LECTURE NOTES

ON

BUILDING MATERIALS AND CONSTRUCTION TECHNOLOGY
ACADEMIC YEAR 2021-22

I B.Tech.–II SEMESTER(R20)

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I Year - I Semester		L	T	P	C
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BUILDING MATERIALS AND CONCRETE TECHNOLOGY (ESC1203)					

Aim and Objective of this course
1. To introduce various building construction materials
2. To describe various properties of ingredients of concrete
3. To explain various properties and tests of fresh and Hardened Concrete

Course Outcomes (COs)
1. Know various engineering properties of building construction materials and suggest their suitability
2. Identify the functional role of ingredients of concrete and apply this knowledge to concrete mix design
3. Acquire and apply fundamental knowledge in the fresh and hardened properties of concrete

Syllabus

Unit - I (Stones, Bricks, Tiles, Wood and Paints)
Stones: Classification of Stones – Properties of stones in structural requirements
Bricks: Composition of good brick earth, Various methods of manufacturing of bricks
Tiles: Characteristics of good tile – Manufacturing methods, Types of tiles
Wood: Structure – Properties – Seasoning of timber – Classification of various types of woods used in buildings – Defects in timber
Paints: White washing and distempering, Constituents of paint – Types of paints – Painting of new and old wood – Varnish

Unit – II (Aggregates, Cement and Admixtures)
Aggregates: Classification of aggregate, Bond, Strength and other mechanical properties of aggregate, Physical properties of aggregate, bulking of sand, Deleterious substance in aggregate, Soundness of aggregate, Alkali-Aggregate reaction – Thermal properties, Sieve analysis – Fineness modulus – Grading curves – Grading of fine and coarse aggregates as per relevant IS code, Maximum aggregate size
Portland Cement: Chemical composition, Hydration, Structure of hydrated cement – Setting of cement, Fineness of cement, Tests for physical properties – Different grades of cements
Supplementary cementitious materials: Fly ash, GGBS, Silica fume, Rice husk ash, Calcinated ash (Basic properties and their contribution to concrete strength)
Admixtures: Mineral and Chemical admixtures

Unit - III (Fresh Concrete)
Manufacture of concrete – Mixing and vibration of concrete, Workability – Segregation and bleeding – Factors affecting workability, Measurement of workability by different tests, Effect of time and temperature on workability – Quality of mixing water, Ready mix concrete, Shotcrete

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Unit - IV (Hardened Concrete)
Water / Cement ratio – Abram's law, Gel space ratio, Nature of strength of concrete – Maturity concept, Strength in tension and compression – Properties of Hardened Concrete (Elasticity, Creep, Shrinkage, Poisson's ratio, Water absorption, Permeability, etc.), Relating between compression and tensile strength, Curing

Unit - V (Testing of Hardened Concrete)
Factors affecting properties of Hardened concrete, Compression tests, Tension tests, Flexure tests, Non-destructive testing methods – Codal provisions for NDT – Rebound hammer and UPV method

TEXT BOOKS
1. "Concrete Technology" by M. S. Shetty - S. Chand & Co., 2004
2. "Engineering Materials" by Rangwala S C, (36th edition), Anand Charotar Publishing House
3. "Concrete Technology" by Shantha Kumar – Oxford Publications

REFERENCE BOOKS
1. "Building Materials" by S. K. Duggal, New Age International Publications
2. "Building Materials" by P. C. Verghese, PHI learning (P) Ltd., 2009
3. "Properties of Concrete" by A. M. Neville – Pearson – 4th edition

BUILDING MATERIALS & CONSTRUCTION

UNIT - 1

STONES, BRICKS & TILES

Stones:-

* stone is defined as the material. Natural, hard substance formed from minerals & Earth materials which are present in rocks. Rocks may be defined as the portion of Earth's crust having no definite shape & structure. all rocks have a definite chemical composition & are made up of minerals & organic matter.

Rock forming minerals:-

* Quartz, felspar, mica, dolomite, silicate, oxides, carbonates, phosphates, sulphates etc.,
* the various types of rocks from which building stone are usually derived are granite, marble, slate, balast, trap, sand stone & limestone. the condition which governs. the selection of stone for structural purpose are cost, fashion, ornamental value & durability. today the coarse & fine aggregate used for making concrete are produced from crushing stones (granite & sand stone)
* stone has been used in the construction of the important structure from pre historic age i.e., the tajmahal of India, Great wall of china etc.,

Properties of building stones & relation to their structural requirements :-

Appearance :-

* For face work of the following building i.e., for their architectural beauty it should uniform colour & structure to keep the appearance of a building for a long time.

Structure :-

* A broken stone should not be dull in appearen & should have uniform texture free from cracks patches of loose (or) soft material.

Strength :-

* A stone should be strong & durable to with stand the disintegration action of weathing agencies compressive strength of building stones is in b/w 60 - 200 N/mm^2

Weight :-

* It is an indication of the porosity & density good stone should be less porous . they shouldn't absorb more than 5% of water.

Hardness :-

* When stone are subjected to a considerable amoun of wear friction as in case of floors, pavements etc., the hardness is determined by the Mohrs scale.

Toughness :-

* The measure of impact that a stone can with stand is defined as toughness, the stone used should be tough when moving loads are anticipated

Seasoning :-

* The stone should be useful seasoned.

weathering :-

* The resistance of the stone against the wear & due to natural agencies should be high

workability :-

* stone should be workable so that, cutting, dressing & bringing it out in the required shape & size.

Fire resistance :-

* stone should be free from calcium carbonate, oxides of iron & minerals having different co-efficients of thermal Expansion. So, stones offer greater resistance to electricity.

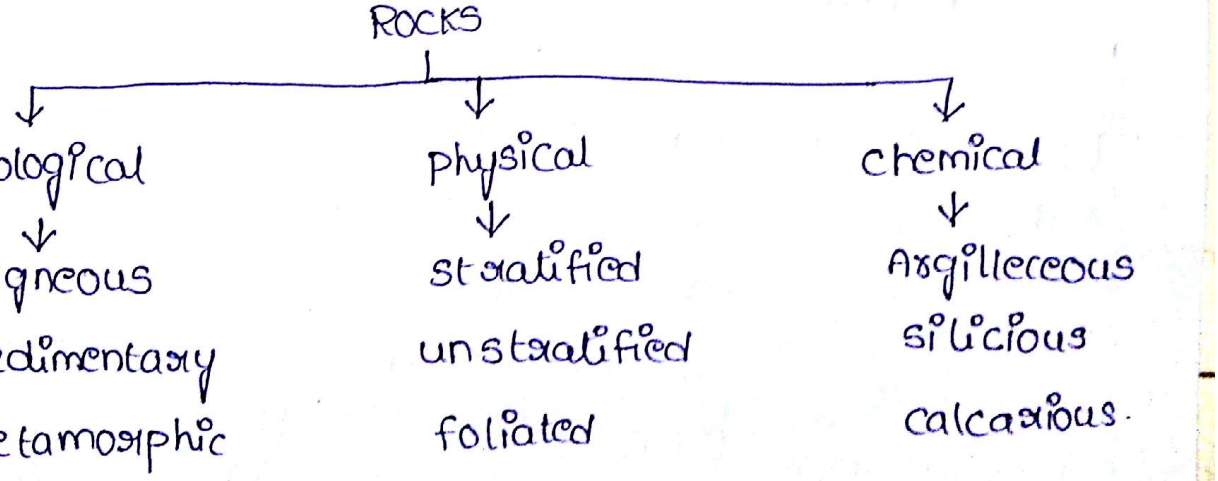
specific gravity :-

* The specific gravity of stone lies between 2.3 - 2.5

=> classification of stones :-

* The rocks may be classified as

1. Geological formation
2. physical formation
3. chemical formation



Based on geological formation:-

* This classification based upon the made of the formation.

(1) Igneous rocks

(2) sedimentary rocks

(3) Metamorphic rocks

(1) Igneous rocks:-

* they are formed by cooling of melten lava released during a volcanic activity. these stones are very strong & durable.

Ex:- Granite, balast, trap etc.,

(2) sedimentary rocks:-

* they are formed by sedimentation in water followed by intense pressure which converts the sediments into rocks.

Ex:- Lime stones, sand stones etc.,

Metamorphic rocks:-

* They are igneous (or) sedimentary rocks which have been changed due to either pressure (or) temperature (or) both i.e., pressure & temperature

(a) sand stone into Quartzite

(b) Lime store into marble

(c) Granite into Greiss.

Based on physical characteristics:-

* the rocks are classified into

(1) Stratified

(2) unstratified

(3) foliated.

(1) Stratified:

* These rocks show distinct layers along which the rocks can be split.

Ex: Sand stone, lime stone, marble etc.,

(2) unstratified rocks:

* These rocks don't show any distinct layers & can't be easily split.

Ex: Granite, balast, trap etc.

(3) foliated Rocks:

* These rocks can split up only in a definite direction. most of the metamorphic rocks have a foliated structure expe. except for quartzite & marble which have granulose structure.

Based on chemical composition:-

* The rocks may be classified as

(1) Argillaceous

(2) Silicious

(3) Calcarious.

(1) Argillaceous:

* It consisting of clay minerals the rocks are hard & brittle.

Ex: Slate etc.

(2) Siliceous:

* It consisting of silica i's sand the rocks are very hard & durable

Ex: Granite, balast etc.

(3) calcarious:

* It consisting of carbonate of lime

Ex: lime stone, Marble etc.

⇒ Quarrying of stones:-

* The open part of the natural rocks from which useful stone is obtained is known as quarry while selecting a quarry site, the points to be keep in mind are:

* Availability of sufficient quantity of the stone of desired quality.

* proper transportation facilities.

* cheap local labour.

* problems associated with drainage of rain water.

Stone quarrying tools:-

* wedge, pin, hammer, scrapping spoon, tamping bar, priming needle, jumper, barrel, crowbar, claying iron.

Methods of quarrying:-

* Methods of quarrying are classified in three groups.

(1) Quarrying with hand tools.

(2) Quarrying by use of channelling machine.

(3) Quarrying by blasting with explosives.

(1) Quarrying with hand tools:-

* Quarrying is done by excavating, wedging, heating

Excavating:-

* stones buried in earth are excavated with pick axes, screw bars, chisels, hammers etc.

Wedging :-

* If the rocks contain cracks & fissures, steel wedges are driven through the cracks & the pieces are seperated.
* If natural cracks are absent, hole of about 10cm ø & dipth 20-25cm are first made along a line at 10-15 cm distance by hand tools (or) drills flat steel wedges are inserted into the holes on either side blw these conical steel plugs are driven. when these plugs are driven in the rocks drilled along a line. cracks are formed along these lines in the rock & at the depth of the holes. these blocks seperated are lifted up wedging works are well in soft rocks like marble, limestone, sand stone etc.

Heating :-

* If the rock occurs in layers & the surface is heated by fire, the differential expansion seperate the upper layer from the lower layer.

Quarrying by use of channelling machines :-

* we first cut channels of sufficient depth with the channel machine along the three sides which form the plan of the block to be removed
* Horizontal holes are then driven lunceath the block from the exposed face.
* wedges are then driven into the horizontal holes when the block break loose.

* The block is lifted from its bed to be cut into the slabs of required sizes.
* Rocks of granite for cutting into slabs & polishing for floor slabs are Exported for the above purpose are mined in this method.

Quarrying by blasting :-

* Materials used for blasting explosives used for blasting can be gun powder / blasting powder (A mixer of charcoal, salt petre & sulphur) blasting cotton & chemical explosives like dynamite available from government controlled agencies & cordite.
* The operations involved are :

boring
charging
tamping
firing.

Boring :-

* Holes are drilled of required diameter & depth are made along the lines at the required spacing.

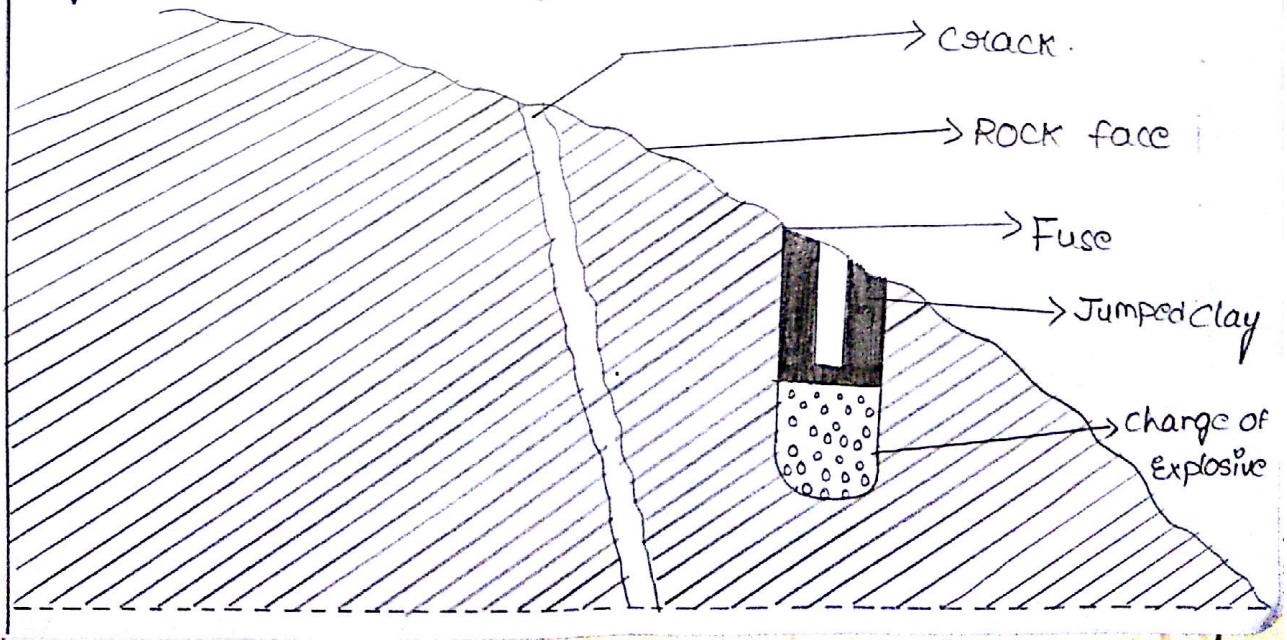
Charging :-

* The holes are cleaned & drilled well using a piece of dry cloth. the required amount of charge is placed in the holes. the necessary quantity of gun powder is placed at the bottom of the hole keeping the top part of the hole free.

Tampering :-

* After placing a greased priming needle at the center of the hole, the top part of the hole is filled with layers of sandy clay, moorum with 1 Each layer well rammed in place with a brass tamping bar. this forms a hole for the fuse to be placed the priming needle is withdrawn & a fuse wire of sufficient length is cut at one End & inserted through the hole into the gun powder. the other End of the fuse wire is kept projecting out by 60-90cm (on the other hand are use dynamite as explosive use of detonator one End of the fuse wire is connected to detonator which is lowered into the hole. other End of the fuse is kept the hole as in the case of gun powder firing)

* The free End of the fuse is fired directly by a fire coal by use of Electric Spark.

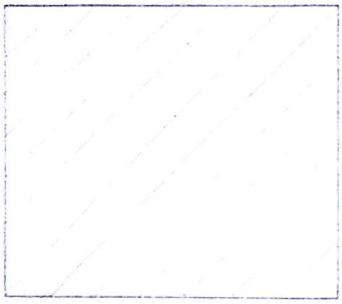


Precautions in blasting :-

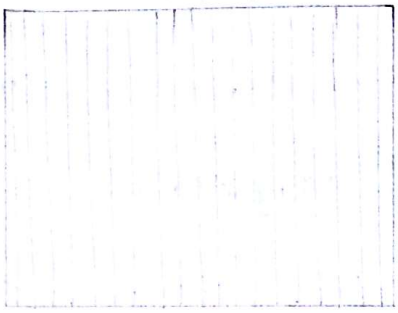
* Accidents may take place during blasting.
* Blasting should not be carried out in late evening (or) early morning hours.
* The blasting hours should be made public A siren should warn the workmen & near by public timely to retire to a safe distance.
* The danger zone, an area about 200m radius, should be marked with red flags.
* First aid should be available.
* The no. of charges fired, the no. of charges exploded & the misfires should be recorded
* Explosives should be stored & handled carefully
* Detonator & Explosives not be kept together
* wear safety, helmate, shoes, gloves etc.,

Dressing of Stones :-

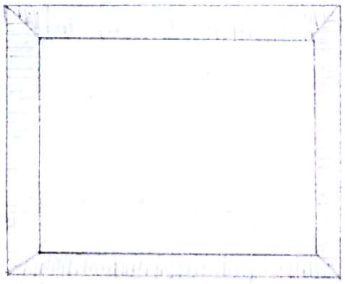
A quarried stone has rough surfaces which are dressed to obtain a definite and regular shape. Dressing of stones is done immediately after quarrying and before seasoning to achieve less weight for transportation. Dressing of stones provides pleasing appearance, proper bedding with good mortar joints, special shapes for arches, copier etc. The various types of dressed stones are :



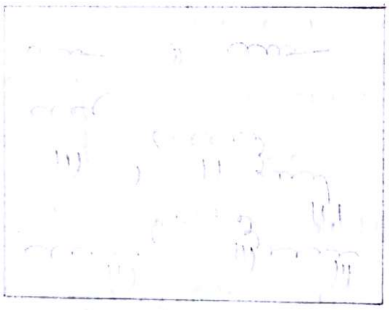
Stoked



Tooled (or) machine tooled surface



Punched (or) Rough tooled surface



Rock faced.

Composition of good brick earth :-

A brick is rectangular in size and shape can be handled with one hand brick may be made of burnt clay (or) mixture of sand and lime (or) flyash and sand (or) portland cement concrete.

Traditional bricks :

Modular bricks :

Modular bricks size 19cm x 9cm x 9cm

When placed in masonary the 19cmx9cmx9cm brick with mortar becomes 20cmx10cmx10cm

Weight of brick is 3 kgs.

The clay used for brick making consists mainly of silica and alumina mixed in such proportion that the clay becomes plas-tic when water is added to it. It consists of small proportions of lime, iron, manganese, sulphur etc.

The proportions of various ingredients are :

Silica —	50-60 %
Alumina —	20-30 %
Lime —	10 %
Magnesia —	< 1 %
Ferric oxide —	< 7 %
Alkalies —	< 10 %

Carbon dioxide, Sulphur trioxide, Water } very small percentage

It is important to understand what happens to clay when it is burnt. Heating clay upto about 640°C provides physical changes the moisture is drivenout. The organic matter is burnt out and water of crystallization is driven out. When clay is cooled, it absorbs moisture from air and gets hydrated to its original sta-te. If such a block is immersed in water, it disintegrates.

If we heat clay upto 700-1000°C chemical changes take place by which alumina and silica in a clay together resulting in a compound which is strong and stable. After this chemical trans-formation, it doesn't turn back to clay on cooling. It doesn't crumble down the clay when immersed in water proper burni-ng to be required immersed in water. Proper burning to be required temperature in brick making.

Manufacture of Bricks :-

Preparation of brick earth :

Unsoiling → Digging → Weathering → Blending → Tempering

↓

Moulding

↓

Drying

↓

Burning

↓

Brick

Unsoiling : The soil used for making building bricks should be free from gravel, sand, lime and kankar particles, organic matter etc. About 20 cm of the top layer of the earth, containing stones, gravels, roots etc. is removed after cleaning the area.

Digging : After removing the top layer of the earth, the digging operation should be done.

Weathering : The clay is allowed to weather by keeping it exposed to open air for a considerable period, so that the lumps of clay break down into smaller particles and get matured.

Blending : The clay is washed and processed before moulding into bricks. The clay mass is mixed uniformly with spades. Add water to the soil for moulding of required quantity.

Tempering : For manufacturing quality bricks tempering is done in plug mills and the operation is called plugging

Moulding of Bricks : Bricks are moulded in many ways depending on the quality of the product to be made.

They may be

(i) Hand moulding

(ii) Machine moulding

Hand moulding is classified as

(a) Ground moulding

(b) Table moulding

(a) Ground moulding : The process of making bricks on the ground by manual labour is termed as ground mould-ding. For ground moulding a layer area of ground is levelled, smoothened, plastered with mud mortar and sprinkled with sand.

(b) Table moulding : The process of moulding the bricks on a table by manual labour is known as table moulding. The general process of making and moulding brick-s is the same as an ground moulding. The mod-ular stands behind the moulding table for moulding the bricks instead of sitting on the gr-ound.

(ii) Machine moulding : When a layer no. of bricks are to be made at the same spot and where clay is very hard in plastic clay machines, the plugged clay machines, the plugged clay in a plastic cond-ition is faced through a rectangular opening of size equal to the length & breadth of the bri-ck then they are cut into strips of the thickn-ess of the brick and then dried.

In dry clay machines, the clay is reduced to powder, filled

dry into a mould by the machine and subjected to very high pressure to produce hard and well shaped bricks.

Drying of bricks : The object of drying is to remove the moisture to control the shrinkage and time during burning. The bricks may be dried by 2 methods.

(1) Natural drying
(2) Artificial drying

Natural drying :

The process of drying the bricks, in open air is known as natural drying.

In natural drying, when the moulded bricks become enough to be handled, they are laid on their edges on a raised and sanded ground, these are allowed to dry for 1 (or) 2 days. They become hard for stacking.

Artificial drying : The process of drying bricks are heated in a special dries known as tunnel drier, room drier (or) chamber drier. Then raw bricks are carried trollies which are passed through drying chamber

Burning of bricks : After drying the bricks are burnt to make them hard, strong and durable. The bricks may be burnt in any of the following 2 methods:

(i) Clamp burning
(ii) Kiln burning

Characteristics of good tiles :

→ should be uniform and pleasing colour
→ should posses accurate size and shape
→ Should be uniformly burnt.
→ Should be free from cracks, twists and other defects.
→ Should have good resistance to dampers.
→ Should be durable

→ Should be resistant to almospheric effects.

Tiles :-

It is defined as thin slates of clay prepared in various shapes. They are manufactured from clay. They required mole care in their manufacturing. Since, they are liable to be damaged in drying and burning by way of warping and cracking.

They should be dried in the shade, burnt and cooled in specially made kilns. Tiles may be moulded by hand (or) by machine

Types :- They are 2 types : (1) Roof tiles

(2) Flood tiles

Roof tiles may be classified as (a) Flat terracing tiles

(b) Clay ridge and ceiling tiles

The tiles which are used for covering the roofs of buildings are kno -wn as roofing tiles. Roofing tiles must have high resistances to almos -pheric effects. They are made in a no. of different designs to suit the requirements.

Flat terracing tiles : These tiles are rectangular in shape and are of various dimensions. They are laid in lime (or) ceme -nt mortar. These tiles can be used for flat as we -ll as for sloped roofs.

Clay ridge and ceiling tiles :

These tiles shall be made from soil of even texture and shall be uniformly burnt. They shall be uniform in shape, size and be fr -ee from irregularities such as cracks and particles of stones.

Usual Sizes : Length 250mm to 150 mm

Width 200mm to 100 mm

Thickness 35mm to 50 mm

Flooding Tiles: These are used for finishing the surfaces of floors of water closets, bathrooms, kitchens, hospitals and other such places, where cleanliness is prime importance.

Floor tiles are available in following sizes

L	W	Th
150	150	8
200	200	20
225	225	22

Requirements of floor Tiles:

* Should be free from pebbles, grit, lime (or) other foreign material visible to naked eye either on the surface (or) on the factured surface.
* The fractured surface when broken should be clean, dense and sharp at the edges.
* When struck with each other, they should have a ringing sound.
* Should not absorb water more than 24% by their weight when immersed for 24 hrs.
* They should have maximum resistance to impact.

Manufacturing:

Tiles are made in the same manner as bricks, but are thinner and lighter, so require greater care. These are manufactured from a clay mass with (or) without adding mixtures of colouring impurities by moulding and subsequent burning about 1300°C.

Use of materials: Aluminium

Gypsum

Glass

Bitmious materials

Aluminium :

Aluminium is used as a construction materials because of its aesthetic appearance. The principle constituents of bauxite [$Al_2O_3 2H_2O$] which yield aluminium on a commercial stater are hydrated oxides of aluminium and iron with silica.. Some other aluminium ores are corundum, Kaolin (or) china clay and Kryolite.

Aluminium is silver white in color with a brittle metallic lustre on freshly broken surface. It is malleable less ductile than copper but expels zinc, tin and lead. Aluminium is harder than tin. Aluminium is very light, soft, stronger and durable, has low thermal conductivity but is a good conductor of electricity. Aluminium can be riveted and welded. It can be tempered at 350°C. Tensile strength is 117.2 N/mm² in the cast foil and 241.3 N/mm² when drawn into wires aluminium can be powder coated to give various shades. so as to fit in the surroundings. Since it is corrosi -on resistant it is an ideal materials for buildings near sea shore and industrial areas. The maintanance cost is nil.

Uses : It is suitable for making door and window frames, railin -gs of shop and corrugated sheets for roofing systems. Alumi -nium taminates, boards / panels are made from alumini -um sheets.

Glass : A hard, brittle and transparent material obtained by fusing and sulphur cooling on amorphous mixture of vario -us metallic silicates is known as glass.

General Classification of Glass :

1. Soda-lime glass :- It is mainly a mixture of sodium silicate and calcium silicate used in the manufacture of gla -ss tubes and other laboratory apparatus, plate gla -ss, window glass etc.

2. Potash-lime glass : It is mainly a mixture of potassium silicate and calcium silicate used in the manufacture of glass articles which have a withstand high temperature

3. Potash-lead glass : It is mainly a mixture of potassium silicate and lead silicate used in the manufacture of artific -ial gems, electrical, bulbs, lenses, prisms etc.

4. Common glass : It is known as bottle glass. It is made from cheap raw materials. It is mainly a mixture of sodium silicate, calcium silicate and iron silicate used in the manu -facture of bottle glass.

Gypsum : Gypsum is a combination of calcium sulphate with water of crystallization [$CaSO_4 2H_2O$] and it is white colour substance. It is found in the form of rock in nature, gypsum can be used as building material. It is used in the manu -facture of cement to increase its setting time.

Bituminous materials :

It is used in construction materials. Bitumen is a non-crystalline viscous materials derived from petroleum by natural (or) refinery process. Bitumen is black in colour.

Bitumen is not affected by light, air (or) water individually but in combination they can make it brittle, porous and susceptible to oxi -dation forming cracks. It becomes soft at temperature between 30°–100°C. It must be protected from exposure to heat. Its composition is carbon 87%, hydrogen 11% and oxygen 2%.

Uses:

It is used for manufacture of roofing and damp proofing, road pavements etc.

Aggregates :

The classification of Aggregates is done by following factors

1. Based on size → { Fine Aggregate / Coarse Aggregate }

Fine Aggregate :

The Aggregates having ≤ 4.75 mm . It is called fine Aggregate

Coarse Aggregate :

Aggregates having > 4.75 mm those are called coarse Aggregate

2. Based on source

a) Rock forming Aggregates :

Igneous rocks :

Formed by the Molten magma and solidify the masses & cool down.

Sedimentary Rocks :

Due to the Wheathering Action these rocks are formed

Metamorphic Rocks :

the combination of Igneous & sedimentary Rocks are Metamorphic Rocks

b) Artificial & Synthetic Aggregates :

Eg: Robo sand

c) Recycled Aggregates :

d) Marginal materials

3. Based on Density of Aggregates :

Normal Weight

Light Weight

Heavy Weight

Light Weight :

the Expanded vermiculate & Expanded prelite are the light Weight Aggregates used in Insulating concrete Works.

Pumice is the light Weight Aggregate which is used in insulating & filling concrete works.

Expanded slag & Expanded shale & clay these are generally used in structural construction works

Properties of Aggregates :-

Quality of Aggregate :

1. Presence of Deleterious (Harmful) materials
2. Aggregate crushing value
3. Aggregate Abrasion value
4. Aggregate Impact value
5. Soundness of Aggregate

Properties Controlled by porosity :

Specific gravity test
Bulk density
Water Absorbtion & surface moisture

Crushing Test Of Aggregate :

We need to determine the quality of Aggregate by using Aggregate crushing value

To find the crushing value of Aggregate by using the standard procedure recommended by IS: 2386-(part-4)-1963 and We have some limitations regarding to Aggregate crushing value.

The recommendations are given in IS - 383 - 1970

Type of Aggregate	Applications	Crushing value
Coarse Agg (12.5 - 10mm)	using in wearing Coating in runways Roads & pavements	≯ 30 %.
Coarse Agg (12.5 - 10mm)	other than wearing coating	≯ 45 %.

Impact Test :—

Type of Aggregate	Applications	Impact value
Coarse Agg (12.5 - 10mm)	using in wearing Coating in runways Roads & pavements	≯ 30%
Coarse Agg (12.5 - 10mm)	Other than wearing coating	≯ 45 %

Hammer Weight → 15 Kgs
Hammer Height → 30.5 cms
No. of Blows → 25 blows

2.35 → passing sieve ∝ value of Agg

Abrasion Test :—

Abrasion :

It is the Frictional Resistance offered by the material against another material (over the surface)

Eg. Vehicles moving on Road

Attrition :

It is the Frictional Resistance offered by the material over the surface of same material. It is called Attrition.

Eg: Agg rubbing action in Railway Ballast

Aggregate Abrasion Test :

By using Los Angels machine & Devals Abrasion Test Apparatus to find the Abrasion value of the Aggregate. the Test procedure is given in IS : 2368 - part 4 - 1963 and limitations of the Abrasion value is recommended in IS : 383 - 1970.

Type of Aggregate	Applications	Abrasion value
Coarse Agg (12.5 - 10 mm)	Using in Wearing coating, pavements, Runways	$\not>$ 30%
Coarse agg (12.5 - 10mm)	Other than Wearing coating	$\not>$ 50%

Soundness Test :

Soundness of the Aggregate is measured of resistance to disintegration of aggregate due to chemical attack (or) freezing & thawing actions

The soundness of Fine & Coarse Aggregates is represented by the loss of Weight after 5 cycles of drying & Immersion in standard chemical sol of Na_2SO_4 (or) $MgSO_4$

The soundness of Agg is directly proportional to Porosity of Aggregate

The limits of loss of weight in soundness test suggested by IS : 383 - 1970

Type of Agg	Reagent used	Soundness of Agg
Fine Agg ≤ 4.75 mm	Sodium sulphate	≯ 10 %
	Magnesium sulphate	≯ 15 %
Coarse Agg > 4.75 mm	Sodium sulphate	≯ 12 %
	Magnesium sulphate	≯ 18 %

Fineness Modulus Of The Aggregate : >6.3

The Fineness Modulus is the measure of Fineness of the Aggregate the magnitude of Fineness modulus is determined by

$$F.M = \frac{\Sigma \text{Cumulative \% of Weight retained on IS seive}}{100}$$

the Magnitude of Fineness Modulus is Increases the Fineness of Aggregate is Increases

the Approximate Range of Fineness Modulus for coarse Aggregate is 3-5 & for Fine Aggregate the Range varies b/w 5-8

In case two different types of Aggregates are mixed together then find the Fineness modulus of combined mixture

$$F.M_{combined} = (FM_1)V_1 + (FM_2)V_2$$

Where $V_1, V_2 \rightarrow$ volume factors of those 2 materials

FM_1 & $FM_2 \rightarrow$ Fineness Modules of 2 diff Agg's

Find Fineness Modulus of a Sample Aggregate which Seive Analysis is done ?

Is sieve size	% passing	% Retained
25	100	0
20	95	5
16	56	44
12.5	30	70
10	15	85
4.75	3	97
2.36	0	100

$$\Sigma \% \text{ retain} = 401$$

$$F.M = \frac{401}{100}$$

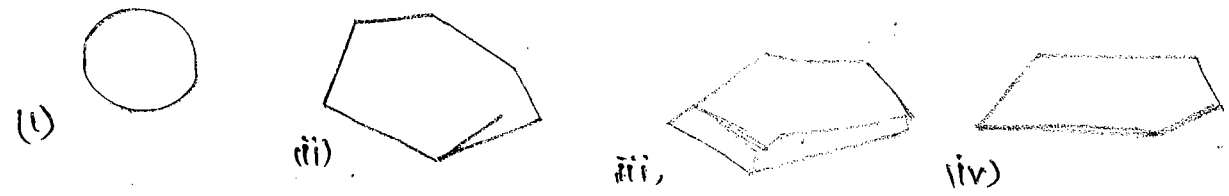
$$F.M = 4.01$$

Shape & Texture of the Aggregate :

the shape is a important parameter in Aggregates why because it is directly influences the strength and workability of the concrete.

the shape of the Aggregate is classified into 4 major types

1. Spherical
2. Irregular
3. Flaky (or) Flat
4. Needle shaped



Rounded Aggregates are more preffered in concrete mix calculation because of its Bonding property

The irregular shaped Aggregates are not suitable in concrete mix design and the Flaky and Elongated Aggregates also neglible in concrete mix design because of its improper shape & surface area.

Needle shape Aggregated are surely avoided in concrete mix design because of its sharp Edges.

The Flakious Index & Elongation Index & Angularity number is measured for the shape of the Aggregate of size greater than > 6.3 mm.

Shape of Aggregates :

Shape of Aggregates	Details
Angular shape	Well defined edges
Elongated shape	The length of Agg is more when compared to other dimension
Flaky	The Agg having thin in thickness relative to other dimensions
Irregular	The Randomness is present in perfection of shape
Rounded Agg	Absence of sharp Edges

Surface Texture :

the surface Texture of the Agg is important in developing Bond in Interface. The surface Texture depends upon the crystalline structure, pre structure, Transpot media & various other factors including the climatic conditions also

Surface Texture	Details
Crystalline Texture	Disability Of crystalline Prop's on the surface
Glassy Texture	It having sharp Edges
Granular Texture	these are the uniform round grained aggregates
Honey coombed Texture	Visibility pores on surface
Rough Texture	Medium grained (Proper shaped)
Smooth Texture	No sharp Edges on the Surface of the Aggregate

5M(07)M

Specific gravity, Density, Water Absorption of Agg :-

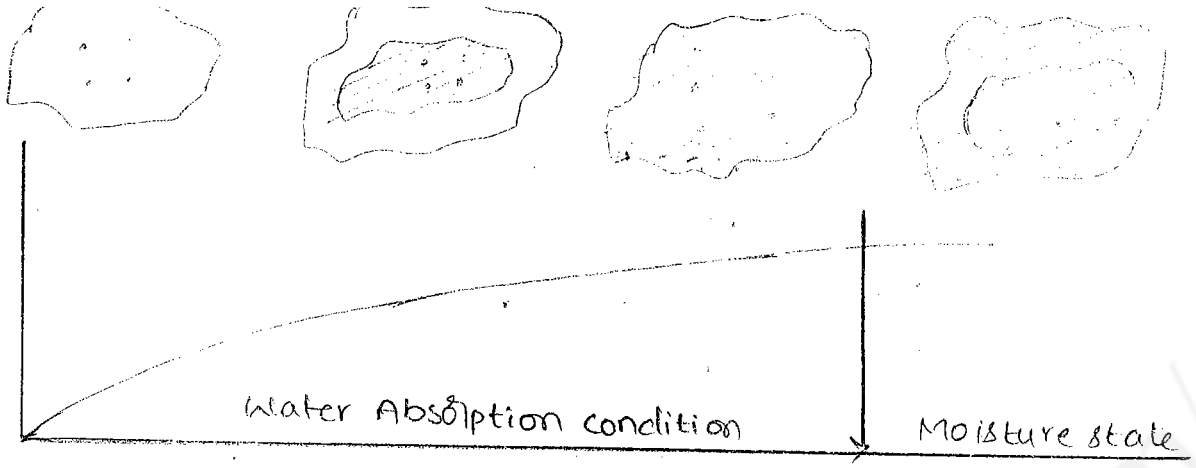
The Specific gravity of Aggregate is the ratio of Density of Aggregate to Density of Water. The Aggregate Exists under 4 different moisture conditions (Water Absorption conditions) namely

i) Bone dry condition
ii) Air dry condition
iii) Saturated surface dry condition
iv) Moisture condition.

the Water content present in these conditions are different.

the specific gravity of the Aggregates are determined under these conditions

Generally, the specific gravity of the saturated surface dry condition of Aggregate is used in concrete mix design



Generally, the aggregates consists inherent pores. Some of the poles are interlinked with surface texture and remaining are interlinks with Interiol structure of the material (ol) Aggregate.

Because of these condition the Bone dry sample may having some moisture content in the Interiol structure after 24 hrs of oven dry also.

thats way the Bone dry sample specific gravity is not used in concrete mix Design

the oven dry sample is acheived by drying the sample in oven at 100°c in 24 hrs.

Air dry sample completely depends upon climatic conditions. So, we neglible this condition.

the saturated surface dry condition is acheived by taking an Agg sample & it is immersed in water at 30°c in 24 hrs. After that taking the agg sample from water & clean the surface with cotton cloth It is called saturated surface dry condition of Agg

$$\text{Specific gravity of Agg} = \frac{\text{Unit weight of Agg}}{\text{Unit Weight of } H_2O}$$

(ol)

$$\frac{\text{Density of Agg}}{\text{Density of water}}$$

$$S.p.G = \frac{M_2 - M_1}{(M_2 - M_1) - (M_3 - M_4)}$$

M_1 = Empty Wt of picnometer

M_2 = Empty + Agg

M_3 = Empty + Agg + water

M_4 = Empty + Water.

To find specific gravity of Agg we use picnometer & Density Bottle methods

Normal specific gravity of Agg varies in range of 2.5 - 2.8

Thermal Properties of the aggregates:

The rocks and aggregates and passes thermal propeties which are significant in established the quality of the aggregates in concreate construction work.

The properties of aggregates as fallows

1. co-efficient of thermal Expansion.
2. specific heat
3. Thermal Conductivity.

Out of these specific heat and conductivity of found very important in mass concreate work.

where rigorous control as temparature is necessary also these properties are consequent of in case of light weight concrcate used for multipurpose.

An average value of linear thrmal co-efficient of Expansion of concreate may be taken as 9.98×10^{6} in Same condition the range may be taken as range may [illegible] to 10.8×10^{-6}/c is depending

upon the other Concreate properties the range of may Varrying from 10.8×10^{-6}/c to 16.2×10^{-6}/c.

Similarly for Cement Mortar it may varries from 7.9×10^{-6}/c to 12.6×10^{-6}/c. Generally the linear thermal Coefficient of is Common Rocks in varios between 0.9×10^{-6} to 26×10^{-6}/c.

21/8/13

3. FRESH CONCRETE

Fresh concrete or plastic concrete is a freshly mixed mate which can be moulded into any shape

Workability:- (easy to mixing, placing, compacting, finishing)

The quality of concrete satisfying the require is termed as workable concrete. The word "workability" or workable concrete signifies much wider and deeper meaning the other terminology "consistency" often used loosely for workabil

Factors Affecting Workability:-

Workable concrete is the one which exhibits very lit internal friction in particle and particle (or) which overc the frictional resistance offered by the formwork surfa reinforcement contained in the concrete with just the amo of compacting effort forth coming.

a) water content
b) size of aggregates
c) mix proportions
d) Shape of aggregates
e) surface texture of aggregate
f) Grading of aggregate
g) use of Admixtu

a) **water content:-** water content in a given volume of concr will have significant influences on the workability. The higher the water content per cubic meter of concrete, the higher will be the fluidity of concrete, which is one of t important factor affecting workability..

→ for controlled, concrete one cannot arbitrarily increase the water content. In case, all others steps to improve workability fail, only as last recourse the addition of more water can be considered. more water can be added. Provided a correspondingly higher quantity of cement is al added to keep the water/cement ratio constant, so that strength remains the same.

b) **mix proportions:-** Aggregate/cement ratio is an important factor influencing workability. The higher the aggregate/ cement ratio, the leaner is concrete. In lean concrete, less quantity of paste is available for providing lubricatio per unit surface ~~of~~ area of aggregate and hence mobilit of aggregate is restrained.

c) Size of Aggregates:-

The bigger size of aggregate, the less is the surface area and hence less amount of water is required for wetting the surface and less matrix of paste is required for lubricating the surfaces to reduce internal friction

→ For a given quantity of water and paste, bigger size of aggregates will give higher workability. The above of course will be true within certain limits.

d) Shape of Aggregates:-

The shape of aggregates influences workability in good measure. Angular, elongated (or) flaky aggregates make the concrete very harsh when compared to rounded aggregates (or) cuboidal aggregates

→ The reason that explains why river sand and gravel provide greater workability to concrete than crushed sand and aggregate.

e) Surface Texture:-

The influence of surface texture on workability is again due to the fact that the total surface area of rough textured aggregate is more than the surface area of smooth rounded aggregate of same volume.

→ A reduction of inter particle frictional resistance offered by smooth aggregates also contributes to higher workability

f) Grading of Aggregates:-

A well graded aggregate is the one which has least amount of void in a given volume. With excess amount of paste, the mixture becomes cohesive and fatty which prevents segregation of particles. Aggregate particles will slide past each other with the least amount of the compacting efforts. The better the grading, the less is the void content and higher the workability.

g) Use of Admixtures:-

It may be noted that the initial slump of con. crete mix or what is called the slump of reference mix should be about 2-3 cm to enhance the slump many fold at a minimum dose.

use of air-entraining agent being surface-active reduces the internal friction b/n the particles. They also act as artificial fine aggregates of very smooth surface. It can be viewed that air bubbles act as a sort of ball bearing b/n the particles to slide past each other and give easy mobility to the particles. similarly, the fine glassy pozzolanic materials, inspite of increasing the surface area offer better lubricating effects for giving better workabi

Measurement of workability at different Test:-

The following test are commonly employed to measure workability:-

a) Slump test
b) Compacting factor test
c) Flow test
d) Kelly Ball test
e) Vee Bee consistometer test

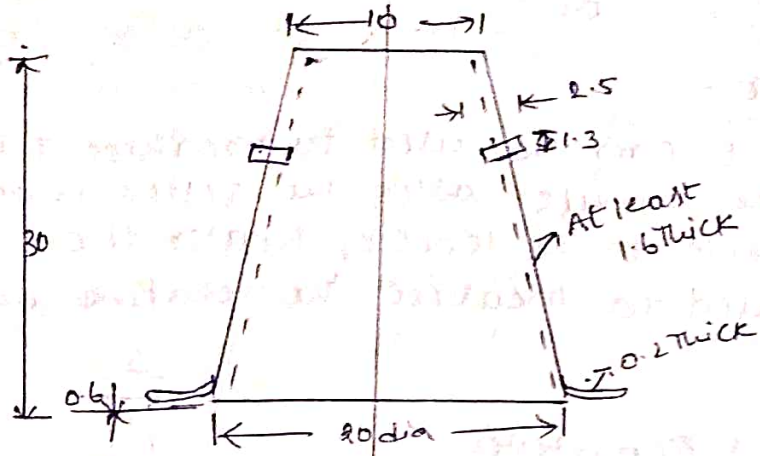
a) Slump test:- It is the most commonly used method of measuring consistency of concrete which can be employed either in laboratory (or) at site of work. It is not a suitab method for very wet (or) very dry concrete.

The apparatus for conducting The Slump test essenti consist of metallic mould in the form of a frustum of a cone having the internal dimensions are under:

Bottom dia:- 20 cm
Top " :- 10 cm
Height " :- 30 cm

The thickness of the metallic sheet for the mould should be not be thinner than 1.6mm. Sometimes the mould is provided with suitable guides for lifting vertically up. For tamping the concrete, a steel tamping rod 16mm dia.. 0.6mts along with bullet end is used as shown in figure. The internal surface of the mould is thoroughly cleaned and freed from superfluous moistur and adherence of any old set concrete before commencing The test

The mould is placed on a smooth, rigid and non-absorbant surface. The mould is then filled in four layers, each approx $1/4^{th}$ layer of height of the mould. Each layer is tamped 25 times by the tamping rod taking care to distribute the strokes evenly over the c/s. After the top layer has been rodded, the concrete immediately by raising it slowly and carefully in a vertical direction. This allows the concrete to subside This subsidence is referred as slump of concrete



(Dim in cm)

Typical mould for slump test

The pattern of slump is shown in figures. It indicates the characteristic of concrete in addition to the slump value. If the concrete slump evenly is called true slump. if one half of the cone slides down, it is called shear slump. In case of shear slump, the slump value is measured as the difference in height of the mould and the average value of subsidence. Shear slump also indicates that the concrete is non-cohesive and shows the characteristic of segregation.

→ It is seen that the slump test gives fairly good consistent result for a plastic-mix. This test is not sensitive for a stiff-mix

→ The test also suggest that in the "very high" category of workability measurement of workability by determination of "flow" by flow test will be more appropriate.

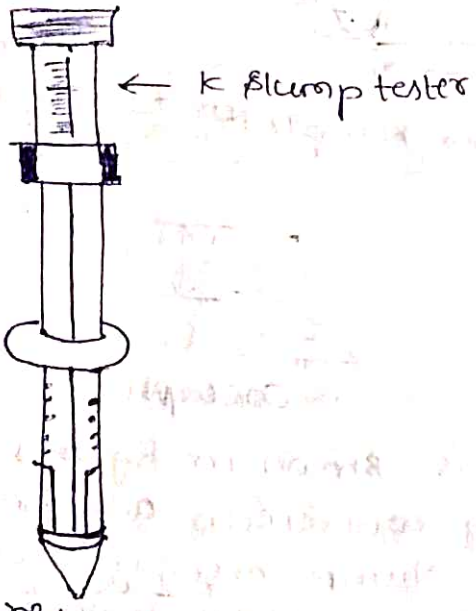
Therefore a lean mix with a tendency of harshness a

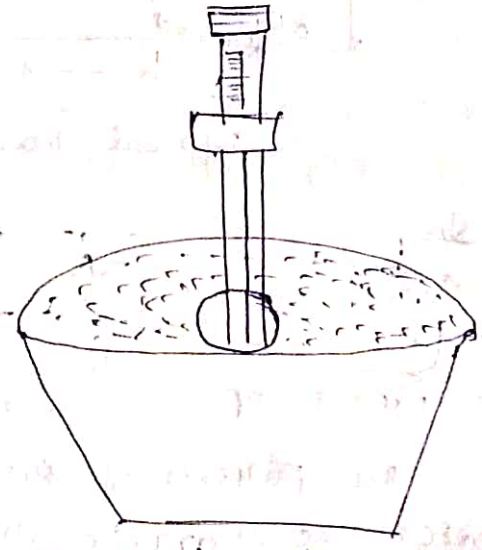
true slump can easily change to shear slump. In that case, the test can be repeated.

The slump test is very useful on site to check day-to-day (or) hour-to-hour variation in quality of mix. An increase in slump, may mean for instance that the moisture content of the aggregate has suddenly increased (or) there has been sudden change in the grading of aggregate. It shows that slump test has more practical utility than the other test for workability

K-Slump tester:-

It can be used to measure the slump directly in one minute after the tester is inserted in the fresh concrete to the level of floater disc. This tester can also be used to measure the relative workability





Measuring the K-Slump

Procedure:

1) Wet the tester with water and shake off the excess
2) Raise the measuring rod, tilt slightly and let it rest on the pin located inside the ~~tested~~ tester.
3) Insert the tester on the levelled surface of concrete vertically down until the disc floater rest at the surface of the concrete. Do not rotate while inserting (or) removing the tester.
4) After 60 seconds, lower the measuring rod slowly until it test on the surface of the concrete that has entered the tube and read the K-slump directly on the scale of the measuring rod.

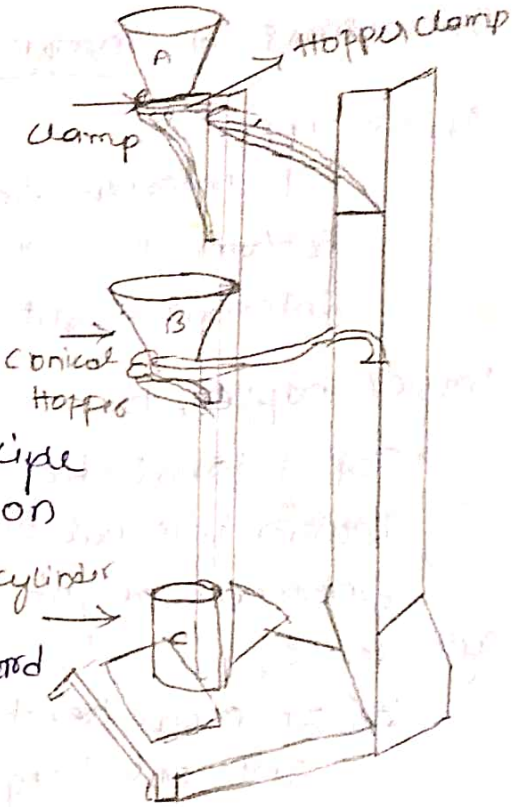
5) Raise the measuring rod again and let it rest on the pin

6) Remove the tester from the concrete vertically upwards again lower the measuring rod slowly till it touches the surface of the concrete retained in the tube and read workability (W) directly on the scale of the measuring rod.

Compression FACTOR TEST:

The compacting factor test is designed primarily for use in the laboratory but it can also be used in the field. It is more precise and sensitive that the slump test and is particularly useful for concrete mixes of very low workability as are normaley used when concrete is to be compacted by variation vibration such dry concrete are insensitive to slump test

The compacting factor test has been developed at the Road Reasearch laboratory UK and it is one of the most efficient test for measuring the workability of concrete.



compacting factor apparatus

This test works on the principle of determing the degree of compaction acheived by a standard amount of work done by allowing the concrete to fall through a standard height. The degree of compaction, called the compacting factor is measured by the density ratio ie The ratio of the density actually achieved in the test to density of same concrete fully compacted

The Sample test of concrete to be tested is placed in the upper hopper up to the brim. The top-door is opened so that the concrete falls in to the lower hopper. then the top-door of the lower hopper is opened and the concrete is allowed to fall into the cylinder.

→ The excess concrete remaining above the top level of the cylinder is then cut off will the help of Plane bladed supplied with the apparatus. The out side of cylinder is wiped clean. The concrete is filled up exactly upto the top level of the cylinder. It is weighed to the nearest 10gms. this weight is known as "weight of partially compacted concrete".

→ The cylinder is emptied and then refilled with the concrete from the same sample in layers approximately 5cm deep. this weight is known as "weight of fully compacted concrete".

$$\therefore \text{Compacting factor} = \frac{\text{weight of partially compacted concrete}}{\text{weight of fully compacted concrete}}$$

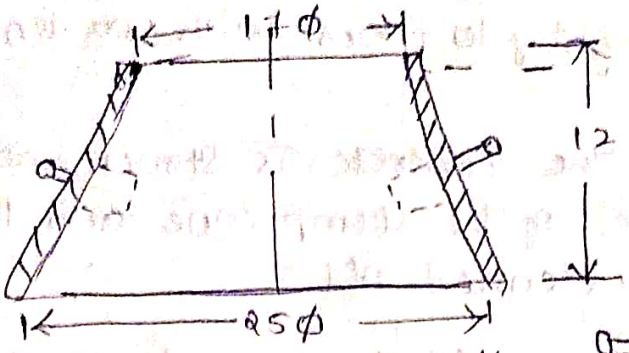
Dimensions of compacting FACTOR:-

	Dim in cm
Upper hopper A,	
Top internal dia	25.4
Bottom " "	12.7
Internal height	27.9
Lower hopper, B	
Top internal dia	22.9
Bottom internal dia	12.7
Internal height	22.9
Cylinder C,	
Internal dia	15.2
Internal height	30.5
Distance bln bottom of upper hopper and top of lower hopper	20.3
Distance bln bottom of lower hopper and top cylinder	20.3

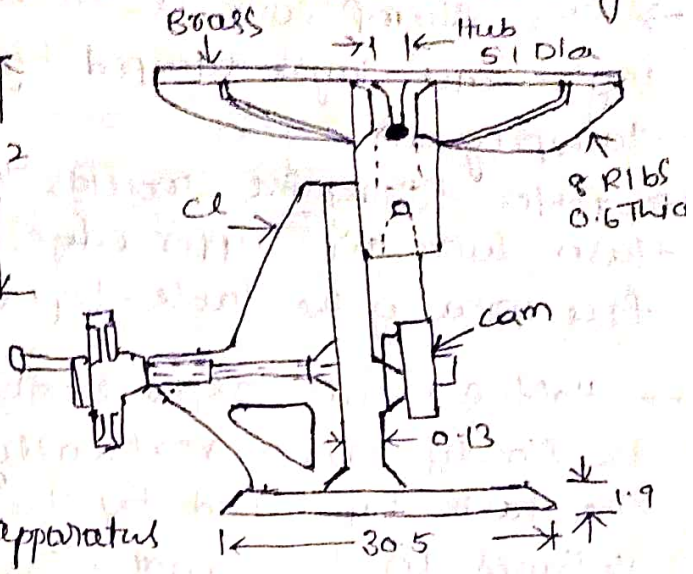
The weight of fully compacted concrete can also be calculated by knowing the proportion of materials their specific gravities, and volume of cylinders

FLOW TEST:-

This is the test, which gives an indication of the quality of concrete w.r.t consistency, cohesiveness and the proneness to the segregation. In this test, a standard mass of concrete is subjected to jolting.



mould for Flow test



Flow table Apparatus

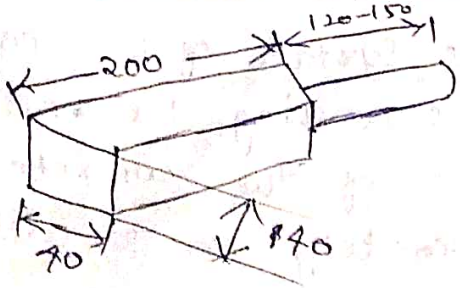
It can be seen that apparatus consist of flow table about 76 cm, in dia over which concentric circles are marked. A mould made from smooth metal casing in the form of a frustrum of a cone is used with the following internal dimensions. The base is 25 cm in ϕ, upper surface is 17 cm in dia and height of cone is 12 cm.

The table top is cleaned of all gritty material and is wetted. The mould is kept on the centre of the table, firmly held and is filled in two layers. Each layer is rodded 25 times with a tampering rod 1.6 cm in ϕ (dia) and 61 cm long rounded at the lower tamping end. After the top layer is rodded evenly, the excess of concrete which has overflowed the mould is removed.

$$\text{Flow percent} = \frac{\text{Spread dia in cm} - 25}{25} \times 100$$

Tamping Bar:-

It is made of suitable hardwood and having dimensions



Procedure:-

→ The table is made level and properly supported Before commencing the test the table-top and inn Surface of the mould is wiped with a damp cloth.

→ The slump cone is filled with concrete in two eq layers each layer tamped lightly 10 times with wooden tamping bar

→ After filling the mould, the concrete is struck off flush with the upper edge of the slump cone and the free area of the table-top cleaned off

→ Half a minute after striking off the concrete, the co is slowly raised vertically by the handles. After thi the table-top raised by the handle and allowed to fal 15 times in 15 seconds. The concrete spreads itself ou The dia of the concrete spread shall then be measur in two directions, parallel to the table edges. The

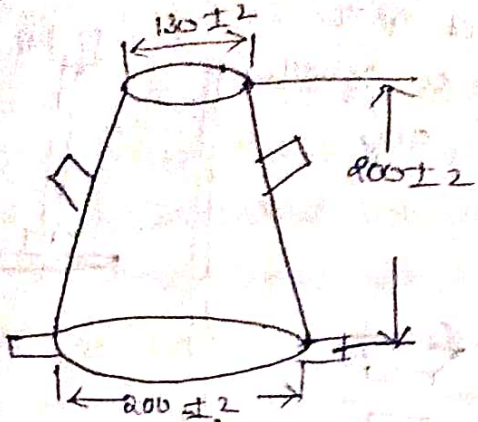
KELLY BALL TEST:-

This is a simple field test consisting of the measurement of the indentation made by 15cm dia metal hemisphere weighing 13.6 kg when freely placed o fresh concrete. The test has been devised by Kelly and hence it is known as Kelly Ball Test.

The advantages of this test is that it can be performed on the concrete placed in site and it is claim that this test can be performed faster with a greater precision than slump test. The disadvantages are that it requires a large sample of concrete and it cannot be used when ~~cannot~~ the concrete is placed in thin sect The minimum depth of concrete must be at least 20cm and the minimum distance from the centre of the ball to nearest edge of the concrete 23cm

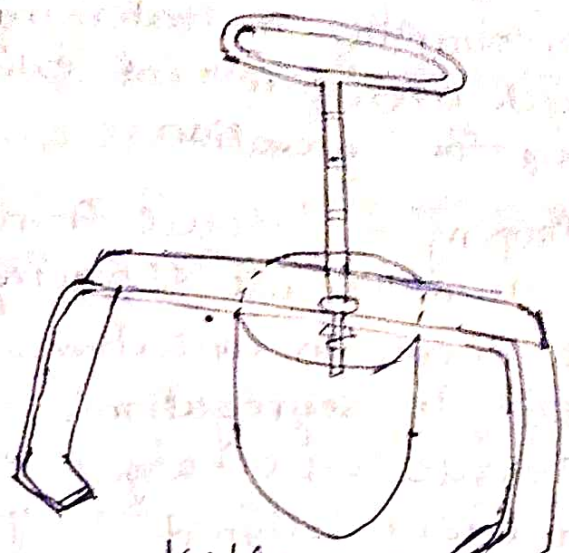
The surface of the concrete is struck off leve avoiding excess working. The ball is lowered gradually on the surface of the concrete. The depth of penetrati is read immediately on the stem to nearest 6mm.

The test can be performed in about 15 sec and it gives much more consistent result than slump test.



Dim in 'mm'

concrete mould



Kelly Ball

VEEBEE TEST:-

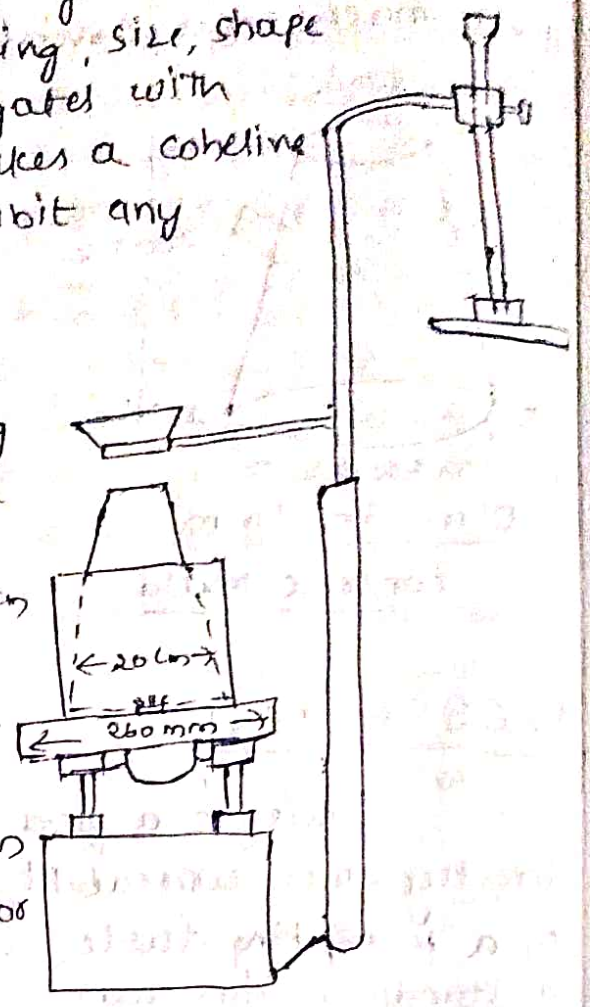
This is a good laboratory test to measure indirectly the workability of concrete. This test consists of a vibrating table, a metal pot, a sheet metal cone, a standard iron rod.

The glass disc attached to the swivel arm is turned and placed on the top of the concrete in the pot. The electrical vibrator is then switch on and simultaneously a stop watch started. The vibration is continued till such a time as the conical shape of the concrete disappears. Immediately when the concrete fully assumed a cylindrical shape, The stop watch is switched off. The time required for the shape of concrete to change from slump cone shape to cylindrical shape in seconds is known as vee Bee Degree. This method is very suitable for very dry concrete whose slump value cannot be measured by slump test but the vibration is too vigorous for concrete with a slump greater than about 50mm

Segregation:-

It is defined as the separation of the constituent materials in concrete. A good concrete is one in which all ingredients are properly distributed to make a homogeneous mixture.

A well made concrete, taking into consideration various parameters such as grading, size, shape and surface texture of aggregates with optimum quantity of water makes a cohesive mix. such concrete will not exhibit any tendency for segregation.



Vee-Bee consistometre

Drooping of concrete from heights as in the case of placing concrete in column concreting will result in segregation. When concrete is discharged from a badly designed mixer, (or) from a mixer with worn out blades, concrete shows a tendency of segregation conveyance of concrete by conveyor belts, wheel barrow, long distance haul by dumper, long lift by skip and hoist are the other situation promoting segregation of concrete.

Vibration of concrete is one of the important methods of compaction. It should be remembered that only comparatively dry mix should be vibrated. The use of air-entraining agents appreciably reduces segregation

Segregation is difficult to measure quantitatively but it can be easily observed at the time of concreting operation. The pattern of subsidence of concrete in slump test (or) the pattern of spread in the flow test give a fair idea of the quality of concrete w.r.t segregation

Setting time of concrete:-

Setting time of concrete differs widely from setting time of cement. Setting time of concrete does not coincide with the setting time of cement with which the concrete is made.

The setting time of concrete depends upon

w/c ratio, temperature conditions, type of cement, use of mineral admixture, use of plasticizers. in particular retarding plasticizer

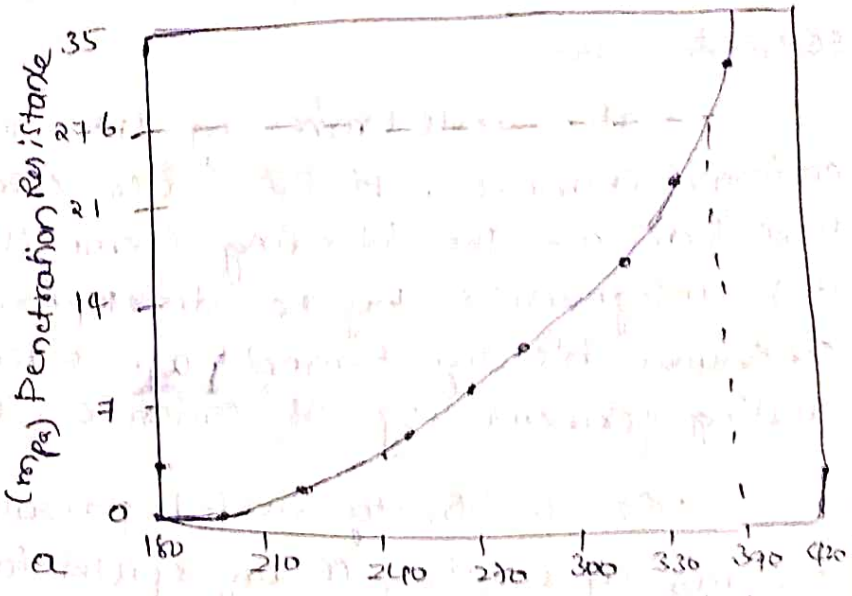
The setting time of concrete is found by pentrometer test. ~~The method of test is covered by~~ is applied to prepared mortar and grouts.

The apparatus consist of a container which should have minimum lateral dimension of 150mm and minimum depth of 150mm.

There are six penetration needles with bearing areas of 645, 323, 161, 65, 32 & 16mm². Each needle stem is scribed circumferentially at a distance of 25mm from the bearing Area

A device is provided to measure the fore required to cause penetration of needle.

→ Bring the bearing surface of needle in contact with mortar surface. gradually and uniformly apply a vertical force downwards on the apparatus until the needle Penetrates to a depth of 25±1.5 mm, The clear distance should be two times The diameter of the bearing area. Needle is inserted at least 25mm from the wall of container.



Plot the graph of penetration resistation at ordinate and elapsed time at abscissa. Not less than six penetration resistance determination is made. continue the test until one penetration resistance of at least 27.6mpa is reached. connect various points by a smooth curve.

Bleeding:

Bleeding is sometimes referred as water gain. It is a particular form of segregation, in which some of the water from the concrete comes out to the surface of concrete, being of the lowest specific gravity among all the ingredients of concrete.

The top surface has a higher content of water and is also devoid of aggregate matter; it also develops big shrinkage cracks. If laitance is formed on a particular lift, a plane of weakness would form and the bond with the next lift would be poor. This could be avoided by removing the laitance fully before the next lift is poured.

Bleeding rate increases with time up to about one hour (or) so and there after the rate decreases but continues more (or) less till the final setting time of cement.

water while traversing from top to bottom, makes continous channels. If the water cement ratio used is more than 0.7, the bleeding channels will remain continuous and unsegmented by the development of gel, This continuous bleeding channels are often responsible for causing permeability of concrete structures

Use of finely divided pozzolanic materials reduces bleeding by creating a longer path for the water to travel. Rich mixes are less susceptible to bleeding than lean mixes.

In the pavement construction finishing is done by texturing (or) brooming. Bleeding water delays the texturing and application of curing compounds.

MIXING AND VIBRATION OF CONCRETE:-

mixing:

Through mixing of the materials is essential for the production of uniform concrete. The mixing should ensure that the mass becomes homogeneous uniform in colour and consistency. There are two types of mixing. They are:

(i) Hand mixing
(ii) machine mixing

(i) Hand mixing:- (By batchings the materials is taken)

It is used for small scale concrete works. As the mixing cannot be thorough and efficient, it is desirable to add 10% more cement to cater for the inferior concrete produced by this method.

Hand mixing should be done over an impervious concrete (or) brick floor of sufficiently large size to take one bag of cement. Spread out the measured ~~spread out the measured quantity~~ of coarse aggregate and fine aggregate in alternate layers. pour the cement on the top of it, and mix them dry by shovel, turning the mixture over and over until the uniformity of colour is acheived. The uniform mixture is spread out in thickness of about 20 cm. water is taken in water-can fitted with a rose-head and sprinkled over the mixture and simultaneously turned over. This operation is continued till such time a good uniform, homogeneous concrete is obtained.

(ii) Machine mixing:- (By volumes the materials is taken)

mixing of concrete is almost invariably carried out by machine, for reinforced concrete work & for medium (or) large scale, mass concrete work. machine mixing is not only the efficient, but also economical, when the quantity of concrete to be produced is large. many types of mixers are available for batch-mixers and continous mixers. Batch mixer produce concrete, batch by batch with time interval, where as continous mixer

Produce concrete continously without stoppage till such time the plant is working.

→ Batch mixer may be of pan type (or) drum type. The drum type may be further classified as tilting, non-tilting, reversing (or) forced action type. They are speciallly suitable for stiff and lean mixes, which present difficulties with most other types of mixers, mainly due to sticking of mortar in the drum. The shape of the drum, the angle the size of blades, the angle at which drum is feed, affect the efficiency of mixer.

VIBRATION: It is used to reduce compactness. where high compressive strength is required, it is necessary that the stiff concrete, with ~~1000 water/concrete~~ low water/cement ratio be used. To compact such concrete mechanically operated vibratory equipment must be used.

The modern high frequency vibrators make it possible to place economically concrete which is impracticable to place by hand. A concrete with about 4cm slump can be placed and compacted fully in a closely spaced reinforced concrete work, where as, for hand compaction, much higher consistency about 12cm slump may be required.

Types of vibrator:-

1) plate vibrator
2) screen Board vibrator
3) Table vibrator
4) Needle vibrator (needle dia 75mm) < Electric / Petrol

MANUFACTURE OF CONCRETE:

The ~~steps~~ steps of manufacture of concrete are:-

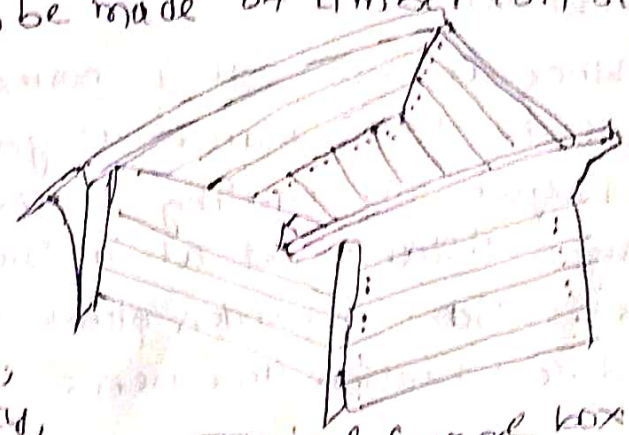
a) Batching b) mixing c) Transposing d) placing
e) compacting f) curing g) Finishing.

a) Batching: measurement of materials for making concrete is known as Batching. There are two methods of Batching:-

1) Volume Batching
2) weigh Batching.

(i) Volume Batching:- Volume Batching is not a good method for proportioning the material because of the difficulty it offers to measure granular material in terms of volume.

Cement is always measured by weight. It is never measured in volume. Generally, for each batch mix, one bag of cement is used. The volume of one bag of cement is taken as thirty five litres Guage boxes are used for measuring the fine and coarse aggregate. Gauge Guage boxes are generally called farmas. They can be made of timber (or) steel Plates.



Typical Guage box

(ii) Weigh Batching:-

It is the correct method of measuring the materials. use of weight system in batching, facilities accuracy, flexibility, and simplicity. Different types of weigh batchers are available. The particular type to be used, depends upon the nature of the job.

In smaller works, the weighting weighing arrangement consist of two weighing buckets, each connected through a system of levers to spring-loaded dail which indicate the load. The weighing buckets are mounted on a central spindle about which they rotate.

Aggregate weighing machines require regular attention if they are to maintain their accuracy.

b) mixing condition in before after mixing & vibration

c) Transporting concrete:

concrete can be transported by a variety of methods and equipments. The precaution to be taken while transporting concrete is that the homogeneity obtained at the time of mixing should be maintained while being transported to the final place of deposition. The methods are to adopted are:

i) mortar pan
ii) wheel barrow, Hand cart
iii) Crane, bucket and ropeway
iv) Truck mixer and dumper
v) Belt conveyors
vi) chute
vii) skip & Hoist
viii) RMC transit mixer
ix) Pump and pipe line ~~x) Heli-copter~~

(i) Mortar pan: while this method nullifies the segregation to some extent, particularly in wide members it suffers from the disadvantage that this method exposes greater surface area of concrete for drying conditions.

(ii) Wheel barrow: It is normally used for transporting concrete to be placed at ground level. This method is employed for hauling concrete for comparatively longer distance as at in the case of concrete road construction. A wooden plank road is also provided to reduce vibration and hence segregation.

(iii) Crane, Bucket and Ropeway:

→ Crane can handle concrete in high rise construction projects and are becoming a familiar sizes in big cities. Cranes are fast and versatile to move concrete horizontally as well as vertically along the boom and allows the placement of concrete at exact point.

Rope way and bucket of various sizes are used for transporting concrete to a place, where simple method of transporting concrete is found not feasible.

(iv) Truck mixer and bumpers:-

For large concrete works particularly for concrete to be placed at ground level, trucks and dumpers (or) ordinary open steel-body tipping lorried can be used.

v) Belt conveyors:-

Belt conveyors have very limited applications in concrete construction. ~~The principal objection is~~

The disadvantage is that the concrete is exposed over long stretches which causes drying and stiffening particularly, in hot, dry & windy weather

vi) Chute:- Chute are generally provided for transporting concrete from ground level to a lower level. This not good method of transporting concrete.

vii) Skip & Hoist:- This is one of the widely adopted methods for transporting concrete vertically up for multistorey building construction.

viii) Transit mixer:- Transit mixer is one of the most popular equipments for transporting concrete over a long distance particularly in Ready mixed concrete plant.

(ix) pumps and pipeline:-

pumping of concrete is universally accepted as one of the main methods of concrete transportation and placing.

Concrete pumps:- The modern concrete pump is a sophisticated, reliable and robust machine. In the past a simple two-stroke mechanical pump consisted of a receiving hopper, a inlet & an outlet value, a piston and a cylinder.

d) Placing:-

→ Placing concrete within earth mould.
(ex:- Foundation concrete for wall (or) columns)

→ Placing concrete within large earth mould (or) timber plank forms work.

Ex:- Road slab and Airfield slab.

→ placing concrete in layer with in timber (or) steel shutters.

(Ex:- pier (or) mass concrete in dam construction)

→ placing concrete within usual from work.

(Ex: columns, beams and floors)

→ placing concrete under water

e) Compactions :-

compaction of concrete is the process adopted for expelling the entrapped air from the concrete. The following methods are adopted for compacting the concrete:-

a) Hand compaction → Rodding, Ramming, Tamping

b) compaction by vibration

c) " by pressure & jolting

d) " by spinning

f) Curing:- To kept the concrete in water for certain period

→ curing methods may be divided in to four categories:-

1) water curing 2) membrane curing

3) Application of heat 4) miscellaneous.

g) finishing:- Finishing operation is the last operation in making concrete. Finishing in real sense does not apply to all concrete operations.

Qualities of water:-

water is an important ingredient of concrete as it actively participates in chemical reaction with the cement. since quality of water affects the strength, it is necessary for us to go into the purity & quality of water.

Mixing water:

In many specifications, the quality of water is covered by a clause saying that water should be fit for drinking.

The criterion of probability of water is not absolute: drinking water may be unsuitable as mixing water when the water has a high concentration of sodium (or) potassium and there is a danger of alkali-aggregate reaction.

Mixing of sea water tends to cause persistent dampness and efflorescences.

Curing water:

Generally, water satisfactory for mixing is also suitable for curing purposes, iron (or) organic matter may cause staining, particularly if water flows slowly over concrete and evaporates rapidly. curing with sea water may lead to attack of reinforcement

Test on water:

A simple way of determining the suitability of water for mixing is to compare the setting time of cement and strength of mortar cubes using the water.

EFFECT OF Temperature on concrete during workability

When fresh concrete is laid at the site then proper curing of concrete is required, then there are many factors factors that affect the workability of concrete and temperature is one of them. Temperature is almost in every aspect has negative effects on Properties of concrete & same is the case with the workability of fresh concrete.

When temperature increases, then in the same Proportion workability of fresh concrete decreases. The reason is "when temperature increases then

evaporation rate also increases due to that hydration rate decreases and hence concrete will gain strength earlier. Due to fast hydration of concrete, a hardening comed in concrete and that decreases the workability of fresh concrete. Therefore, in return manipulation of concrete becomes very difficult.

when temperature increases then fluid viscosity increased too and that phenomenon affect the flow ability of fresh concrete. Flow ability of concrete slow reducing and hence, as a result concrete workability decreases. And when workability of concrete decreases, then due to the less flow ability of fluid, voids within the mass of concrete develops more.

This is because deeper air voids in concrete only fill, if freshly mixed fluid has the ability to move deeper inside the small opening of concrete. Due to higher temperature, viscosity of fluid increases and that viscous of fluid resist the movement of fluid.

when empty voids are left in concrete, that became reason of a reduction in the strength of concrete.

conclusion:

Temperature decreases the setting time by increasing hydration rate and that increase the age strength of concrete. If concrete is not properly laid, the strength distribution will not remain ~~for~~ the same throughout the c/s.