

Unit - 3

Text book

Get! M.S. Shetty

Fresh concrete

* Workability: It is defined as that property of freshly mixed concrete or mortar which determines the ease and homogeneity with which it can be mixed, placed, compacted and finished.

Ease:- It is related to rheology of fresh concrete which includes performance parameters of stability, mobility and compactability.

* workability of fresh concrete is complex system of two critical parameters, consistency and homogeneity.

parameters, consistency and setting time.
Consistency: It is the relative mobility or ability of a freshly mixed concrete to flow and the usual measurements are; slump for concrete, flow for mortar or grout, and penetration resistance for neat cement paste.

* Major factors affecting consistency are :-

Major factors affecting consistency are water & cement contents and its characteristics, air content, temperature, plasticity of the cement paste, aggregate content and its characteristics, mixing conditions, chemical admixtures and mineral additives used. All of these uniform and stable distribution

Homogeneity: Which means uniform and stable of cement aggregate and water, and resistance to segregation is a critical physical property of plastic concrete.

is a critical physical position with respect to ease of placement with.

* Low viscosity is essential for ease of placement. Cohesion and for resistance to segregation and bleeding that is necessary for homogeneity.

- * Addition of superplasticizers improves the wetting out and mixability of the concrete mix. It reduces yield stress which means less mixing energy and time are.

are required. It improves homogeneity of the various mineral additives and admixtures.

* Factors affecting workability :-

1. Influence of mix proportions.

2. Influence of agg properties.

3. Influence of Admixtures

4. Effect of Environmental conditions.

5. Effect of time.

* Measurement of workability :-

1. Slump cone test.

2. Compacting factor test.

3. Vee-Bee consistency test.

4. Flow test.

* Slump cone test :-

The concrete slump test measures the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete and therefore the ease with which concrete flows. It can also be used as an indicator for an improperly mixed batch.

The test is popular due to the simplicity of apparatus used and simple procedure. The slump test is used to ensure uniformity for different kinds of concrete under field conditions.

The test is carried out using a metal mould in the shape of a conical frustum known as a slump cone or Abrams cone, that is open at both ends and has attached handles. The tool typically has an internal diameter of 100 millimeters (3.9 in) at the top and of 200 millimetres (7.9 in) at the bottom with a height of 305 millimeters (12.0).

(2)

This cone is filled with fresh concrete in three stages. The mould is carefully lifted vertically upwards, so as not to disturb the concrete cone. The slump of the concrete is measured by measuring the distance from the top of the slumped concrete to the level of the top of the slump cone.

* compaction factor test:

Compaction factor test is the workability test for concrete conducted in laboratory. The compaction factor is the ratio of weights of partially compacted to fully compacted concrete. It was developed by Road Research Laboratory in United Kingdom and is used to determine the workability of concrete. The compaction factor test is used for concrete which have workability for which slump test is not suitable.

* Vee-Bee consistency test:

The main objective of Vee-Bee test is to determine the workability of the freshly mixed concrete. The Vee-Bee test gives an indication about the mobility and the compactibility aspect of the freshly mixed concrete.

The experiment is named after the developer N Bahumer of Sweden. The method can be also applied for dry concrete. Vee-Bee test requires cut the relative effort measurement to change the mass of the concrete from a definite shape to the other. That is, as per the test, from the conical shape to the cylindrical shape by undergoing vibration process.

* Flow test :-

The flow table test or flow test is a method to determine consistency of fresh concrete. Flow table test is also used to identify transportable moisture limit of solid bulk cargoes. It is used primarily for assessing concrete that is too workable to be measured using the slump test, because the concrete will not retain its shape when the cone is removed.

* Setting time of concrete :-

- * The setting time of concrete depends upon the w/c ratio, temperature conditions, type of cement used, mineral admixture, use of plasticizers in particular deterring plasticizer.
- * The setting parameters of concrete is more than of particular significance for size engineers than setting time of cement.
- * The setting time of concrete is found by penetrometer test, This method of test is covered by IS 8142 of 1976 and AS TM-C-403
- * The setting time of concrete is found by penetrometer test, This method of test is covered by IS 8142 of 1976 and AS TM-C-403
- * The apparatus consist of a container which should have minimum lateral dimension of 150mm and minimum 150mm depth.
- * There are six penetration needles with bearing area of 645, 326, 161, 65, 32 & 16, mm^2 each needle stem is scribed circumferentially at a distance of 25mm.

from the bearing area.

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

* Sieve the concrete sample in 4.75mm sieve and filled in the container. Compact the mortar by rodding, tapping, jacking or by vibrating. level the surface and keep it covered to prevent the loss of moisture.

* Insert a needle of appropriate size gradually and uniformly apply a vertical force down ward on the apparatus until the needle penetrates to a depth of 25 ± 1.5 mm as indicated by the scribe mark.

The time taken to penetrate 25mm depth could be about 10 sec. Record the force required to produce 25mm penetration and the time of inserting from the time water is added to cement.

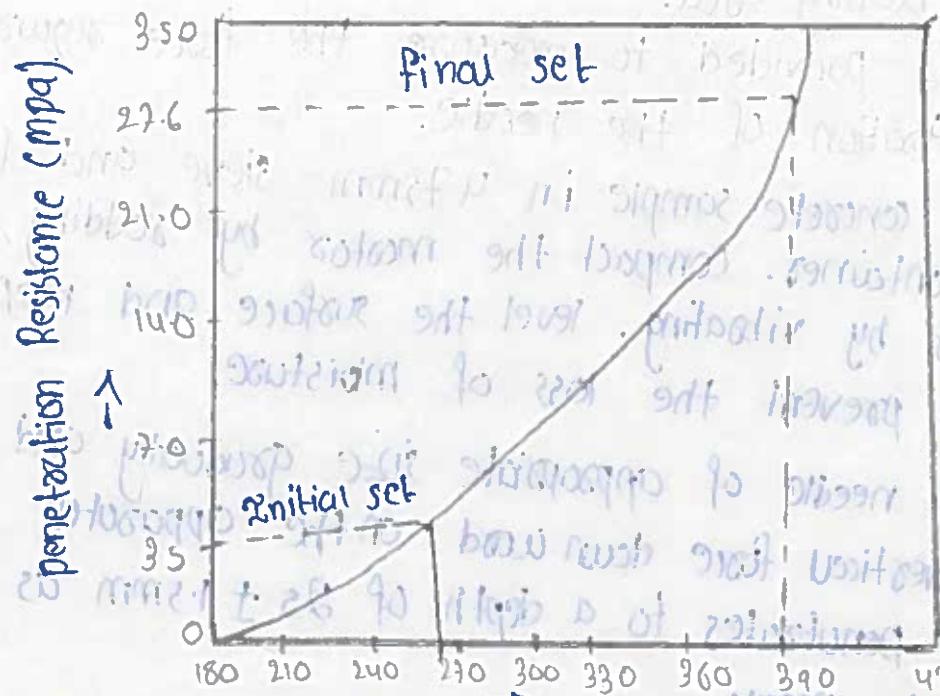
* calculated the penetration resistance by dividing the recorded force by the bearing area of the needle. This is the penetration resistance.

* for the subsequent penetration avoid the area where the mortar has been disturbed. The clear distances should be two times the diameter of the bearing area.

* needle is inserted at least 95mm away from the wall of container.

* plot a graph of penetration resistance as ordinate and elapsed time abscissa. Not less than size penetration resistance determination is made.

* continue the tests until one penetration resistance of at least 27.6 mpa is reached. connect the various point by a smooth curve.



Plot of penetration resistance vs Elapsed time
And Honda curve used to determine times of setting of concrete.

- * Segregation
- * It can be defined as the separation of the constituent materials of concrete.
- * A good concrete is one in which all the ingredient are properly distributed to make a homogeneous mixture.
- * If C.A separate from the rest ingredient of concrete then this tendency is known as segregation.
- * Such C.A separate from the rest ingredient of concrete then this tendency.
- * such concrete is not only going to be weak lack of homogeneity is also going to induce all undesirable properties in the hardened concrete.
- * Segregation are three types
 - i) C.A separating out or setting from the rest of the matrix.

- (iii) The paste or matrix separating away from it.
- (iv) water separating out from the rest of the material being a material of lowest specific gravity.
- * A well made concrete taking into consideration various parameters such as grading, size, shape and surface texture of agg. With optimum quantity of water, makes a cohesive mix. Such concrete will not exhibit any tendency for segregation.
 - * The cohesive and fatty characteristics of matrix do not allow the aggregates to fall apart at the same time, the matrix itself is sufficiently contained by the agg.
 - * Similarly water also does not find it easy to move out freely from the rest of the ingredients.
 - * 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 gives a fair idea of the quantity of concrete with respect to segregation.
- Two types of segregation can occur.
1. The separating out of coarser particles in a dry mix, termed segregation.
 2. separation of cement paste from the mix in the case of lean and wet mixes, termed bleeding.

Bleeding :-

- * It 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 ingredients of concrete.
- * Bloating 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 shows excessive bleeding.
- * Due to bleeding water comes up at the top surface sometimes along with water cement also comes to the surface (worked with trowel and floats).
- * This formation of cement paste of the surface is known as 'laitance'. Due to this the surface of slabs percentages will not have good wearing quality.
- * Laitance produce dust in summer and mud in rainy season. The top surface has a higher water content and also devoid of agg. matter. It also develops higher shrinkage cracks.
- * If w/c ratio is more than 0.7 the bleeding channel will remain continuous and unsegmented. These continuous bleeding channels are often responsible for permeability of the concrete structures.

$$\text{Bleeding water percentage} = \frac{\text{Total quantity of bleeding water}}{\text{Total quantity of water in the sample of concrete}}$$

* Mixing and vibration of concrete :-

* Mixing of concrete can be done by two

i) Dry mix.

ii) Wet mix.

In First mix cement, fine aggregate and coarse aggregate in mixture give a complete mix of these dry ingredient.

* Then add the water in dry mix and matrix the paste and form the concrete.

* The dry mix help to maintain homogeneity in concrete mix.

* Vibration of concrete :-

* Vibration in concrete done for compaction. In compaction, the air voids & water voids will remove from concrete.

* Some methods are adopted for compaction.

a) Hand compaction.

i) Rodding ii) Ramming iii) Tamping.

b) Compaction by vibration

i) Internal vibrator (Needle vibrator)

ii) form work 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

* process of manufacture of concrete :-

production of quality concrete requires meticulous care exercised at every stage of manufacture of concrete.

The various stages of manufacture of concrete are

(a) Batching : The measurement of materials for making concrete is K/a batching. There are two methods of batching.

(i) Volume Batching (ii) weight 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.

* weight Batching : - weight batching is the correct method of measuring the materials. use of weight system in batching facilitates accuracy, flexibility and simplicity.

(b) Mixing : - Through mixing of the materials is essential for the production of uniform concrete. The mixing should ensure that the mass becomes homogeneous and uniform in colour and consistency.

(i) Hand mixing.

(ii) Machine 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% more cement to water for the inferior concrete produced by this method.

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.

(c) Transporting :- concrete can be transported by a variety of methods and equipment. 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 adopted for transportation of concrete

- (a) Mortar pan
- (b) Wheel Barrows, Hand cart
- (c) Crane, Bucket and Rope way
- (d) Crane Bucket and Rope way
- (e) Tautk mixer and Dumper
- (f) Belt conveyors
- (g) chute
- (h) skip and floist
- (i) Transit mixer
- (j) pump and pipeline
- (k) Helicopters.

(l) Placing concrete : The precautions to be taken and methods adopted while placing concrete in the under mentioned situations will be discussed.

(a) placing concrete within earth mould.

Ex:- foundation concrete for a wall or column.

(b) placing concrete in layers within timber or steel shaft.

Ex:- mass conc. in dam constant of concrete chutment & point.

(c) placing concrete within large earth mould or timber plank form work.

Ex:- Road slab and Airfield slab.

(d) placing concrete within usual form work.

Ex:- columns beams and floors

(e) placing concrete under water.

(f) compaction of concrete :-

compaction of concrete is the process adopted for compaction of concrete is 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.

The following methods are adopted for compacting the concrete.

(a) Hand compacting

(i) Rodding

(ii) Ramming.

(iii) Tamping

(b) compaction by vibration

(i) Internal vibration (needle vibrator)

(ii) form work vibrator (External vibrator)

(iii) Table vibration

(iv) platform vibrator.

(v) surface vibrator (screeed vibrator)

(vi) vibratory Roller.

(c) compaction by pressure and Jolting

(d) compaction by spinning

(f) curing of concrete :-

curing methods may be divided broadly into four categories

(a) water curing

(b) membrane curing.

(c) Application of heat.

(d) miscellaneous.

* Qualities of mixing water :-

If water is fit for drinking it is fit for making concrete. This does not appear to be a true statement for all conditions.

— o —

and at all submerged habitats in form of bottom growth

colonies

Previous records (a)

Recent records (b)

Report of distribution (c)

Observations (d)

Notes on collection (e)

1. Collected from a shallow X
at the base of a tree 10 ft.
tall. Found in a dense thicket of
mangroves. The soil was
dark brown and moist.

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1. FRESH CONCRETE :-

Workability :- It defines as that property of freshly mixed concrete (or) mortar which determines the ease's homogeneity with which it can be mixed, placed, compacted and finished.

Easiness :- It is related to rheology of fresh concrete which includes performance parameters of stability, mobility and compactability.

* Workability of fresh concrete is a complex system of two critical parameters, consistency & homogeneity.

Consistency :- It is the relative mobility or ability of a freshly mixed concrete to flow, and the usual measurements are; slump for concrete, flow for mortar or equivalent to penetration resistance for neat cement paste.

* Major factors affecting consistency are:- water, content, cement content and its characteristics; air content, temperature, plasticity of cement paste, aggregate content & its characteristics, mixing condition & chemical admixtures & mineral additives used.

Homogeneity :- which means uniform and stable distribution of cement aggregate and water, and resistance to segregation as a critical physical property of plastic concrete.

* Low viscosity is essential for easiness of placement with cohesion, and for resistance to segregation & bleeding that is necessary for homogeneity.

* Addition of superplasticizer improves the setting out mixability of the concrete mix. It reduces yield stress which means less mixing energy & time are required. It improves homogeneity of the various mineral additives & admixtures.

Measurement of Workability :-

1. Slump cone test
2. Compacting factor test
3. Vee-Bee Consistency test.
4. Flow test.

Factors affecting Workability :-

1. Influence of Mix proportions
2. Influence of Agg. proportions
3. Influence of Admixtures
4. Effect of Environmental conditions
5. Effect of time.

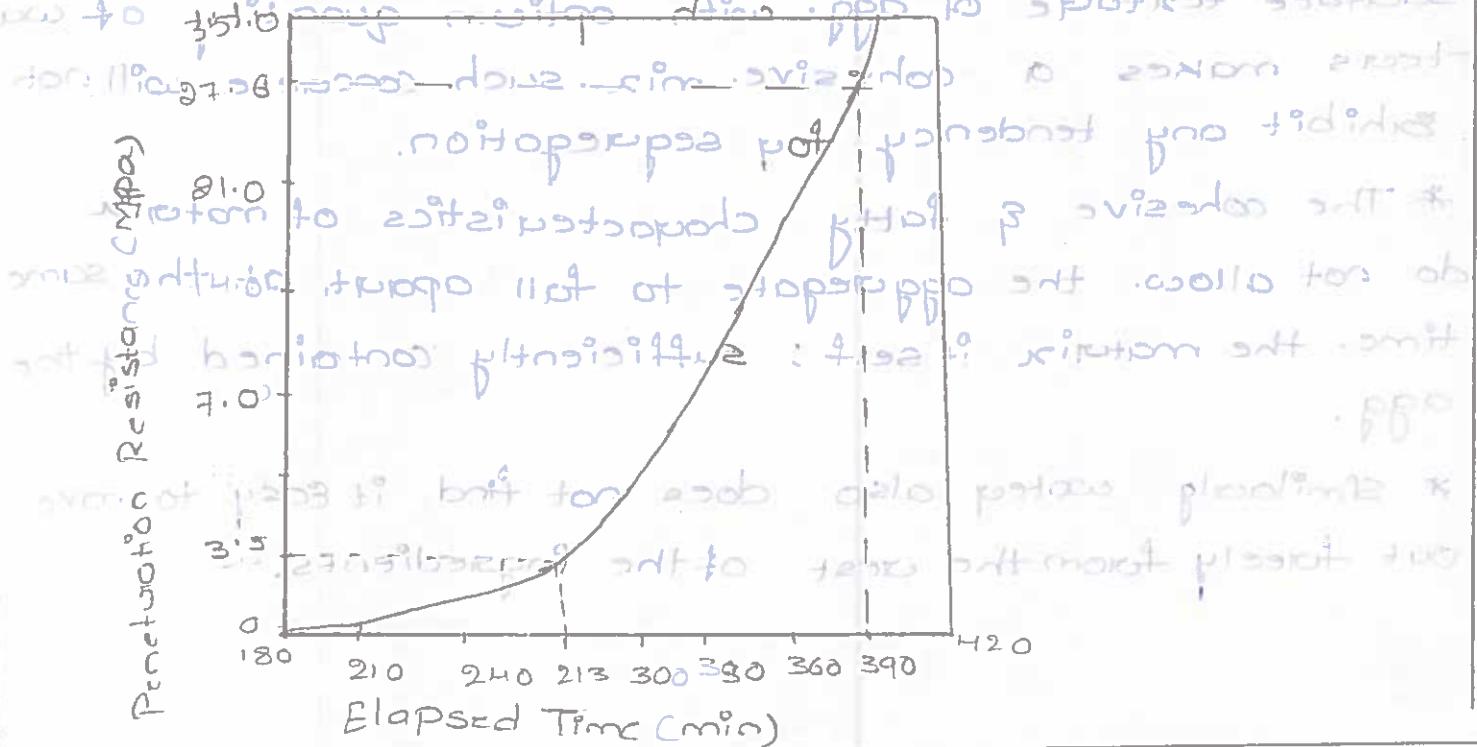
Setting time of concrete:-

- * The setting time of concrete depends upon the w/c ratio, temperature conditions, type of cement, use of mineral admixture, use of plasticizer in particular regarding plasticizer.
- * The setting parameter of concrete is more of practical significance for site engineers than setting time of cement.
- * The setting time of concrete is found by Penetrometer test. This method of test is covered by IS 8142 of 1976 and ASTM C-403.
- * The apparatus consist of a container which should have minimum lateral dimension of 150mm & minimum 150mm depth.
- * There are six penetration needles with bearing area of 645, 323, 161, 65, 32 & 16 mm². Each needle stem is scribed circumferentially at a distance of 25mm from the bearing area.
- * A device is provided to measure the force required to cause penetration of the needle.
- * Sieve the concrete sample in 4.75 mm sieve & filled in the container. compact the mortar by jodding, tapping, racking or by vibrating level the surface & keep it connected to prevent the loss of moisture.

- * Insert the needle of appropriate size. Gradually & uniformly apply a vertical force downwards on the apparatus until the needle penetrates to a depth of 25 ± 1.5 mm as indicated by a scribe mark.
- * The time taken to penetrate 25 mm depth could be about 10 sec. Record the force required to produce 25 mm penetration and the time of inserting from the time water is added to cement.
- * Calculate the penetration resistance by dividing the record force by the bearing area of the needle. This is the penetration resistance.
- * For the subsequent penetration avoid the area where the mortar has been disturbed. The clear distances should be two times the diameter of the bearing area of probe no two penetrations ≥ 10 mm apart.
- * Needle is inserted at least 25 mm away from the wall containing water to 350 mm.

Plot a graph of penetration resistance as ordinate and elapsed time as abscissa. Not less than six penetrations. Determination is made.

Continue the tests until one penetration resistance of at least 27.6 MPa is reached the various point by a smooth curve.



Plot of penetration Resistance vs Elapsed time & Hand fit curve used to determine Times of setting of concrete.

Segregation:-

- * It can be defined as the which all the constituent materials of concrete.
- * A good concrete is one in which all the ingredient are properly distributed to make a homogeneous mixture.
- * If C.A separates from the rest ingredient of concrete then this tendency is known as segregation.
- * such concrete is not only going to be weak, lack of homogeneity is also going to induce all undesirable properties in the hardened concrete.
- * Segregation has three types of binary concrete
 - (i) C.A separating out on setting from the rest of the matrix.
 - (ii) The paste of matrix separating away from C.A.
 - (iii) water separating out from the rest of the material being a material of lowest specific gravity.
- * A well made concrete, taking into consideration various parameters such as grading, size, shape & surface texture of agg. with optimum quantity of water makes a cohesive mix. such concrete will not exhibit any tendency for segregation.
- * The cohesive & fatty characteristics of matrix do not allow the aggregate to fall apart at the same time. the matrix itself is sufficiently contained by the agg.
- * Similarly water also does not find it easy to move out freely from the rest of the ingredients.

- * 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 gives a fair idea of the quantity of concrete with respect to segregation.

Two types of segregation can occur

1. The separating out of coarse particles in a dry mix termed segregation.
2. separation of cement paste from the mix in the case of lean & wet mixes, termed bleeding.

Bleeding :-

- * It is sometimes referred as coating 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 ingredients of concrete.
- * Bleeding is predominantly observed in a highly wet mix, badly proportioned, & insufficiently mixed concrete.
- * In this members like. root slab or road slabs and when concrete is placed. in sunny weather show excessive bleeding
- * Due to bleeding water comes up at the top surface sometimes along with coating cement also comes to the surface. (blown with the trowel & floats)
- * This formation of cement paste at the surface is called laitance. Due to this surface of slabs parameters will not have good wearing quality.
- * Laitance produce dust in summer & monsoon season. The top surface has a higher coating content & also devoid of agg. matrix. It also develops higher shrinkage cracks.

Bleeding water percentage = $\frac{\text{Total quantity of bleeding water}}{\text{Total quantity of water in the sample of concrete}}$

Process of manufacturing of concrete :-

Production of quality concrete requires meticulous care exercised at every stage of manufacturing of concrete.

The various stages of manufacturing of concrete are

Batching:- The mass measurement of concrete & materials for making concrete is known as batching. There are two methods of batching

(i) Volume batching & weight batching.

Volume Batching:- It is not preferred as it is not accurate method. As volume batching is not a good method, for proportioning to measure granular material in terms of volume less than the same volume of dry compacted sand.

Weight batching is the correct method of measuring the materials. Use of weight system in batching, facilitates accuracy, flexibility and simplicity.

(b) Mixing:- Though 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.

(i) Hand mixing (ii) Machine 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% more cement to cater efficient, it

is desirable to add 10% more cement to cater for the introd. concrete produced by this method.

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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 mixes and continuous mixes.

(c) Transporting :- 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 adopted for transportation of concrete.

- | | |
|-------------------------------|------------------------|
| (a) Moway pan. | (f) chute. |
| (b) wheel Barrow, Hand cart | (g) skip and Hoist |
| (c) crane, Bucket on Rope way | (h) Transit Mixers |
| (d) Truck mixer and Dumper | (i) pump and pipe line |
| (e) Belt conveyors | (j) Helicopter. |
- (d) placing - concrete:-

The precautions to be taken and methods adopted while placing concrete in the under mentioned situations will be discussed.

(a) placing concrete within earth method mould.

Ex :- form concrete for a wall or column.

(b) placing concrete in layers with timber or steel shoring

Ex :- mass conc. in dam constⁿ of constⁿ. of concrete abutment pieces.

(c) placing concrete within large. smooth mould over timber planks form work.

Ex:- Road slab. and Air field slab

(d) placing concrete within usual form work.

Ex:- columns, beams and floors

(e) placing concrete under water.

(e) 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.

The following methods are adopted for compacting the concrete

(a) hand compacting.

(i) Rodding (ii) Ramming (iii) Tamping.

(b) compaction by vibration.

(i) Integral vibration (Needle vibration)

(ii) form work vibration (External vibration)

(iii) Table vibration

(iv) platform vibration

(v) surface vibration (scattered vibration)

(vi) vibratory rolling.

(c) compaction by pressure and rolling.

(d) compaction by spinning.

(f) curing of concrete:-

curing methods may be divided broadly

into four categories

- (a) water curing (b) membrane curing.
- (c) Application of heat (d) Miscellaneous.

Qualities of mixing water:-

If water is fit for drinking, it is fit for making concrete. This does not appear to be a true statement for all conditions.

Mixing and vibration of concrete:-

Mixing of concrete can be done by two.

- ① Dry mix ② wet mix.

- * First mix cement, fine aggregate, and coarse aggregate.
- In mixture give a complete mix of these dry ingredient.
- * Then add the water in dry mix to paste and form the concrete.
- * The dry mix helps to maintain homogeneity in concrete mix.

Vibration of concrete:-

- * vibration in concrete done for compaction
- in compaction the air voids & water voids will remove from concrete.
- * some methods are adopted for compaction
 - a. Hand compaction
 - (i) Rodding (ii) Ramming (iii) Tamping,
 - b. Compaction by vibration
 - (i) Integral vibration (Needle vibrator)
 - (ii) framework vibration (External vibrator)
 - (iii) Table vibrator
 - (iv) platform vibrator.
 - (v) surface vibration (scaged vibration)
 - (vi) vibratory rolling.
 - (c) compaction by pressure & jolting
 - (d) compaction by spinning.

Effect of time and temperature on workability :-

when temperature increases, then in the same proportion workability of fresh concrete decreases. The reason that stands behind is "when temperature increases then evaporation rate also increases due to that hydration rate decreases and hence, concrete will gain strength easily.