Fresh Concrete

Process of Manufacture of Concrete

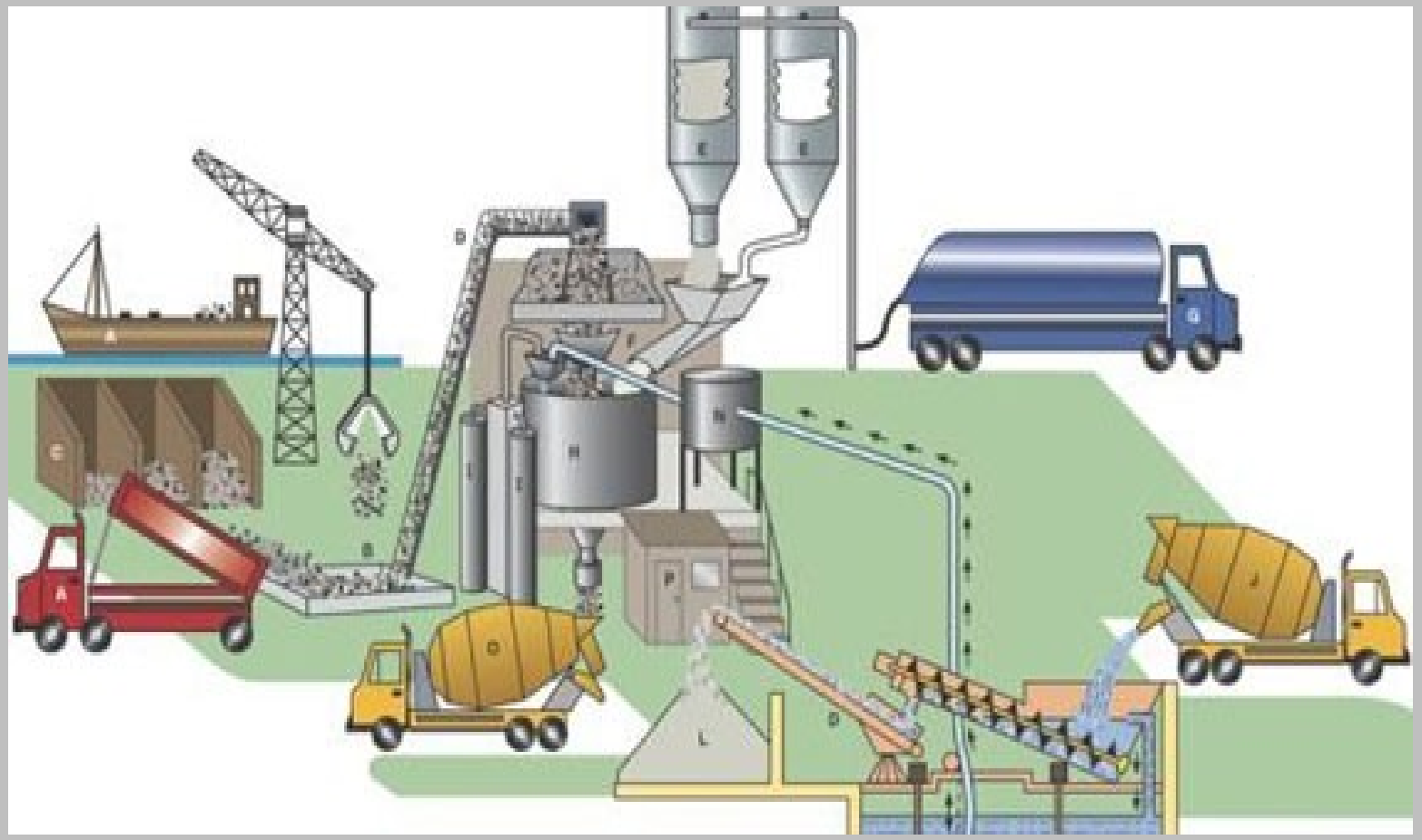
- **It is interesting to note that the ingredients** of good concrete and bad concrete are the same.
- **If meticulous care is not exercised,** and good rules are not observed, the resultant concrete is going to be of bad quality.
- **With the same material if intense care** is taken to exercise control at every stage, it will result in good concrete.

Good Concrete and Bad Concrete Quality

Process of Manufacture of Concrete

- **The various stages of manufacture of concrete are:**
- (a) Batching
- (b) Mixing
- (c) Transporting
- (d) Placing
- (e) Compacting
- (f) Curing
- (g) Finishing.

Process of Manufacture of Concrete



Batching

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.

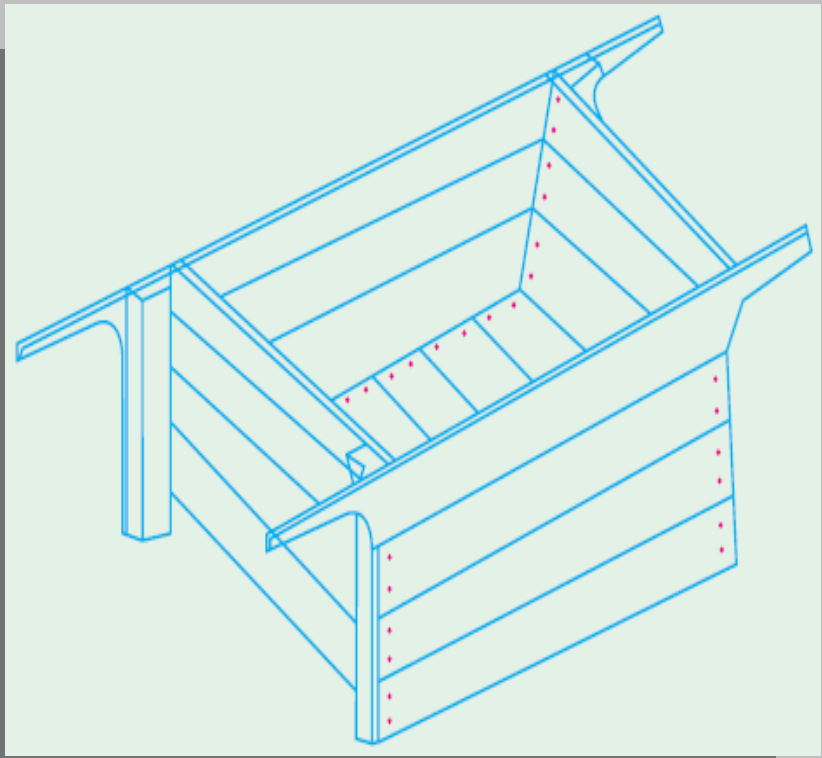
- **Volume of moist sand in a loose condition weighs much** less than the same volume of dry compacted sand.

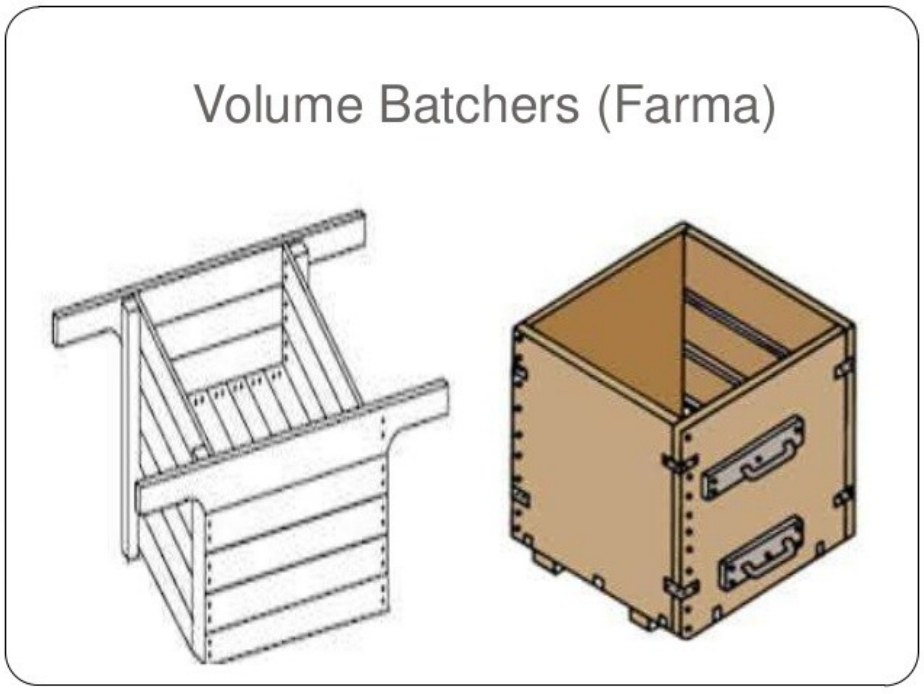
- **The effect of bulking** should be consider for moist fine aggregate.

- For **unimportant concrete or for any small job**, concrete may be batched by volume.

Batching : Volume Batching

- **Volume batching:**





Batching : Volume Batching

Table 6.3. Volume of Various gauge boxes

Item	Width cm	Height cm	Depth cm	Volume litres	Quantity number
A	33.3	30	20	20	1
B	33.3	30	25	25	2
C	33.3	30	30	30	2
D	33.3	30	35	35	2
E	33.3	30	40	40	2
F	33.3	30	45	45	2
G	33.3	30	50	50	1

Table 6.4 Batch volume of materials for various mixes

	Cement kg.	Sand, litres	Coarse aggregate, litres
1 : 1 : 2 (M 200)	50	35	70
1 : 1 1/2 : 3 (M 200)	50	52.5	105
1 : 2 : 3	50	70	105
1 : 2 : 4 (M 150)	50	70	140
1 : 2 1/2 : 5	50	87.5	175
1 : 3 : 6 (M 100)	50	105	210

Batching

Weigh Batching:

- **Weigh batching is the correct method of measuring** the materials.
- Use of **weight system in batching, facilitates, accuracy, flexibility and simplicity**.
- Large weigh batching plants have automatic weighing equipment.
- On large work sites, the weigh bucket type of weighing equipment's are used.

Batching : Weigh Batching

Batching : Weigh Batching

Batching : Weigh Batching

Mixing

- Thorough 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 methods adopted for mixing concrete:
(i) Hand mixing (ii)Machine mixing

Mixing: Hand mixing

- **Hand mixing is practised** for small scale unimportant concrete works.
- **As the mixing cannot be thorough and efficient**, it is desirable to add 10 per cent 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 quantity of coarse aggregate** and fine aggregate in alternate layers.

Mixing: Hand mixing

- **Pour the cement on the top of it, and mix them dry by shovel, turning the mixture** over and over again until uniformity of colour is achieved.
- **Water is taken in a 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.

Mixing: Hand mixing

Mixing: Machine Mixing

- **Mixing of concrete is almost invariably carried out by machine**, for reinforced concrete work and for medium or large scale mass concrete work.
- **Machine mixing is not only efficient, but also economical, when the quantity of concrete** to be produced is large.
- They can be classified as batch-mixers and continuous mixers.
- **Batch mixers produce concrete, batch by batch with time interval, whereas continuous mixers** produce concrete continuously without stoppage till such time the plant is working.

Mixing: Machine Mixing

- **In normal concrete work, it is the batch mixers** that are used.
  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.
- As per I.S. 1791–1985, concrete mixers are designated by a number representing its nominal mixed batch capacity in litres. The following are the standardized sizes of three types:
- a. Tilting: 85 T, 100 T, 140 T, 200 T
- b. Non-Tilting: 200 NT, 280 NT, 375 NT, 500 NT, 1000 NT
- c. Reversing: 200 R, 280 R, 375 R, 500 R and 1000 R

Mixing: Machine Mixing

Mixing: Machine Mixing

Mixing: Machine Mixing

Mixing: Machine Mixing

Transporting : Mortar Pan

- **Use of mortar pan for transporation of concrete** is one of the common methods adopted in this country.
- In this case, concrete is carried in small quantities.
- While this **method nullifies the segregation to some extent, particularly in thick members Greater loss of water, particularly, in hot weather concreting**

Transporting : Wheel Barrow

- **Wheel barrows are normally used for transporting concrete** to be placed at ground level.
- **This method is employed for hauling concrete for comparatively** longer distance as in the case of concrete road construction.
- **If concrete is conveyed by wheel barrow over a long distance,** on rough ground, it is likely that the concrete gets segregated due to vibration.

Transporting : Wheel Barrow

Transporting : Crane, Bucket and Rope way

- **A crane and bucket is one of the right equipment** for transporting concrete above ground level.
- **Crane can handle concrete** in high rise construction projects and are becoming a familiar sites 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 the exact point.
- **Cranes carry skips or buckets containing concrete. Skips have discharge door at the bottom**, whereas buckets are tilted for emptying.
- For a medium scale job the bucket capacity may be 0.5 m^3.

Transporting : Crane, Bucket and Rope way

Transporting : Crane, Bucket and Rope way

Transporting : Truck Mixer and Dumpers

- **For large concrete works particularly for concrete to be placed at ground level**, trucks and dumpers or ordinary open steel-body tipping lorries can be used.
- **As they can travel to any part of the work, they have much advantage over the jubilee wagons**, which require rail tracks.
- **Dumpers are of usually 2 to 3 cubic metre capacity, whereas** the capacity of truck may be 4 cubic metre or more.

Transporting : Truck Mixer and Dumpers

Transporting : Truck Mixer and Dumpers

Transporting :Belt Conveyors

- **Belt conveyors have very limited applications in concrete construction.**
- **The principal objection is the tendency of the concrete to segregate on steep inclines,** at transfer points or change of direction, and at the points where the belt passes over the rollers.
- **Conveyors can place large volumes of concrete quickly where access is limited.**

Transporting :Belt Conveyors

Transporting :Chute

- **Chutes are generally provided for transporting concrete from ground level to a lower level.**
- **The sections of chute should be made of or lined with metal and all runs** shall have approximately the same slope, not flatter than 1 vertical to 2 $^{1/2}$ horizontal.
- **The lay-out is made in such a way that the concrete** will slide evenly in a compact mass without any separation or segregation.

Transporting : Chute

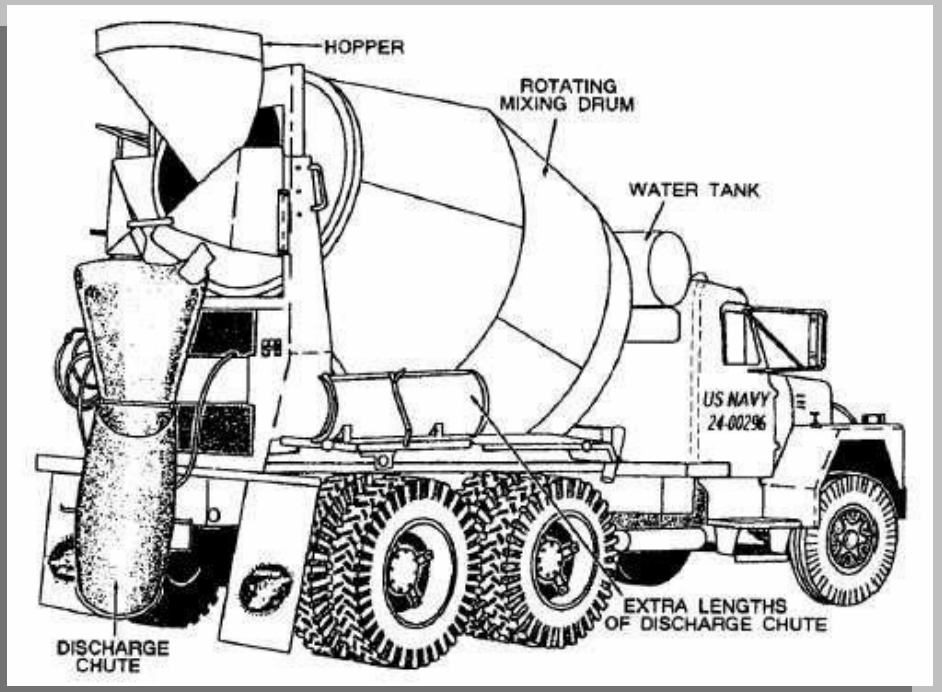
Transporting :Skip and Hoist

- **This is one of the widely adopted methods for transporting concrete vertically** up for multi-storey building construction.
- **At the ground level, mixer directly feeds the skip and the skip travels up over** rails upto the level where concrete is required.
- **At that point, the skip discharges the concrete automatically** or on manual operation.

Transporting :Transit Mixer

- Transit mixer is one of the most popular equipments for transporting concrete over a long distance particularly in **Ready Mixed Concrete plant (RMC).**
- **In India, today (2000 AD) there are about 35 RMC plants and a number of central batching plants are working**. They are truck mounted having a capacity of 4 to 7 m^3.
- **In one, mixed concrete is transported to the site by keeping it agitated all along at a speed varying between 2 to 6** revolutions per minute.
- **In the other category, the concrete is batched at the central batching plant and mixing is done in the truck mixer** either in transit or immediately prior to discharging the concrete at site.

Transporting



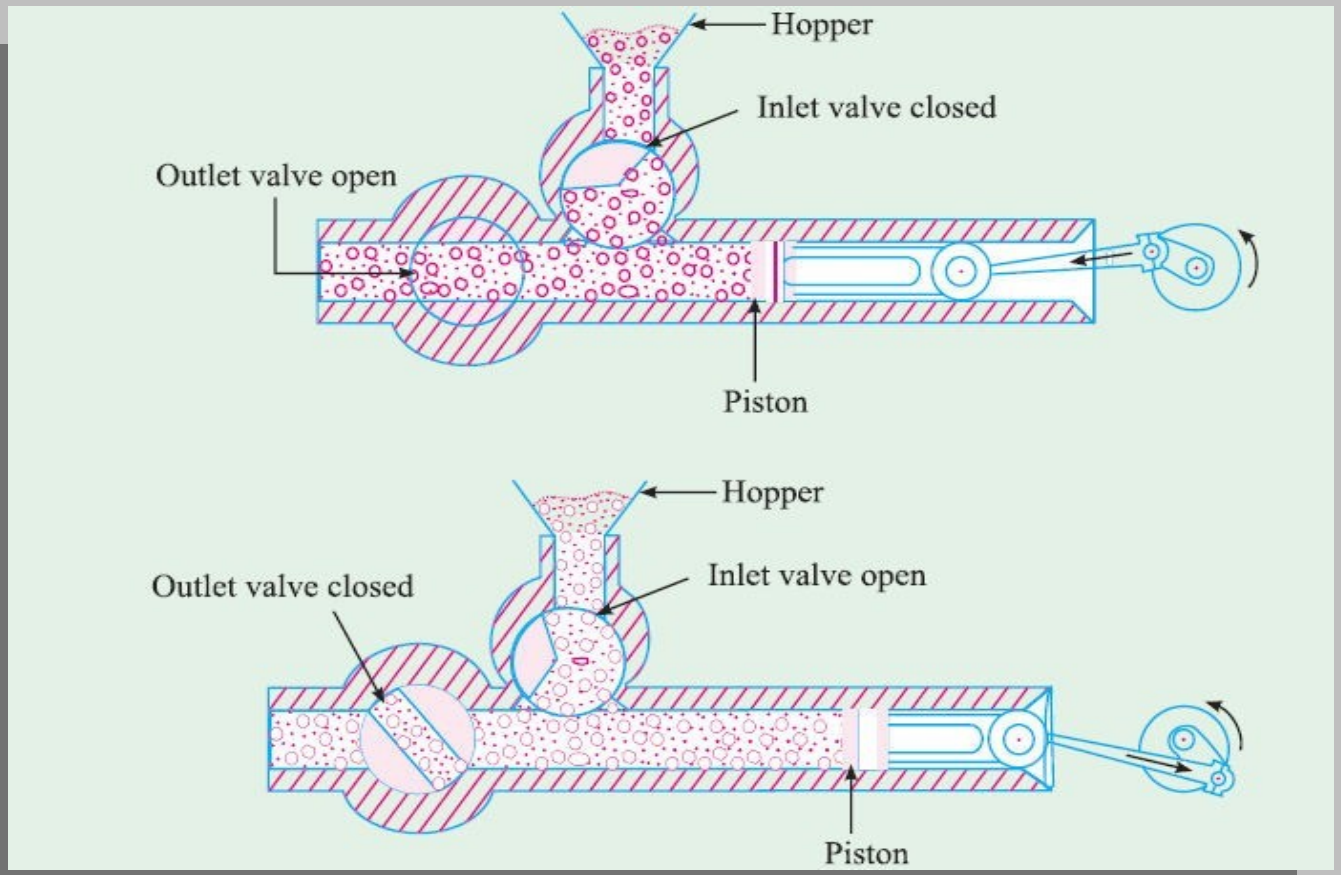
Transporting :Pumps and Pipeline

- **Pumping of concrete is universally accepted as one of the main methods of concrete transportation and placing.**
- **Adoption of pumping is increasing throughout the world as pumps become more reliable** and also the concrete mixes that enable the concrete to be pumped are also better understood.
- **The first patent for a concrete pump was taken in USA in the year 1913**.
- By about 1930 several countries developed and manufactured concrete pump with sliding plate valves.
- The modern concrete pump is a sophisticated, reliable and robust machine.

Transporting :Concrete Pumps

- In the **past a simple two-stroke mechanical pump consisted of a receiving hopper**, an inlet and an outlet valve, a piston and a cylinder.
- The pump was powered by a diesel engine.
- The **pumping action starts with the suction stroke drawing concrete** into the cylinder as the piston moves backwards.
- **During this operation the outlet value is closed. On the forward stroke, the inlet valve closes** and the outlet valve opens to allow concrete to be pushed into the delivery pipe.

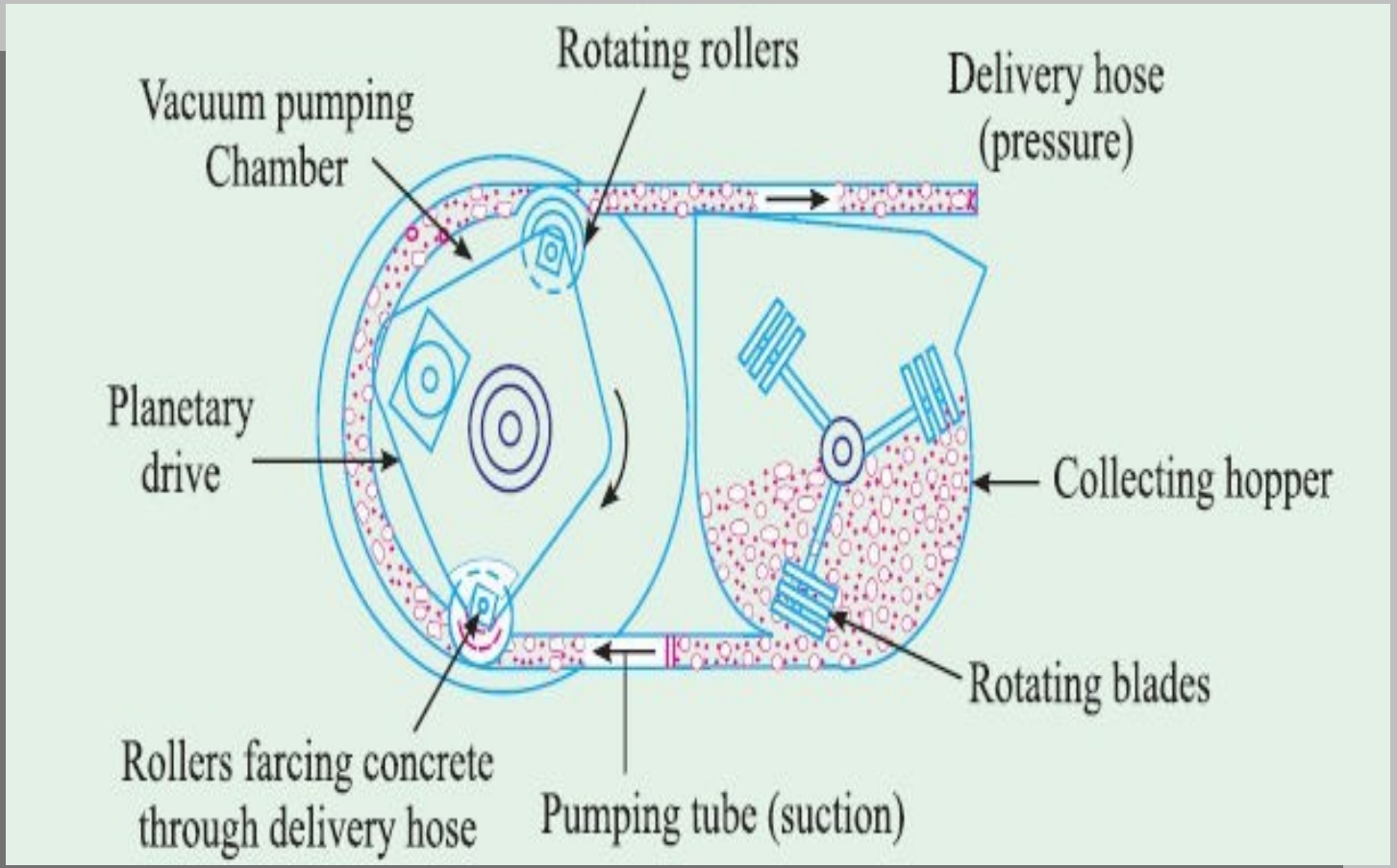
Transporting :Concrete Pumps



Transporting :Concrete Pumps

- **The modern concrete pump still operates on the same principles** but with lot of improvements and refinements in the whole operations.
- **In this concrete placed in a collecting hopper is fed by rotating blades into a flexible pipe connected to the pumping chamber**, which is under a vacuum of about 600 mm of mercury.
- **The vacuum ensures that, except when being squeezed by roller, the pipe shape remains cylindrical** and thus permits a continuous flow of concrete.
- **Two rotating rollers progressively squeeze** the flexible pipes and thus move the concrete into the delivery pipe.

Transporting :Concrete Pumps



Transporting :Pipelines and couplings

- **It is equally important to have correct diameter of pipeline with adequate wall thickness** for a given operating pressure and well designed coupling system for trouble free operation.
- **A poor pipeline can easily cause blockages arising from leakage of grout. Pushing of abrasive material** at high pressure, through pipeline inevitably creates a great deal of wear.
- **Continuous handling, frequent securing** and releasing of couplings creates wear at joints..

Transporting :Pipelines and couplings

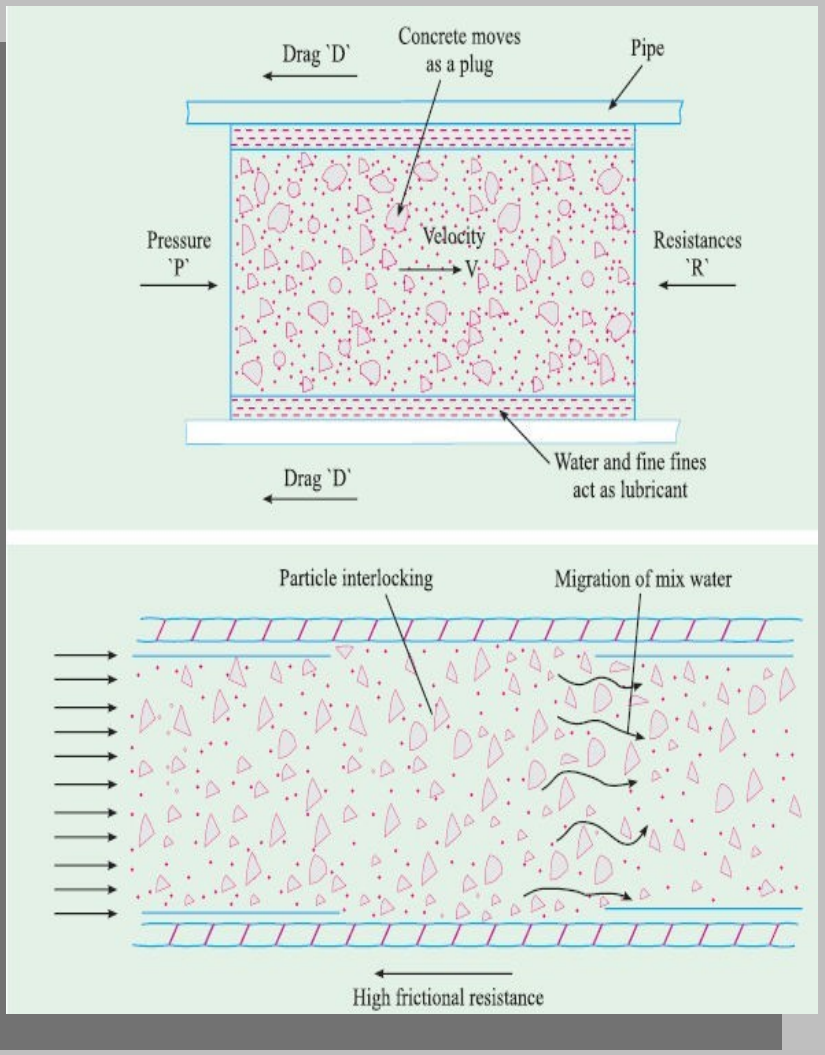
- Generally almost all pumped concrete is conveyed through 125 mm pipeline.
  - General rule is that the pipe diameter should be between 3 to 4 times the largest size of aggregate.
  - Concrete has been pumped to over 400 m and a distance of over A height horizontal 2000 m.

Pumpable Concrete

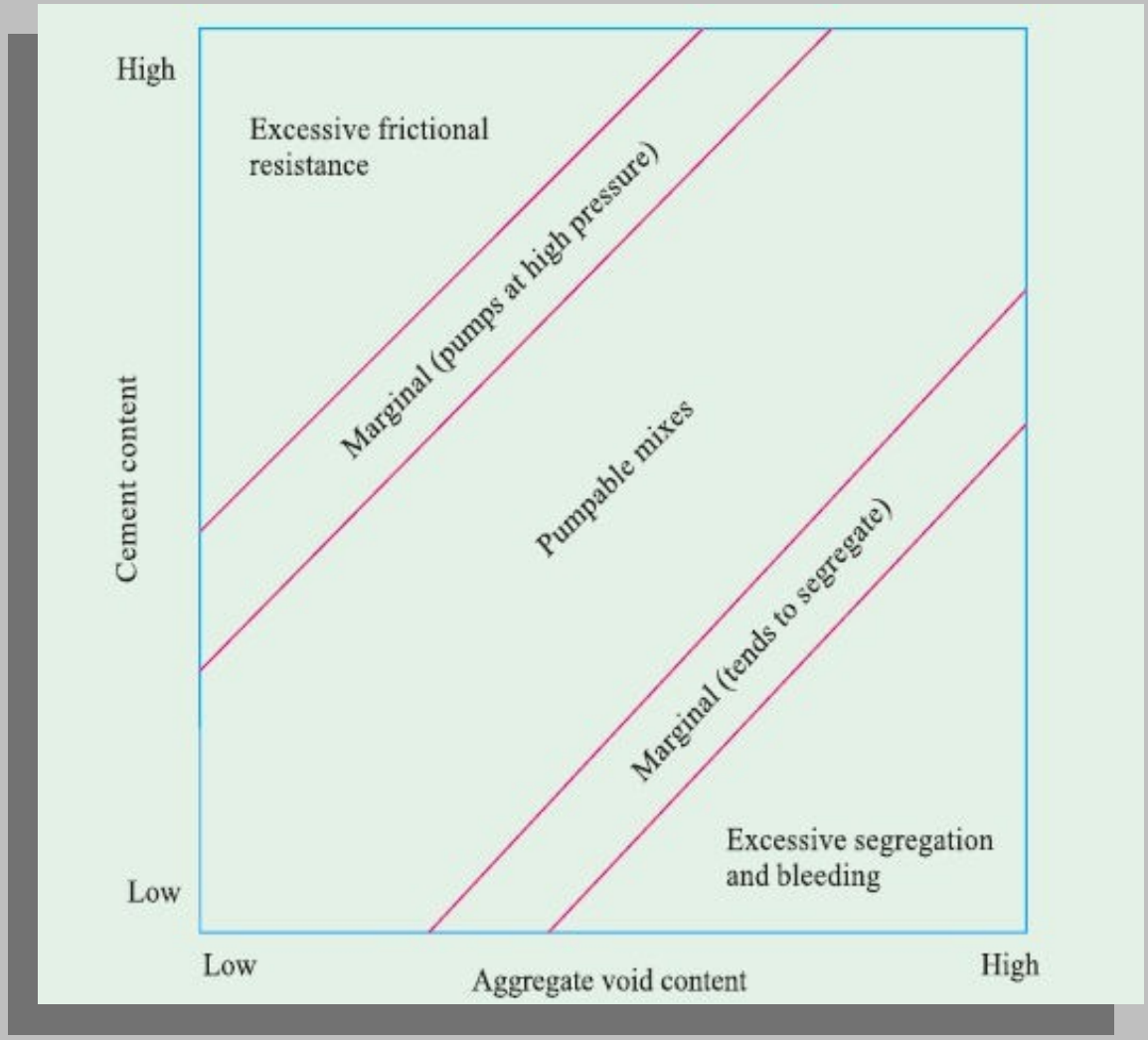
- **A concrete which can be pushed through a pipeline is called a pumpable concrete**.
- **It is made in such a manner that its friction at the inner wall of the pipeline does not become very high** and that it does not wedge while flowing through the pipeline.
- **Pumpable concrete emerging from a pipeline flows in the form of a plug which is separated from the pipe** wall by a thin lubricating layer consisting of cement paste.
- **For continuous plug movement, the pressure generated by the flow resistance must not be greater** than the pump pressure rating.

Pumpable Concrete

However if the concrete is too saturated at higher W/C ratio the concrete at certain pump pressures may be such that water is forced out of the mix, creating an increase in flow resistance and a possible blockage.



Design Considerations for Pumpable Concrete



Placing Concrete

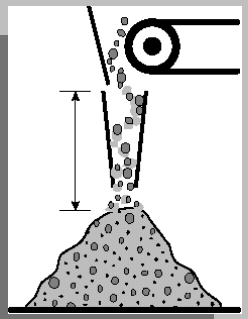
- It is not enough that a concrete mix correctly Designed
- batched, mixed and transported, it is of utmost importance that the concrete must be placed in systematic manner to yield optimum results.
- **Placing concrete within earth mould. (example: Foundation concrete for a wall or column).**
- **Placing concrete within large earth mould or timber plank formwork.** (example: Road slab and Airfield slab).
- **Placing concrete in layers within timber or steel shutters.** (example: Mass concrete in dam construction or construction of concrete abutment or pier).

Placing Concrete

- Placing concrete within usual from work. (example: Columns, beams and floors).
- Placing concrete under water.

Placing Concrete

Concrete spread evenly across the subgrade by the paver before consolidation and finishing



Placement with Conveyor Belt

Placing Concrete

Placing and Finishing Concrete

Curb/Curb and Gutter

Concrete deposited into hopper of slip form curb and gutter machine which then extrudes the concrete into the desired shape

Placing Concrete

Placing and Finishing Concrete

Concrete Pump

Placing concrete by pump and placing boom.

Underwater Placement Methods

- **Tremie, Pump, Bottom dump buckets, Grouted preplaced aggregate** (specialized),Toggle bags, Bag work, Diving bell Basic Recommendations

- Water velocity = 3 m / min.
- Water temperature = 5°C
- w/c = 0.45
- Cementing materials content = 390 kg/m^3
- Slump range 150 to 225 mm

Underwater Placement Methods

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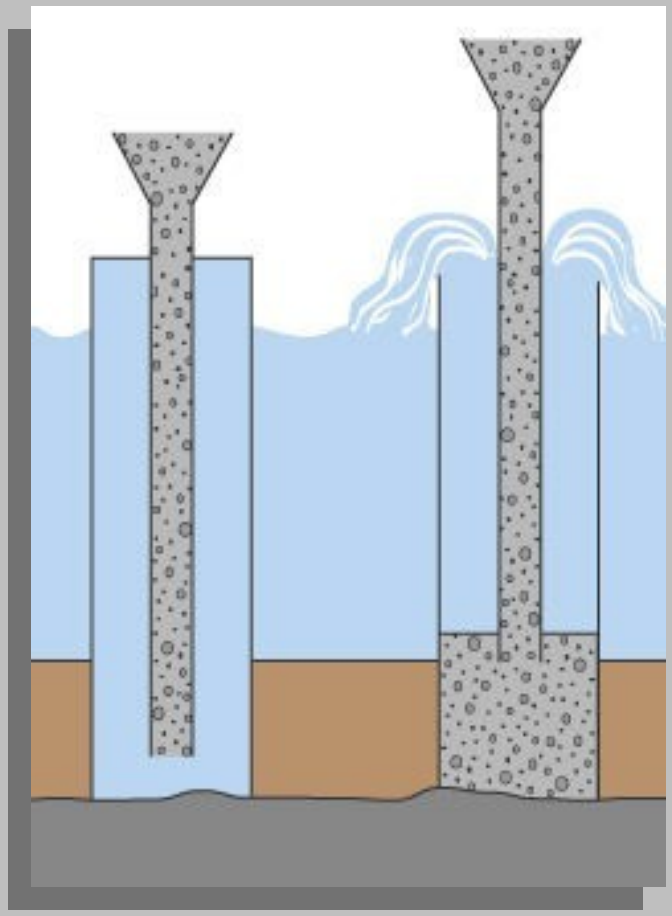
Underwater Placement Methods



Tremie

Compaction of Concrete

- **Compaction of concrete is the process adopted for expelling the entrapped air from the concrete.**
- In the **process of mixing, transporting and placing of concrete air is likely to get entrapped in the concrete.**
- **In other words, stiff concrete mix has high percentage of entrapped air and, therefore** , would need higher compacting efforts than high workable mixes.
- **In order to achieve full compaction and maximum density, with reasonable compacting efforts available at site**, it is necessary to use a mix with adequate workability.

Compaction of Concrete

- The following methods are adopted for compacting the concrete:
- Hand Compaction
- (i) Rodding (ii) Ramming (iii) Tamping
- Compaction by Vibration
- (i) Internal vibrator (Needle vibrator)
- (ii) Formwork vibrator (External vibrator)
- (iii) Table vibrator
- (iv) Platform vibrator
- (v) Surface vibrator (Screed vibrator)
- vi) Vibratory Roller.
- (c) Compaction by Pressure and Jolting
- (d) Compaction by Spinning.

Compaction of Concrete: Hand Compaction

- Hand compaction of concrete is adopted in case of unimportant concrete work of small magnitude.
- **Rodding is done continuously** over the complete area to effectively pack the concrete and drive away entrapped air.
- **Light ramming can be permitted in unreinforced foundation** concrete or in ground floor construction.
- **Tamping is one of the usual methods adopted in compacting roof or floor slab or road pavements** where the thickness of concrete is comparatively less and the surface to be finished smooth and level. **Tamping consists of beating the top surface by wooden cross beam**

Compaction of Concrete: Hand Compaction

Compaction of Concrete: By Vibration

- Where high strength is required, it is necessary that stiff **concrete, with low water/cement ratio be used.** To compact such concrete, mechanically operated vibratory equipment, must be used.

  - **A concrete with about 4 cm slump can be placed and compacted fully in a closely spaced reinforced concrete** work, whereas, for hand compaction, much higher consistency say about 12 cm slump may be required.

  - **The action of vibration is to set the particles of fresh concrete in motion, reducing the friction between them** and affecting a temporary liquefaction of concrete which enables easy settlement.

Compaction of Concrete: By Vibration

- **Internal Vibrator:** Of all the vibrators, the internal vibrator is most commonly used. This is also called, **"Needle Vibrator", or "Poker Vibrator". This essentially consists of a power unit, a flexible shaft and a needle.**
- **Formwork Vibrator (External Vibrator):** Formwork vibrators are used for concreting columns, thin walls or in the casting of precast units. **The machine is clamped on to the external wall surface of the formwork.**
- **Table Vibrator:** This is the special case of formwork vibrator, where **the vibrator is clamped to the table. They are commonly used for vibrating concrete cubes.**

Compaction of Concrete: By Vibration

- **Platform Vibrator:** Platform vibrator is nothing but a table vibrator, but it is larger in size. **This is used in the manufacture of large prefabricated concrete elements such as electric poles, railway sleepers, prefabricated roofing elements etc.**

- **Surface Vibrator:** Surface vibrators are sometimes knows as, "Screed Board Vibrators". A small vibrator placed on the screed board gives **an effective method of compacting and leveling of thin concrete members, such as floor slabs, roof slabs and road surface.**

- **Vibratory Roller:** One of the recent developments of compacting very dry and lean concrete is the use of Vibratory Roller. **Such concrete is known as Roller Compacted Concrete.**

Compaction of Concrete: By Vibration

Compaction of Concrete: By Vibration

Compaction of Concrete: By Vibration

Curing of Concrete

- **Concrete derives its strength by the hydration of cement particles. The hydration of cement is not a momentary action but a process continuing for long time.** The quantity of the product of hydration and consequently the amount of gel formed depends upon the extent of hydration.
- **Cement requires a water/cement ratio about 0.23 for hydration and a water/cement ratio of 0.15 for filling the voids in the gel pores.** In other words, a water/cement ratio of about 0.38 would be required to hydrate all the particles of cement and also to occupy the space in the gel pores.

Curing of Concrete

- **Curing is the process of controlling the rate and extent of moisture loss from concrete during cement hydration**
- **Curing can also be described as keeping the concrete moist and warm enough** so that the hydration of cement can continue.
- Curing methods may be divided broadly into four categories:
- (a) Water curing
- (b) Membrane curing
- (c) Application of heat
- (d) Miscellaneous

Curing of Concrete

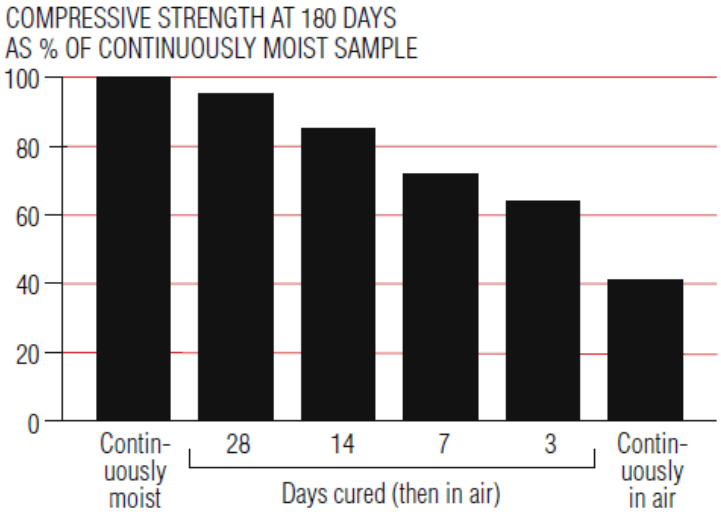
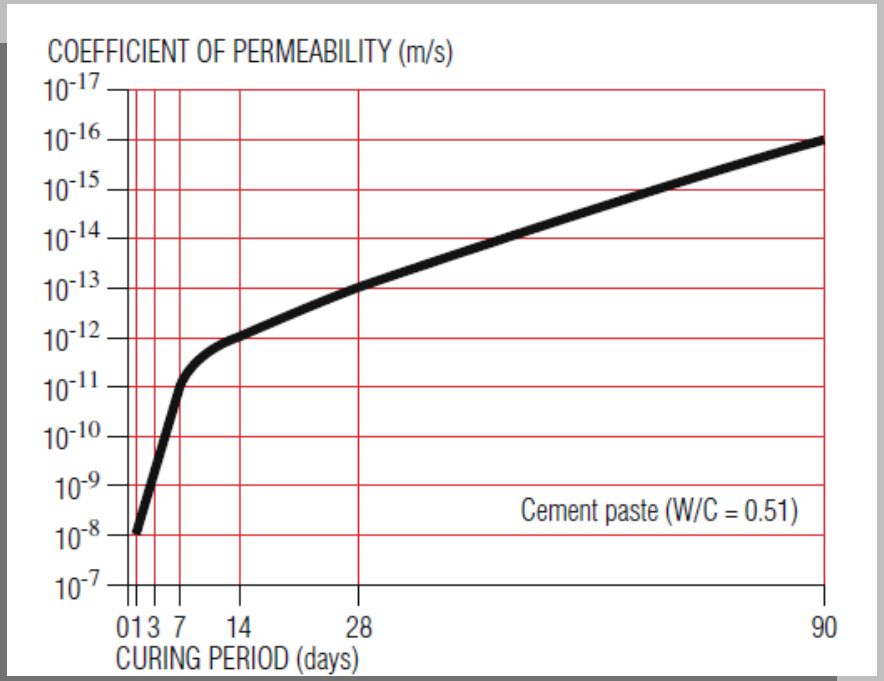


Figure 1: Effect of duration of water curing on strength of concrete.



Curing of Concrete: Water curing

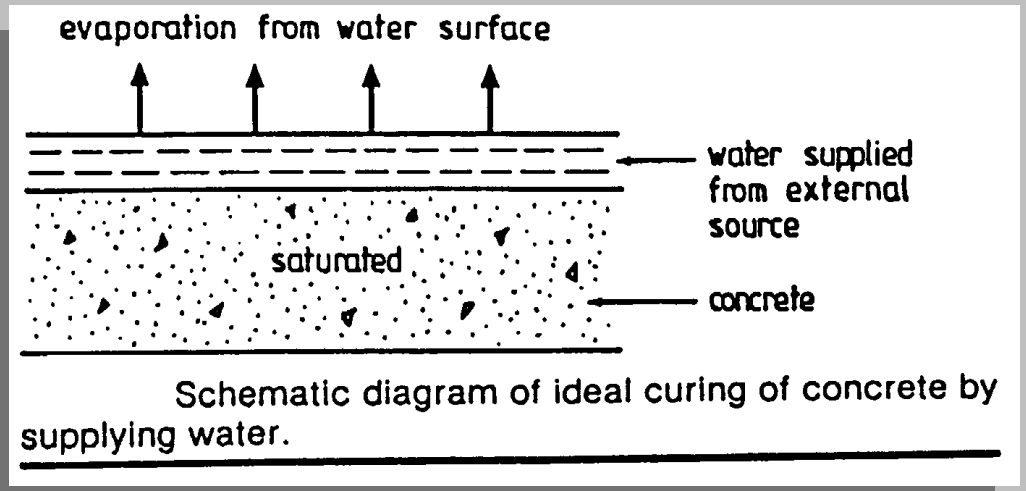
- This is by far the best method of curing as it satisfies all the requirements of curing namely, promotion, of hydration, elimination of
  - shrinkage and absorption of the heat of hydration.
  - (a) Immersion
  - (b) Ponding

(c)Spraying or Fogging

(d) Wet covering

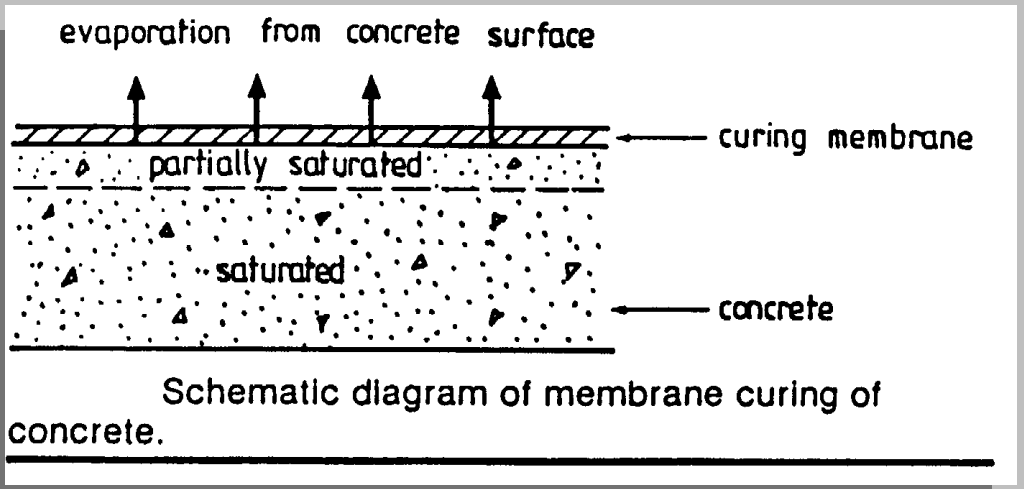
Curing of Concrete

Water curing is when the concrete is covered with a layer of water for a period of time and the evaporation of moisture is from the surface of the water.



Schematic diagram of ideal curing of concrete by supplying water.

Membrane curing is the most practical with today's Construction schedules.



Schematic diagram of membrane curing of concrete.

Curing of Concrete: Membrane Curing

- **Sometimes, concrete works are carried out in places** where there is acute shortage of water.
- The **quantity of water, normally mixed for making concrete is more than sufficient to hydrate the cement**, provided this water is not allowed to go out from the body of concrete.
- **Concrete could be covered with membrane** which will effectively seal off the evaporation of water from concrete.
- **Curing compounds are liquids which are usually sprayed directly onto concrete surfaces** and which then dry to form a relatively impermeable membrane that retards the loss of moisture from the concrete.

Curing of Concrete: Membrane Curing

Curing of Concrete: Application of heat

- **When concrete is subjected to higher temperature** it **Accelerates** the hydration process resulting faster in development of strength.
- **Therefore, subjecting the concrete to higher temperature and maintaining** the required wetness can be achieved by subjecting the concrete to steam curing.
- The exposure of concrete to higher temperature is done in the following manner:
- (a) Steam curing at ordinary pressure.
- (b) Steam curing at high pressure.
- (c) Curing by Infra-red radiation.
- (d) Electrical curing.

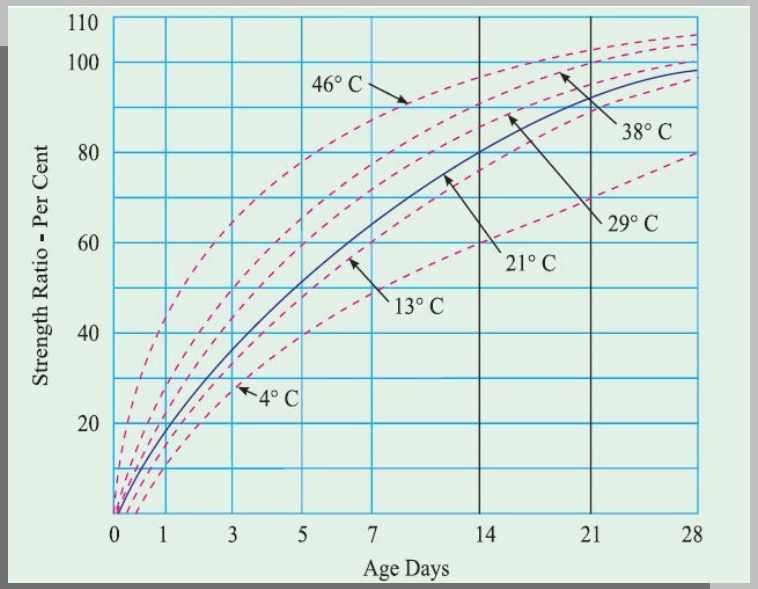
Curing of Concrete: Application of heat

- A faster attainment of strength will contribute to many other advantages mentioned below.

- (a) Concrete is vulnerable to damage only for short time.
- (b) Concrete member can be handled very quickly.
- (d) A smaller curing tank will be sufficient.
- (e) The work can be put on to service at a much early time,
- (f) Pre-stressing bed can be released early for further casting.
- (g) A fewer number of formwork will be sufficient or alternatively with the given number of formwork more outturn will be achieved.

Steam curing at ordinary pressure

- **Application of steam curing to in situ construction will be a little difficult task.** However, at some places it has been tried for in situ construction by forming a steam jacket with the help of tarpaulin or thick polyethylene sheets.



High Pressure Steam Curing

- **The high pressure steam curing is something different from ordinary** steam curing, in that the curing is carried out in a closed chamber.
- **High pressure steam cured concrete develops in one day, or less the strength as much as the 28 days' strength of normally cured concrete**. The strength developed does not show retrogression.
- **High pressure steam cured concrete exhibits higher resistance to sulphate attack, freezing and thawing action** and chemical action. It also shows less efflorescence.

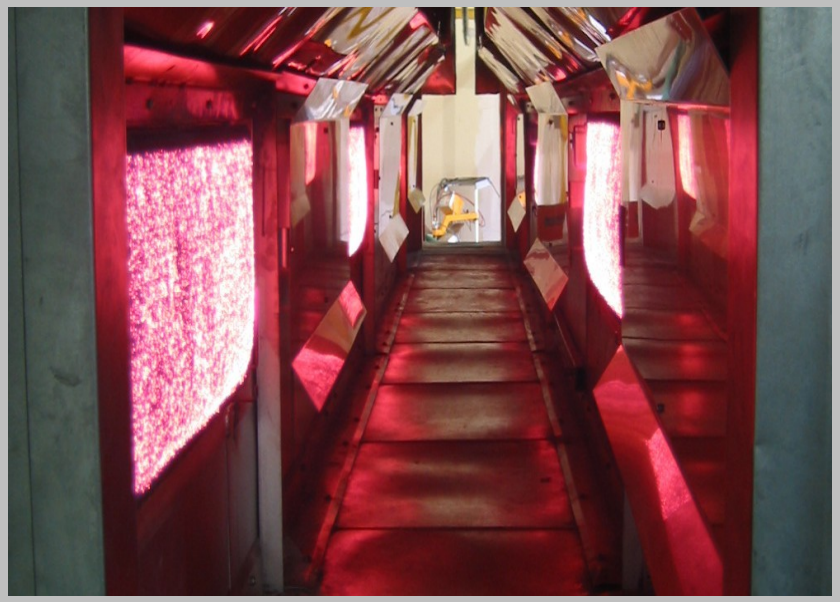
High Pressure Steam Curing

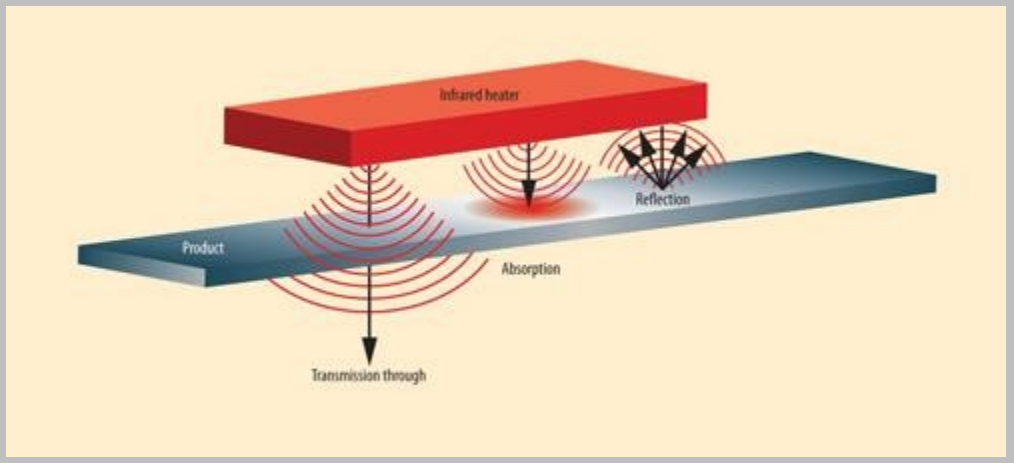
- **High pressure steam cured concrete exhibits lower drying shrinkage, and moisture movement.**
- **In high pressure steam curing, concrete is subjected to a maximum temperature of about 175°C** which corresponds to a steam pressure of about 8.5 kg/sq.cm.

Curing by Infra-red Radiation

- **Curing of concrete by Infra-red Radiation has been practised in very cold climatic regions** in Russia.
- **It is claimed that much more rapid gain of strength can be obtained than with steam curing and that rapid initial temperature** does not cause a decrease in the ultimate strength as in the case of steam curing at ordinary pressure.
- **The system is very often adopted for the curing of hollow concrete products.** The normal operative temperature is kept at about 90°C.

Curing by Infra-red Radiation





Electrical Curing

- **Concrete can be cured electrically by passing an alternating current (Electrolysis trouble will be encountered if direct current is used)** through the concrete itself between two electrodes either buried in or applied to the surface of the concrete.
- **Care must be taken to prevent the moisture** from going out leaving the concrete completely dry.

Electrical Curing

Properties of Fresh Concrete

- **Workability**

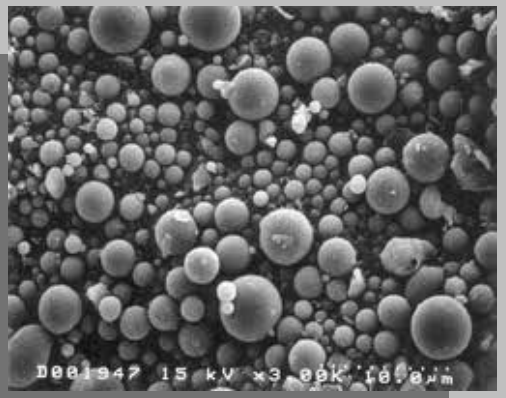
- **The function of water is also to lubricate the concrete so that the concrete can be compacted** with specified effort forthcoming at the site of work.

- **The lubrication required for handling concrete without segregation, for placing without loss of homogeneity, for compacting with the amount of efforts** forth-coming and to finish it sufficiently easily, the presence of a certain quantity of water is of vital importance.

- ***Workability*** **is the ability of a fresh (plastic) concrete mix to fill the form/mold properly with the desired work (vibration) and without reducing the concrete's quality.**

Workability

Workability depends on water **content, aggregate** (shape and siz **distribution), cementitious** conte and age (level of hydration) and can be modified by adding chemical admixtures, like super-plasticizer



Factors Affecting Workability

- Water Content
- Mix Proportions
- Size of Aggregates
- Shape of Aggregates
- Surface Texture of Aggregate
- Grading of Aggregate
- Use of Admixtures.

Water content or Water Cement Ratio

- **More the water cement ratio more will be workability of concrete.** Since by simply adding water the inter particle lubrication is increased.
- **High water content results in a higher fluidity and greater workability.** Increased water content also results in bleeding. another effect of increased water content can also be that cement slurry will escape through joints of formwork.
- **More water can be added, provided a correspondingly higher quantity of cement is also added to keep the water/cement ratio constant**, so that the strength remains the same.

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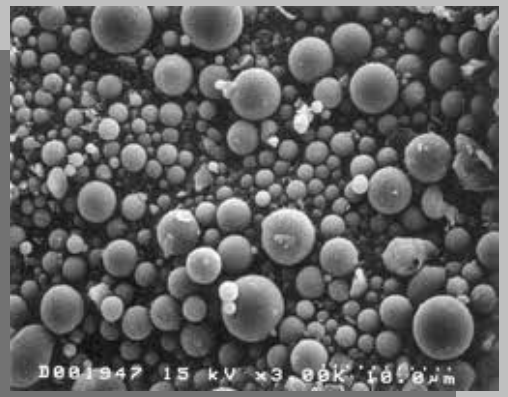
Mix Proportions

- **The higher the aggregate/cement ratio, less quantity of paste is available for providing lubrication,** per unit surface area of aggregate and hence the mobility of aggregate is restrained.
- **On the other hand, in case of rich concrete with lower aggregate/cement ratio,** more paste is available to make the mix cohesive and fatty to give better workability.



Size of Aggregate & Surface Texture

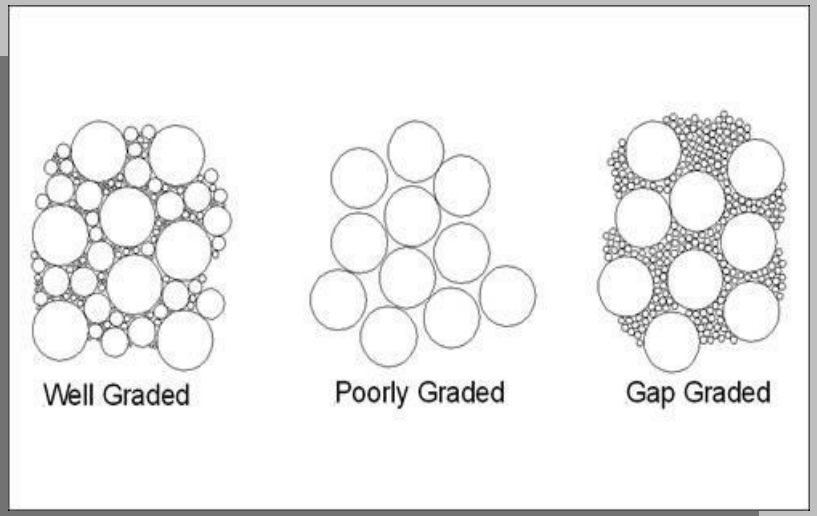
- **The bigger the size of the aggregate, the less is the surface area and hence less amount of water is required for wetting the surface and less matrix or paste** is required for lubricating the surface to reduce internal friction.
- **Greater size of Aggregate-** less water is required to lubricate it, the extra water is available for workability
- **Porous aggregates require more water compared to non absorbent aggregates** for achieving same degree of workability.

Shape of Aggregates

- **Angular, elongated or flaky aggregate makes the concrete very harsh when compared** to rounded aggregates or cubical shaped aggregates.
- **Contribution to better workability of rounded aggregate will come from the fact that for the given volume or weight it will have less surface area** and less voids than angular or flaky aggregate.
- **Not only that, being round in shape, the frictional resistance is also greatly reduced.** This explains the reason why river sand and gravel provide greater workability to concrete than crushed sand and aggregate.

Grading of Aggregates

- **A well graded aggregate is the one which has least amount of voids in a given volume and higher the workability.**
- Other factors being constant, when the total voids are less, excess paste is available to give better lubricating effect.
- With excess amount of paste, the mixture becomes cohesive and fatty which prevents segregation of particles.



Use of Admixtures

- **Chemical admixtures can be used to increase workability**.
- **Use of air entraining agent produces air bubbles which acts as a sort of ball bearing between particles** and increases mobility, workability and decreases bleeding, segregation.
- **The use of fine pozzolanic materials also have better lubricating effect** and more workability.

Weather Conditions

- **If temperature is high, evaporation increases, thus workability** decreases.
- **If wind is moving with greater velocity, the rate of evaporation also increase reduces** the amount of water and ultimately reducing workability.

Measurement of Workability

It is discussed earlier that workability of concrete is a complex property.

Slump Test

Compacting Factor Test

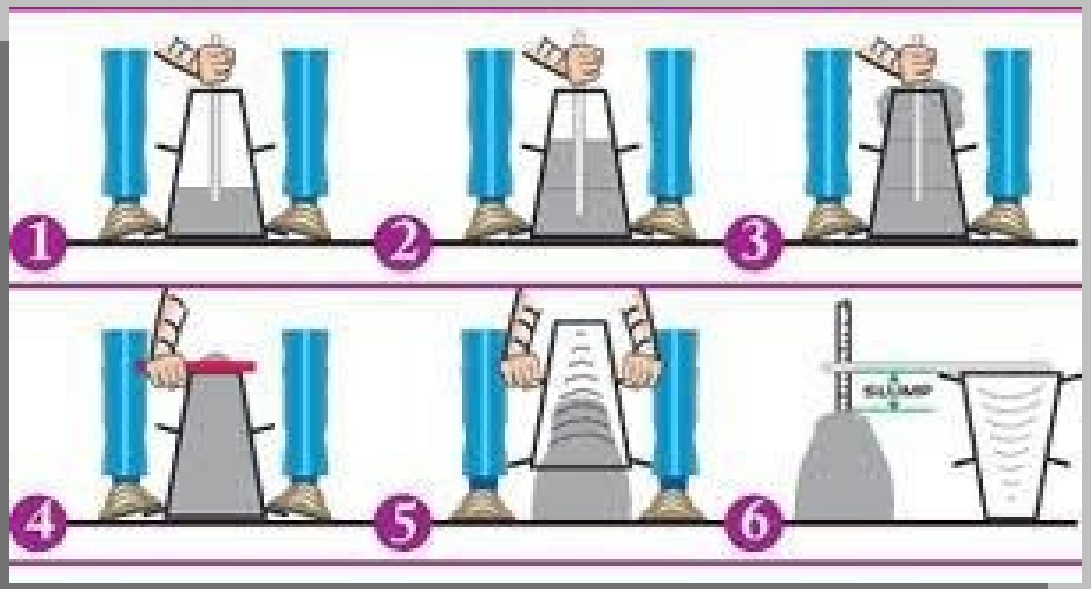
Flow Test

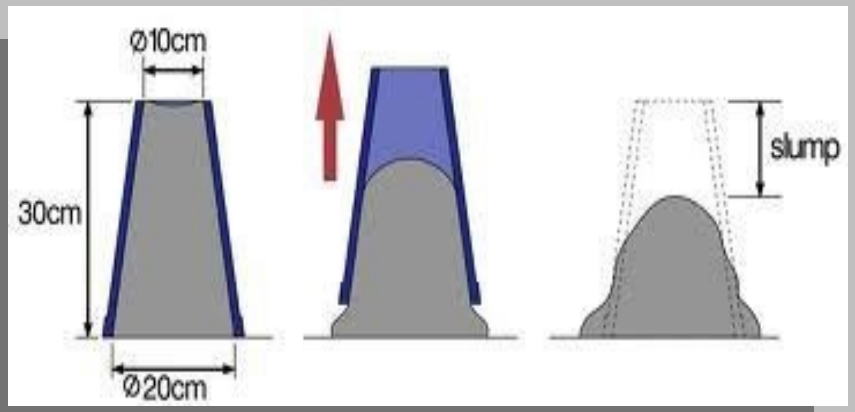
Vee Bee Consistometer Test.

Slump Test

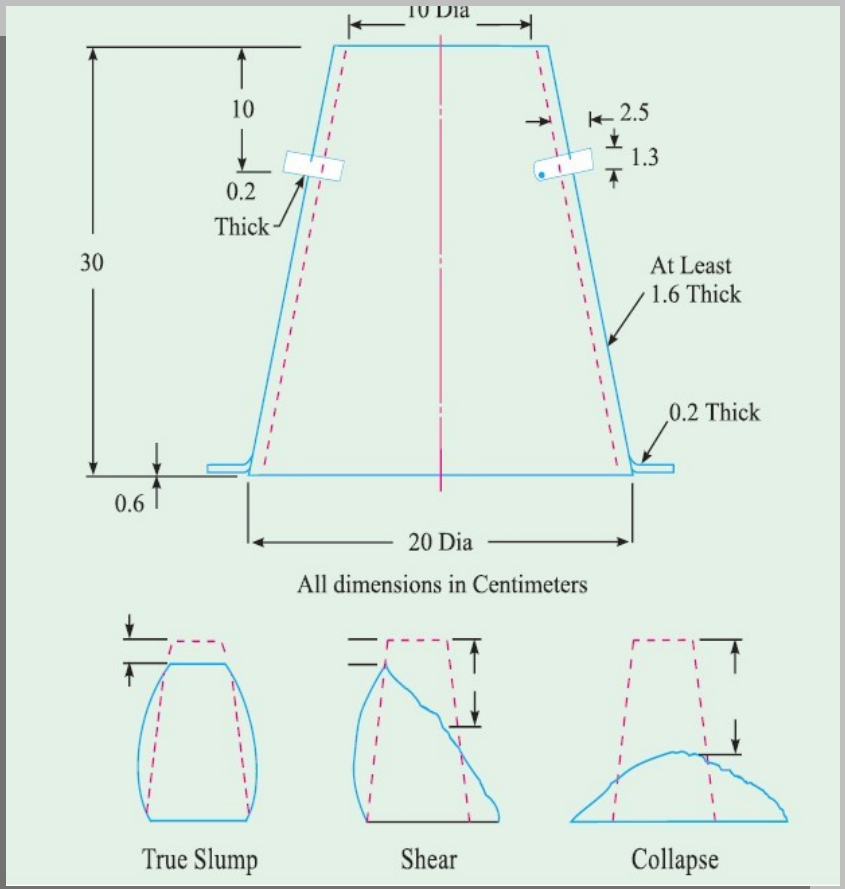
- **Slump test is the most commonly used method of measuring consistency** of concrete which can be employed either in laboratory or at site of work.
- It is not a suitable method for very wet or very dry concrete.
- **Additional information on workability and quality of concrete can be obtained** by observing the manner in which concrete slumps.
- **Quality of concrete can also be further assessed by giving a few tappings** or blows by tamping rod to the base plate.
- **The deformation shows the characteristics** of concrete with respect to tendency for segregation.

Slump Test





Slump Test


10 Dia
10
0.2
Thick
30
2.5
1.3
At Least
1.6 Thick
0.2 Thick
0.6
20 Dia
All dimensions in Centimeters
True Slump
Shear
Collapse

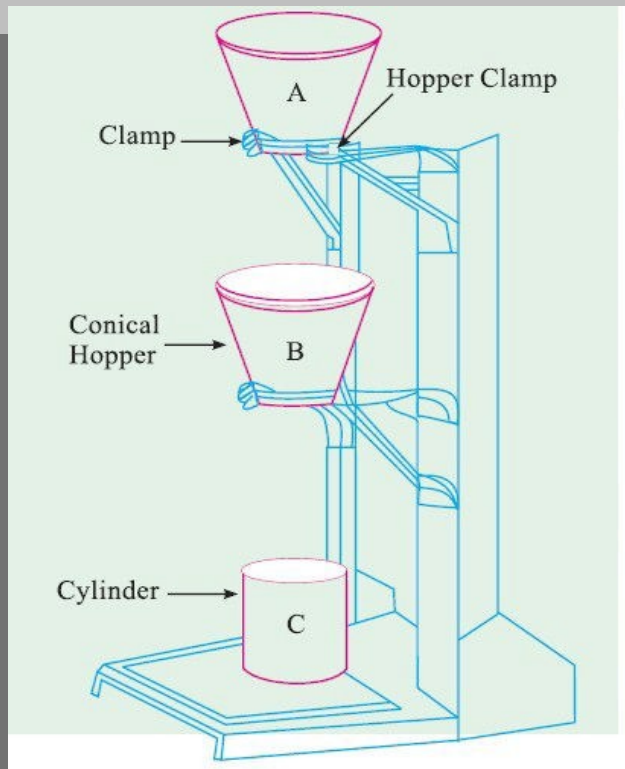
Slump Test

Degree of workability	*Slump mm*	*Compacting factor*		*Use for which concrete is suitable*
		Small appartus	*Large appartus*	
Very Low compacting factor is suitable	–	0.78	0.80	Roads vibrated by power-operated machines. At the more workable end of this group, concrete may be compacted in certain cases with hand-operated machines.
Low	25–75	0.85	0.87	Roads vibrated by hand-operated machines. At the more workable end of this group, concrete may be manually compacted in roads using aggregate of rounded or irregular shape. Mass concrete foundations without vibration or lightly reinforced sections with vibration.
Medium	50–100	0.92	0.935	At the less workable end of this group, manually compacted flat slabs using crushed aggregates. Normal reinforced concrete manually compacted and heavily reinforced sections with vibration
High	100–150	0.95	0.96	For sections with congested reinforcement. Not normally suitable for vibration. For pumping and tremie placing
Very High	–	–	–	Flow table test is more suitable.

Compacting Factor Test

- **It is more precise and sensitive than the slump test and is particularly useful for concrete mixes** of very low workability as are normally used when concrete is to be compacted by vibration.
- The **compacting factor test has been developed at the Road Research Laboratory U.K**.
- This test **works on the principle of determining the degree of compaction achieved 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 i.e.,** the ratio of the density actually achieved in the test to density of same concrete fully compacted.

Compacting Factor Test



Compacting Factor Apparatus

$$\text{The Compacting Factor} = \frac{\text{Weight of partially compacted concrete}}{\text{Weight of fully compacted concrete}}$$

Compacting Factor Test

Upper Hopper, A	Dimension cm
Top internal diameter	25.4
Bottom internal diameter	12.7
Internal height	27.9
Lower hopper, B	
Top internal diameter	22.9
Bottom internal diameter	12.7
Internal height	22.9
Cylinder, C	
Internal diameter	15.2
Internal height	30.5
Distance between bottom of upper hopper and top of lower hopper	20.3
Distance between bottom of lower hopper and top of cylinder	20.3

Flow Test

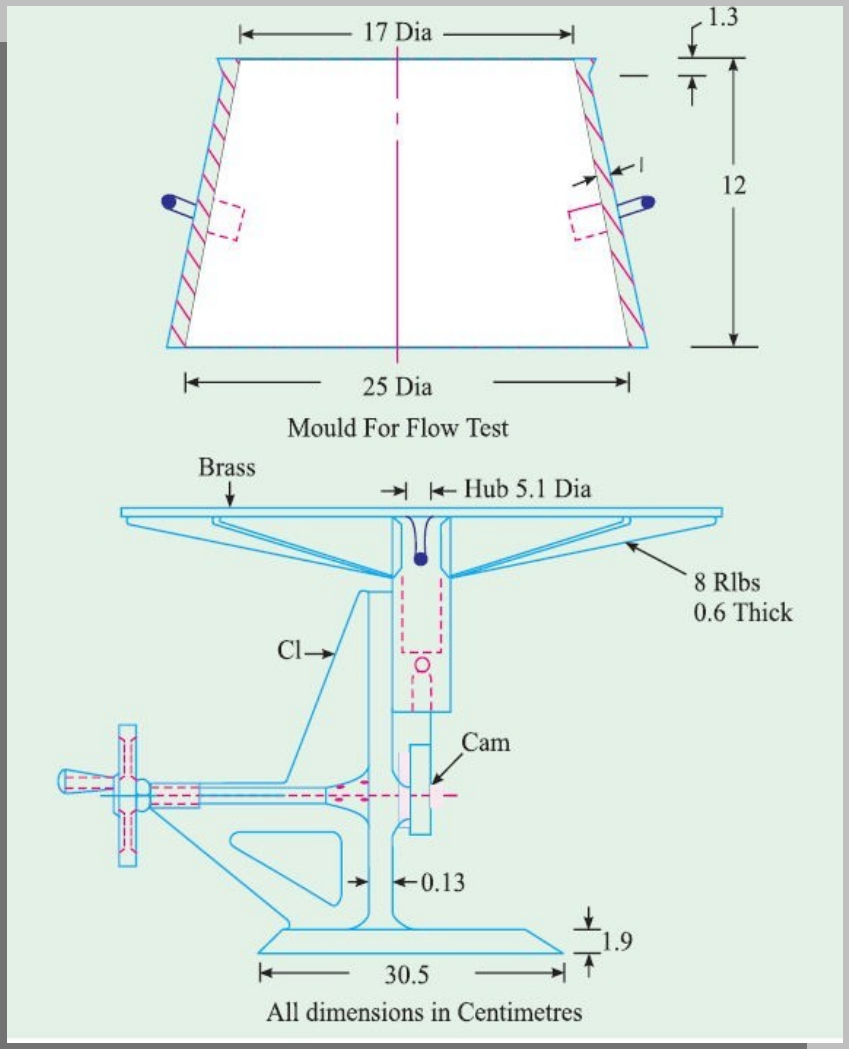
- **This is a laboratory test, which gives an indication of the quality of concrete with respect to consistency, cohesiveness** and the proneness to segregation.
- **The table top is cleaned of all gritty material and is wetted. The mould is kept on the centre of the table**, firmly held and is filled in two layers.
- **Each layer is rodded 25 times with a tamping rod 1.6 cm in diameter and 61 cm long rounded** at the lower tamping end.
- **The mould is lifted vertically upward and the concrete** stands on its own without support.

Flow Test

- **The table is then raised and dropped 12.5 mm 15 times in about 15 seconds**. The diameter of the spread concrete is measured in about 6 directions to the nearest 5 mm and the average spread is noted.

$$\text{Flow, per cent} = \frac{\text{Spread diameter in cm} - 25}{25} \times 100$$

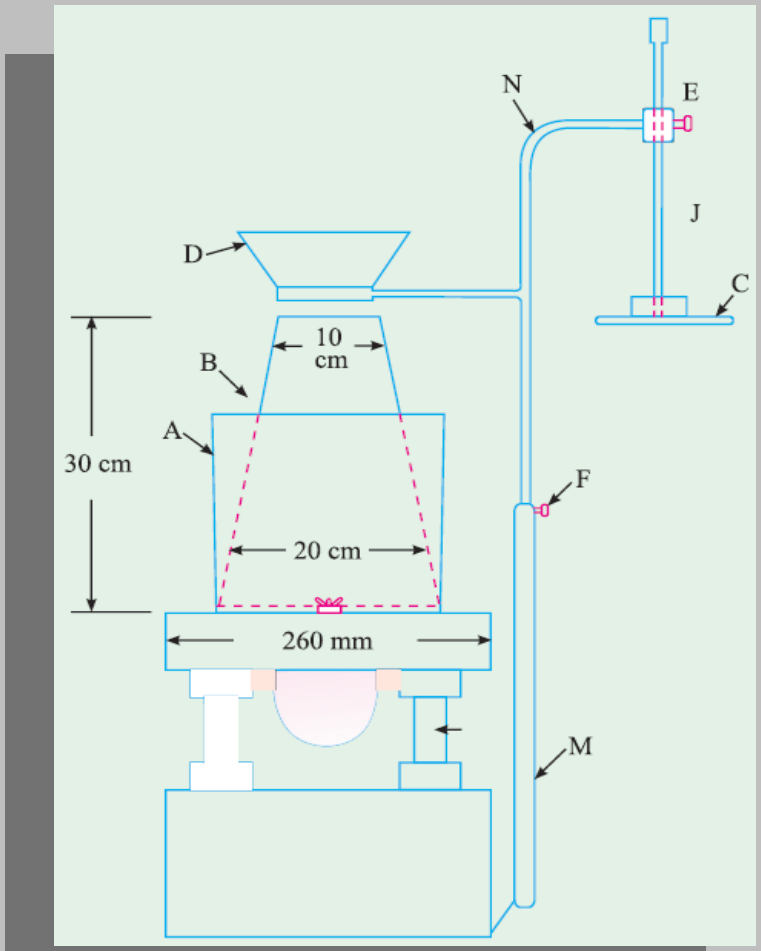
Flow Test


17 Dia
1.3
12
1
25 Dia
Mould For Flow Test
Brass
Hub 5.1 Dia
8 Rlbs
0.6 Thick
Cl
Cam
0.13
1.9
30.5
All dimensions in Centimetres

Vee Bee Consistometer 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 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 50 mm.

Vee Bee Consistometer Test



Segregation

- **Segregation can be defined as the separation of the constituent materials** of concrete.
- **A good concrete is one in which all the ingredients are properly distributed** to make a homogeneous mixture.
- **There are considerable differences in the sizes and specific gravities** of the constituent ingredients of concrete.
- **Therefore, it is natural that the materials** show a tendency to fall apart.

Segregation

- **Badly proportioned mix where sufficient matrix** is not there to bind and contain the aggregates
- **Insufficiently mixed concrete** with excess water content
- **Dropping of concrete from heights** as in the case of placing concrete in column concreting
- **When concrete is discharged from a badly designed mixer**, or from a mixer with worn out blades
- **Conveyance of concrete by conveyor belts, wheel barrow, long distance haul by dumper,** long lift by skip and hoist are the other situations promoting segregation of concrete

Segregation

Bleeding

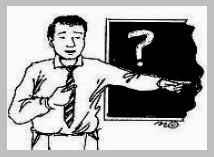
- **Bleeding is sometimes referred as water gain. It is a particular form of segregation,** in which some of the water from the concrete comes out to the surface of the concrete, being of the lowest specific gravity among all the ingredients of concrete.
- **Bleeding is predominantly observed in a highly wet mix, badly proportioned and insufficiently mixed concrete.**
- In thin members like roof slab or road slabs and when concrete is placed in sunny weather show excessive bleeding.

Bleeding

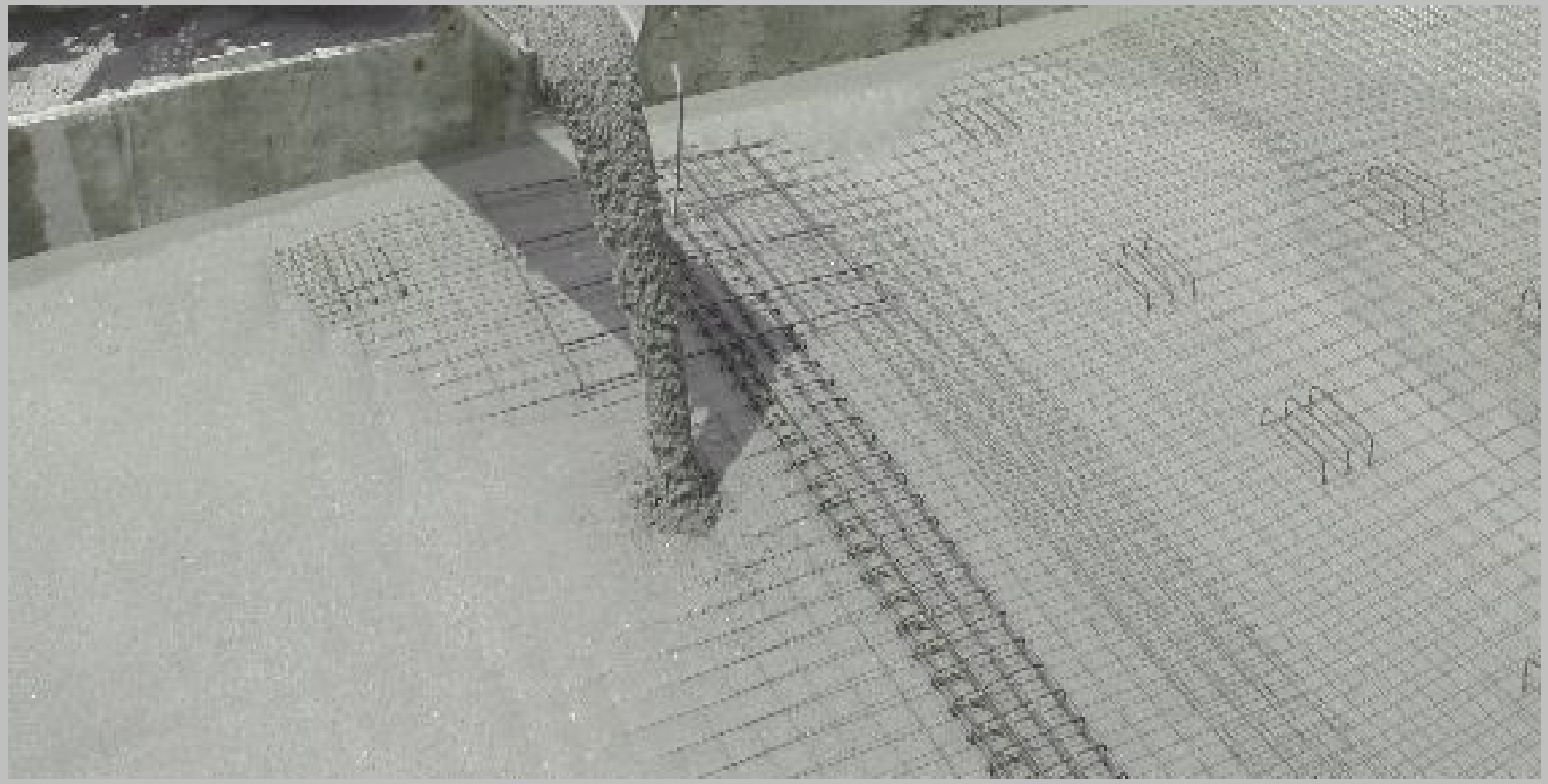
Bleeding

- **Bleeding can be reduced by proper proportioning and uniform and complete mixing.**
- **Use of finely divided pozzo-lanic** materials reduces bleeding by creating a longer path for the water to traverse.
- **Air-entraining agent is very effective in reducing** the bleeding.
- **Bleeding can be reduced by the use of finer cement or cement with low alkali content.** Rich mixes are less susceptible to bleeding than lean mixes.

Bleeding



Any ?



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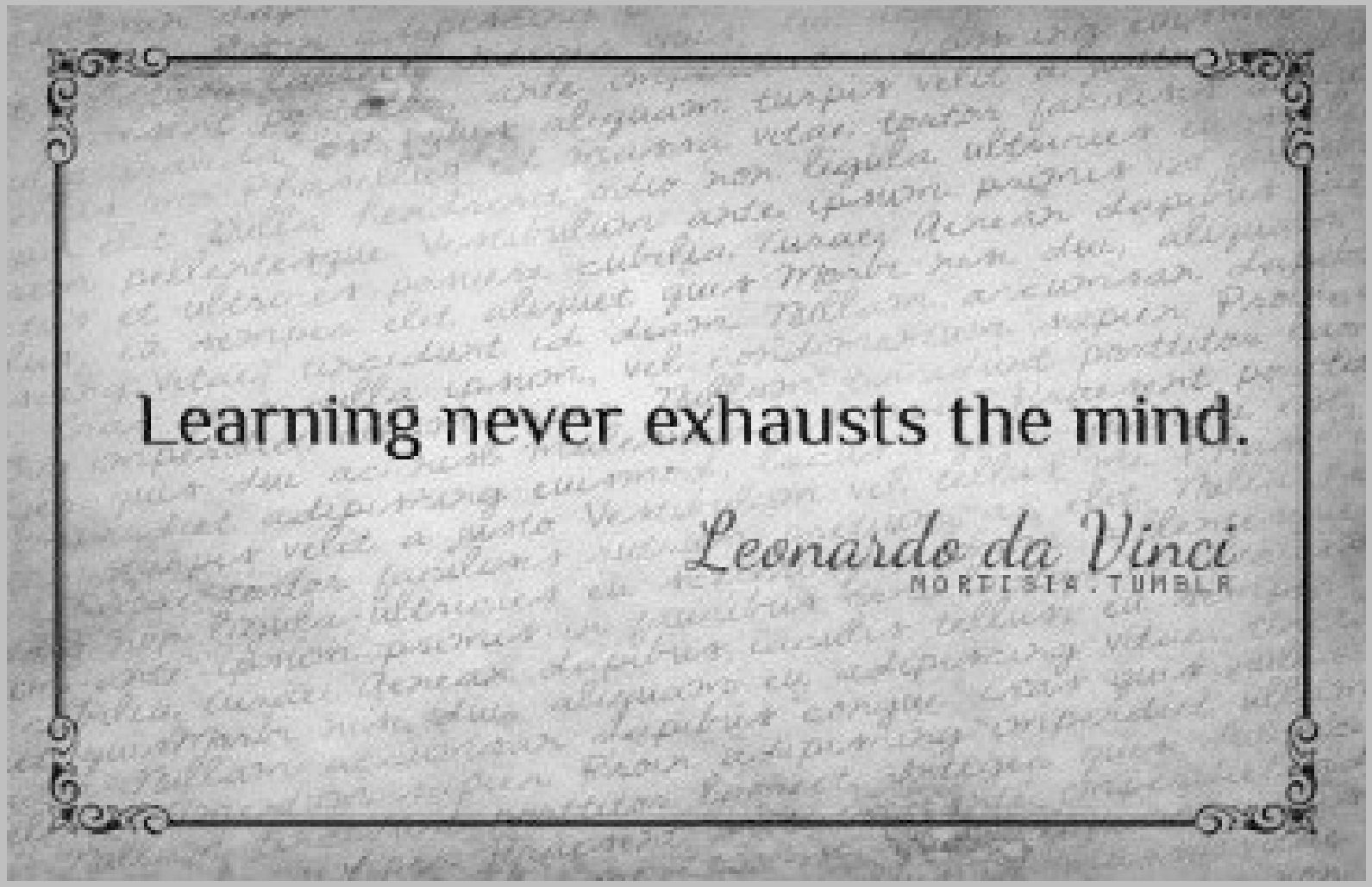

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