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SEMESTER 02

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SUBIMMITTED ENGR IQTEDAR

Q1A) Briefly explain Classification of causes of concrete deterioration.

1. Frost Action

2. Effect of fire

3. Sulphate attack

4. Alkali-Aggregate Reaction

Frost action

Corrosion of reinforcing steel and other embedded metals is the leading cause of deterioration in concrete. When steel corrodes, the resulting rust occupies a greater volume than the steel. This expan- sion creates tensile stresses in the concrete, which can eventually cause cracking, delamination, and spalling etc.

Effect of fire

Concrete performs exceptionally well at the temperatures encountered in almost all applications. But when exposed to fire or unusually high temperatures, concrete can lose strength and stiffness. shows the effect of high temperatures on the compressive strength, flexural strength, and modulus of elasticity of cured concrete, as determined by various investigators (Lankard 1968). As shown in the graphs, modulus of elasticity is the most sensitive to elevated temperature, followed by flexural strength and compressive strength.

The graphs represent a wide range of values because several factors influence the performance of concrete at elevated temperatures. Numerous studies have found the following general trends:

Concrete that undergoes thermal cycling suffers greater loss of strength than concrete that is held at a constant temperature, although much of the strength loss occurs in the first few cycles. This is attributed to incompatible dimensional changes between the cement paste and the aggregate.

Concrete that is under design load while heated loses less strength than unloaded concrete, the theory being that imposed compressive stresses inhibit development of cracks that would be free to develop in unrestrained concrete.

Concrete that is allowed to cool before testing loses more compressive strength than concrete that is tested hot. Concrete loses more strength when quickly cooled (quenched) from high temperatures than when it is allowed to cool gradually.

Concrete containing limestone and calcareous aggregates performs better at high temperatures than concrete containing siliceous aggregates (Abrams 1956). One study showed no difference in the performance of dolostone and limestone (Carette 1982). Another study showed the following relative aggregate performance, from best to worst: firebrick, expanded shale, limestone, gravel, sandstone and expanded slag.

Proportional strength loss is independent of compressive strength of concrete.

Concrete with a higher aggregate-cement ratio suffers less reduction in compressive strength; however, the opposite is true for modulus of elasticity. The lower the water-cement ratio, the less loss of elastic modulus.

If residual water in the concrete is not allowed to evaporate, compressive strength is greatly reduced. If heated too quickly, concrete can spall as the moisture tries to escape.

Sulphate attack

Naturally occurring sulfates of sodium, potassium, calcium, or magnesium are sometimes found in soil or dissolved in groundwater. Sulfates can attack concrete by reacting with hydrated compounds in the hardened cement. These reactions can induce sufficient pressure to disrupt the cement paste, resulting in loss of cohesion and strength. Calcium sulfate attacks calcium aluminate hydrate and forms ettringite. Sodium sulfate reacts with calcium hydroxide and calcium aluminate hydrate forming ettringite and gypsum. Magnesium sulfate attacks in a manner similar to sodium sulfate and forms ettringite, gypsum, and brucite (magnesium hydroxide). Brucite forms primarily on the concrete surface, consumes calcium hydroxide, lowers the pH of the pore solution, and then decomposes the calcium silicate hydrates. Environmental conditions have a great influence on sulfate attack. The attack is greater in concrete exposed to wet/dry cycling (Fig. 12). When water evaporates, sulfates can accumulate at the concrete surface, increasing in concentration and their potential for causing deterioration. Porous concrete is susceptible to weathering caused by salt crystallization. Examples of salts known to cause weathering of field concrete include sodium carbonate and sodium sulfate (laboratory studies have also related saturated solutions of calcium chloride and other salts to concrete deterioration). Under drying conditions, salt solutions can rise to the surface by capillary action and, as a result of surface evaporation, the solution phase becomes supersaturated and salt crystallization occurs, sometimes generating pressures large enough to cause cracking and scaling (Mehta 2000). Thaumasite may form during sulfate attack in moist conditions at temperatures usually between 0°C and 10°C (32°F to 50°F) and it occurs as a result of a reaction between calcium silicate hydrate, sulfate, calcium carbonate, and water. In concrete undergoing excessive thaumasite formation, cracks can be filled with thaumasite and haloes of white thaumasite surround aggregates. At the concrete/soil interface, the surface concrete layer can be "mushy" with complete replacement of the cement paste by thaumasite. Sulfate attack is a particular problem in arid areas, such as the Northern Great Plains and parts of the Western United States. Seawater also contains sulfates but is not as severe an exposure as sulfates in groundwater. Resistance to sulfates can best be achieved by using a low waterto-cement ratio and a cement with a limited amount of tricalcium aluminates. As outlined in ASTM C 150, Type II cement contains less than 8% C3A, and Type V cement contains less than 5%. Cements meeting the ASTM C 1157 requirements of Type MS cement (moderate sulfate resistant) and Type HS cement (high sulfate resistant) can also be used to provide sulfate resistance, as well as moderate sulfate-resistant cements per ASTM C 595. Studies have shown that some pozzolans and ground-granulated blast-furnace slags increase the life expectancy of concrete exposed to sulfates. Good results have been obtained with fly ash

Alkali-Aggregate Reaction

Alkali aggregate reactions (AAR) occur when aggregates in concrete react with the alkali hydroxides in concrete producing a hygroscopic gel which, in the presence of moisture, absorbs water and causes expansion and cracking over a period of many years. This alkali-aggregate reaction has two forms, namely: Alkali-silica reaction (ASR) and Alkali-carbonate reaction (ACR).

The former is of higher concern since aggregates containing various forms of silica materials are very common whereas the latter occurs rarely because of the unsuitability of carbonates for use in concrete.

Nonetheless, concrete deterioration caused by each type of alkali-aggregate reaction is similar. It should be known that no structure has ever collapsed due to alkali-aggregate reactions, but there are cases in which structural concrete members demolished due to the effect of alkali-aggregate reactions.

Most of the structures severely cracked by AAR are exposed to the weather or are in contact with damp soil. This is because- for a significant amount of expansion to occur, sufficient presence of moisture is essential. Apart from moisture, high content of alkali in the concrete is also essential.

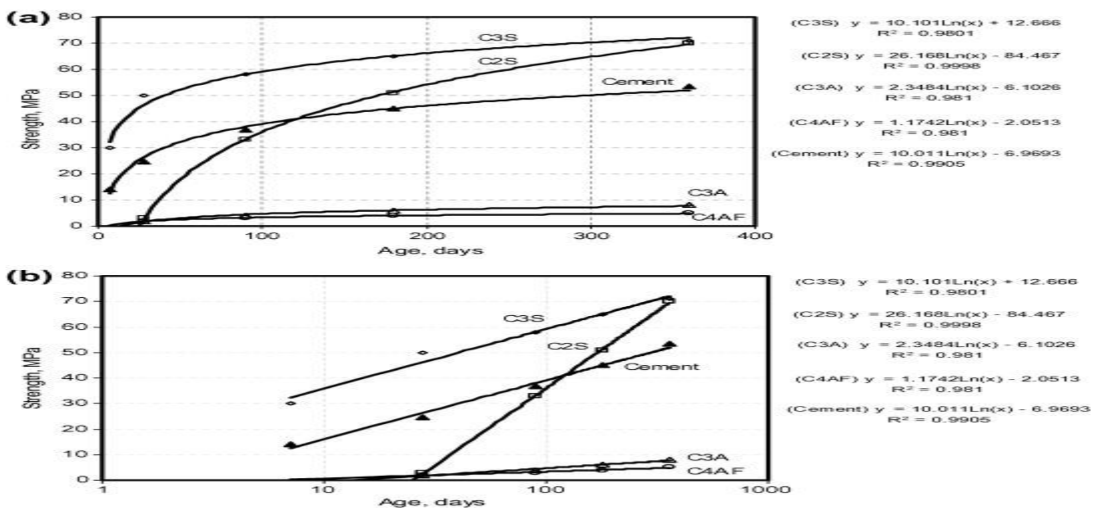
Q1B) What are the Effect of Cement Characteristics on Strength and Heat of Hydration explain briefly.

(ANS). Since the rates of reactivity of individual Portland cement compounds with water vary considerably, it is possible to change the strength development characteristics of cements simply by changing the compound composition.

For example, the early strengths at 3, 7 and 14 days would be high if the cement contains relatively large amounts of C3S and C3A; and the early strength would be low if the cement contains a larger proportion of C2S.

Also, from theoretical considerations, the ultimate strength of a high-C2S cement should be greater than that of a low-C2S cement. Laboratory studies confirm this (Figure).

Also, as the compound composition of the cement affects the heat of hydration, it is to be expected that cements containing high C2S will not only exhibit slow hardening but also less heat production (Figure).



Mix Combination	Heat of Hydration, kJ/kg			Heat Factors, % [a]		
	24 hours	48 hours	72 hours	24 hours	72 hours	72 hours
100%PC	178.0	226.5	226.5	100	100	100
80%PC+20%FA	152.0	195.0	222.2	85.4	86.1	86.9
80%PC+15%FA+5%MK	166.1	211.6	239.2	93.3	93.4	93.5
80%PC+15%FA+5%SF	167.0	213.5	242.8	93.8	94.3	94.9
65%PC+35%FA	129.9	166.3	188.4	73.0	73.4	73.7
65%PC+30%FA+5%MK	131.9	169.0	191.4	74.1	74.6	74.8
65%PC+25%FA+10%MK	139.9	187.3	213.3	78.6	82.7	83.5
65%PC+30%FA+5%SF	144.7	186.6	212.3	81.3	82.4	83.0
65%PC+25%FA+10%SF	148.0	189.1	215.0	83.1	83.5	84.1
45%PC+55%FA	96.0	126.0	146.9	53.9	55.6	57.4
45%PC+45%FA+10%MK	100.7	137.4	156.3	56.6	60.7	61.1
45%PC+40%FA+15%MK	96.5	133.6	153.1	54.2	59.0	59.9
45%PC+45%FA+10%SF	111.2	143.4	163.2	62.5	63.3	63.8
95%PC+5%MK	191.2	244.2	276.3	107.4	107.8	108.0
90%PC+10%MK	193.3	247.5	280.4	108.6	109.3	109.6
85%PC+15%MK	176.6	232.7	265.2	99.2	102.7	103.7
95%PC+5%SF	195.3	249.4	285.5	109.7	110.1	111.6
90%PC+10%SF	196.2	250.7	286.5	110.2	110.7	112.0

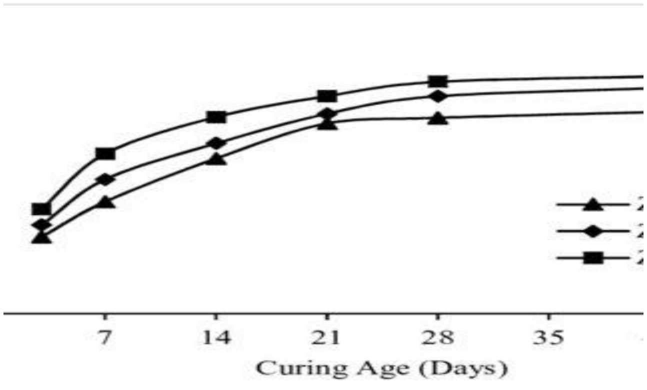
[a] Heat ratios determined with respect to PC values

Influence of cement composition on heat of hydration

The rates of strength development and heat evolution can also be controlled by controlling the fineness of cement.

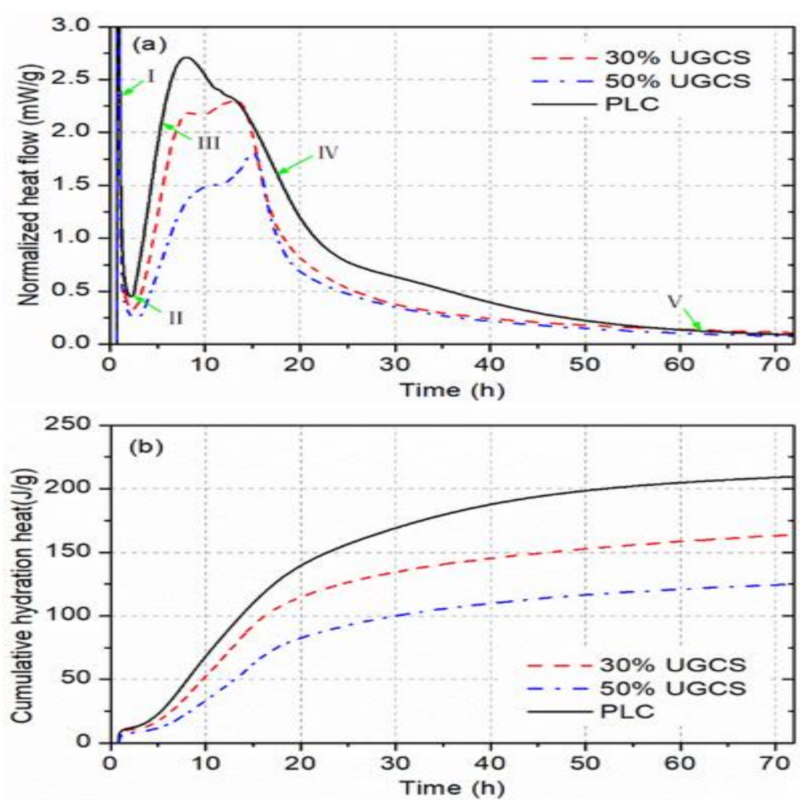
For example, with a given compound composition, by making a change in the surface area of the cement from 300 to 500 m2 /kg Blaine, it was possible to increase the 1, 3, and 7 day compressive strengths of the cement mortar by about 50 to 100 percent, 30 to 60 percent, and 15 to 40 percent , respectively.

Typical data on the influence of fineness on strength are shown in Figure.



Influence of cement fineness on strength

Effect of Cement Characteristics on Strength and Heat of Hydration



Q2A) Define Admixture. when concrete admixture is used? And explain briefly it's types?

(ANS). <u>Admixture</u>

Admixtures are those ingredients in concrete other than cement, water, and aggregates that are added to the mixture immediately before or during mixing as to obtain the required properties.

Concrete admixtures (additives) enhances the properties of concrete for applications in construction with special requirements.

Concrete additives are used to achieve desired workability in case of low water cement ratio, and to enhance setting time of concrete for long distance transportation of concrete.

It is of much importance for a civil site engineer to know about the types of admixtures (additives) and their properties for better selection and application in concrete works.

As per BIS (IS – 9103: 1999), Concrete Admixture is defined as a material other than water, aggregates and hydraulic cement and additives like Pozzolana or slag and fiber reinforcement, used as on ingredient of concrete or mortar and added to the batch immediately before or during its mixing to modify one or more of the properties of concrete in the plastic or hardened state.

When Concrete Admixtures Used?

When properties cannot be made by varying the composition of basic material.

To produce desired effects more economically.

Unlikely to make a poor concrete better.

TYPES;

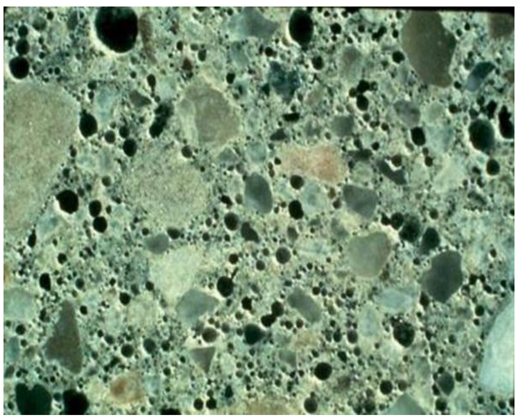
1. Air-entraining Admixtures
2. Plasticizers
3. Retarding Admixtures
4. Accelerating Admixtures
5. Corrosion Inhibiting Admixtures
6. Water-proofing Admixture
7. Grouting Admixture
8. Mineral Admixtures

Air-entraining Admixtures

Air-entraining admixtures are used to introduce and stabilize microscopic air bubbles in concrete. These are generally used to improve workability, ease of placing, increased durability, better resistance to frost action and reduction in bleeding.

The common Air-Entraining agents are natural wood resins, neutralized vinsol resins, polyethylene oxide polymers and sulfonated compounds.

These bubbles are introduced by an air entraining agent, a type of chemical that includes detergents.



The primary ingredients used in airentraining admixtures are salts of Vinsol resin, synthetic detergents and salts of petroleum acids.

In cold weather, water in concrete converts into ice . As ice occupies more volume than liquid water so it exerts stress on surrounding concrete as a result concrete might crack . But air bubbles inside the concrete provide space for the enhanced volume of ice and prevents cracks in the concrete.

Plasticizers

Plasticizers or water reducers, and super plasticizer or high range water reducers, are chemical admixtures that can be added to concrete mixtures to improve its workability.

In order to produce stronger concrete, less water is added which makes the concrete mixture less workable and difficult to mix, necessitating the use of plasticizers.

ACTION OF PLASTISIZERS

The action of plasticizers is mainly to fludify the mix and improve the workability of concrete , mortar or grout .

Plasticizers arealso often used when pozzolanic ash is added to concrete to improve strength.

Adding 1-2% plasticizer per unit weight of cement is usually sufficient. Adding an excessive amount of plasticizer will result in excessive segregation of concrete which is not advisable

It give flowable concrete with high slimp

It enableseasy placing of concrete even in areas of heavy reinforcing steel congestion.

Plasticizers are commonly manufactured from pop lignosulfonates which is a by-product from the paper industry.

In ancient times,the Romans used animal fat, milk and blood to improve workability of concrete mixes.

Retarding Admicture

Retarding admixtures are used to slow down the speed of the reaction between cement and water by affecting the growth of the hydration products or reducing the rate of water penetration to the cement particles. The use of a retarder will increase the setting time and may delay strength development of the concrete.

Retarders can be to allow the placing of a large pour of concrete over several hours.

to extend the time between mixing and placing. to prevent setting of the concrete in the truck in case of delay.

The typical materials used as retarders are:

Lignin,

Borax,

Sugars,

Tartaric acid and salts.

Accelerating Admixture

The admixture thatcauses an increase in the rate of hydration hydraulic of the cement and thus shortens the time of setting, increases the rate of strength development.

Accelerating admixtures are used for quicker setting times of concrete. It provides higher early strength development in freshly cast concrete.

Calcium chloride is a common accelerator, used to accelerate the time of set and the rate of strength gain.

Corrosion Inhibiting Admixture

The function of this type of admixture is to enhance the long term durability of reinforced concrete.

Corrosion-inhibiting admixtures can significantly reduce maintenance costs of reinforced concrete structures throughout a typical service life of 30 to 40 years.

Grouting Admixture

It is a powder admixture which can be used for making neat cementitious grouts. It comprises a water reducing / plasticising agent.

ADVANTAGES

Higher Strength

Higher fluidity

Lower permeability

Reduced bleeding

Mineral Admixtures

Mineral admixtures are “inorganic” materials that also have pozzolanic properties. These very fine grained materials are added to the concrete mix to improve the properties of concrete, or even as a replacement for Portland cement and aggregates.

Types of Mineral Admixtures

FLY ASH

BLAST-FURNANCE SLAG

SILICA FUMES

RICE HUSK

FLY ASH

Fly ash is a by-product of the combustion of powdered coal in thermal power plants.

Concrete using fly ash is generally reported to show reduced segregation and bleeding.

to improved watertig

Blast furnace slag is a byproduct of iron manufacture.

Concrete containing slag as a mineral admixtures generally offers better chemicalresistance due hit ness.

Silica Fume

Silica fume is an industrial by-product consisting of ultrafine particle. It is recovered from electric furnace by means of dust collectors from the waste gas emitted during the production of ferro-silicon metal.

It can be used as an water reducing admixture.

Mineral admixtures are generally used in concrete to help make it stronger as well as to make it more economical. Another very important benefit is that it is an environmentally responsible and effective way to recycle industrial and other waste by-products.

Q2B) Explain following

1.slump test

2.conpaction factor test

3.flow test

4.kelly ball test

5.vee bre test

(ANS). Following tests are carried out to find workability of concrete.

Slump Test

Compacting FactorTest

FlowTest

Kelly Ball Test

Vee BeeTest

Slump Test

A slump test is a method used to determine the consistency of concrete. The consistency, or stiffness, indicates how much water has been used in the mix. The stiffness of the concrete mix should be matched to the requirements for the finished productquality

Slump is a measurement of concrete’s workability, or fluidity.

It’s an indirect measurement of concrete consistency or stiffness.

Principle

The slump test result is a measure of the behavior of a compacted inverted cone of concrete under the action of gravity. It measures the consistency or the wetness of concrete.

Slump Test Apparatus

Slump cone : inverted cone, 300 mm (12 in) of height. The base is 200 mm (8in) in diameter and it has a smaller opening at the top of 100mm.

Scale for measurement,

Temping rod(steel) 16mm diameter, 60cm length

Procedure

1. The base is placed on a smooth surface and the container is filled with concrete in three layers, whose workability is to be tested .

2. Each layer is temped 25 times with a standard 16 mm (5/8 in) diameter steel rod, rounded at the end.

3. After the top layer has been tamped, the concrete is struck off level with trowel and tamping rod.

4. Then, the mould is removed by lifting it slowly and carefully in a vertical direction. This allows the concrete to subside. This subsidence is referred as slump concrete.

5. The difference in level between the height of the mould and that of the highest point of the subsided concrete is measured. This difference in height in mm is taken as slump of concrete.

Types Of Slump

The slumped concrete takes various shapes, and according to the profile of slumped concrete, the slump is termed as;

Collapse Slump

Shear Slump

True Slump

Collapse Slump

In a collapse slump the concrete collapses completely

A collapse slump will generally mean that the mix is too wet or that it is ahigh workability mix, for which slump test is not appropriate

Shear Slump

In a shear slump the top portion of the concrete shears off and slips sideways. OR If one-half of the cone slides down an inclined plane, the slump is said to be a shear slump.

True Slump

If concrete subsides evenly it is called true slump

Compaction Factor Test

compacting factor test, developed at the road research laboratory UK is more precise and sensitive than the slump test.

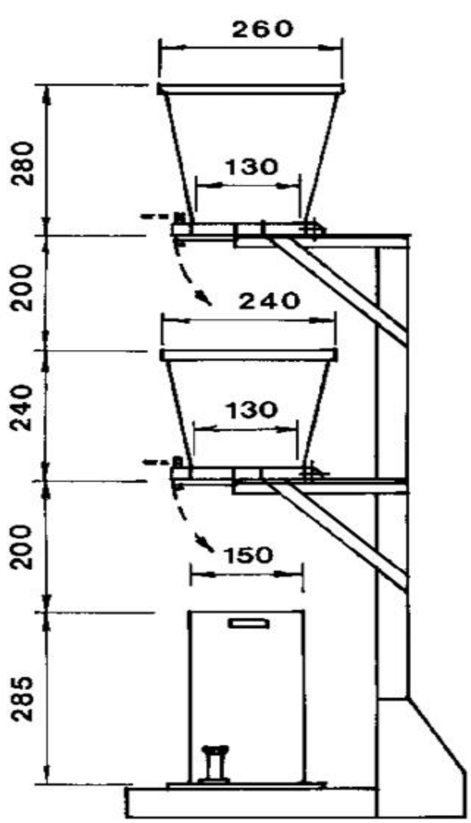
It is primarily designed for laboratory work but can also be used in the field.

It is particularly useful for concrete mixes of very low workability

Normally used when concrete is to be compacted by vibration such concrete may constantly fail to slump.

for the normal range of concrete the compacting factor lies between 0.8- 0.92.

Compaction Factor Test



Procedure of Compaction Factor Test on Concrete

Place the concrete sample gently in the upper hopper to its brim using the hand scoop and level it.

Open the trapdoor at the bottom of the upper hopper so that concrete fall into the lower hopper. Push the concrete sticking on its sides gently with the road.

Open the trapdoor of the lower hopper and allow the concrete to fall into the cylinder below.

Cut of the excess of concrete above the top level of cylinder using trowels and level it.

Weight the cylinder with concrete. This weight is known as the weight of partially compacted concrete (W1).

Empty the cylinder and then refill it with the same concrete mix in layers approximately 5 cm deep, each layer being heavily rammed to obtain full compaction.

Level the top surface.

Weigh the cylinder with fully compacted. This weight is known as the weight of fully compacted concrete (W2).

Find the weight of empty cylinder (W).

Calculation of Compaction Factor Value

The compaction factor is defined as the ratio of the weight of partially compacted concrete to the weight of fully compacted concrete. It shall normally to be stated to the nearest second decimal place.

Compaction Factor Value= (W1-W) / (W2-W)

Composition	Slump in mm	Compacting Factor
NC	62	0.90
Mix 1	48	0.90
Mix 2	32	0.89
Mix 3	25	0.88
Mix 4	20	0.84
Mix 5	15	0.82

Flow Table Test

The flow table test or flow test is method to determine the consistence off resh concrete

Application When fresh concrete is delivered to a site by a truck mixer it is sometimes necessary to check its consistence before pouring it into formwork.

If the consistence is not correct, the concrete will not have the desired qualities once it has set, particularly the desired strength.

If the concrete is too pasty, it may result in cavities within the concrete which leads to corrosion of the rebar, eventually leading to the formation of cracks (as the rebar expands asit corrodes). Cavities will also lower the strength of concrete.

Equipment

Flow table, 70 cm x 70 cm.

Abrams cone, open at the top and at the bottom -30 cm high, 17 cm top diameter, 25 cm basediameter.

Tamping rod, 60 cm height

Scale for measurement

Conducting

The flow table is wetted.

The cone is placed on the flow table and filled with fresh concrete in two layers, each layer 25 times tamp with tamping rod.

The cone is lifted, allowing the concrete to flow

The flow table is then lifted up several centimeters and then dropped, causing the concrete flow a little bit further

After this the diameter of the concrete is measured in a 6 different direction and take the average.

Kelly Ball Test

Another method used in the field and laboratory to measure the consistency of concrete is the ball penetration test which is also known as the Kelly ball test.

Procedure

It is performed by measuring the penetration, in inches, of a 6-in. diameter steel cylinder with a hemi spherically shaped bottom , weighing 30 lbs.

Advantages

One of the advantages of the ball penetration test can be performed on the concrete in a wheelbarrow, or other suitable container.

Another advantage of this method is its simplicity and the rapidity with which the consistency of the concrete canbedetermined.

It is also not dependent on a procedure of filling and rodding a container like the slump test.

VEE BEE Test

It is based on measuring the time (Called VEBE time) needed to transfer the shape of a concrete mix from a cone to a cylinder (these shapes are standardized by the apparatus of this test), by vibrating and compacting the mix. The more VEBE time needed the less workable the mix is. This method is very useful for stiff mixes.

Apparatus

Cylindrical container with diameter = 240 mm, and height = 200 mm

Mold: the same mold used in the slumptest.

Disc : A transparent horizontal disc attached to a rod which slides vertically

Vibrating Table : 380*260 mm, supported by four rubber shock absorbers

Tamping Rod

Stop watch

Procedure

Slump test as described earlier is performed, placing the slump cone inside the sheet metal cylindrical pot of the consistmeter.

The electrical vibrator is then switched on and simultaneously a stop watch started.

Thevibration is continued till such time as the conical shape of the concrete disappears and the concrete assumeacylindrical shape.

This can be judge by observing the glass disc from the top disappearance of transparency.

Immediately when the concrete fully assume 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 shapein second is known asVibe Degree

This method is very suitable for very dry concrete whose slump value cannot be measureby slump test. The test fails if VEBETime is less than 5 seconds .

Q3A) Define and explain briefly

1.batching.

3.transporting

2.mixing.

4.placing

5.compacting.

6.curing

Batching

Batching is the process of measuring concrete mix ingredients by either mass or volume and introducing them into the mixer.

To produce concrete of uniform quality, the ingredients must be measured accurately for eachbatch.

Transporating

1) Mortar Pan :
   Concrete is carried in small Quantities

2) Wheelbarrows and Buggies:

The capacity of wheelbarrows varies from 70 to 80 litres.

Suitable for concrete road construction where concrete is deposited at or below mixer level.

3)Belt Conveyors:

Conveying concrete horizontally or higher/lower level.

4) Cranes and Buckets:

Used for Work above ground level , Buckets use with Cranes, cableways, and helicopters.

5)Pumps:

Conveying concrete from central discharge point to formwork.

6) TransitMixer:

Used for transporting the concrete over long distance particularly in RMC plant .

Placing of concrete

The process of depositing concrete in its required position is termed as placing. Concrete should be placed in systematic manner to get optimum results.

Precautions: Placing concrete within earthmould

All loose earth must be removed.

Roots of trees must be cut.

If surface is dry, it should be made damp.

If it istoo wet or rain, then slush must be removed

Placing concrete with in usual form work:

Adopted for column ,beam and slabs

Check the reinforcements are correctly tied and placed.

Mould releasing agent should beapplied.

The concrete must be placed carefully with a small quantity at a time so that they will not block the entry of succeedingconcrete.

Placing concrete under water:

Concrete having cement content at least 450kg/m3 and a slump of 10 to 17.5cm can be placedunderwater.

Mixing:

The mixing should be ensured that the mass becomes homogeneous , uniform in colour and consistency.

Methods of Mixing :

1.Hands(using hand shovels)

2.Stationary Mixers

3.Ready mix concrete

Hand Mixing:

Mixing by hands using ordinary tools like, hand shovels etc.

This type of mixing is done for less output of concrete.

Procedure:

1. Measured quantity of sand is spread evenly on platform.

2. Spread the measured quantity of cement on this sand and mix it till the colour of concrete mixture is uniform.

3. Spread the measured quantity of coarse aggregate on the platform with sand and cement. Now spread the mixture of cement and sand on the stack of aggregate and mix it atleast 3 times.

4. Add 3 quarters of total quantity of water required and turn the material towards the center.

Concrete is sometime mixed at jobsite in a stationary mixer having a size of 9 cubic meter. These mixers may be of :

1. Tilting type ,

2. Non-Tilting type ,

Compaction of concrete:

Compaction of concrete is 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 .

It has been found from the experimental studies that 1% air in the concrete approximately reduces the strength by 6%.

If we don't expel this air, it will result into honeycombing and reduced strength

Different Methods Of Concrete Compaction:

1)Hand Compaction:

Rodding

Ramming

Tamping

2)Compaction by Vibration:

Internal vibrator

Formwork Vibrator

Table Vibrator

Platform vibrator

Surface vibrator .

Curing:

Curing is the process in which the concrete is protected from loss of moisture and kept within a reasonable temperature range.

The result of this process is increased strength and decreased permeability.

Curing is also a key player to reduce cracks in the concrete, which powers durability and strength.

Curing can be defined as a procedure for insuring the hydration of the Portland cement in newly-placed concrete.

It generally implies control of moisture loss and sometimes of temperature

Need for curing:

Causes Hydration reaction of cement with water.

Loss of water by evaporation can be prevented.

For completing of Hydration reaction

Methods of curing:

Immersion

Ponding

Spraying

Covering with wetsand

Wetted Hessian (gunnybags)

Membranecuring

Water proof plasticsheeting

(Q3B) Define Segregation in concrete and factor causing segregation in concrete?

(ANS). Segregation in concrete

Segregation is the “Separation of constituent materials in concrete.” In concrete technology, segregation is of three types:

1. Separation of Coarse aggregate from the concrete mixture,

2. Separation of Cement pastes from the concrete during its plastic stage.

3. Separation of water from the concrete mix (Bleeding in concrete)

Concrete is a mixture of Cement, fine and coarse aggregates. A good concrete is one which all the constituents are properly categorized to form a homogeneous mixture. The primary cause of Segregation in concrete is the differences in specific gravities of the constituents, Specific gravity of Cement is in between 3.1-3.6g/cc and for aggregate it lies between 2.6-2.7g/cc due to this differences, the aggregate separates from the matrix and causes segregation in concrete.

Factors causing segregation in concrete

1. Transporting concrete mixes for long distances.

2. Poorly proportioned mix, where sufficient matrix is not there to bind the aggregates.

3. Dropping concrete from more than 1m.

4. Vibrating concrete for a long time.

How to minimize segregation in concrete

1. Segregation can be controlled by maintaining proper proportioning the mix.

2. By proper handling, placing, transporting, compacting and finishing of concrete.

Bleeding in concrete

Bleeding is a form of segregation in which water present in the concrete mix is pushed upwards due to the settlement of cement and aggregate.

The specific gravity of water is low, due to this water tends to move upwards.

Bleeding ordinarily occurs in the wet mix of concrete.

The Prime factor for bleeding in concrete is the high dosage of Water cement ratio.

Higher water-cement ratio weakens concrete and leads to excessive bleeding.

The bleeding in concrete is not harmful if the rate of evaporation of water is equal to the rate of bleeding.

Bleeding in concrete

How bleeding effects concrete stability

1. As mentioned above, water move upwards in bleeding, sometimes with this water certain amount of cement moved along with water to the concrete surface. When the top surface is worked up with the trowel, the aggregate goes down and cement paste forms at the top surface this is called ‘Laitance in concrete.’ Due to the formation of Laitance, structures may lose its wearing capacity and decreases its life.

2. Water while moving from bottom to the top, forms water voids in the matrix and reduces the bond between aggregate and the cement paste.

3. Forming of water at the top surface of concrete results in delaying the surface finishing.

4. Excessive bleeding breaks the bond between the reinforcement and concrete.

How the bleeding in concrete is controlled

1. Bleeding in concrete is controlled by Adding minimum water content in the concrete mix.

2. Encouraging the use of admixtures in the mix.

3. By adding more cement in the mix.