CONCRETE

Concrete is the mixture of cement, coarse aggregate, fine aggregate and water in specific proportions. Concrete is relatively a brittle material ----- its tensile strength is very small as compared with its compressive strength. This disadvantage can be offset by reinforcing or pre-stressing concrete with steel reinforcement.

Reinforced concrete (RC) possesses many of the best properties and is used in variety of construction including building frames, floors, slabs, walls; bridges; pavements; piles; dams; water retaining structures etc.

VARIOUS TERMS USED / STEPS FOR CONCRETING OPERATION

a) Batching

The process of proper and accurate measurement of concrete ingredients to ensure uniformity of proportions and aggregate grading as per mix design proportions is called batching. Batching may be by volume or by weight.

Batching by Volume

Batching by volume is generally adopted for general construction works and it is carried out by using wooden or steel boxes, wheel barrows, etc. In volume batching, bulking effect of sand has to be taken into account.

Batching by Weight

Batching by weight is adopted for large and important projects and batching plants are used for this purpose. Weight batching is more accurate than volume batching,

b) Mixing

After correct batching all the ingredients of concrete are thoroughly mixed until the concrete of uniform color and required consistency is obtained. Mixing of concrete may be done manually or mechanically.

Manual Mixing

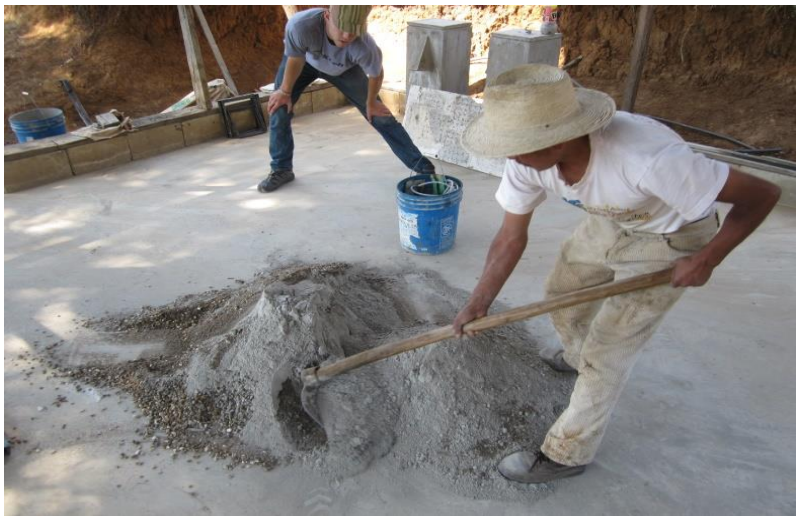

Fig 01: Manual Mixing

Manual mixing is adopted for small and unimportant construction activities. Concrete is less efficient and requires more cement than that required in machine mixing to obtain the same strength.

Machine Mixing

Machine mixing is adopted for general construction works and in this batch mixers or continuous mixers are used. Batch mixers are either with tilting drum or with non-tilting drum. Batch mixers are available in various capacities. Batch mixers with tilting drum are most commonly used. For general works 10/7 or ¼ cubic yard capacity mixers are used. 10/7 means 10 cubic feet of dry material yields 7 cubic feet of wet concrete. 1-cement bag capacity mixers are convenient and generally used. Mixing time shall not be less than 90 seconds.

Fig 02: Machine Mixing

Ready-mixed concrete is batched in central batching plants and delivered to various job-sites in trucks, usually mixer mounted. The concrete may be mixed en route or after arrival at the site. Concrete may be kept plastic and workable for as long as 1.5 hours by slowly revolving the mixer. However, better control of mixing time can be maintained if water is added and mixing started after arrival of the truck at the job site where the operation can be inspected.

c) Transportation

The process of carrying the concrete from the place of mixing to the place of final position of its deposition is known as transportation. Transportation may be manual or mechanical.

Manual Transportation

Manual transportation is adopted for small construction activities and when the place of deposition is closed to the place of mixing

Mechanical Transportation

Mechanical transportation through pumps or lifts' and is adopted for large construction activities or when the place of deposition is away from the place of mixing. Minimum time should be consumed in transportation.

Fig 03: Mechanical Transportation with Pump

d) Placing of Concrete

The process of depositing the concrete in its required position is called placing of concrete. Concrete should be placed carefully in position and should not be thrown from heights to avoid segregation.

When working is to be suspended / stopped for some time, grooves should be made in the finish work for joining the next concrete work before its initial setting.

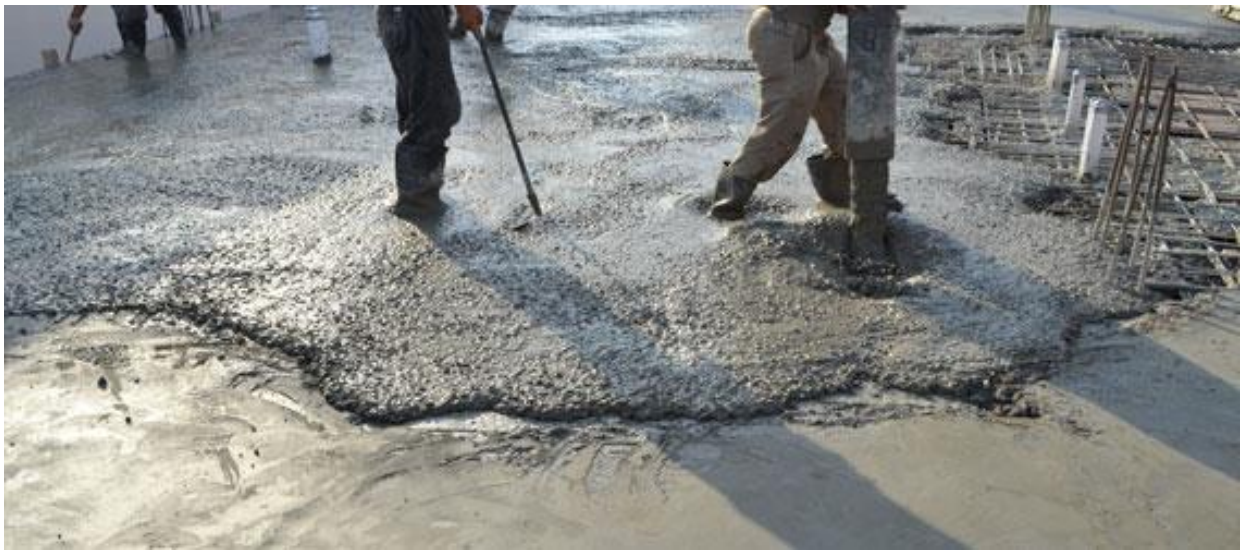

Fig 04: Placing of Concrete

Good concrete placing and compacting techniques produce a tight bond between the paste and aggregate and fill the forms completely. Both of these factors contribute to the full strength and best appearance of concrete. The following are some of the principles of concrete placement:

Segregation: Avoid segregation during all operations, from the mixer to the point of placement, including final consolidation and finishing.

Fig 05: Segregation

Consolidation: Thoroughly consolidate the concrete, working solidly around all embedded reinforcement and filling all form angles and corners.

Bonding: When placing fresh concrete against or upon hardened concrete, make sure that a good bond develops.

Temperature control : Take appropriate steps to control the temperature of fresh concrete from mixing through final placement. Protect the concrete from temperature extremes after placement.

Maximum drop: To save time and effort, you may be tempted to simply drop the concrete directly from the delivery chute regardless of form height. However, unless the free fall into the form is less than 4 feet, use vertical pipes, suitable drop chutes, or baffles. suggests several ways to control

e) Compaction & Finishing

The process of consolidating the concrete after placing in its position is known as compaction of concrete. With the presence of air bubbles / voids in the concrete, its strength reduces considerably. 5% air voids in concrete may reduce its strength up to 30%. Compaction may be manual or by mechanical means.

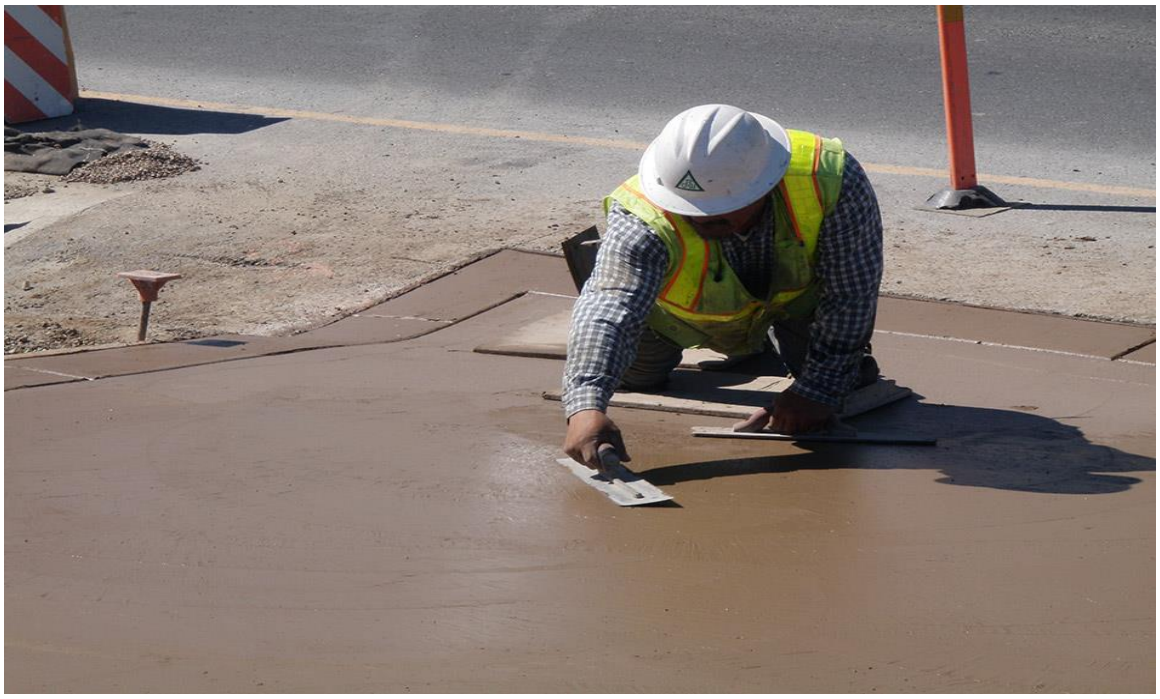

Fig 06: Finishing of Concrete

Manual Compaction

Manual compaction through tempering and rodding is adopted for small and less important concrete works.

Mechanical Compaction

Mechanical compaction through vibrators is done for large, massive and general concrete works. Vibrators may be external or internal types.

f) Curing

The process of keeping the concrete moist or wet for certain time period after finishing & setting is called curing.

Concrete is cured for minimum 7-10 days normally in order to:

1- Complete the hydration process.

2- Gain the strength of concrete.

Any one of the following methods is normally adopted for curing:

i) By wet jute bags

ii) By ponding

iii) By sprinkling water

iv) By immersing in water pond

v) By steam

vi) By adding construction chemicals

Concrete made with ordinary and sulphate resistant cements should be cured for at least 08 days, while that made with low-heat cement for at least 14 days. Concrete made with high-early-

strength cement should be kept moist until sufficient strength has been attained, as indicated by test cylinders.

Curing by wet Jute Bags

In this method, the concrete surface to be cured is covered with wet jute bags and upon drying of these bags sprinkling of water is done to keep them moist. This process is continued till the curing period is over. This method is suitable for small horizontal as well as vertical surfaces.

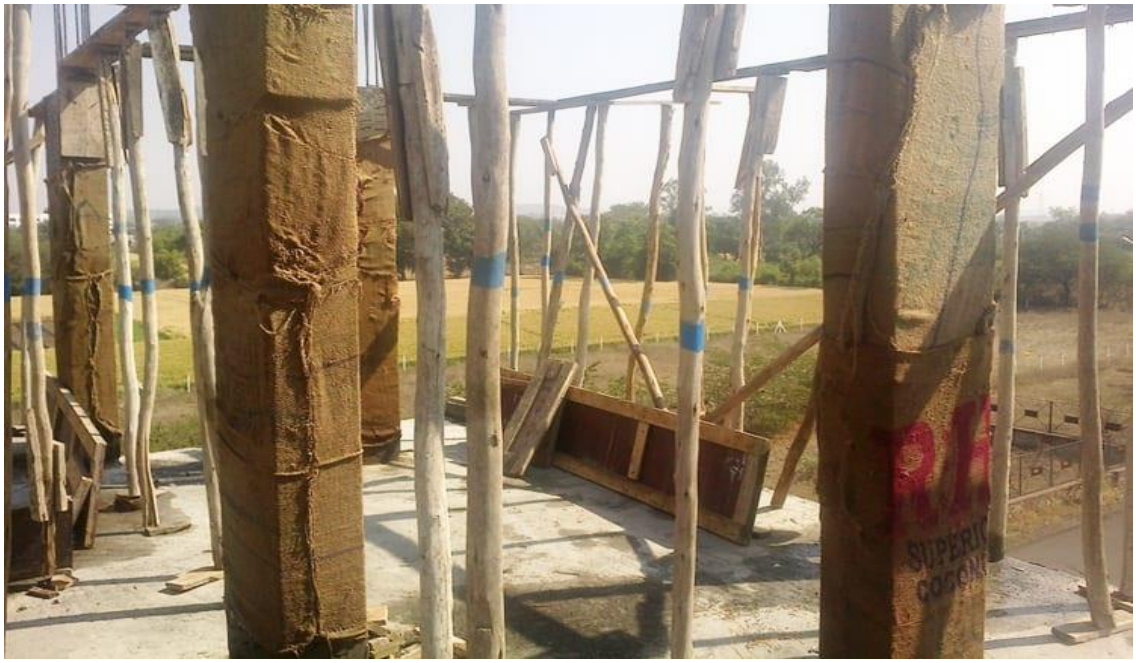

Fig 07: Curing by Wet Jute Bags

By Ponding

In this method, the concrete surface to be cured is filled (ponding is done) with the water till the curing period is over. This method is suitable for horizontal surfaces.

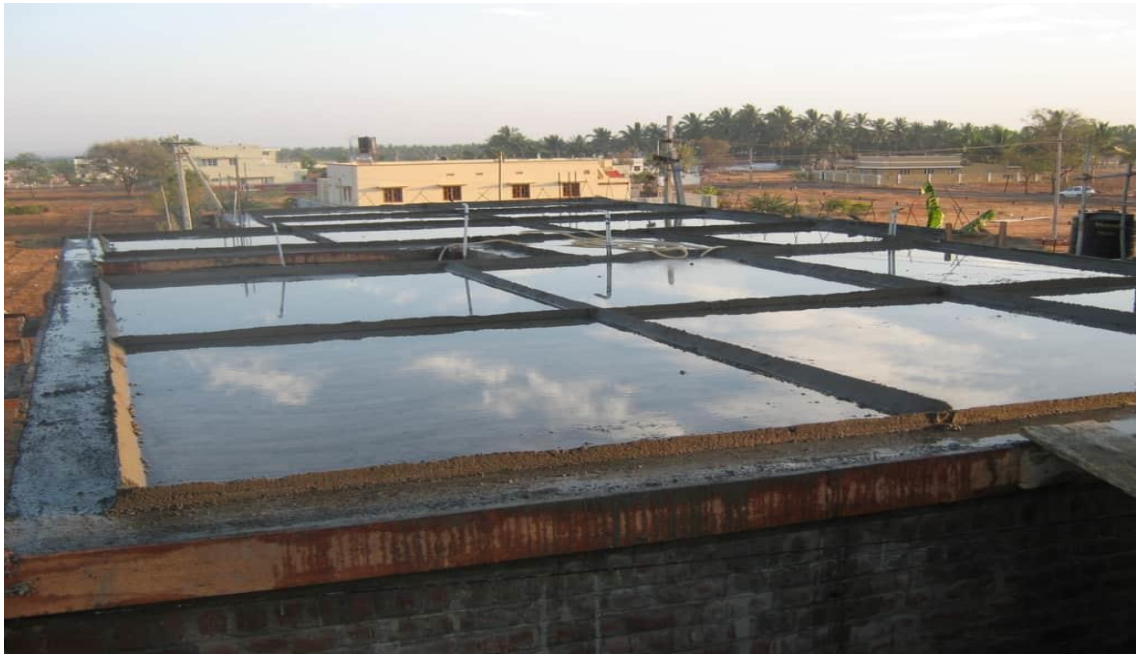

Fig 08: Curing by Pond

By Sprinkling Water

In this method, water is continuously sprinkled on the vertical surfaces till the curing time is over.

By Immersing in Water Pond

This is adopted for pre-cast concrete members. In this method, the precast members are immersed in water till the curing period is over.

By Steam

Fig 08: Curing by Steam

This method is used for pre-cast concrete members and steam under pressure is sprayed over the concrete structure. Steam curing quickens the hardening of concrete and reduces the time period of curing.

By Adding Construction Chemicals

In this method, certain construction chemicals are added to stop / reduce the evaporation of water from the concrete. No typical curing is required.

IMPORTANT PROPERTIES OF CONCRETE

For a specific type of structure, certain characteristics of concrete to be used may be more important than others. For example, concrete for a multistory building or bridge should have high compressive strength, whereas concrete for a dam should be more durable and watertight whereas strength can be relatively small.

Workability

It is the ease with which concrete can be placed & finished. It is an important property for many applications of concrete. One characteristic of workability is consistency or fluidity which can be measured using slump test. (ASTM C143).

In the slump test, a specimen of concrete mix is placed in a mould shaped as the frustum of a cone, 12 in high, with 8-in diameter at base and 4-in diameter at top. When the mould is lifted up the change in height of specimen is measured. This change in height is taken as the slump value. Higher is the water content larger is the stump value.

Durability

Concrete should be capable of withstanding the weathering effects, chemical action and should be able to resist load to which it will be subjected in service life. Much of the weather damage sustained by concrete is attributable through freezing and thawing cycles. Resistance of concrete to such damage can be improved by increasing the water tightness.

Water Tightness

It is an important property of concrete that can be improved by reducing the amount of water in the mix. Excess water leaves voids and cavities after evaporation, and if they are interconnected, water can penetrate or pass through the concrete. Prolonged thorough curing as well as entrained-air (minute bubbles) usually increases water tightness. Water tightness can be increased by improving effective compaction of concrete, controlling aggregate grading, using construction chemicals etc.

Strength

This property is usually of main concern. Normally it is determined by knowing the ultimate strength of a specimen in compression tested in the lab but sometimes flexural or tensile capacity is also important which can also be determined through lab tests. Since concrete usually gains strength over a long period, (90 days) the compressive strength at 28 days is commonly used as a measure of this property. Concrete strength is influenced mainly by the water cement ratio, mix proportions and other factors.

Concrete Strength May Be Improved By

- Decreasing water cement (W/C) ratio
- Using higher strength aggregates
- Using well graded aggregate resulting lesser voids
- Proper moist curing of concrete.
- Adding a pozzolanic material, such as fly ash
- Effective compaction of the concrete.
- Suction of excess water with a vacuum from the concrete in the form work.

Concrete Admixtures

Admixtures are additions to the mix used to achieve certain goals.

Here are the main admixtures and what they aim to achieve.

Accelerating admixture-accelerators are added to concrete to reduce setting time of the concrete and to accelerate early strength. The amount of reduction in setting time varies depending on the amount of accelerator used (see your ready mix supplier and describe your application). Calcium chloride is a low cost accelerator, but specifications often call for a nonchloride accelerator to prevent corrosion of reinforcing steel.

Retarding admixtures-Are often used in hot weather conditions to delay setting time. They are also used to delay set of more difficult jobs or for special finishing operations like exposing aggregate. Many retarders also act as a water reducer.

Fly Ash- Is a by product of coal burning plants. Fly ash can replace 15%-30% of the cement in the mix. Cement and fly ash together in the same mix make up the total cementious material.

- Fly ash improves workability
- Fly ash is easier to finish
- Fly ash reduces the heat generated by the concrete
- Fly ash costs to the amount of the cement it replaces

Air Entraining Admixtures- must be used whenever concrete is exposed to freezing and thawing, and to deicing salts. Air entraining agents entrains microscopic air bubbles in the concrete: when the hardened concrete freezes, the frozen water inside the concrete expands into these air bubbles instead of damaging the concrete.

- Air entrainment improves concrete workability
- Air entrainment improves durability
- Air entrainment produces a more workable mix

Water reducing admixtures-reduces the amount of water needed in the concrete mix. The water cement ratio will be lower and the strength will be greater. Most low range water reducers reduce the water needed in the mix by 5%-10%. High range water reducers reduce the mix water needed by 12% to 30% but are very expensive and rarely used in residential work.