Batching, Mixing, Compacting, and Curing Concrete

Batching

Is the process of measuring quantities of concrete mixture ingredients by either mass or volume and introducing them into the mixer.

To produce a uniform quality concrete mix, measure the ingredients accurately for each batch. Most concrete specifications require that the batching be performed by weight, rather than by volume.

Water and liquid air-entraining admixtures can be measured accurately by either weight or volume.

Mixing Fresh Concrete

Concrete should be mixed until it is uniform in appearance and all the ingredients are evenly distributed.

- **Hand mixing: Suitable for small jobs.**

•Dry materials mixed first

•Water added slowly at the center

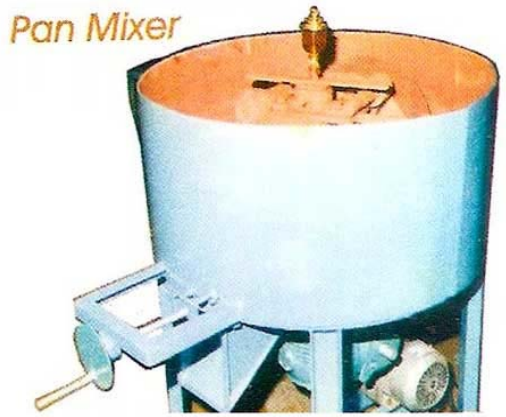
•Mixing from outside to inside.

➢ *Machine mixing*

1. Electrical or gasoline operated

2. Portable or stationary

3. Rotating horizontal drum type or rotating tilting drum type



***Tilting drum mixers*: are preferable for the mixes of low workability and for those containing large size aggregates.**

***Pan mixers*: Efficient with stiff and cohesive mixes.**

Used for: **Precast concrete, Small quantities of concrete and mortar in the laboratory**

***Non tilting drum mixer*: the concrete is sometimes susceptible to segregation**

Notes:

In the drum - type mixers: No Scraping of the sides takes place. Thus the first mix will leave behind mortar stuck to the walls of the mixer; means less mortar in the mix.

To overcome this problem **buttering Procedure (adding Mortar (less CA) prior to mixing) is suggested.**

Mixer Sizes

Laboratory use = 0.04m^3

Huge mixer for field or mixing plants use = 13 m^3

Correct sequence of mixing

Step 1: **Butter the mixer (extra paste)**

Step 2: **CA + some water**

Step 3: **Mix**

Step 4: **FA + cement + some water**

Step 5: **Remaining water**

Step 6: **Wait until full mixing is achieved.**

Mixing Time

- **The optimum mixing time depends on:**
  the type and size of mixer (batch volume)
  the speed of rotation, the quality of blending of ingredients.

- **A minimum time of 1 minute should be assured so as to obtain a uniform mix.**

❖ **Under mixing: not homogenous mix.**

❖ **Over mixing tends to:**

- **Lower the slump (loss of workability)**
- **Decrease air entrainment.**
- **Decrease the strength of the concrete.**
- **Loss of time**
- **Loss of energy**

Ready - Mixed Concrete

- **Concrete is batched at the plant.**
- **Better quality control of materials and concrete.**
- **No need for storage space at the site.**
- **Saving time.**
- **Economy.**

Compaction Fresh Concrete

- Fresh concrete must be compacted so that :
- ✓ It will spread evenly inside the form.
- ✓ Entrapped air voids will be minimized and a dense concrete will be obtained.

Methods :

1. Roding: suitable for laboratory work and small jobs.
2. Vibrating :
   a. Internal Vibrators (inside concrete)
   b. External Vibrators (on formwork)
   c. Vibrating Tables

Figure 14-16. Honeycombs and rock pockets are the results of inadequate consolidation.

a. Internal Vibrators

- **The poker is immersed in concrete and thus applies approximately harmonic forces; hence, the alternative names of poker vibrator or immersion vibrator.**

  They are useful for heavily reinforced concrete and relatively inaccessible sections.

- **It is good because all work done directly on the concrete.**

➢**Using of Vibrator:**

Immersed in concrete, Moved from one place to another, and vibrated every 0.5 to 1 m for 5 sec to 2 min; depending on concrete consistence.

Stop: when a surface of concrete appears. Concrete should be neither honeycombed nor contain an excess of mortar.

The vibrator should be withdrawn slowly. An insertion time of 5 to 15 seconds will usually provide adequate consolidation.

b. External Vibrators

- Vibrators are rigidly clamped to the framework which rests on an elastic support, so that both the form and the concrete are vibrated. Therefore, the framework should be strong. The vibration frequency ranges from 50 to 150Hz.
- External vibrators are used for precast or thin in situ sections having a shape or thickness which is unsuitable for internal vibrators.
- Concrete should be placed in layers of suitable depth so as to be able to expel air.

c. Vibrating Tables

Used mostly in:

- **Compaction of precast concrete units (uniform vibration).**
- **In laboratory works.**

- For 1 m^3 concrete (3-4) minutes of vibration sufficient.
- Proper compaction is obtained when concrete surface becomes shiny with film of water and paste appearing.
- Under compaction (Under Vibration) may cause honeycombing, more entrapped air, cold joints, placement lines and subsidence cracking.
- Over compaction: excess bleeding, segregation, loss of entrained air, loss of time and energy.

- Under Vibration commonly observed more than over vibration.

Curing:

- **Producing a moist environment around concrete for hydration to continue at suitable temperatures.**

  Curing Methods and Materials: These can be divided into three groups:

A. Supplying Additional Moisture:

1. **Ponding or immersion in water.**
2. **Spraying or fogging (sprinkling) periodically.**
3. **Saturated Wet Covering (Burlap)**

Curing affect greatly the strength of concrete, reduce the liberation of heat and allow the chemical reaction to take place normally.

Development of Strength and Curing

Curing is the name given to procedures used for promoting the hydration of cement, and thus, the development of strength of concrete.

The curing procedure being control of the temperature and of the moisture movement from and into the concrete.

The object of curing at normal temperature is to keep concrete saturated as nearly saturated as possible, until the originally water-filled space in the fresh cement paste has been occupied to the desired extent by the product of hydration of cement.

The water existence aims to provide appropriate condition to achieve as much hydration as possible, yet the amount of total hydration is dependent also on w/c ratio of the mix.

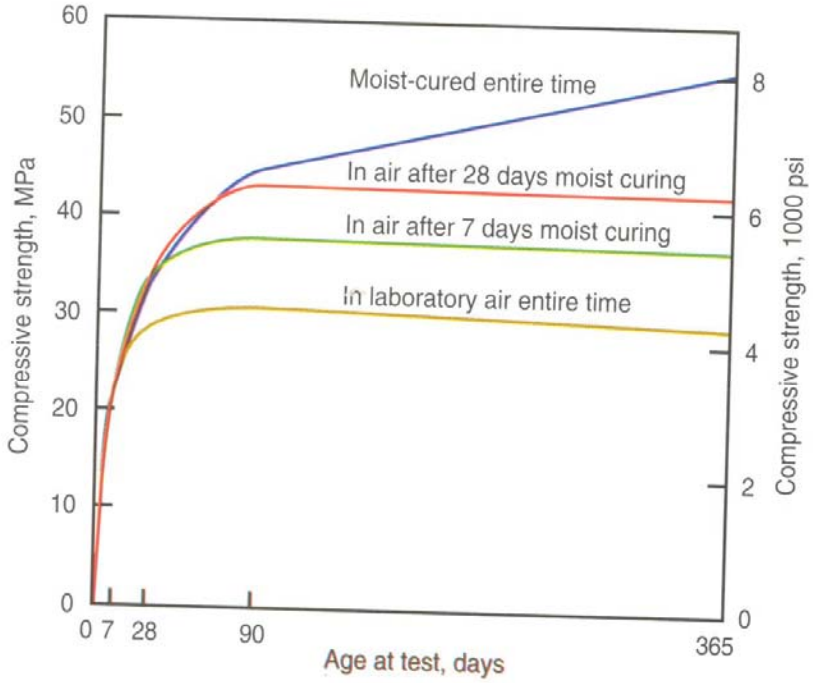


Figure 15-2. Effect of moist curing time on strength gain of concrete (Gonnerman and Shuman 1928).

B. Sealing in the mix water

Prevent evaporation of moisture using:

- **Plastic sheeting or impervious paper: Used to cover more complex shapes; more flexible than water proof paper.→ High convenience and Lower labor needed.**

Waterproof paper: applied on soon as the surface has hardened, and after concrete is sufficiently wet.

- **Membrane-Forming Curing Compounds: Created by compounds such as resins, waxes or synthetic rubbers which are dissolved in volatile solvent or emulsified in water.**

- **Application should happen after some water curing took place.**
- **Used for vertical surface.**
- **Not entirely prevent evaporation (less effective than plastic sheets).**

C. Accelerated Curing

Supplying Heat and Additional Moisture to the Concrete Accelerates Strength Gain.

1. Low - Pressure Steam Curing

2. High - Pressure Steam Curing