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OVERVIEW ON CONCEPTS OF ORDINARY CONCRETE AND ITS PROPERTIES

Rehan Ali Khan[1], Moizuddin Siddiqui[2], Shahbaz Ahmad[3]

[1]HoD Civil Engg. Deptt., [2,3]Assistant Professor, Integral University , Campus Shahjahanpur

ABSTRACT

*An artificially built-up stone resulting from hardening of a mixture of cement, aggregates and water with or without a suitable admixtures, is generally known as 'Concrete'.The branch of civil engineering which deals with the fundamental principles of concrete is known as Concrete Technology. Generally concrete can be prepared by two methods, they are Ordinary concrete and Controlled concrete. We will discuss about the properties of concrete and its components. W/C ratio plays a important role in making controlled concrete, to achieve required workability and characteristic compressive strength***.**

***Keywords*: *Concrete, w/c ratio, workability, grade of concrete*.**

I. CONCRETE

Concrete is a structural material which consists of cement , coarse sand , coarse aggregate and water as main component . Admixtures are also used in concrete , type and quantity of admixtures depend upon the climatic conditions, distance of batching plant from the site and nature of the work and grade of concrete used. In concrete cement acts as binder material and quantity of the components depends upon the grade of concrete or as per design mix.

"The homogenous mixture of Cement, Sand and stone chips when casted by mixing it with adequate amount of water is called concrete. The process of preparing the mix is called concrete mix"

IS 456-2000 - Plain and reinforced concrete-code of practice. All the raw materials of concrete such as cement, sand and stone chips are collected in the required proportion and then put into the rotating drum and are rotated firstly in dry state and then water is added in the amount sufficient to make a workable concrete.

Fig.1 Concrete in plastic state

II. INGREDIENTS OF CONCRETE

A. Cement:

Cement when mixed with water forms cement paste or matrix, which hardens due to chemical reaction called hydration. During the process of setting and hardening, the cement binds the aggregates together in presence of water. The function of cement is to provide strength, durability and water tightness to the concrete.

Fig.2 Loose Cement

B. Aggregates:

Aggregates can be used alone in road bases and various types of fill or can be used with cementing materials (such as Portland cement or asphalt cement) to form composite materials or concrete. The most popular use of aggregates is to form Portland cement concrete. The aggregates are used in the concrete to provide economy in the cost of concrete. Aggregates acts as filler only. These do not react with the cement and water. Aggregates are mainly of two types .i.e. fine aggregates and coarse aggregates.

An ideal aggregate used for the manufacture of concrete and mortar, should meet the following requirements specified by IS: 383-1970.

Fig.3 20mm aggregates for concreting

- It should be hard , strong and durable.
- It should dense, clear and free from any coating.
- It should be free from deleterious materials.

- It should not be flaky and elongated.
- It should not contain any material which is liable to attack steel reinforcement of RCC.

C. Water:

As we know that concrete is one of the most durable construction material and quality of mixing water are related to performance in fresh as well as harden state. The impurities present in the water effects the setting and hardening properties of the cement water is also main component of cement and its important function is to form cement paste, to lubricate the aggregates and to provide required workability to the concrete mix. P_h value should not be less than six.

The quality of water governs the strength of concrete. The quantity of water required for concreting, depends upon the grading of aggregates and the method of compaction. 10% percent excess water reduces the strength of concrete by 15% and 20% excess of water reduces the strength of concrete by 50%.

IS 3025-1984 -Methods of sampling and test for water and waste water.

D. Admixtures:

Admixtures are the ingredients of concrete which are added to concrete before or during mixing of the concrete components. On the basis of their functions, they are classified as follows:

1. Air-entraining admixtures
2. Water-reducing admixtures
3. Plasticizers
4. Accelerating admixtures
5. Retarding admixtures
6. Hydration-control admixtures
7. Corrosion inhibitors
8. Shrinkage reducers
9. Alkali-silica reactivity inhibitors
10. Coloring admixtures

The major reasons for using admixtures are:

1. Cost of concrete construction can be reduced by using admixtures
2. Desirable properties in concrete can be achieved effectively.
3. Quality of concrete during the stages
   of mixing, transporting, placing, and curing in adverse
   weather conditions can be maintained
4. To overcome certain emergencies during concreting
   Operations

III. GRADE OF CONCRETE

Many types of grade of concrete is used in the field of Civil Engineering .e.g. M15 , M20, M25 M30 and so on. 'M' stands for the mix and 15 is the characteristic compressive strength of the cube of concrete after 28 days of curing which is tested in Compression Testing Machine (CTM). Unit of compressive strength is Kg/cm2.

Size of the cube is 15cmX15cmX15cm.

For nominal mix [cement: Sand: aggregates(stone chips)]

M15: 1:2:4

M20: 1:1.5:3

M25: 1:1:2

Ordinary concrete is manufactured by taking components by volume and in case of controlled concrete the components are taken by weight in a controlled manner.

The design mix or controlled mix is used in variety of important structures for better strength, reduced variability, economical mix as well as desired resultant quality.

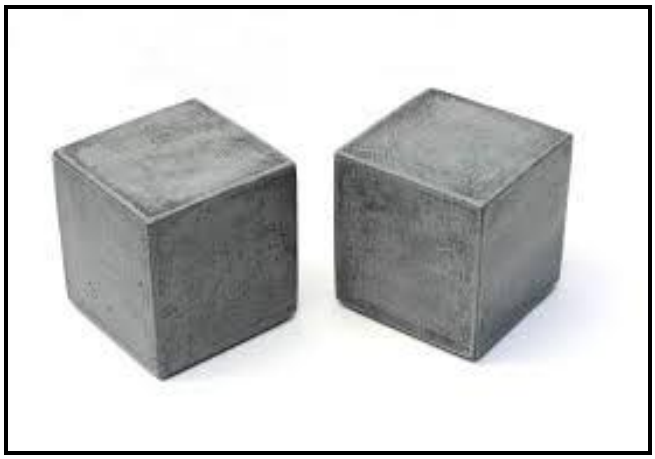

Fig.4 casted concrete cubes of size 150mmx150mmx150mm

Properties of Concrete in Plastic state:

Following are the four properties of concrete

1) Workability
2) Segregation
3) Bleeding
4) Permeability

1) Workability: The property of the concrete in which concrete with lubrication is required without segregation , for placing without loss of homogeneity , ease in compaction and easily finish is termed as Workability of concrete .

Factors affecting workability:

- Water content
- Size of aggregates
- Mix proportions
- Shape of aggregates
- Surface texture of aggregates
- Use of Admixtures

Measurement of Workability:

- Slump Test

- Compacting Factor Test
- Vee Bee Consist meter Test
- Flow Test

2) Segregation: It can be defined as the separation of component materials of concrete. If a concrete sample shows tendency of separation of aggregates from other components then the sample is said to be showing segregation. Such concrete will be weaker concrete. It is caused by the differences in sizes and weights of the constituent particles. Segregation can be controlled by properly choosing the grading of aggregates and by carefully handling wet mixes. In relatively lean and dry mixes, segregation can be caused by the coarser particles separating out because they travel farther along the slope or settle to a greater extent than finer particles. The second form of segregation occurs in very wet mixes in which the cement – water paste separates from the mix.

Fig.5 Segregation on removal of formwork

3) Bleeding: Bleeding is the outcome of the water from the components of concrete to the surface of concrete. Due to bleeding, cement also comes up with water and this cement paste is called as Laitance.

Bleeding water percentage = Total quantity of bleeding water/Total quantity of water in concrete X 100

4) Impermeability: The impermeability of hardened concrete may be defined as the property to resist entry of water. This property of hardened concrete is achieved by preparing the concrete mix in controlled manner as per IS codes. To produce impermeable concrete thorough mixing of concrete, proper compaction of concrete, proper curing, properly graded and non-porous aggregates are required.

IV. ADVANTAGES OF CONCRETE

Following are the advantages of concrete:

- Concrete is most widely used as construction material in place of Brick work or Reinforced brick. ,
- It is used in the construction of heavy structures like Dams , Reservoirs , Multistory Buildings , Bridges , Flyovers, Runways etc…
- Concrete can be used in Foundations, Super structures , Partitions, slabs etc . Pre-stressed and Light weight concrete is used to complete the work within sanctioned duration.

- Preparation of concrete is a controlled process and different grades of concrete can be prepared as per requirement or site conditions.
- Life of the concrete is almost 100 years as compared to 50 years life of Brick Structure.
- Concrete with steel makes Reinforced Concrete which is used in more than 80% of the construction work.
- Construction in all the four zones of Earth Quake changes the grade of concrete for use in light and heavy structures.
- Strength of concrete is more than brick and components of conc. Are easily available in the market.

V. USES OF CONCRETE IN COMPARISON TO OTHER BUILDING MATERIALS

- Concrete is a versatile material which provides strength, permanence, durability, fire resistance etc, which is not found in other building materials.
- Concrete is a site made materials unlike other construction materials.
- Concrete is also water proof up to some extent.
- Other materials like bricks , stones , wood etc, cannot be mould into desired shape , only concrete can be molded into required shape and size .
- Constructions of important structures like Dams , Bridges , Water treatment plants, tunnels metros , mega structures use only concrete to get desired shape , strength, durability and performance.
- Combination of concrete and steel is called as RCC, which has replaced almost 90% of the RB work.
- Special concretes like Air entrained concrete, Light weight concrete , Pre stressed concrete are prepared and used in special conditions where ordinary concrete and other building materials cannot be used .

VI. DISADVANTAGES OF CONCRETE

- Due to low tensile strength, concrete is required to be reinforced to avoid cracks.
- In long structures expansion joints are required; if there are large temperature variations.
- Construction joints are provided to avoid cracks due to drying shrinkage and moisture expansion.
- Concrete made with ordinary Portland cement, gets integrated in the presence of alkalies, sulphates etc.
- Sustain loads develop creep in structures.

VII. WATER CEMENT RATIO

The ratio of water and cement by weight in a concrete mix, is known as water cement ratio.

A. Water Cement Ratio Law

Dutt Abrahams (1918), after carrying out a number of experiments, established a relation between water and cement, which is known as" water cement ratio law".

It states that," With given concrete materials and conditions of tests, the quantity of mixing water used per bag of cement determines the strength of the concrete so long as the mix is of a workable plasticity."

B. Effect of Water Cement Ratio on Compressive Strength of Concrete

According to water cement ratio law, the strength of concrete only depends upon the quantity of water used in the workable concrete mix and is quite independent of the proportion of cement and aggregates. The strength of concrete is inversely proportionally to the water cement ratio .i.e. lower the water cement ratio, greater is the strength of concrete and vice versa. The relation between water cement ratio by weight and the developed compressive strength of concrete at 28 days may be shown graphically.

Water cement ratio is generally expressed in volume of water required per 50 kg of cement. A rich mix of concrete posses higher strength than that a lean mix of desired workability with excessive quantity of water.

The concrete gains strength due to hydration of cement and if it is cured at a temperature below 23^0 C, gains strength up to 28 days.

For preparing ordinary concrete, the quantity of water used is 5% by weight of aggregates plus 20% by weight of cement.

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