Sampling, mixing and curing of fresh concrete

Sampling of fresh concrete (ASTM C172-90):

1. Collect two or more portions of concrete in less than 15 min. time during the discharge of the middle of the batch. Do not obtain portions from the very first or last portions (The first and the last 15% of the volume).

2. Composite the portions into one sample in a container. The sample shall be not less than 28 liter for strength test. Smaller samples may be obtained for slump and air content tests.

3. Transport the samples to the place where the tests are to be performed. Combine the samples and remix them by shovel.

4. Start slump test, or air content test, or both in 5 min. after taking last portion of the sample. Start molding specimens for strength tests within 15 min. after making the composite sample.

- Keep the elapsed time between obtaining and using the samples as short as possible and protect the sample from the sun, wind and other sources of evaporation and contamination.
ASTM (C94-96)

- Slump, air content and temperature tests shall be made at the time of placement as often as necessary. Strength tests as well as slump, air content and temperature tests shall be made at least once for each 115 m$^3$.

- If the measured slump or air content fall outside the specified limits, a check test shall be made from another portion of the same sample. In case of a second failure, the concrete shall be considered to have failed the requirement of the specification.
Making and curing concrete test specimens (ASTM C192-95):

**Scope:**

This test covers the procedure for making and curing test specimens of fresh concrete in the laboratory under accurate control of materials and test conditions. The prepared specimens may be used to develop information for the following purposes:

- Concrete mixture proportions.
- Evaluation of different mixtures and materials.
- Providing specimens for research purposes.

**Apparatus:**

- A balance of accuracy of 0.3% of the weight of the sample.
- Tamping rod (16 mm or 10 mm diameter).
- Mallet.
- Trowel and shovel, straight edge, ruler, scoops, mixing bowls, pans.
- A mechanical mixer.
- Slump apparatus.
- Molds: Cylinder molds (6 in diameter, 6 in or 12 in height)

**Procedures:**

**A. Preparation of Materials:**

1. The room temperature shall be (20-30 °C)
2. Cement shall be stored in dry sample.
3. Store the aggregate in individual size fractions in order to prevent segregation.
4. Determine the specific gravity, absorption and moisture content of aggregates.
5. Determine the weights of the mix proportions.

**B. Mixing procedures:**

**General**

1. Mix concrete in a suitable mixer or by hand in batches of such size to leave about 10% excess after molding the test specimens.
2. Hand-mixing procedures are not applicable to air-entrained concrete or concrete with no measurable slump.
3- It is important not to vary the mixing sequence and procedure from batch to batch unless the effect of such variation is under study.

**Machine mixing**

1- Put the coarse aggregate in the mixer, add some of the mixing water and the solution of admixture, when required (add with water).
2- Start the mixer. Add the fine aggregate, cement and the rest of water with the mixer running.
3- Mix for 3 min. after adding all the materials, then allow for 3 min. rest and then mix for 2 min.
   Cover the opening of the mixer during the rest period.
4- Deposit the mixed concrete into clean pan and remix by a shovel to eliminate segregation.
5- Take care to compensate the mortar adhering the sides of the mixer as follows:
   Prior to mixing, the sides of the mixer is ‘buttered’ by mixing a similar batch. The mortar adhering the sides is intended to compensate the loss of mortar from the test batch.

**Hand mixing**

1- In a watertight, clean, damp metal pan, mix the cement, insoluble admixture, if used, and the fine aggregate without addition of water until they are thoroughly blended.
2- Add the coarse aggregate and mix the entire batch without addition of water until the coarse aggregate is uniformly distributed throughout the batch.
3- Add water, and the admixture solution if used, and mix the mass until the concrete is homogenous in appearance and of the desired consistency.

C. Molding the test specimen:
1- Mold specimens as near as practicable to the place where they are to be stored during the first 24 hours.
2- Place molds on a rigid surface free from vibration and other disturbances.
3- If it is not practicable to mold the specimens where they will be stored, move them to the place of storage immediately after being struck off.
4- It may be necessary to remix the concrete in the mixing pan with a shovel to prevent segregation during the molding of specimens.
5- Place the concrete in layers in the molds using scoop or shovel. The number of layers is as indicated in the table below:

<table>
<thead>
<tr>
<th>Specimen type</th>
<th>Depth (mm)</th>
<th>Number of layers</th>
<th>Depth of layer (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder</td>
<td>Up to 300</td>
<td>3</td>
<td>equal</td>
</tr>
<tr>
<td></td>
<td>Over 300</td>
<td>-</td>
<td>100</td>
</tr>
</tbody>
</table>
6- Move the scoop or shovel around the top edge of the mold as the concrete is discharged in order to ensure symmetrical distribution of the concrete and for minimizing segregation of coarse aggregate within the mold.

7- Further distribute the concrete by use of a tamping rod prior to the start of compaction.

8- Compact each layer by rodding or vibration as indicated in the table below:

<table>
<thead>
<tr>
<th>Slump</th>
<th>Compaction method</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 7.5 cm</td>
<td>Rodding</td>
</tr>
<tr>
<td>&lt; 2.5 cm</td>
<td>Vibration</td>
</tr>
<tr>
<td>(2.5 – 7.5) cm</td>
<td>Either Rodding or Vibration</td>
</tr>
</tbody>
</table>

9- Finally level the surface of the concrete using a trowel.

**Rodding**

1- Rod each layer with the rounded end of the rod using the number of strokes and size of rod specified in in the table below:

<table>
<thead>
<tr>
<th>Specimen type</th>
<th>Size</th>
<th>Diam. of rod (mm)</th>
<th>Number of strokes / layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder</td>
<td>150 mm diam.</td>
<td>16</td>
<td>25</td>
</tr>
</tbody>
</table>
2- Rod the bottom layer throughout its depth. Distribute the strokes uniformly over the cross section of the mold and for each upper layer allow the rod to penetrate about 12mm into the underlying layer when the depth of the layer is less than 100mm and about 25 mm when the depth is 100mm or more.

3- After each layer is rodded, tap the outside of the mold lightly 10-15 times with the mallet to close any holes left by rodding.

**Vibration**

1- The duration of vibration required will depend upon the workability of the concrete and the effectiveness of the vibrator.

2- Continue vibration only long enough to achieve proper compaction of the concrete.

3- Fill the molds and vibrate in the required number of approximately equal layers. Place all the concrete for each layer in the mold before starting vibration of that layer. Add the final layer, so as to avoid over filling by more than (6mm). Then finish the surface.

- 150 mm cubic molds can be used according to (BS 1881:Part 3). The cube should be filled in three layers, each layer to be rodded 35 times by 25 mm square rod.
In placing the final layer, try to put the amount of concrete that will exactly fill the mold after compaction.

**D. Curing:**

1. Immediately cover the specimens by a non absorptive plate or wet thick cloth.
2. After $24 \pm 8$ h. remove the specimens from the molds.
3. Keep the specimen in a moist room or water tank at temperature of $(23 \pm 2 \, ^\circ C)$ until the moment of testing.

*Figure 1 : The mechanical mixer for concrete*