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COIMBATORE

DEPARTMENT OF CIVIL ENGINEERING

19CEB201 – CONSTRUCTION MATERIALS

II YEAR / III SEMESTER

Unit 3 : Concrete

Topic 6 : Properties of Hardened Concrete

Properties of Hardened Concrete

The properties of hardened concrete are as follows:-

- Strength
- Shrinkage
- Durability
- Impermeability

Strength

The strength of concrete is basically called compressive strength and depends on three factors.

- Paste strength
- Interfacial bonding
- Aggregate strength

Strength

Paste Strength:

It is mainly due to the binding properties of cement that the material is compacted together. If the paste has a high binding strength, it will have a high concrete strength.

Interfacial Bonding:

Interfacial bonding is very essential with respect to strength. Clay disrupts the bonding relationship between paste and aggregate. The aggregates should be washed for better bonding between the paste and the aggregate.

Aggregate strength:

It is mainly aggregates that give strength to concrete, especially coarse aggregates that act like bones in the body. Rough and angular aggregates provide better bonding and higher strength.

Strength

Factors affecting the strength of concrete:

Following are the factors that affect the strength of concrete:

a. Water-cement ratio

b. Type of cementing material

c. Cement content

d. Type of aggregates

e. Air content

f. Admixtures

Strength

a. Water-cement ratio:

It is the water cement ratio that basically controls the strength property. The lower the water cement ratio, the higher the strength.

b. Type of cement:

The type of cement affects the hydration process and therefore the strength of concrete.

c. Amount of cementing material:

It is the paste that holds or binds all the materials. Thus the greater the cement content the stronger it will be.

Strength

d. Aggregate Type:

Since they provide greater bonding, rough and angular aggregates are better.

e. Admixtures:

Chemical mixtures such as plasticizers reduce the water to cement ratio and increase the strength of concrete at the same water cement ratio. Mineral mixtures affect strength in later stages and increase strength by increasing the amount of cement content.

Shrinkage

- Concrete is subjected to either autogenous or induced volume changes.
- Volume change is one of the most damaging properties of concrete, affecting long-term strength and durability.
- For the practical engineer, the aspect of volume change in concrete is important from the point of view that it produces unsightly cracks in the concrete.
- Hard concrete undergoes three types of shrinkage that are important with respect to its dimensional stability:

    1. Plastic shrinkage.
    2. Drying Shrinkage.
    3. Thermal shrinkage.

Shrinkage

Plastic shrinkage:

- It is the shrinkage that freshly placed concrete passes through until it is completely set. It can also be called initial shrinkage.
- There is such a major volumetric change from evaporation, bleeding, seepage and soaking by the formwork to water loss from fresh concrete.
- Excessive shrinkage in the initial stages may develop extensive cracking in the concrete at the setting.
- Therefore, all precautions should be taken to avoid excessive loss of water due to evaporation.
- The rate of plastic shrinkage mainly depends upon the rate of evaporation of water and the temperature during the casting of the concrete. The plastic shrinkage of the concrete is higher if the cement content in the concrete is more.

Shrinkage

Drying Shrinkage:

- As the concrete is completely set and hardened, some further shrinkage may result in moisture, or further loss of drying, due to contraction of the gel-structure.
- Such shrinkage is practically an essential and irreversible property of concrete.
- Careful design of reinforcement has to be met to avoid its side effects.
- The main cause of the drying shrinkage is the loss of the water content because of the evaporation from the freshly hardened concrete which is exposed to the environment.

Shrinkage

Thermal shrinkage:

- This may be due to a drop in the temperature of the concrete being held until it is fully set.
- Thus, when the concrete is placed at 30 ° C, cooled to 15 ° –18 ° C, some shrinkage can be expected.
- This may be negligible in its account. But when drying is added to shrinkage, it becomes necessary.

Durability

- The durability of the concrete can be defined as the capacity of the concrete to bear all the forces of the deterioration.
- Environmental forces such as weathering, chemical attack, heat, freezing and thawing seek to destroy concrete.
- The period of existence of concrete without being adversely affected by these forces is known as durability.
- Usually dense and strong concretes have better durability.
- Cube crushing strength alone is not a reliable guide to durability.
- Concrete should have a sufficient amount of cement content and a low water-to-cement ratio.

Impermeability

- It is the resistance of concrete to the flow of water through its pores.
- The excess water during concreting leaves a large number of continuous pores leading to permeability.
- Since permeability decreases the durability of concrete, it should be kept very low by low water-cement ratios, dense and well graded aggregates, good compaction and continuous curing in low temperature conditions.
- The cement material used should be sufficient to provide adequate workability with low water cement ratio and available compaction method.

Modulus of Rupture

- Modulus of rupture is a measure of the tensile strength of concrete beams or slabs.
- Flexural strength identifies the amount of stress and force an unreinforced concrete slab, beam or other structure can withstand such that it resists any bending failures.
- Modulus of rupture is also known as flexural strength, bond strength or fracture strength.

Thank You!!