Concrete Technology Final Term Examination

I**nstructor**: Engr. Usama Ali **Total Marks:** 50

Note: 1. Attempt all questions. Write short and to the point answers. Use provided lectures to answer all questions.

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1. (a) What is re-tempering of concrete? In which case is re-tempering of concrete done?

ANSWER A:

Retempering is the process of changing the consistency of a concrete mixture by adding water and remixing. As it is common to send the concrete to the placement site with slightly less water than the maximum that may be used, it is expected that a specified amount of water can be added if necessary. The contractor may add the water because the mixture arrives at the site in a condition that would make placement and finishing difficult. These difficult HCCs are often called harsh mixtures. The usual cause of a harsh mixture is sand with a high void content. Sands with a high void content are usually irregular in shape with an abundance of re-entrant angles and internal fractures and voids. Iron-stained clay coatings are common. Other causes of concrete that seems too dry are improper grading of the aggregate and the presence of mud or mud coatings on the aggregate Mixtures with a low w/c (below 0.45) can be difficult to place unless an effective water reducer is used. A good air-void system or the presence of fly ash as a substitute for part of the cement can help make.

(b) What is the normal RPM of the agitator of a transit mixer? What is the minimum limitation of total revolutions of agitator in a transit mixer set by ASTM before concrete placement? (3+3 marks) (CLO1)

ANSWER B:

The drum is turned at medium speed (about 8 rpm) for 70 revolutions while driving to the job site. The PCC is agitated (< 2 rpm) until discharge. A minimum time (often 1 to 2 hours) between the time at which when the mixing water was introduced to the portland cement and aggregates and discharge at the site.

Minimum limitation of revolution:

Agitating speed is usually about 2 to 6 revolutions per minute, and mixing speed is generally about 6 to 18 revolutions per minute. Mixing for long periods of time at high speeds, about 1 or more hours, can result in concrete strength loss, temperature rise, excessive loss of entrained air, and accelerated slump loss.

2. (a) What will be the expected loss in strength of 3000psi concrete if it curing has not been performed at all?

ANSWER A:

When the concrete reaches 3000 psi compressive strength a gang of four jacks with 10 inch throws on a mobile card is lowered into the block outs at the end of a slab and a jack is positioned on the end each strand in one lane.

(b) What is the percentage efficiency of membrane curing as compared to water curing?

ANSWER B:

The percentage efficiency of membrane curing is 80-90% can be achieved as compared to water curing.

(c) What is meant by retrogression of strength in concrete? Which method of curing promotes retrogression in concrete strength? (2+2+3) (CLO1)

Answer C:

A change in the hydration products that are formed when cement is exposed to high temperatures (>110°C / 230°F). It can be described as a decline of cement strength at elevated temperatures where decreased strength is observed with increasing time.

Method:

The most effective methods of curing concrete are wet coverings or water spraying that keeps the concrete continually damp. Curing compounds should be able to maintain the relative humidity of the concrete surface above 80% for seven days to sustain cement hydration.

3. a) What do you mean by endurance level? What is the endurance level of concrete and steel?

ANSWER A:

Endurance (also related to sufferance, resilience, constitution, fortitude, and hardiness) is the ability of an organism to exert itself and remain active for a long period of time, as well as its ability to resist, withstand, recover from, and have immunity to trauma, wounds, or fatigue.

The endurance limit for concrete as the stress level below which it can withstand the threshold fatigue life of 2 million loading cycles. They observed that the sample which did not fail within 2 million cycles, even sustained 4 million load cycles.

A certain stress level, the steel alloy never fails due to cyclic loading alone. Typical values of the endurance limit for steels are 1/2 the ultimate tensile strength. For iron, aluminum and copper alloys, endurance limit is typically 0.4 times the ultimate tensile strength.

(b) What is the difference between attrition and erosion of concrete?

ANSWER B:

Attrition is mechanical wear through tooth-tooth contact abrasion is mechanical wear produced by interaction between teeth and other materials. While Erosion is chemical dissolution of dental hard tissue by acidic substances and this process also enhances mechanical wear by demineralizing and softening of dental hard.

(c) What steps should be taken to improve bond strength of reinforcement in concrete? (2+2+3) (CLO1)

ANSWER C:

To improve the strength of bond strength of concrete we have to add steel bars and wire which have excellent high tensile yield properties. ducitility and elasticity that complement concretes attributes. To provide added durability when required, black steel bars are galvanized or epoxy coated.also non-metallic reinforcing bar alternatives made from glass fiber polymers are obtained, because it will never cause corrosion.

4. What is creep? What are the factors affecting creep? What difference is between creep and strain relaxation? (5 marks) (CLO1)

ANSWER:

Creep the tendency of a solid material to move slowly or deform permanently under the influence of persistent mechanical stresses is called creep.

Factors affecting Creep:

1. WATER-CEMENT RATIO:

The rate of creep is increased with increasing water cement ratio.

2. HUMIDITY:

It is influenced by humidity and drying condition of the atmosphere.

3. AGE OF CONCRETE:

The rate of creep rapidly decreases with time. The time taken by a concrete structure to attained creep is 5 years.

4. AGGREGATE:

Aggregates with moisture movement and low elastic modulus cause a large amount of creep. The rate of creep generally decreases with the increase of the size of aggregates.

5. ADMIXTURES:

Some admixtures (mainly accelerators) are also responsible for causing creep in concrete.

Difference:

The difference between creep and strain is that Creep is an increase in plastic strain under constant stress. While the Stress relaxation is a decrease in stress under constant strain. But the Creep is an increased tendency toward more strain and plastic deformation with no change in stress.

5. What is the difference between drying shrinkage and plastic shrinkage? Is drying and plastic shrinkage reversible? (5 marks) (CLO1)

ANSWER:

DIFFERENCES:

Drying shrinkage:

Loss of water from fresh concrete, which leads to plastic shrinkage, can occur in a couple of ways. The predominant mode is, however, through evaporation from an exposed surface. Concrete can also lose water through suction by the subbase or, depending on the type of material used in its manufacture, the formwork. Such loss of water can aggravate the effects of surface evaporation. It is generally accepted that the loss of water from the paste fraction of concrete due to external factors generates negative capillary pressures that cause the volume of the paste to contract, hence the shrinkage. The rate of water evaporation is usually aggravated by a combination of high wind speed, low relative humidity, and high ambient and

concrete temperatures. Though these conditions are most likely during the summer months, they can occur at any time. The rate at which bleed water is transported to the concrete surface will impact the potential for the phenomenon or form of cracking commonly referred to as plastic shrinkage cracking. It has been reported that if the rate of surface evaporation exceeds about 0.1 Ib/ft2 /h (0.5 kg/ m2 /h), the loss of moisture may exceed the rate at which bleed water reaches the surface.

Plastic shrinkage:

The loss of moisture from concrete after it hardens, and hence drying shrinkage, is inevitable unless the concrete is completely submerged in water or is in an environment with 100 percent relative humidity. Thus, drying shrinkage is a phenomenon that routinely occurs and merits careful consideration in the design and construction of concrete structures. The actual mechanisms by which drying shrinkage occurs are complex, but it is generally agreed upon that they involve the loss of adsorbed water from the hydrated cement paste [3-5]. When concrete is initially exposed to a drying condition - one in which there is a difference between the relative humidity of the environment and that of the concrete - it first loses free water. In the larger capillary pores this results in little or no shrinkage. In the finer water-filled capillary pores (2.5 to 50 nm size) due to loss of moisture, curved menisci are formed, and the surface tension of water pulls the walls of the pores.

Reversible Or Not:

Drying shrinkage:

In drying shrinkage, the excessive water which has not taken part in hydration process would migrate from interior of concrete core to the concrete surface. As a result of evaporation of the water moisture, the volume of concrete shrinks. The reduction in volume owing to moisture loss is termed shrinkage. In fact, aggregates in concrete would not cause shrinkage and helps to resist the deformation. So the drying shrinkage is reversible.

Plastic shrinkage:

Plastic shrinkage occurs in a freshly mixed concrete, with loss of water by evaporation from its surface,after placing and before hardening of the concrete. This can lead to plastic shrinkage cracking if the rate of evaporation is higher than that of the bleeding water rising to the surface of the concrete.

6. (a) What are risks to concrete structure exposed to sea water? How do you increase resistance of concrete to sea water? (5 marks) (CLO1)

ANSWER A:

Concrete structures experience hazardous effects due to exposure to sea water. They experience different physical and chemical deteriorating processes. Sea water is generally composed of 3.5% soluble salts by weight. It PH may rise to 8.2 and dissolved CO_2 make it more acidic.

Magnesium sulphate present in sea water reacts Calcium hydroxide which is a constituent of cement and forms calcium sulphate which causes serious damage to concrete structures. Leaching effect and sulphate attacks are other damaging phenomenon due to sea water exposure of concrete. Moreover, due to porous structure of concrete, water may reach the reinforcement and causes corrosion which in turn, causes failure. The most damaged area of the structure is that which is high water mark whereas always submerged area remains least affected.

(b) Concrete is required for the internal columns of a building. The specified 28 days strength is (x+y+15) MPa (where x and y are the last two digits of your Roll no.) The following equations may be used to find average compressive strength

$$fm = fmin + 7 \qquad for\ fmin\ < 21\ MPa$$

$$fm = fmin + 8.5 \qquad OR \qquad fmin = 1.1 * fmin + 5 \quad for\ 21MPa < fmin < 35MPa$$

. The slump required is 50mm and a maximum size of 25mm is required. The fine aggregate has a Fineness modulus of 2.60. Preliminary tests indicate that FA and CA have a specific gravity of 2.65 and 2.7, with 1 percent absorption in C.A and 2% free moisture in F.A. The Bulk density of C.A is 1600 kg/m³. Find the required quantities of ingredients. (15 marks) (CLO2)

Roll No: 16080

SOLUTION:

F_c = 8+0+15 = 23 MPA

F_m = 23 + 8.5 = 31.5 MPA

Required slump = 50mm

Fineness modulus of aggregate = 2.60

Specific gravity of CA= 2.7 with one percent absorption

Specific gravity of FA= 2.65 with 2 percent free moisture

Bulk density of CA = 1600 kg/ m^3

- As there are no special exposure conditions, so type 1 cement will be used
- Water cement ratio for the non-air entrained concrete of strength 32 MPA is calculated as follows;

From table 34.5 Mpa concrete has w/c ratio of 0.48 so by interpolation, the w/c ratio of 32 MPA is calculated as 0.51

- The weight of water is calculated from table 179kg/m^3 for 25-50mm slump and 25mm maximum aggregate size
- Weight of cement = $\frac{179}{0.51}$ = 350.98kg/m^3
- The dry rodded volume of coarse aggregate for fineness modulus of 2.60 and maximum aggregate size is 0.69.

Density of aggregate given = 1600kg/m^3

Weight of aggregate = 1600 × 0.69 = 1104 kg

With one percent absorption, Weight of CA = 1104 (1+ $\frac{1}{100}$) = 1115.04 kg

- Volume of cement = $\frac{350.98}{3.15\times1000}$ = 0.1114 m^3
- Volume of water = $\frac{179}{1000} = 0.179$ m^3
- Volume of CA = $\frac{1115.04}{2.7\times1000}$ = 0.413 m^3
- Volume of air = 0.015 m^3
- Total volume minus FA = 0.7184 m^3

- Volume of FA = 1- 0.7184 = 0.2816 m^3
- SSD weight of FA = $0.2816 \times 2.65 \times 1000$ = 746.24 kg
- Adjustment of moisture = 165 kg of water