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**Q1(A)**

**Answer**

**Classification of causes of concrete deterioation**

1. **Frost action:**

Freeze/thaw damaga occurs in concrete whenthe water molecules in concrete freeze and expand beyond the volume constraints of the concrete.

When the 91% of the pores of concrete are filled withwater, the concrete is known to be saturated to be saturated.

When these water molecules freeze, they expand by 9% and because there no room for their increased valume, the concrete distresses.

The freeze can cause to weak the bonds in cement around the aggregate to break and concrete can crack in those places.

As the water in moist concrete freezes, it produces pressure in the capillaries and pores of the concrete.

If the pressure exceeds the tensile strength of the concrete, the cavity will repture.

Frost action is a major cause of deterioration of concrete in cold climates. It takes place due to freezing or water within the concrete pores and cavities during extremely cold weather.

Water on freezing expand and exerts pressure on the walls of the pores. This cyclic freezing of water in the pores are responsible for the development of cracks of various nature in the concrete.

**To minimize frost action following measures should be taken:**

In cold weather, the water-cement ratio should be kept as law as possible. This will not allow any extra water to remain within the concrete pores. Hence forst formation will not take place.

Use good drainge and covering methods for removing any surface water staying on the concrete during the curing process.

Some aggrigate may absorb so much water (to critical saturation) that they cannot accommodate the expansion and hydraulic pressure that occurs during the freezing of water.

The result is expension of the aggregate and possible disintegration of the concrete. If a problem particle in near the surface of the concrete , if can cause a popout.

1. **Effect of fire:**

The concrete as a building material has a very good behavior when it exposed to fire, especially when it is compared to any others building material like wood steel.

But this is not mean that the concrete has infinite fire resistance in some level whwn the concrete exposed tp high temperature up to 900o C, significant changes in the meahanical properties of the structural elemenets like stiffness and strength willbe occur.

 **Physical and chemical response to fire**

**100 to 140o****C- E**vaporation of the free water inside the concrete mix.

**300oC**- the cement paste will start to shirink due to water evaporation and thr aggregate will expaand. This will cause damage which is called the spalling of concrete.

**400 to 600o C-** the calcium hydroxide in the cement paste breaks to calcium oxide . this will couse a significant reduction in the concrete strength.

**Spalling of concrete**

 The spalling of concrete is the breaking and spiltting of the concrete element surface layers due to high thermal exposure. The spalling can be classified to three types.

1. Aggregate spalling
2. Corner and surface spalling
3. Explosive spalling

**3.Sulphate attack**

Sulphate attack on concrte is a chemical breakdown meechanism where sulphate ions attack cpmponents of the cement paste.

The compound responsible for sulphate attack on concrte are water-soluble sulphate-comtaining salts, such alkali-each(calcium, magensium) and alkali (sodium, postassium) sulphate that are capable of chemically reacting with components of concrte.

**Form of sulphate Attack on concrete.**

Sulphate attack on concrete might show itself in defferent forms depending on:

The chemical formof the sulphate

The atmospheric enivernment which the concrete is exposed to.

**4. Alkali- Aggregate Rection.**

Sodium and potassium hydrocides of cement are capableof reaction with silica.

Since amorphous sillica is a common component of many coarse aggregates, such an alkali-aggregate reaction may create harmful effect on cement concrete.

This is because the gel-like silicate structures produced by the above reaction are quite weak and unstable and result in rreater expansion.

These may be the coase of prequent creaking in some concrete.

For avoiding this reaction, either the percentage of alkalies (K2 O and Na2O) has to be kept very low in the portland cemeny.

Or a great care has to be taken for selecting aggregates free of silica.

**Q1(B)**

**Answer**

**Effect of cement characteristics on strength and heat of hydration**

Since the rates of reactivity of individual portland cement compound with water vary considerablly, it is possile to change the strength development charactistics the cement 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 amount of C35; and cantains a larger proportion of C 2S.

Also from theoretical consideration, the ultimates stregth of high-C2S cement should be greater studies confirmthe 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 herderning but also less heat production.

The tayes of strength development ans geat evolution can also 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 /kgblaine, it was possilbeto increase the 1,2 and 7 days compressive strengts of the cement mortar bt about 50 to 100 percent, 30 to 60 percent, and 15 to 40 percent, respectively.

**Q2(A)**

**Answer**

**ADMIXTURE**

 Admixtures are these ingrdients in concrete other that cement, water and aggregates that are added to the mixtureimmediatly before or during mixture as obtain the required properties.

Concrete admixture( additives) enhances the properties of concrete for applictions in construction with specical 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 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 admixture (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 ,ixture to modify one or more of the properties of concrete in the plastic or hardened state.

 **When concrete admixture used.**

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

To produced desired effects more economically.

Unlikely to make a poor concrete better.

**Q2(B)**

**Answer**

**Slump test**

**Definition**

A slimp test is a method used to determine the consistencyof 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 prodect quality

Slump is a measurement of concrete’s workabilty, or fluality

Its an indirect measurement of concrete consistency or stiffness.

**Principle**

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

**Procedure**

1. The base is placed on a smooth surface and container is filled with concrete in three layers, whose workability is to be tested
2. Each layer is temped 25 times with a standard 16mm(5/8 in) diameter steel rod rounded at the end.
3. After the top layer has been tamped, the concrete is struck off level wwith trowel and tamping rod
4. Then, the mould is removed by lifting is slowy and carefully in a vertical direction. Then allows the concrete to subside. This subsidence is referred as slump concrete
5. The different in level between the height of the mould and that of the highest point of the subsided concrete is measured. This differencr is height in mm is taken as slump of concrete.

 **Compaction Factor Test :**

**Introdection**

Compacting factor test, developed at the raod research laboratory Uk is more precise and sensitive than the slump test.

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

It is particularly usefull 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

**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 rhe road.

Open the tradoor of the lower hopperand 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 weigth is known as the weigth 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 rammad to obtain full compaction.

Level the top syrface

Weigh the cylinder with full compacted . this weight is know as the weight of fully campacted concrete**(W2).**

Find the weight of empty clyinder**(W).**

**FLOW TEST:**

A urine flow test calculates the speed of urine flow oner time. It may be used to check how the bladder and sphincterare working. The bladder is part of the urinary tract………. the device calculates the amount of urine, rate of flow in secong, and the length of times until all urine has been passed. The floe table test or flow test is a method to dtermine consistency of fresh concrete. Flow table test is also used to identify transportable moisture limit of sould bulk cargeoes.

**Kelly Ball Test**

 The kelly ball test is a simple and inexpensive test that is performed on concrete. It provides an indication of yield strees, and the results of the test can then be correlated with concrete slump. The test can be successfully used for special concrete mixes, including light and heavy weight concrete.

**Vee Bee Test**

Vee bee test is used to determine the consistency of concrete. The test determines the comsistency of concrete using a Vee-Bee consistomter. This is achieved by measuring the time requiredfor transporting by vibration, a concrete specimen in the shape of conical frustum into a cylinder

**Q3(A)**

**Answer**

**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 each batch.

 **Volume batching:-**

This method is generally adopted for small jobs .

Gauge boxes are used for measuring the fine and

coarse aggregate.

The volume of gauge box is equal to the volume one og bag of cement.

Batching is the process in which the quantityor proportion of materials like cement, aggregate, water, etc are measured on the basic of either weigh or volume to prepare the concrete mix. Concrete batching plant id used to mix and blend cement, water, sand and aggregates to form quality concrete without which building any construction project is not possible. It becomes necessary that the concrete batching plant is effecient and soeedy in order to complete a constuction project as soon as possible.

**Mixing**

Mixing is the process of blending all the individual tracks in a recording to create a version of the song that sound as good as possible. The mix. The process can include: balancing the level of the tracks that have been recorded fine-tuning to sounder of each instrument or voice using equalisation (EQ) in indstrial process engineering, mixtureis a unit opreation that inolves maniputation of a heterogeneous physical system with the intent to make it more homogeneous. Mixingd is performed to allow heat and/ or mass transfer to occur between one or more strems, components or phases.

 **Transpoting**

Transpot is defined as a way to move things from one place to another. An example of transpot is a city bus. An example of transport is a cargo ship. Definition of transpot transpot verb:1 to transfer or convey from ane place to another transpoting ions across a living membrane 2: to carry away strong and often internsely plasesant emotion.

**Placing**

1. Physical environment : space….
2. 2a: an indefinite region or expanse all over the place. ...

3a : a particular region, center of population, or location a nice place to visit. ...

4 : a particular part of a surface or body : spot.

5 : relative position in a scale or series:

A position among the leading competitors, usually the first, second, or third at the finish line. the position of the competitor who comes in second in a horse race, harness race, etc.

**Compacting;**

Compaction is what happens when something is crushed or compressed. In many places, garbage undergoes compaction after it's collected, so that it takes up less space. The process of making something more compact, or dense and very tightly packed together, is compaction. Rainforests, dry forests, sand dunes, mountain streams, lakes, rivers, oceans, beaches, and deltas are just a few examples of where compaction, and eventually cementation, can occur.

**Curing;**

Curing is a process during which a chemical reaction (such as polymerization) or physical action (such as evaporation) takes place, resulting in a harder, tougher or more stable linkage (such as an adhesive bond) or substance (such as concrete). Curing of Concrete is a method by which the concrete is protected against loss of moisture required for hydration and kept within the recommended temperature range. Curing will increase the strength and decrease the permeability of hardened concrete.

**Q3 (B)**

**Answer**

Segregation means separation of designed fresh concrete ingredients from each other resulting in the non-uniform mix. More specifically, this implies the separation of coarse aggregates from the mortar because of differences in size, density, shape and other properties of ingredients in which they are composed. Poorly graded aggregate & excessive water content is the major cause of segregation.

A badly proportioned mix, where sufficient matrix is not there to bond and contain the aggregate cause aggregates to settle down.

Insufficiently mixed concrete with excess water content shows a higher tendency for segregation. Segregation could result from internal factors such as concrete that is not proportioned properly and not mixed adequately, or too workable a mix. It also could result from external factors such as too much vibration, improper transportation, placement, or adverse weather conditions.

Some other factors causing segregation in concrete:-

* Transporting concrete mixes for long distances.
* Poorly proportioned mix, where sufficient matrix is not there to bind the aggregates.
* Dropping concrete from more than 1m.
* 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 peculiar handling, placing, transporting, compacting and finishing of concrete.
3. Adding air entraining agents, admixtures and pozzolanic materials in the mix segregation controlled to some extent.