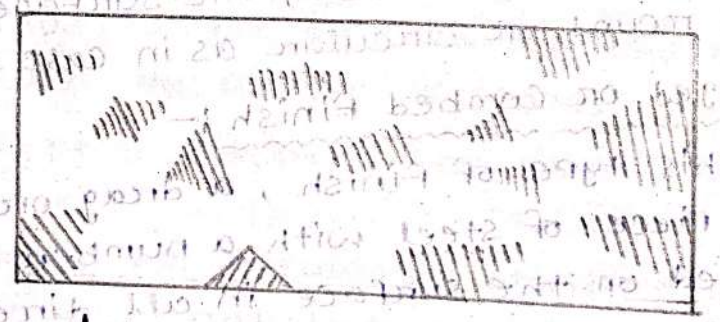
Moulded Finish :-

→ The surface of stone can be moulded in any desired shape so as to improve the appearance of the work. The mouldings can be made either by hand or machine.

Hammer-dressed Finish :-

→ In this type of finish, the stones are made roughly square or rectangular by means of a hammer.

→ Stones have no sharp or irregular corners and have comparatively even surface so as to fit well in masonry.



(Hammer-dressed Finish)

Plain Finish :-

→ In this type of finish, the surface of the stone is made approximately smooth with a saw or with a chisel.

→ There are three terms which is connecting with the timber :-

(I) Converted timber :
(II) Rough timber
(III) Standing timber

(I) Converted timber :-

→ This indicates timber which is sawn out and cut into suitable commercial sizes.

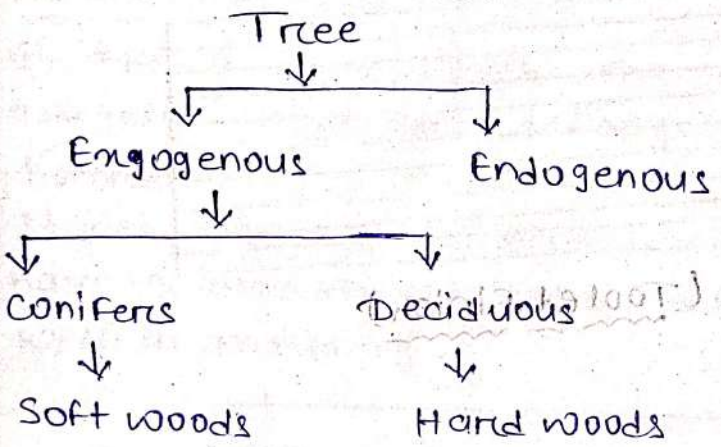
(II) Rough timber :-

→ This indicates timber which is obtained after felling a tree.

(III) Standing timber :-

→ This indicates timber contained in a living tree.

* Classification of tree :-



Exogenous trees :-

→ These trees increase in bulk by growing outwards and distinct consecutive rings are formed in the horizontal section of such a stree. These rings are known as the annual rings because one such ring is added every year and these rings are useful in peredicting the age of tree. The exogenous trees are further subdiveided into two groups.

Polished Finish :-

→ The surface of the stones such as marbles, granites, etc. can be polished either with hand or with machine.

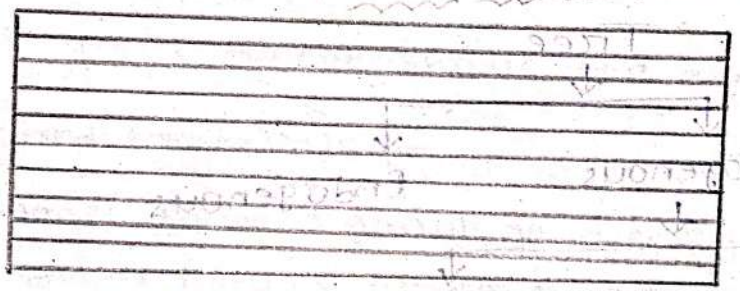
Rubbed Finish :-

→ This type of finish is obtained by rubbing a piece of stone with the surface or by rubbing the surface with the help of a suitable machine.

→ The water and stand are freely used to accelerate the process of rubbing.

Tooled Finish :-

→ The stone surface is finished by means of a chisel and parallel continuous marks, either horizontal or inclined or vertical, are left on the surface as shown in fig. 2-16.



(Tooled Finish)

* Timber :-

Introduction :-

→ The word timber is derived from an old english word timbrian which means the build.

→ The timber thus denotes wood which is suitable for building or carpentry or various other engineering purposes and it is applied to the trees measuring not less then 600 mm in girth or circumference of the trunk.

(I) Conifers
(II) Deciduous

(I) Conifers trees :-

→ The conifers are also known as the ever-green trees and leaves of these trees do not fall till new ones are grown.
→ These trees bear cone-shaped fruits.
→ So, the name of the tree is conifers tree.
→ These trees provide soft woods, light in weight and weak.

(II) Deciduous trees :-

→ These trees are known as broad-leaf tree.
→ A leafs of the tree falls in ~~autom~~ ~~se~~ autumn season and appear in spring season.
→ The woods of this tree is strong, heavy, dark in colour, durable.
→ Deciduous trees do not shows the annual rings.

Soft woods and hard woods :-

→ The soft woods form a group of ever-green trees. the hard woods form a group of broad-leaf trees.
→ It is quite likely that some variety of soft wood may prove to be stronger than some variety of hard wood.

Endogenous trees :-

→ The timber these trees has every limited engineering applications. The examples of endogenous trees are bamboo, cane, palm, etc.

Structure of A Tree :-

→ A tree basically consists of three parts, namely, trunk, crown and roots.
→ The function of the trunk is to support the crown and to supply water and nutrients from the roots to the leaves through branches and from the leaves

back to the rootes.

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

(I) Marcrostructure

(II) Microstructure

(I) Marcrostructure :-

→ The structure of wood visible to the naked eye or at a small magnification is called the ~~mare~~ macrostructure.

Following are different components :-

(1) Plinth :-

→ The innermost central portion or core of the tree is called the pith or medulla. It consists entirely of cellular tissues.

→ When the plant becomes old, the pith dies.

(2) Heart wood :-

→ The inner annual rings surrounding the pith consitute the heart wood. It is usually dark in colour.

→ It indicates dead portion of tree and as such, it does not take active part in the growth of tree.

→ But it imparts rigidity to the tree, hence, it provides strong and durable timber for various engineering purpose.

(3) Sap wood :-

→ The outer annual rings between heart wood and cambium layer is known as the sap wood.

→ It ~~is~~ ~~usually~~ takes active part in the growth of tree and the sap moves in an upward direction through it. The sap wood is also known as the alburnum.

(4) Cambium layer :-

→ The thin layer of sap between sap wood and inner bark is known as the cambium layer.

→ If the bark is removed for any reason, the Cambium layer gets exposed.

(5) Inner bark :-

→ The inner skin or layer covering the cambium layer is known as the inner bark.

(6) Outer bark :-

→ The outer skin or cover of the tree is known as the outer bark

→ It is the outermost protective layer and it sometimes contains cracks and fissures.

(7) Medullary rays :-

→ The thin radial fibers extending from pith to Cambium layer are known as the medullary rays.

→ The function of these ~~layer~~ ray is to hold together the annual rings of heart wood and sap wood.

V. Imp ✱ Seasoning of Timber :-

(1) Meaning of seasoning :-

→ When a tree is newly felled, it contains about 50 per-cent or more of it's own dry weight as water. This water is in the from of moisture. The water is to be removed before the timber can be use for any engineering purpose. In other words the timber is to be dried. This process of drying of timber is known as the seasoning of timber and the moisture should be extracted during seasoning.

→ If the drying is irregular, the shrinkage of timber will also be irregular

→ When these stresses become excessive and are capable of overcoming the ~~cho~~ cohesion of fibers.

→ The wood is a hygroscopic material. The capacity of wood to absorb water vapours from air is called the hydroscopicity of wood.

→ By the process of seasoning, th excess water of timber is extracted in such a way that the

that the moisture content of seasoned timber corresponds to the required moisture content in timber for the environments in which it is to be used.

Objects of seasoning :-

These seasoning of timber is carried out to achieve the following objects :-

(I) To allow timber to burn readily, if used as fuel.
(II) To decrease the weight of timber and thereby to lower the cost of transport and handling.
(III) To impart hardness, stiffness, strength and better electrical resistance to timber.
(IV) To maintain the shape and size of the components of the timber articles which are expected to remain unchanged in form.
(V) To make timber easily workable and to facilitate operations during conversion.
(VI) To make timber fit for receiving treatment of paints, preservatives, varnishes, etc.
(VII) To make timber safe from the attack of fungi and insects.
(VIII) To reduce the tendency of timber to crack.

Methods of seasoning :-

The methods of seasoning can broadly be divided into the following two categories :-

(I) Natural seasoning
(II) Artificial seasoning

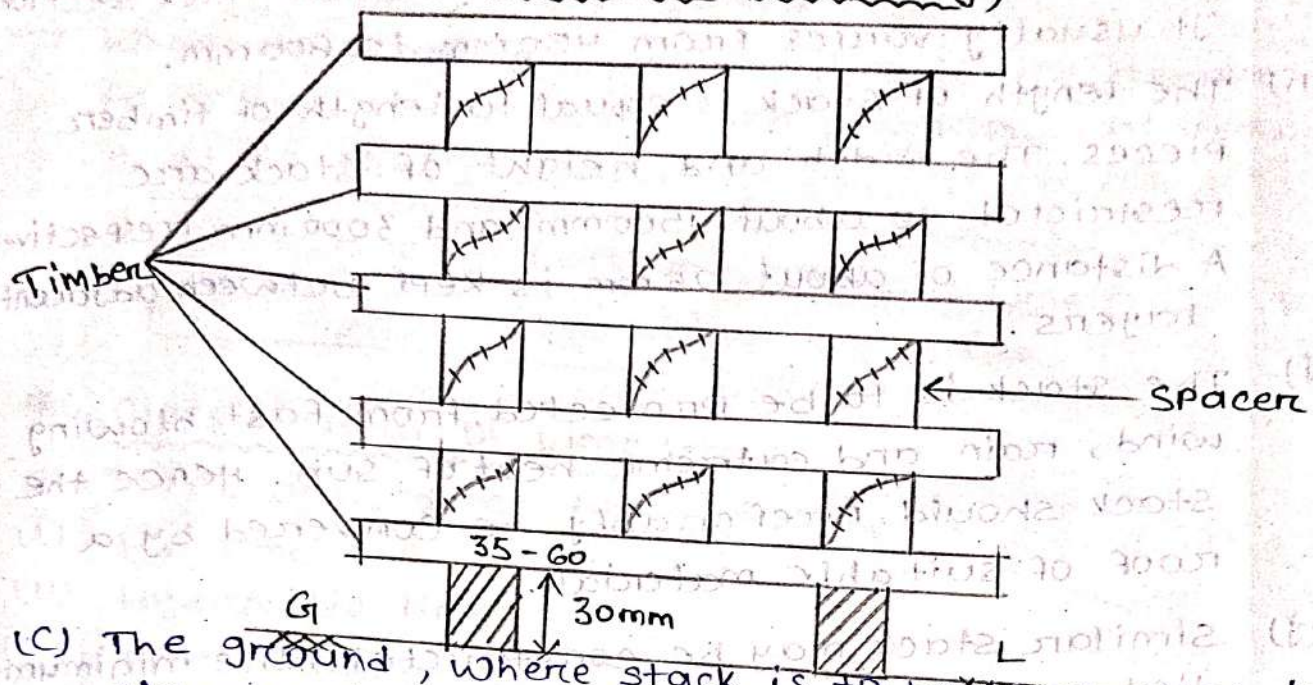
(I) Natural seasoning :-

→ In this method, the seasoning of timber is carried out by natural air and hence it is also sometimes referred to as air seasoning. Following procedure is adopted in the air seasoning :

(a) The timber in log form is not usually fit for the process of seasoning. Hence it is cut and sawn into suitable sections of planks or scantlings.

(b) The timber pieces can either be stacked horizontally or vertically, the former arrangement being very common. Fig shows a typical horizontal stack for air seasoning.

(Stack of seasoning)



(c) The ground, where stack is to be constructed, is cleared and it is levelled for good drainage.

(d) The platform of stack is made slightly higher, about 300mm, than the gound level. For this purpose, the rows of brick or concrete pillars are constructed. The pillars may also be made of creosoted wood or wood coated with coal tar. The tops of pillars should be in the same horizontal plance. The pillars should be durable.

(e) The timber pieces are sorted out (arrange) according to lengths and thicknesses. They are then arranged in layers, one above the other. The care should be taken to see that all members in a particular layer are of the same thickness. If this precaution is not taken, there are chances for timber to become warped or cracked.

(f) Each layer is separated by spacers of sound dry wood. The usual dimensions of spacers vary from 35mm x 25mm to 50mm x 35mm, the larger dimension being the width. The spacers

are to be carefully placed in correct vertical alignment.

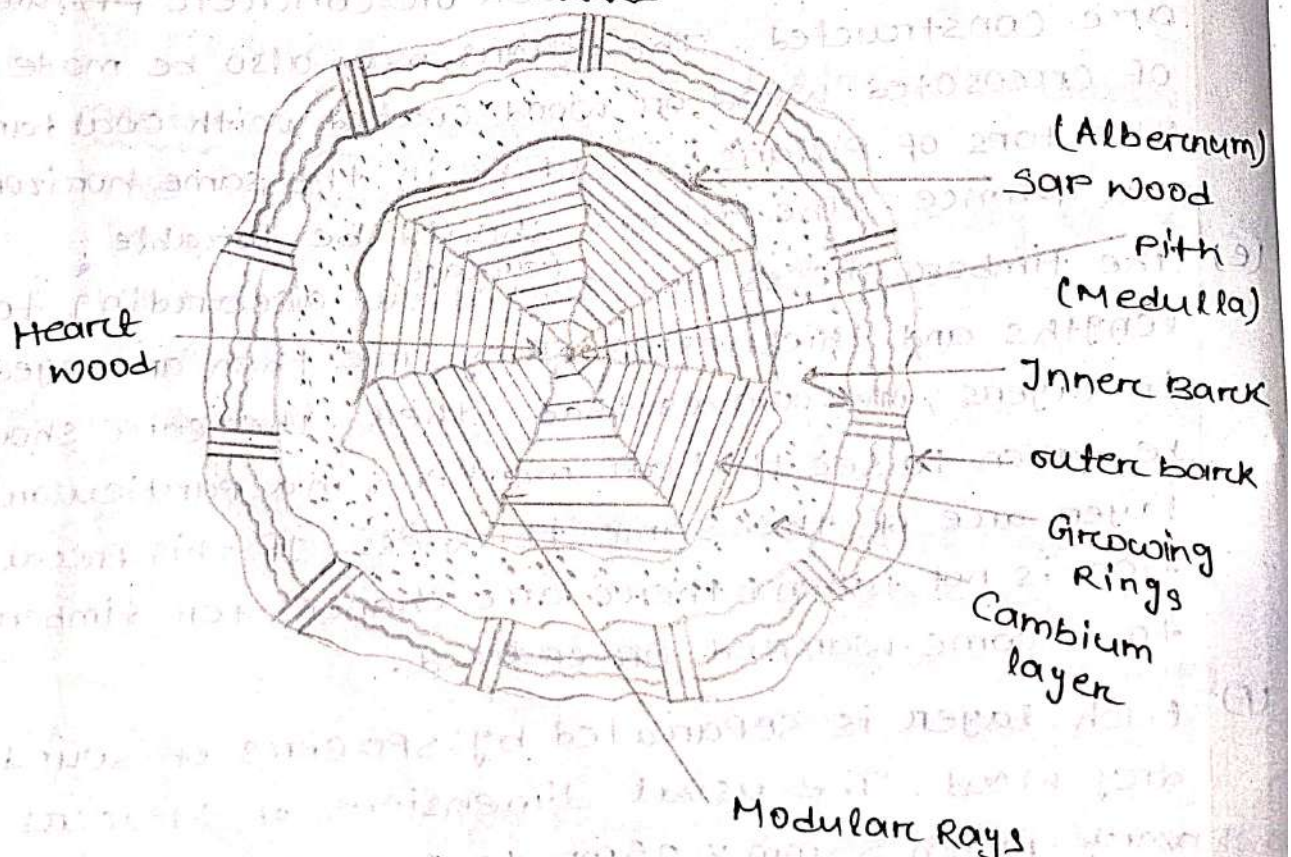
(g) The distance between spacers depends on the sizes of timber members to be seasoned. It is less for thin sections and more for thick section. It usually varies from 450mm to 600mm.

(h) The length of stack is equal to length of timber pieces. The width and height of stack are restricted to about 1500mm and 3000mm respectively. A distance of about 25mm is kept between adjacent layers.

(i) The stack is to be protected from fast blowing wind, rain and extreme heat of sun. Hence the stack should preferably be covered by a roof of suitable material.

(j) Similar stack may be constructed. The minimum distance between adjacent stacks should be at least 600mm.

* Macro structure figure :-



* Lime :-

→ Lime is a binding Material which is works similare like cement. but lime has not morce strength binding capacity, good properties or characteristies like cement.

→ When moisture and carbon dioxide are remove form the lime stone. Then which product remain that is lime.

Limestone	—	Carbon dioxide	=	Lime
$CaCO_3$		CO_2		CaO

* Classification of Lime :-

There are three types of Lime :-

(i) Fat lime
(ii) Hydraulic lime
(iii) Poor lime

(i) Fat Lime :-

→ This lime is also known as the high calcium lime, pure lime, rich lime or white lime.

→ It is prepared by pure carbonate lime which is composed of 95% of calcium oxide and rest of 5% of lime stone is

Properties of Fat Lime :-

→ It hardens slowly.
→ It has high degree of plasticity.
→ It can easily soluble in water.
→ It's colour is pure white.

Use of Fat Lime :-

→ It is used in white washing.
→ Fat lime can be used with sand which is provided in thin joint of brick wall, tile wall etc.

(ii) Hydrolic Lime :-

→ This lime is also known as water lime, It sets under the water.

(iii) Poor Lime :-

→ This lime is also known as impure lime.
→ It contains more then 30% of clay.
→ It sets and harden slowly.
→ It has poor binding property.
→ It's clolour is mouldy white.

* Sand :-

→ Sand formes due to decomposition of sand stone due to various weathering effect.
→ According to the natural sources to the sand it is three types :-

* Sources of sand :-

(i) Pit sand
(ii) River sand
(iii) sea sand

(i) Pit sand :-

→ Pit sand is found from one to two meter depth of the soil from the ground level.
→ Pit sand consist of sharp, angular, grain shape.
→ It is free from salt, so, it grooves to be an excellent material for mortar and concrete.
→ For making good mortar the sand should properly clean, free from organic matters, clay etc.
→ When the brick sand is rubbed between two figurces then the sand should not leave any stain on the fingurce. If there is any stain on the fingurce them any indicates the coating the iron oxide over the sand. This sand is not good for the construction.

(II) River Sand :-

→ The sand which is obtain from bank of the River.

→ The River consist of fine rounded grain.

→ The colour of River sand is all most white.

→ As the river sand is usually avialable in clean condition so, this sand is widly use for the all purpose.

(III) Sea Sand :-

→ The sand is obtain from sea source.

→ Sea sand is also like river sand as fine rounded grain.

→ The colour of sea sand is light brown.

→ Sea sand contain salt. This salt actract moisture from the atmosphere. It causes of dempness, dis intigrestion of materials.

→ Sea sand increase the setting action cement with above reason.

* Classification of sand :-

→ There are three types of sand according to the size :-

(I) Fine sand
(II) Coarse sand
(III) Gravell sand

(I) Fine sand :-

→ The sand passing through a screen (sieve) 1.58 mm is known as fine sand. It is use for the plastering wall.

(II) Coarse Sand :-

→ The sand passing through a screen (sieve) 3.17 mm is known as Coarse sand. It is use for the masonary work.

(III) Gravell Sand :-

→ The sand passing through a screen (sieve) 7.62mm is known as gravell sand. It is use for the concret wall.

IMP * Bulking of Sand :-

→ The presence of moisture on the sand is increase the volume of sand. this is due to the fact the moisture presence a round the sand particles which increase the volume of sand

→ This increase in volume of sand due to the moisture content.

Cement, Aggregates, Water and Admixture

* Cement :-

→ Cement is a binding material which is use for construction of any structure such as building, highway, Railway etc.

→ It sets and hardens easily and it's adhesion quality is superior then other binding Materials.

→ If cement will mix only with the water properly then that mixture is know as cement slurry.

→ If cement will mix with sand and water then that is known as cement mortar.

→ If cement will mix with fine aggregate, coarse aggregate and water that is known as cement concrete.

→ If cement will mix with fine aggregate, coarse aggregate and steel then that is know as rein force cement concrete (RCC).

* Characteristics of cement :-

There are different characteristics of cement :-

→ The colour of cement should be grey with greenies.

→ It should feel smooth then it rubes in between two fingure.

→ If your hand insert into the bag of cement then you should feel cool, not wall.

→ The cement should free form lumps.

* Properties of cement :-

There are three properties of cement :-

(I) Physical properties

(II) Mechanical properties

(III) Chemical properties

(1). Physical Properties :—
Following are the important physical properties of cement :—

→ It gives strength to the masonary.
→ It is an excellent binding material.
→ It is easily workable.
→ It offers good registance to moisture.
→ A thin paste of cement should feel sticky between two fingures.
→ If cement will thrown into the water then that should sink and should n't float on the surface water.
→ The initial setting time of cement 30 minutes and the final setting time of cement 10 hours. (Initial setting time of cement means) after adding of water with dry cement when the cement starts it's setting action. (Hard action. (Final setting time means) in which time the process of hardening stop.

* Workability :—
→ The serialistion process of construct a structure such as :—
(I) Mixing
(II) Transporting
(III) Placing is known as workability. And this workability should be done ~~within~~ they time 30 minutes.

* Composition of cement and it's function :—
→ The ingredients cement such as :—
(I) Lime
(II) Silica
(III) Alumina

(iv) Calcium sulphate
(v) Iron Oxide
(vi) Magnesia
(vii) Sulpher
(viii) Alkalies

(i) Lime :- (CaO)

→ This is the important ingredient of cement.
→ Lime controules the expant and intigrate property.
→ If content of lime excess then it can disintigrate the matercials and it can decrease the strength of the cement.
→ Excess quantity of lime can decrease the setting time of cement.

(ii) Silica :- (SiO_2)

→ It also given strength to the cement due the formation of di-calcium and tri-calcium silicate.
→ If silica quantity is excess then strength of the cement will increase but it will take morce time of the cement.

(iii) Alumina :- (Al_2O_3)

→ Alumina impacts quick setting of cement.
→ Excess quantity of alumina can weakness the cement.

(iv) Calcium sulphate :- ($CaSO_4$)

→ It is in the forms of gypsum and it's function is increase the setting time of cement.

(v) Iron oxide :- (Fe_2O_3)

→ It impacts colour, hardness, and strength of the cement.

(VI) Magnesia :- (MgO)

→ It impacts hardness and colour.

(VII) Sulpher :- (S)

→ Small quantity of sulpher is added which heat the cement.

(VIII) Alkali :-

→ Alkali is added in cement during process.

→ It create the binding capacity between two different material for same materials.

IMP

* Manufacturing of Cement :-

→ Cement is manufacturing in following three step :-

(I) Mixing of Raw material

(II) Burning

(III) Grinding

(I) Mixing of Raw material :-

→ The Raw material for the cement such as lime stone, clay. At first these two materials are mixed either in dry condition or wet condition.

→ If these materials are mixed in dry condition then the process is known as dry process.

→ If these materials are mixed in wet condition then the process is known as wet process.

* Mixing of Raw material in Dry process :-

→ In this process the raw material are first reduced in size of 25 mm.

→ Then ~~the~~ dry air should first over the material

→ Then those dry materials are pulverised into fine powder in ball mill, and tube mill.

→ These operations are done separately for each raw material.

→ Then those are stored in hopper.
→ Then those two materials are mixed in correct proportion. This mix is known as Raw mix.

* Mixing of Raw material in wet process :-

→ In this process the raw material are first reduced in size of 25mm.
→ Then those Materials are stored in silo.
→ Then clay is thoroughly mixed in water in a container which is known as wash mill.
→ Then those mixed clay in storied basin.
→ Now the crushed lime stone and wet clay are mixed in a correct proportion.
→ Then it is properly grinded in ball mill and tube mill. after grinding it is converted in cement slurry.
→ In this stage the chemical composition is added as necessary.
→ Then that slurry is stored in storage stank. Finaly it is redy from the next operation it is burning.

(II) Burning :-

→ The burning of raw material is carried out in rotary kiln. The rotary kiln is form of steel tube.
→ The diameters of rotary kiln is 2.5 to 3 meter.
→ Length of the kiln it is to 90m to 120m.
→ It is laid at a gradient of 1 in 25 to 1 in 30 or 1:25 to 1:30.
→ The kiln rotates about 1 to 3 rebolution per minute.

(III) Grinding :-

→ The clinker (burning condition of limestone and clay) is after form rotary kiln.

→ Then that clinkers is finely grinded in ball mill or tube mill.

→ During grinding small quantity of means 3 to 4 percentage of gypsum is added is clinker.

→ For grinding of clinkers 12 number of steel balls are required. These steel balls impact with the clinkers and converts into powder form.

→ After finishing of grinding now the cement is properly manufacture. It's time to fill all those cement in a back. The limiting weight of cement bag is 50 kg.

* Classification of Cement :-

→ There are 13 types of cement :-

(I) Acid Resistance Cement
(II) Blast Formance Cement
(III) Coloured Cement
(IV) Expanding Cement
(V) High Alumina Cement
(VI) Hydrophobic Cement
(VII) Low heat Cement
(VIII) Pozzolana Cement
(IX) quick setting Cement
(X) Rapid hardening Cement
(XI) Extra hardening Cement
(XII) Sulphate Resistance Cement
(XIII) White Cement

(I) Acid Resistance Cement :-

→ Acid resistance cement composed of acid resistace aggregate such as quartz and qu
sodium fluosilicate.

→ In addition of sodium fluosilicate is accelerated

in hardening process.

→ Acid resistance cement is use for resist the acid and heat.

→ It is not water resistance. But by adding 0.50 percentage of linseed oil it can increase the resistance of water capacity.

(II) Blast Formance Cement :-

→ Slag is obtained from blast formance. Slag is the weast product of manufacturing of pigiron.

→ This cement contains all the basic elements such as lime, Alumina, silica etc.

(III) Coloured Cement :-

→ The cement of desied colour is obtained by mixing different minerial pigments for different colour.

→ The amout of colouring pigment is vercies from 5 to 10 percent. If the quantity of colouring pigment is increase and excid then the cement gain decrease it's strength.

→ To get green colour of cement at chromium oxide.

→ To get Blue colourie at cobalt.

→ To get Brown, Red, Yellow colour at different properction of iron oxide.

→ To get Black and Brown colour is different manganese dioxdie.

→ Colour cement is widely used for finishing of

(IV) Expanding Cement :-

→ This cement is produced by adding by expanding medium such as sulpho-aluminate in ordinary cement.

→ This cement expance where as other cement shrinks.

→ Expanding cement is used for construction for water retaining structure and repairing work of concrete structure.

(V) High Alumina Cement :—

→ This cement is produced by grinding clinkers from by ~~calcium~~ Calcining bauxite and lime.

→ Bauxite is a aluminium agent in which the content of alumina should not be less then 32 percent.

→ This cement is known as cement fondu in England luminate in America.

→ The initial setting time of high ~~temp~~ alumina cement is three half hour and final setting time of is five hours.

→ It can stand with resist with temperature and acid.

→ It evolves greeate heat durcing setting.

→ This cement is very coastly.

(VI) Low heat cement :—

→ Heat is produced durcing setting action of cement (ordinary cement).

→ In order to reduce they amount of heat this low heat cement is used.

→ This cement contains lower percentage of try-calcium of aluminate is 5 percent and dicalcium of silicate of about 46 percent.

→ This cement posess less ~~then~~ compresive strength.

→ The initial and final setting time of cement is as like ordinary cement.

→ This cement is used for the concrete wall.

(VII) Quick setting cement :-

→ This cement is produced by adding small percentage of aluminium sulphate, percentage of gypsum is also reduced.

(gypsum is increase the setting action of cement)

→ In addition of aluminium sulphate it accelerated the setting action of cement.

→ It's initial setting time is 5 minutes and final setting time is 30 minutes.

→ This cement is used for the construction of water logging area.

(VIII) Rapid hardening cement :-

→ The initial and final setting time of cement same as ordinary cement.

→ It attains high strength or

→ The contain which helps for the rapid hardening is try-calcium silicate about 56 percent.

(IX) Extra Rapid hardening cement :-

→ The cement accelerated the setting and hardening cement.

→ It impact 25% higher then rapid hardening cement.

→ Grinding of this cement in strength and disappear in 90 days.

(X) White cement :-

→ This is also like an ordinary cement but it is free from oxide of iron and manganese. Absence of these to mark in white in colour.

→ For burning of the cement oil is used insted of coal.

→ This cement is white in colour.

→ It is used for the floor finishing, plastering.

work, ornamental work etc.
→ It is very coastly for the ordinary cement.

* Fineness of Cement :-

→ When water chemicaly react then function of cement started which is it's strength. after adding water in cement a reaction start which is called hydration of cement.

→ To get proper fineness of cement it need exact quantity of gypsum which control the setting action of cement.

* Standard consistency :- (From record)

* Soundness of Cement :-

→ After addition of water for dry cement it's initial setting starts 30 minutes. It's setting action will stop in 10 hours. The comparcison of it's volume in between initial setting time and final setting time.

(II) Physical Property :-

→ Cement should feel smooth when rub between the two fingers.

→ when the hand insert into the full bag of cement it should feel cool not warm.

→ when the cement is thrown into the water the cement should not float and it should sink.

→ when cement paste is rub between the two fingers then it should feel sticky.

(III) Presence of Lumps :-

→ Full bags of cement should free form lumps.

→ Lumps are forms by the moisture from the atmosphere.

→ If any bag of cement contains lumps then the bag should be rejected.

* (iv) Strength :—

→ To check the strength of the cement at first construct a cube in a proportion of 1:6 where 1 is stand for cement and 6 is stand for sand.

→ After 24 hrs of concentration of cube it should innmersedin water for 3 days.

→ If the cement has good quality then after 3 to 7 days they should not be any crack on the cement cube.

* Laboratory Test of cement :— [From record which is tick on the topic]

(i) Fineness test of cement
(ii) Compressive strength cement
(iii) Tenstile of cement
(iv) consistency test of cement
(v) setting time of cement
(vi) soundness test of cement

Compressive strength of Cement :—

→ This test is carried out to determine the compressive strength of the cement.

Procedure :—

→ The mortar of 1:3 proportion has to prepared.
→ Requirement amount of water is prepared means 0.4 and mix it properly.
→ Then the mortar is placed in the mould or cube having size of cube 76 mm.
→ After placing of mortar in the cube mould it should be well compacted by the vibrating machine.
→ Then the mortar cube is placed on a surface 24 hrs to provides rest.
→ The ~~the~~ cube specimen is removed from the mould. And submerged in clean water for curing for 7 days.

→ After 7 days take out that cube from the mould.
→ Now the load is apply on the cube uniformly of 350 kg/cm² or 35 N/mm².
→ The compressive strength after 3 days should be 11.5 N/mm² and after 7 days, should be 17.5 N/mm².

Tensile test of cement :-

→ A mortar of 1:3 proportion has to be prepared.
→ 8% of water is added. Then the mortar is placed in the mould and vibrate by the vibrationg- Machine.
→ After that the top surface of the cube should levelled by the upto water come out to the top surface.
→ Then apply the load of 3.5 N/mm² on both the cube.
→ The tensile test of 3 days curing cube should not less than the 2 N/mm² hence tensile strength of 7 days cube should not less than 2.5 N/mm².

Soundness test of cement :-

→ once a cement paste has set it should not change in volume. If its volume changes then it desired as a unsound cement. unsound cement causes disintegration, cracks, etc. sound cement does n't change its volume after setting. Soundness of cement can be determine by le-cattlier method. The expansion of cement should n't more than 10 mm.

* Requirement of good Aggregate :-

A good aggregate must be clean, hard, strong durable, and free from impurities like

organic Matter or excessive silt. It should have a shape and texture that allows for good bonding with cement paste, ideally, angular, rough, and cubical, with a low water absorption rate. Gradation, or a mix of sizes is also important for achieving a dense and strong concrete structure by minimizing voids.

* Physical and chemical Requirements :-

Cleanlines :-

Must be free from dirt, clay, silt, organic matter, and other deleterious substances that can weaken concrete.

Hardness and strength :-

Needs to be hard and strong enough to resist wear and tear, impact, and abrasion.

Durability :-

Should be able to withstand weathering and chemical attack.

Absorption :-

Should be have a low water absorption rate ideally not more than 5-10% of its weight.

Shape and Texture :-

Should have a rough, angular, and cubical shape for better bonding with the cement paste.

Gradation :-

A mix of different sizes is ideal for packing tightly, reducing voids, and increasing the density of the concrete.

Specific Gravity :-

Important ~~sizes is~~ Ideal for concrete mix design, it indicates the weight - volume characteristics of the aggregate.

The requirements of good aggregate are as follows. A good aggregate should be strong having sufficient impact, crushing and abrasion...

* What ~~is~~ are the requirements ~~of~~ for good concrete ?
* What are the requirements for fine aggregate.

Feed back :-

Quality Requirements for Aggregate:-

Aggregates should be ~~st~~strong, hard, dense, durable, clear...

2. Requirement of good Aggregate :-

It must be clean that it should be free from lumps, organic materials etc. It should be strong. It should be durable.

Gradation :-

Good coarse aggregates should have a well-graded particle size distribution, with a balance of different sizes. This helps in...

A Good fine Aggregates must be clean & free free from coatings of clay.

* Aggregates are classified into different types depending on their shape, origin and ~~and~~ size. The classification of aggregates in explained below :-

Classification Depending on size :-

→ Depending on the size, aggregates are divided into two types, namely fine aggregate & coarse aggregates.

Fine aggregates :-

→ These are finer particles that are less than 4.75 mm in diameter. These particles include crushed stone or sand.

Coarse Aggregate :-

If the size of the particles is higher than 4.75 mm in diameter. Coarse aggregate materials include a larger portion of rocks, crushed stone, or gravel.

* Classification Depending on shape :-

Round aggregate :-

These are naturally weathered particles that are round and are normally found in riverbeds.

Irregular Aggregate :-

Irregular particles can be man-made or natural. They have angular edges and primarily include crushed stones.

Angular Aggregates :-

The shape of these particles is generally sharp and angular, and they are found in crushing stone.

Flaky Aggregates :-

Flaky aggregates are flat, thin, and have a thickness smaller than the surface area.

Elongated Aggregates :-

Elongated particles have a smaller width compared to their length and are long and thin.

* Classification Based on Density :-

Lightweight Aggregates :-

These lightweight aggregates includes shale that have low density. The density is usually less than 1120 kg/m³.

Normal weight Aggregates :-

These aggregates are primarily used in construction. They normally have standard density. The standard density is 1520 - 1680 kg/m³.

Heavy Weight Aggregate :-

Magnetite or barite are high-density material. They are fundamentally used for shielding radiation. The density is higher than 2080 kg/m³.

* Classification Based on Source Natural Aggregates :-

Igneous :-

These aggregates are formed from cooled magma, including basalt or granite.

Sedimentary :-

These aggregates are formed due to the over-time deposits, namely sandstone or limestone.

Metamorphic :-

These rocks are formed under pressure and heat from other rocks.

* Artificial Aggregates :-

Manufactured :-

They are produced as waste in industrial processes, such as slag from steel production.

Recycled :-

These materials are made from recycled construction materials, such as recycled concrete or crushed glass.

* Classification Based on Texture :-

Smooth :-

They have minimum surface texture and have a strong bond with concrete.

Rough :-

They are rough and have maximum surface area, thus providing a stronger mechanical bond.