

# Concrete Technology

## Lecture 6



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- ▶ **Batching**
- ▶ **Mixing**
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# Batching

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- Batching is the process of measuring concrete mix ingredients by either mass or volume and introducing them into the mixer .
- To produce concrete of uniform quality, the ingredients must be measured accurately for each batch
- There are two types
  1. Volume Batching
  2. Weight Batching



# Volume Batching

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- This method is generally adopted for small jobs .
- Gauge boxes are used for measuring the fine and coarse aggregate.
- The volume of gauge box is equal to the volume of one bag of cement.
- Gauge box are also called as FARMAS. The volume of gauge box is equal in volume to 1 bag of cement.
- Cement is always measured by weight. 1 bag of cement is 50Kg in weight and 35litres in volume.
- Water may be taken either in volume or weight. Because 1kg water=1 liter of water.



# Volume Batching

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- ▶ The quantity of water required is the product of W/C ratio and the weight of cement. This quantity includes the surface moisture in aggregate.

**Table 6.5. Approximate Surface moisture in aggregate–I.S. 456-2000**

<i>Aggregates</i>	<i>Approximate Quantity of surface water</i>	
	<i>Percent by Mass</i>	<i>Litre per m<sup>3</sup></i>
(1)	(2)	(3)
Very wet sand	7.5	120
Moderately wet sand	5.0	80
Moist sand	2.5	40
Moist gravel or crushed rock	1.25 – 2.5	20 – 40



**Table 6.4 Batch volume of materials for various mixes**

	<i>Cement kg.</i>	<i>Sand, litres</i>	<i>Coarse aggregate, litres</i>
1 : 1 : 2 (M 200)	50	35	70
1 : 1 1/2 : 3 (M 200)	50	52.5	105
1 : 2 : 3	50	70	105
1 : 2 : 4 (M 150)	50	70	140
1 : 2 1/2 : 5	50	87.5	175
1 : 3 : 6 (M 100)	50	105	210



# Volume Batching

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- ▶ Not a preferred method of batching because...
  1. the difficulty it offers to proportion granular materials in terms of use.
  2. Volume of moist sand in loose condition is much less than dry compacted sand
  3. Bulking of sand



# Weigh Batching

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- Batching by weight is more preferable to volume batching, as it is more accurate and leads to more uniform proportioning.
- It does not have uncertainties associated with bulking.
- In megaprojects, automatic batching plant is used that facilitates accuracy.
- Usually cement bag is not weighted and assumed to be 50kg. But due to transportation and handling at a number of places, some cement is lost. Sometimes the loss of cement becomes more than 5kg. Therefore, in major jobs cement should be weighted.





# Mixing

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- The mixing should be ensure that the mass becomes homogeneous , uniform in color and consistency .

## **Methods of Mixing :**

- ▶ Hand Mixing
- ▶ Machine Mixing



# Hand Mixing

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- ▶ Practiced for small scale unimportant concrete works.
- ▶ As this method is less efficient, it is desirable to add 10% extra cement to cater for inferior concrete produced by this method.
- ▶ To prepare, spread the C.A and F.A in alternate layers and pour cement powder over them. Then, dry mixing via shovel is carried out and finally, water is sprinkled over the mixture.



# Machine Mixing

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- ▶ Accurate, economical and efficient.
  - ▶ Tilting, Non tilting and Reverse mixers and three main types of machine mixers.
  - ▶ The capacity to mixer in terms of volume should be sufficient to hold one batch of concrete mix corresponding to 1 bag of cement e.g. 1:2:4 mix would requires 200 liters of capacity.
  - ▶ The sequence of charging should be as under
    1. First, about 25% of water is poured in empty drum
    2. About half quantity of CA is placed above which half quantity of FA is poured on which, full quantity of cement is poured and then the remaining quantity of CA and FA is poured.
    3. The remaining 75% water is added into the drum.
    4. In case plasticizers are, 1 liter water is held back in which plasticizers are mixed. This mixture is added after 1 minute.
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# Hand Mixing

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# Machine Mixing

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# Machine Mixing

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# Mixing time

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- ▶ Mixers generally run at speed of 15-20 revolutions per minute.
- ▶ Normally 25-30 revolutions are required for a well designed mixer to mix ingredients properly.
- ▶ Mixing time is usually 1.5 to 2.5 minute and depends upon volumetric capacity of mixer.
- ▶ Batching plant takes 12 minutes to load a transit mixer of 6m<sup>3</sup> capacity.



# Retempering of Concrete

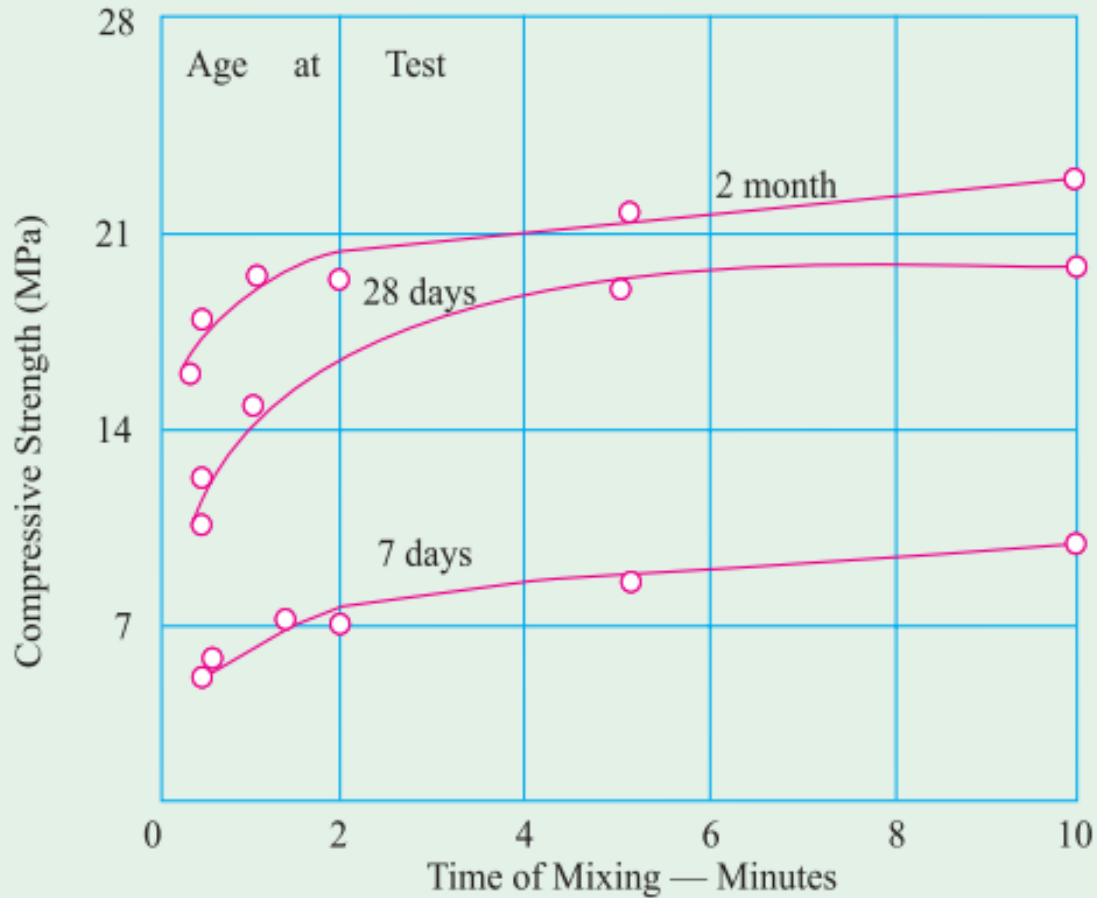
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- ▶ The process of remixing of water to concrete, in addition to required quantity of water is known as retempering of concrete. Sometimes, extra cement is also added while retempering..
- ▶ Retempering is done owing to loss of workability or undue stiffness of concrete at actual site in case of long tunnels, road construction etc. where batching plant is few kilometers away.





# Effect of mixing time on strength of concrete



# Transporting

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- ▶ Concrete can be transported by a variety of methods and equipment. The precaution to be taken while transporting concrete is that the homogeneity obtained at the time of mixing should be maintained while being transported to the final place of deposition. The methods adopted for transportation of concrete are:
    - (a) Mortar Pan
    - (b) Wheel Barrow, Hand Cart
    - (c) Crane, Bucket and Rope way
    - (d) Truck Mixer and Dumpers
    - (e) Belt Conveyors
    - (f) Chute
    - (g) Transit Mixer
    - (h) Pump and Pipe Line etc.
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# Transportation.

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- ▶ Mortar pan is labor intensive. Aggregate is carried in small quantity. Usually used for ground floor. Nullifies segregation. Pan should be wetted prior used.
- ▶ Wheel burrow for comparatively longer distance.
- ▶ Dumpers have capacity of 2 to 3 cubic meters
- ▶ Belts conveyers have limited applications owing to segregation. Additionally, larger exposed surface area causes evaporation of water. Concrete should be remixed before delivery
- ▶ Chute are provided for transporting concrete from ground level to low level. Slope of chute walls should not be more flatter than 1:2.5. Prevents segregation.
- ▶ Transit mixers have capacity ranging from 4-7m<sup>3</sup>. Speed of agitator varies from 2 to 5rpm. A limit of 300 revolutions has been set by ASTM before placing.
- ▶ Pumps and pipelines are considered as the main method of transportation of concrete. Diameter of pipeline is generally 125mm. Concrete can be pumped to a height of 400m. Common problem in concrete pumping is blockage.

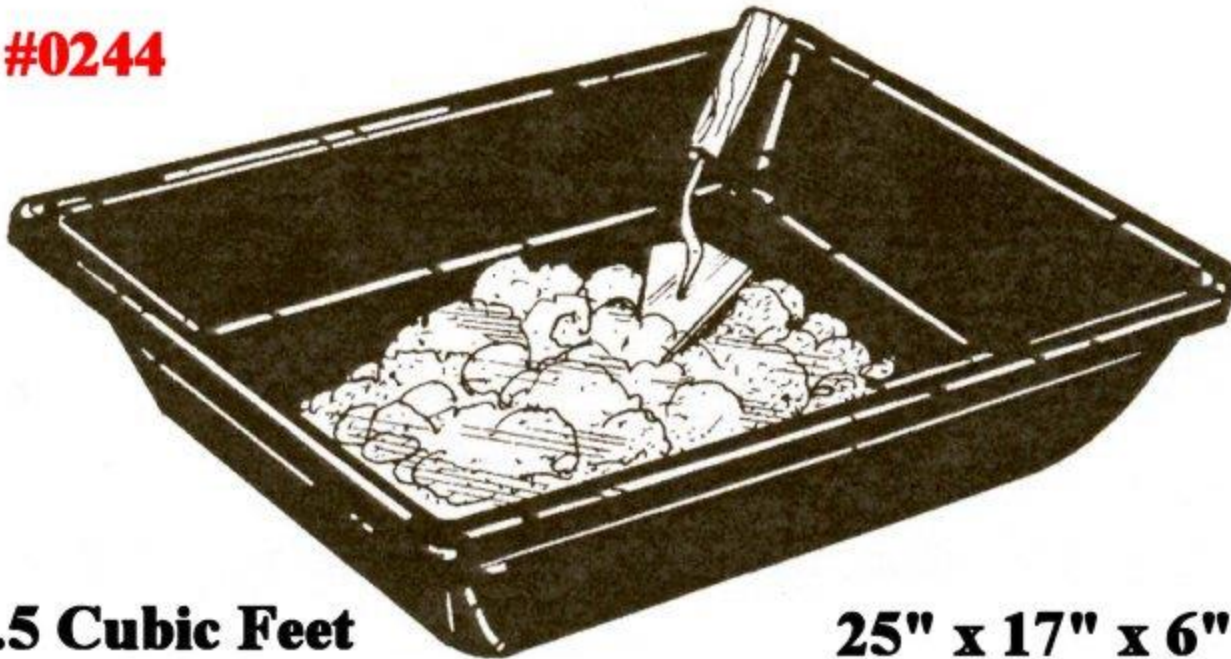


# Mortar Pan

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- ▶ When Concrete is carried in small Quantities

**#0244**



**2.5 Cubic Feet**

**25" x 17" x 6"**



# Wheel barrow and buggies

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# Belt Conveyors

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# Chute

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# Transit Mixer

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# Placing

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- It is not enough that a concrete mix correctly designed, batched, mixed and transported, it is of utmost importance that the concrete must be placed in systematic manner to yield optimum results.
- As far as placing is concerned, the main objective is to deposit the concrete as close as possible to its final position so that segregation is avoided and the concrete can be fully compacted



# Placing Concrete Within Earth Mould

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- ▶ In case of foundations, before placing concrete, loose earth must be removed from bed.
- ▶ The surface of earth must be made damp to avoid absorption of water from concrete. On the other hand If bed is too rain soaked, water must be removed to expose firm bed before placement of concrete.



# Placement of Road Slabs on ground

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- ▶ The must be free from pool of water, organic matter etc.
- ▶ The ground must be made sufficiently damp to prevent absorption of concrete. Sometimes a thin polyethylene sheet is added between ground and concrete slab to serve the purpose.
- ▶ Provision of contraction joints are given.
- ▶ The practice of placing concrete in heaps and then dragging should be avoided.



# Placement of concrete in layers.

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- ▶ When concrete is laid in great thickness as in piers and abutments, or construction of mass concrete dam, concrete is placed in layers.
- ▶ The thickness of layers depends upon mode of compaction.
- ▶ In RCC the thickness of each layer varies between 15cm to 30 cm.
- ▶ In mass concrete, the thickness varies between 30cm and 45cm.
- ▶ *Cold joints* should be avoided.
- ▶ When concrete is placed in layers, it is preferred to leave the top surface rough, so that succeeding layer can have good bond with it



# Placement of concrete in formwork.

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- ▶ It must be checked that reinforcement in formwork, placed and having an appropriate cover.
- ▶ The joints between plywood and wooden planks should be fixed so that concrete matrix will not escape while vibrating.
- ▶ The reinforcement should be clean and free from oil.
- ▶ When concrete is dropped from great height, segregation is most likely to occur, to avoid this tremie or drop chute should be used to direct the concrete within the reinforcement and ties.



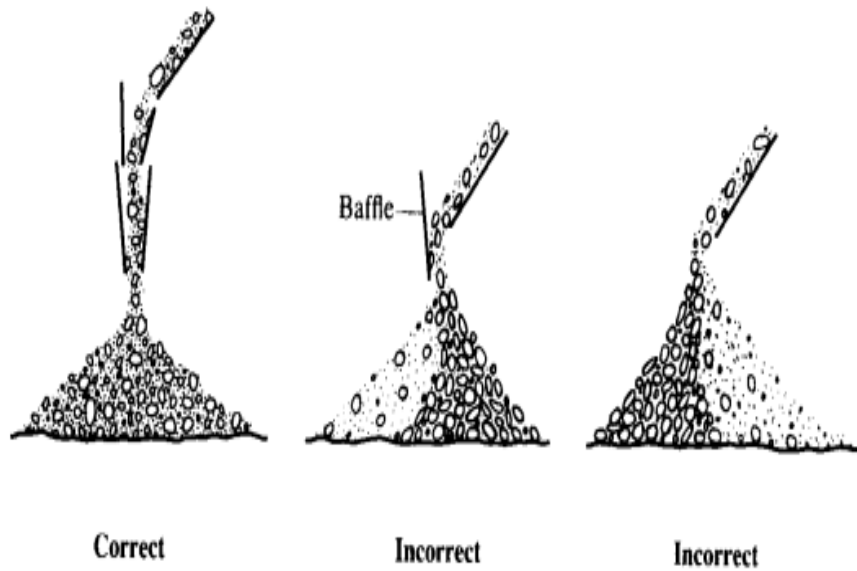
**Table 6.6. Stripping Time of Formwork**

<i>Sr. No.</i>	<i>Type of Formwork</i>	<i>Minimum period before striking formwork</i>
1.	Vertical formwork to columns walls and beams	16 – 24 hours
2.	Soffit formwork to slabs (props to be refixed immediately after removal of formwork)	3 days
3.	Soffit formwork to beams (Props to be refixed immediately after removal of formwork)	7 days
4.	Props to slab spanning up to 4.5 m	7 days
	spanning over 4.5 m	14 days
5.	Props to beam and arches Spanning up to 6 m	14 days
	Spanning over 6 m	21 days

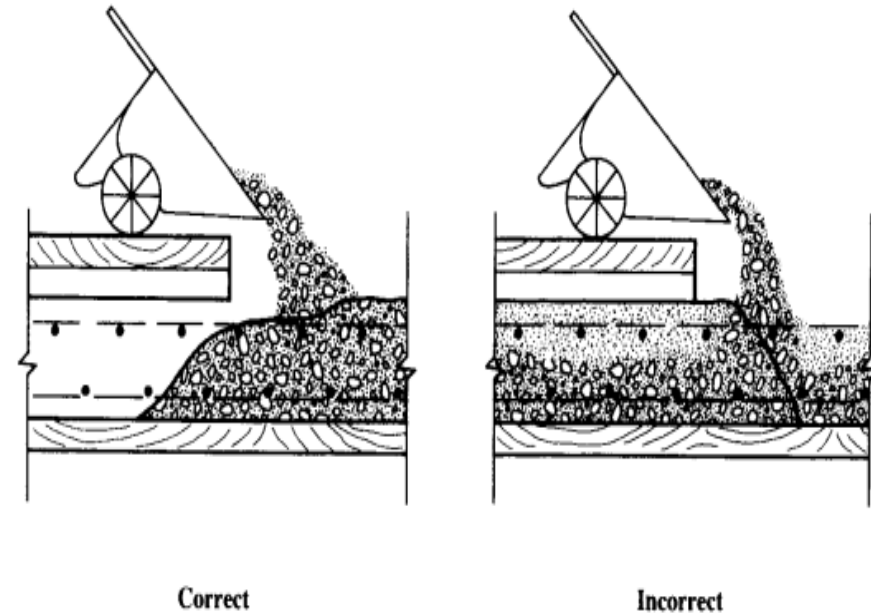


# Placing

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*Fig. 7.6: Control of segregation at the end of concrete chutes  
(Based on ACI Manual of Concrete Practice.)*

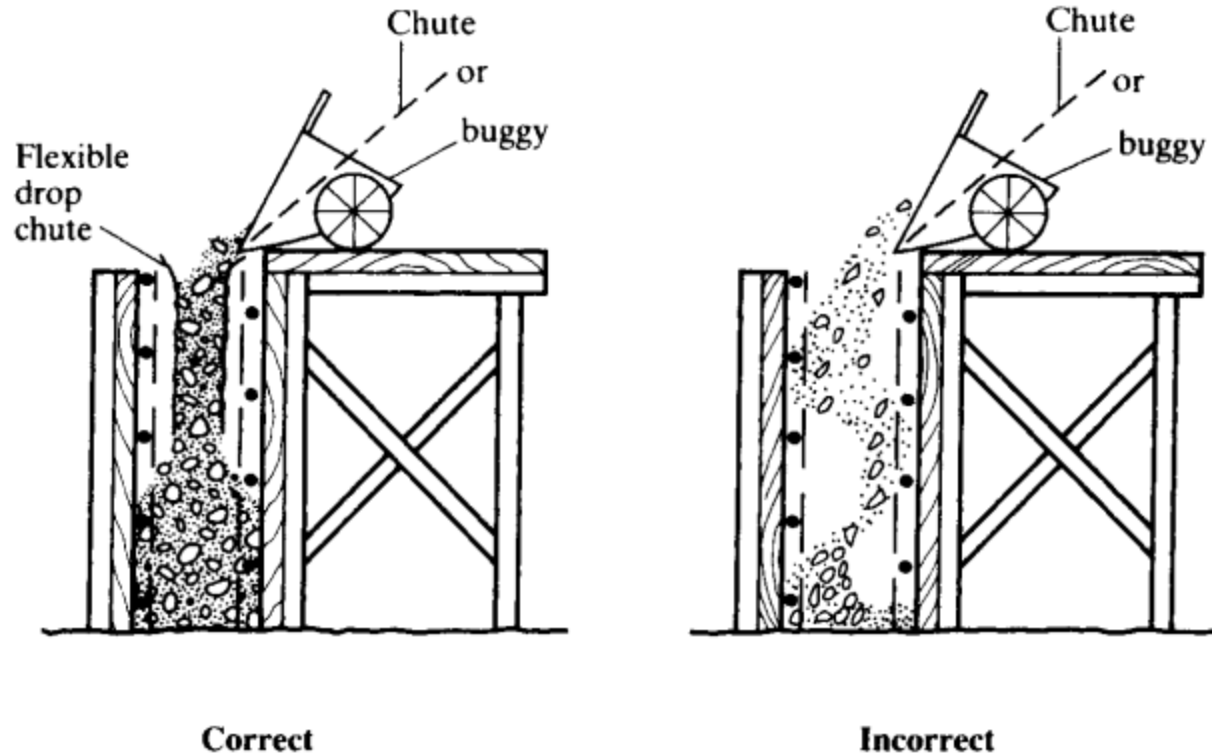


*Fig. 7.7: Placing concrete from buggies  
(Based on ACI Manual of Concrete Practice.)*



# Placing of Concrete in a deep wall

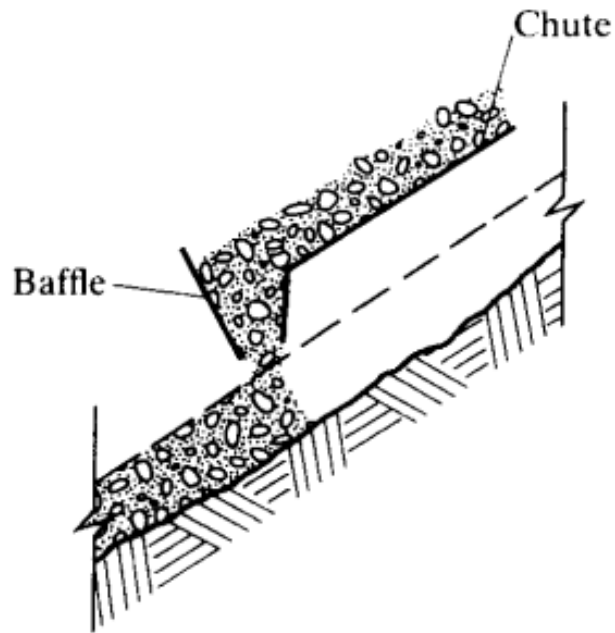
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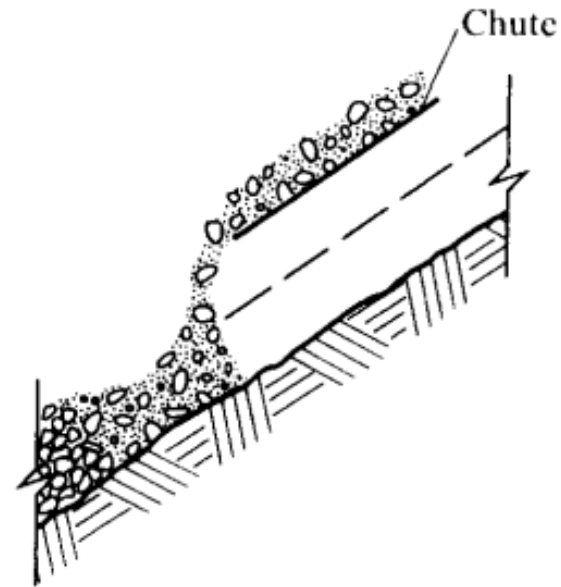


# Placing of concrete on a sloping surface

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**Correct**



**Incorrect**



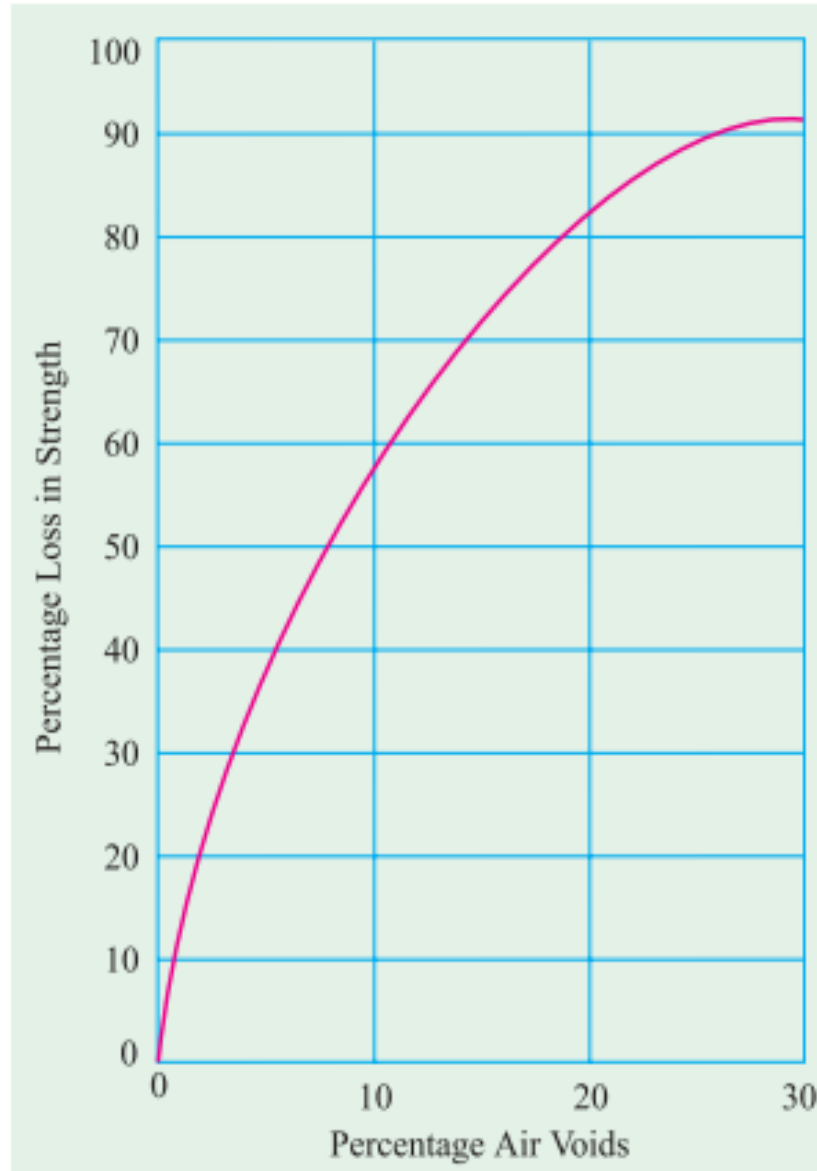
# Compaction

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- The process of compaction of concrete consists essentially of the elimination of entrapped air and forcing the particles into a closer configuration.
- In the process of mixing , transporting and placing of concrete air is likely to get entrapped in the concrete .
- The lower the workability, higher is the amount of air entrapped. In other words, stiff concrete mix has high percentage of entrapped air and, therefore , would need higher compacting efforts than high workable mixes
- If this air is not removed fully, the concrete loses strength considerably. Moreover, durability is also affected.
- Insufficient compaction increases the permeability of concrete resulting in easy entry for aggressive chemicals in solution, which attack concrete and reinforcement to reduce the durability of concrete. Therefore, 100 per cent compaction of concrete is of paramount importance.



# Percentage loss in strength vs Air Voids



# Methods of Compaction

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## ❑ **Hand Compaction (High W/C)**

- I. Rodding (2m long rod and 16mm in dia)
- II. Ramming (for unreinforced concrete)
- III. Tamping (compaction and leveling)

## ❑ **Compaction by Vibration (Low W/C, high strength)**

- I. Internal vibrator
  - II. Formwork Vibrator (for column and thin walls)
  - III. Table Vibrator (concrete cylinders)
  - IV. Platform vibrator (Larger table vibrator)
  - V. Surface vibrator. (slabs, up to 15cm depth)
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# Compaction by vibration

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- ▶ In Compaction by vibration, concrete of slump as low as 40mm can be used while hand compaction requires a minimum slump of 120mm.
- ▶ To prevent damage to vibrator, it should not come in contact with hard objects.
- ▶ Compaction by vibration should be avoided for concrete having high workability.
- ▶ Vibrator can be used vertically, horizontally or inclined. But needle vibrator should be used vertically in beams at intervals.
- ▶ Concrete should be vibrated within an hour of placement.
- ▶ Over vibration caused segregation.



# Hand Compaction

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# Internal Vibrators

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# External Vibrators

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# Table and Platform Vibrators

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# Surface Vibrators

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**THE END**

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