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* MID Term Examination

Q 1 (A) concrete is neither as strong as nor tough as steel , so why is it the most widely used engineering material . Write at least three primary reasons.

* **Answer :- concrete is a popular material for many construction application ,and it is widely used because of it strength , durability, reflectivity, and versatility , these properties make it a study and long lasting option for numerous domestic and commercial setting**

 **OR**

* **The biggest reason concrete is so popular around the world is that is extremely durable concrete is weatherproof meaning that it can withstand the element in almost all capacities it is also resistant to erosion meaning that it will last longer than other building materials**

**There are three primary reasons**

* **FIRST REASON:-concrete possesses excellent resistance to water .unlike wood and ordinary steel. The ability of concrete to withstand the action of water without serious deterioration makes it an , deal material for building structure to control, store, and transport water**
* **SECOND REASON:- The second reason for the widespread use of concrete is the easy with which structural concrete element can be formed into a variety of shapes and sizes. This is because freshly made concrete is of a plastic nature. Which enable the material to flow into preinstalled formwork after a number of hours when the concrete has solidified and hardened to a strong mass the formwork can be removed for reuse**
* **THIRD REASON :- The third reason for the popularity of concrete with engineering it that it is usually the cheapest and most readily available material on the job the principle components for making concrete namely aggregate water and part land cements are relatively inexpressive and are commonly available I most parts of the world**

 **Q1 (B) what are the factors influencing compressive strength of concrete. Explain each of them in detail.**

* **Answer: - concrete strength is affected by many factors, such as quality of raw materials, water/cement ratio, coarse/fine aggregate ratio, age of concrete, compaction of concrete, temperature, relative humidity and curing of concrete.**
* **Water cement ratio: - water cement ratio means the ratio between the weights of water to the weight of cement used in concrete mix. Normally water cement ratio falls under 0.4 to 0.6 as per I S for nominal mix (M 10, M 15……M 25). We all know that water cement ratio will directly affect the strength of concrete. Either it increases the strength if used in correct proportion or decrease it.**
* **SIZE AGGREGATES USED OF :- Aggregates in any particular mix of concrete or selected for their durability . Strength. Workability and ability to receive finish. Aggregates make up some 60% to 80% of the concrete mix . They provide compressive strength and bulk to concrete.**
* **SHAPE OF AGGREGATES ;- Rounded aggregates give more workability to concrete angular or pointed aggregates make concrete harsh**

**Q 2 (A) EXPLAIN MICRO STRUCTURE OF HYDRATED CEMENT PASTE IN DETAIL?**

* **Answer: -2 (A) when Portland cement is dispersed in water, as a result of interaction between calcium, sulfate, aluminates and hydroxyl ions within a few minutes of cement hydration , the needle-shaped crystals of calcium trisulfo-aluminate hydrate called ettringite. First make their appearance. Having low surface area and volume.**
* **A few hours later, large hexagonal shaped crystals of calcium hydroxide also known as portlandite and calcium silicate hydrates (C-S-H gel) having high surface area and volume begin to fill the empty space formerly occupied by water and the dissolving cement particles.**
* **After same days depending on the alumina-to-sulfate ratio of the Portland cement, ettringite may become unstable and will decompose to form mono-sulfo-aluminates hydrate, which has a plane hexagonal in structure**
* **CALCIUM SULFO-ALUMINATES HYDRATES**
	+ **Low surface area :2m2/g calcium sulfo-aluminates hydrates occupy 15 to 20 percent of the solid volume in the hydrated paste and , therefore ,play only a minor role in the microstructure property relationships**
	+ **In pastes of ordinary Portland cement, ettringite eventually transforms to the monosulfate hydrate which forms plane hexagonal-plate crystals.**
	+ **The presence of the monosulfate hydrate in Portland cement concrete makes the concrete weak to sulfate attack.**
* **Calcium hydroxide or Portlandite calcium hydroxide crystals (also called portlandite) occupy 20 to 25 percent of the volume of solids in the hydrated paste.**
* **it tends to form large crystals with a hexagonal –prism shape . The shape is usually affected by the available space, temperature of hydration, and impurities.**
* **Calcium hydroxides have lower surface area (0.5m2/g).**
* **Calcium silicate hydrate or C-S-H gel**
* **The Calcium silicate hydrate phase, abbreviated as CS-H, makes up 50 to 60 percent of the volume of solids in a completely hydrated Portland cement paste and is, therefore, the most important phase determining the properties of the paste.**
* **Although the exact structure of C-S-H is not known, several models have been proposed to explain the structure and surface area.**
* **According to the powers –Brunauer model , the material has a layer structure with a very high surface area .Depending on the measurement technique, surface areas on the order of 100 to 700 m2/g have been proposed for C-S-H**
* **the Feldman sereda model visualizes the C-S-H structure as being composed of an irregular or linked array of layers which are randomly arranged of different shapes and sizes**

**Q 2 (B) WHAT DO WE MEANT OF THERMAL PROPERTIES OF CONCRETE .EXPLAIN EACH OF THEM?**

**ANSWER: - THERMAL PROPERTIES OF CONCRETE**

* **Thermal properties are those properties of a material which is related to its conductivity of heat in other words, these are the properties which are exhibited by a material when the heat is passed through it,**
* **To study about the thermal properties of concrete the following properties needs to be known :**
1. **Thermal conductivity**
2. **Thermal diffusivity**
3. **Specific heat**
4. **Coefficient of thermal expansion**

* **THERMAL CONDUCTIVITY**
* **the thermal conductivity of concrete is one of the key parameters needed to predict temperature variation during hydration**
* **define as the ratio of the flux of heat to temperature gradient**
* **this measures the ability of the material to conduct heat**
* **the major factors influencing the conductivity are moisture content of concrete ,the type of aggregate, the mix proportions, the type of cement and the temperature of the concrete**
* **k =Q\*L/A(T2-T1)**
* **Where :**

**Q=heat flow (W)**

**L=Length or thickness of the material (m)**

**A=surface area of material (m2)**

**T2-T1=temperature gradient**

* **THERMAL DIFFUSIVITY**
* **Thermal diffusivity is measure of the rate at which temperature change within the mass take place.**
* **The large the value of thermal diffusivity of mass the faster the changes will occur.**
* **The value of thermal diffusivity is dependent on the aggregate type, moisture content, and degree of hydration of the cement paste. and exposure to drying**
* **Diffusivity can be determined by :**
* **D=K/Sd**

**D=Thermal diffusivity (m2/S)**

**K=Thermal conductivity ( J/S)**

**S=Specific heat (J/kg)**

**d= density of concrete (kg/m3)**

* **SPECIFIC HEAT**
* **The common range of values for concrete is between 840 and 1170 j/kg per 1o C**
* **Specific heat is defined as the quantity of heat required to raise the temperature of a unit mass of concrete by 1oC**
* **Specific heat represents the heat capacity of concrete.**
* **It also increases with a decrease in the density of concrete.**
* **Specific heat increases with an increase in temperature’s**
* **Coefficient of thermal expansion**
* **The Coefficient of thermal expansion of Portland cement concrete (PPC) range from about 8 to 12 micro- strains/o C**
* **The Coefficient of thermal expansion is usually expressed in micro-strains per unit temperature change**
* **The range of coefficient of thermal expansion values for different concrete reflects the variation in coefficient of thermal expansion of concrete ,s component materials.**

**Q3 (A) Write a brief note on**

1. **Normal strength concrete**
* **ANSAWER:- It is also called normal weight concrete or normal strength concrete. It Has a setting time of 30-90 minutes depending upon moisture in atmosphere, fineness of cement etc. the development of the strength starts after 7 days the common strength values is 10 MPa (1450 psi) to 40 MPa (5800 psi).**
1. **Reinforced concrete**
* **ANSAWER:-Reinforced cement concrete (R.C.C) is the combination of ordinary concrete with the reinforcement to increase its compressive and tensile strength to a great extent. Concrete is a versatile material for modern construction which is prepared by maxing together well-proportioned quantities of cement (even lime in some cases),sand, crushed rock or gravel and water .it has been used from foundation to the rooftops of building, in the construction of highways road traffic, and hydro-power tunnels, irrigation canals, drains, and all other conceivable structures.**
1. **Pre-stressed concrete**
* **ANSAWER:- A creation of internal stresses in a structure in order to improve its performance. Such stresses are designed to counter-act stresses induced by external loads. Concrete is strong and ductile in compression, it is weak and brittle in tension, and hence its response to external loads is improved by pre-compression. Prestressed concrete is a type of Reinforced concrete in which steel has been tensioned against in concrete**

**Q3 (B) Explain briefly interfacial transition zone in concrete.**

* **Answer : concrete is considered to be two phase material**

**Paste phase**

**Aggregate phase**

**At microscopic level, the complexities of the concrete begin to show up, particularly in the vicinity of large aggregate particles. This area is considered as a third phase called the transit zone, which represents, the inter facial region zone between the particles of coarse aggregate and hardened paste.**

**The transition zone is a plane of weakness and therefore has great influence on mechanical behavior of concrete. Transition zone is composed of some bulk concrete paste; the quality of paste is poorer. Due to internal bleeding, water accumulated below elongated, flaky and large pieces of aggregates .this reduces the bond between the paste and aggregate.**

**THE END**