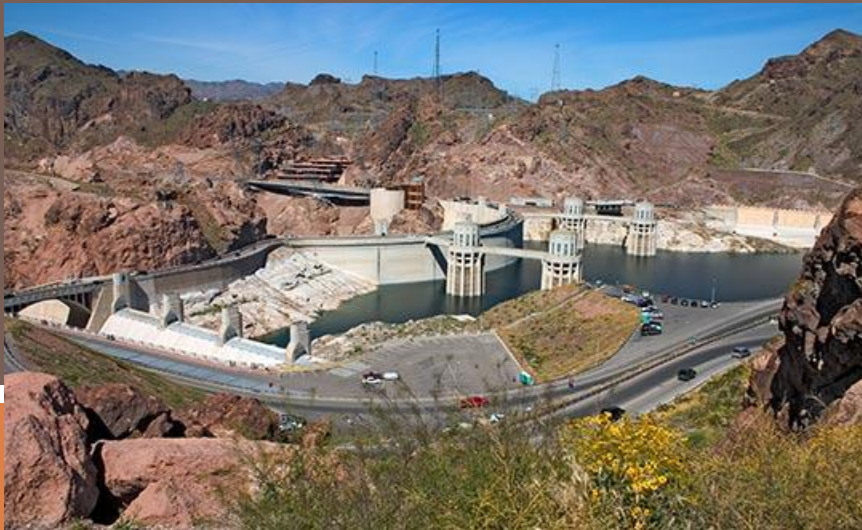


CONCRETE



What is Concrete?



Man made stone.

Constituents

- Cementing material (cement, lime)
- Coarse Aggregate (brick chips, stone chips)
- Fine Aggregate (sand)
- Water
- Admixtures



Types

- Cement Concrete (CC)
- Reinforced Cement Concrete (RCC)
- Lime Concrete (LC)
 - Lime concrete cannot be made reinforced, as lime eats away the steel in due course of time.

How concrete is made?

- All the ingredients are mixed and poured into suitable forms to give desired shape.
- Plastic mass gets converted into solid stone with passage of time due to chemical reaction between cement and water.
- Aggregates don't go under any chemical change, they simply provide mass/volume to the concrete and reduce shrinkage effects.

Advantages

- Versatile
- Economical
- Strong and Durable
- Fire resistant



Disadvantages

- ❑ Low tensile strength
- ❑ Low ductility
- ❑ Volume instability
- ❑ Low strength to weight ratio

PROPERTIES OF FRESH CONCRETE

- Workability
- Consistency
- Segregation
- Bleeding
- Setting Time

WORKABILITY



It is a measure of ease with which concrete can be handled from the mixer stage to its finally compacted stage.

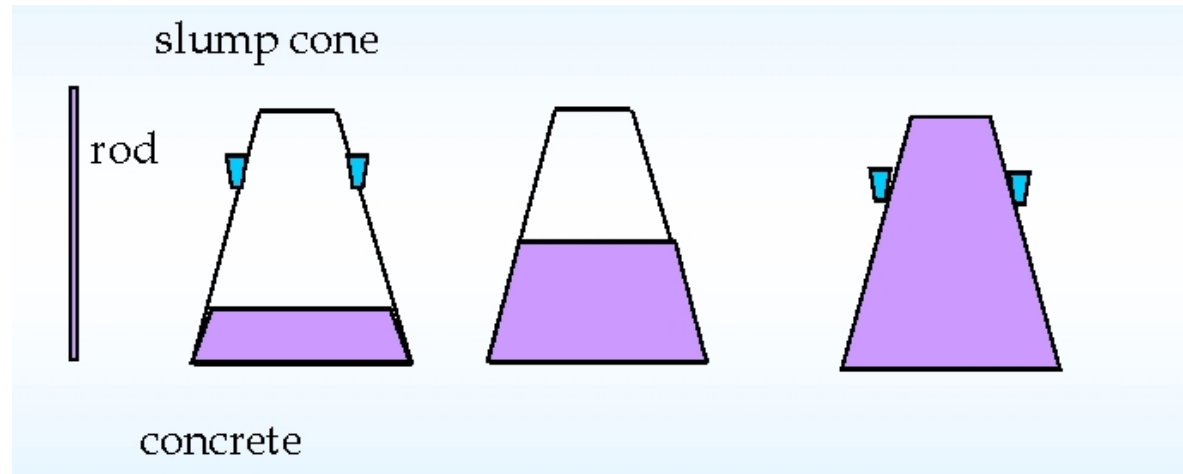
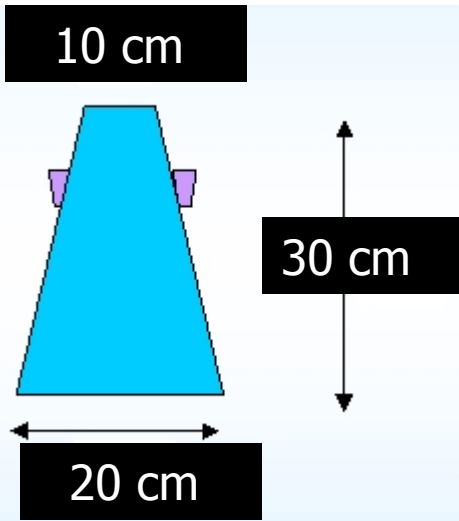
Factors Affecting Workability

- Quantity of water in the mix
- Proper grading of the aggregates in the mix
- Amount of cement
- Ratio of coarse aggregate and fine aggregate
- Shape and surface texture of aggregates
- Method of compaction
- Use of admixtures

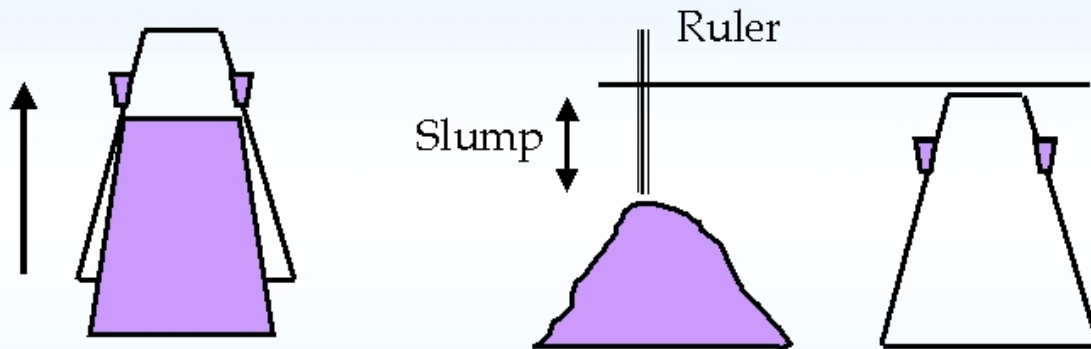
SLUMP TEST

- Workability is measured by Slump Test.

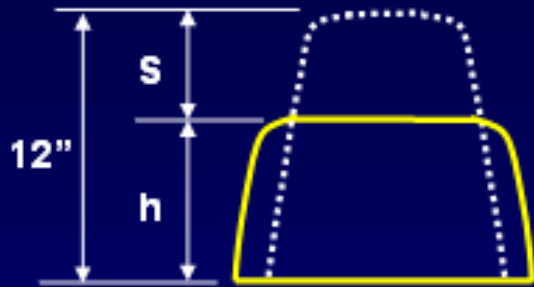




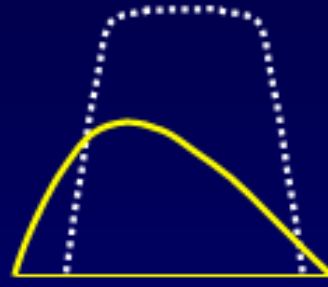
The slump cone is filled in 3 layers. Every layer is evenly rodded 25 times.



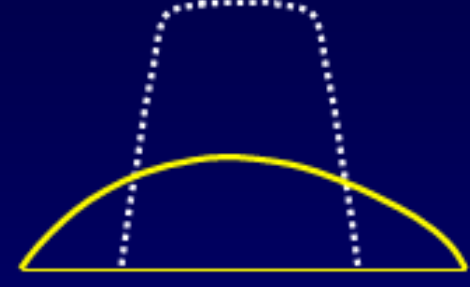
Measure the **slump** by determining the vertical difference between the top of the mold and the displaced original center of the top surface of the specimen.



True Slump



Shear Slump



Collapse slump

s = slump

h = measured height



SEGREGATION

- Tendency of separation of CA grains from the concrete mass.
 - ▣ It increases when concrete mixture is lean and too wet.
 - ▣ It also increases when rather large and rough textured aggregate is used.

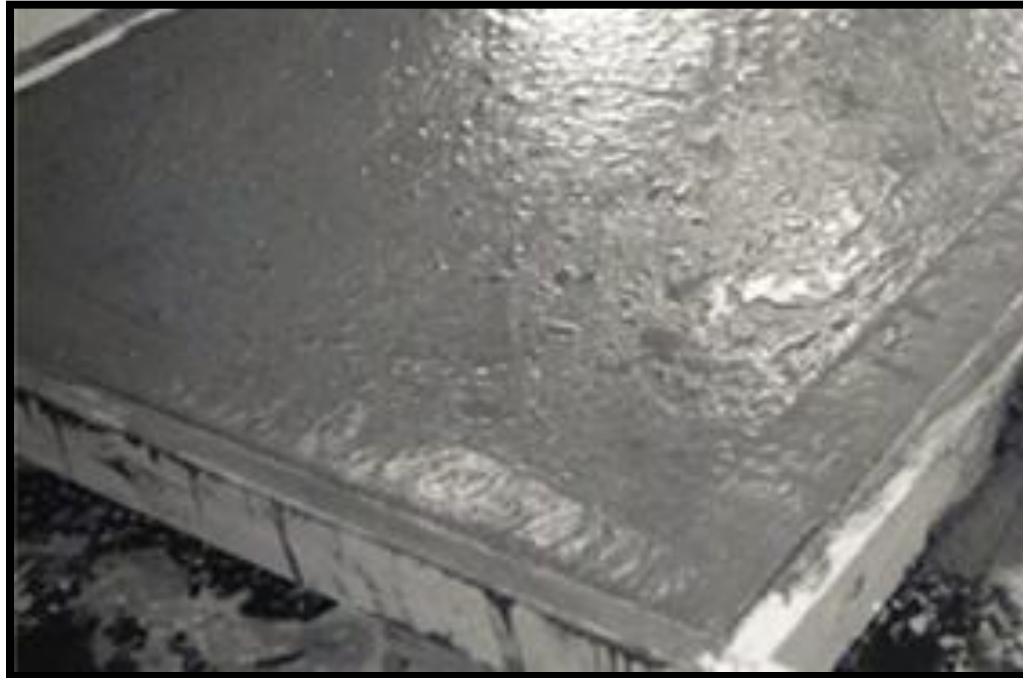
It can be avoided as follows

- ▣ Restricting the amount of water to smallest possible.
- ▣ All the operations like handling, placing and consolidation are carefully conducted.
- ▣ Concrete should not allow to fall from larger heights.



BLEEDING

- Bleeding is the tendency of water to rise to the surface of freshly placed concrete.



BLEEDING

Undesirable effects of bleeding are:

- With the movement of water towards the top, the top portion becomes weak & porous (high w/c). Thus the resistance of concrete to freezing-thawing decreases.
- Water rising to the surface carry fine particles of cement which weaken the top portion. This portion is not resistant to abrasion.


BLEEDING

The tendency of concrete to bleeding depends largely on properties of cement. It is decreased by:

- By adding more cement
- Increasing the fineness of cement
- Reducing water content
- Increasing finer part of fine aggregate

MIX DESIGN

- Mix design is the process of selecting suitable ingredients of concrete & determining their relative quantities with the objective of producing as economically as possible concrete of certain minimum properties such as workability, strength & durability.

- 
- In the past specifications for concrete mix design prescribed the proportions of cement, fine agg. & coarse agg.
 - Volume basis/Weight basis
 - 1:1.5:3, 1:2:4
 - However, modern specifications do not use these fixed ratios.

➤ Most of the time job specifications dictate the following data:

- ▣ Max w/c
- ▣ Min cement content
- ▣ Min air content
- ▣ Slump
- ▣ Strength
- ▣ Type of cement
- ▣ Admixtures
- ▣ Max agg. size

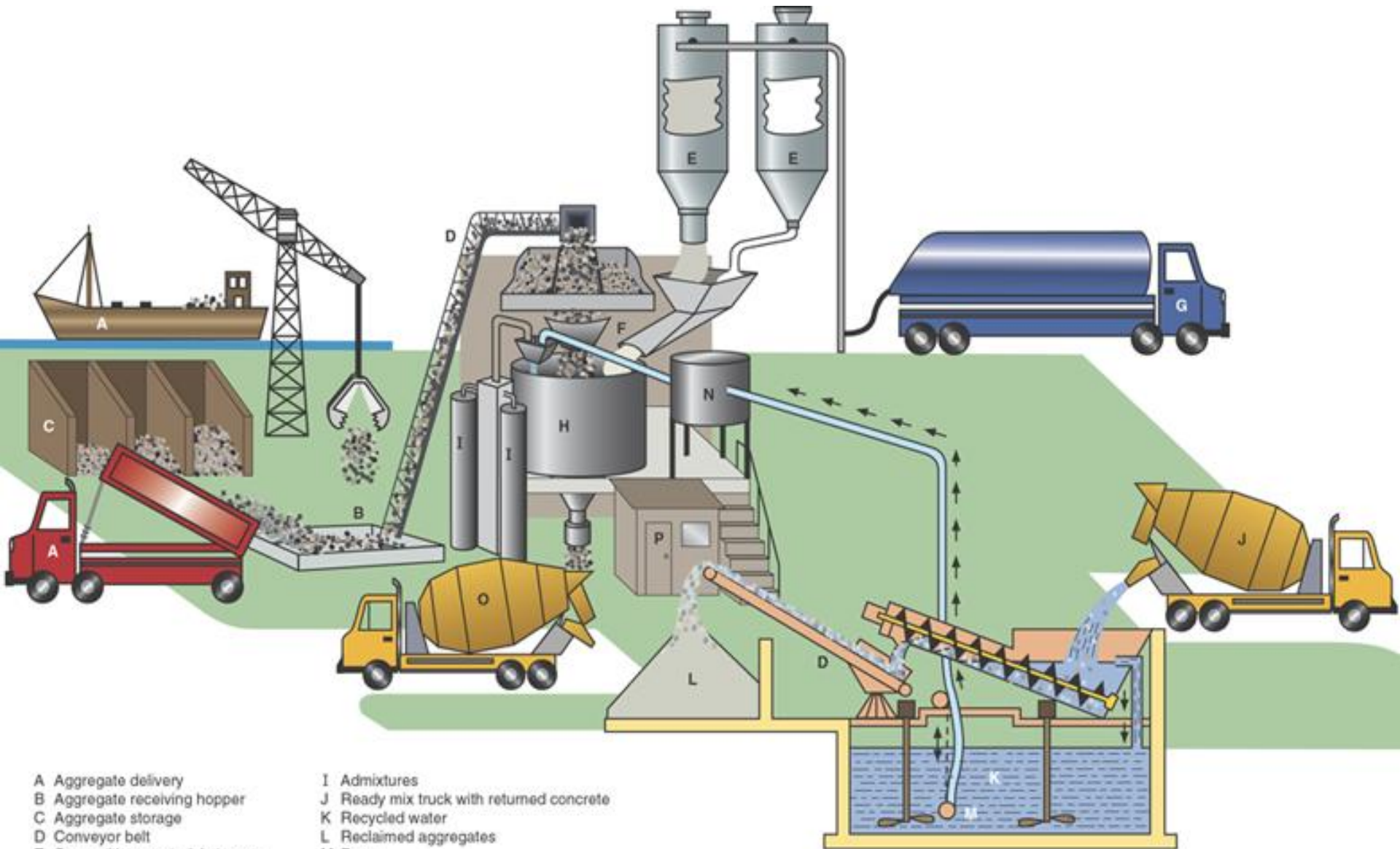
MIXING OF CONCRETE

- The aim of mixing is to blend all of the ingredients of the concrete to form a uniform mass and to coat the surface of aggregates with cement paste.

MIXING OF CONCRETE

- Ready-Mix concrete: In this type ingredients are introduced into a mixer truck and mixed during transportation to the site.
 - Wet – Water added before transportation
 - Dry – Water added at site
- Mixing at the site
 - Hand mixed
 - Mixer mixed

Ready Mix Concrete



- A Aggregate delivery
- B Aggregate receiving hopper
- C Aggregate storage
- D Conveyor belt
- E Cementitious material storage
- F Weigh hopper
- G Cement delivery
- H Mixer

- I Admixtures
- J Ready mix truck with returned concrete
- K Recycled water
- L Reclaimed aggregates
- M Pump
- N Water storage
- O Concrete loaded in ready-mix truck
- P Control room

Mixing at Site



MIXING OF CONCRETE

Mixing time should be sufficient to produce a uniform concrete. The time of mixing depends on the type of mixer and also to some properties of fresh concrete.

- Undermixing → non-homogeneity
- Overmixing → danger of water loss, breakage of aggregate particles

Transporting the Concrete

- Concrete prepared has to be transported to its place of use before hydration of cement starts.
- During transportation, efforts should be made to prevent segregation of concrete.

Placing of Concrete

- To avoid segregation, concrete should not be dropped from height more than 1 m.

COMPACTION OF CONCRETE

- The process of compacting concrete consists essentially of the elimination of entrapped air. This can be achieved by:
 - ▣ Tamping or rodding the concrete
 - ▣ Use of vibrators

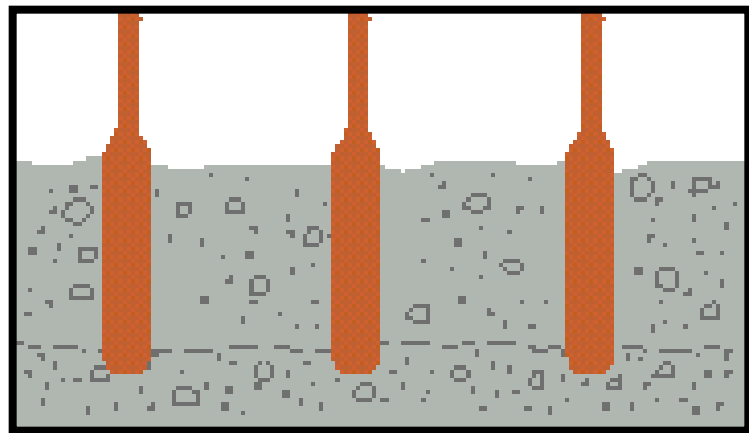
VIBRATORS

- Internal vibrator: The poker is immersed into concrete to compact it.
- External vibrators

Internal Vibration

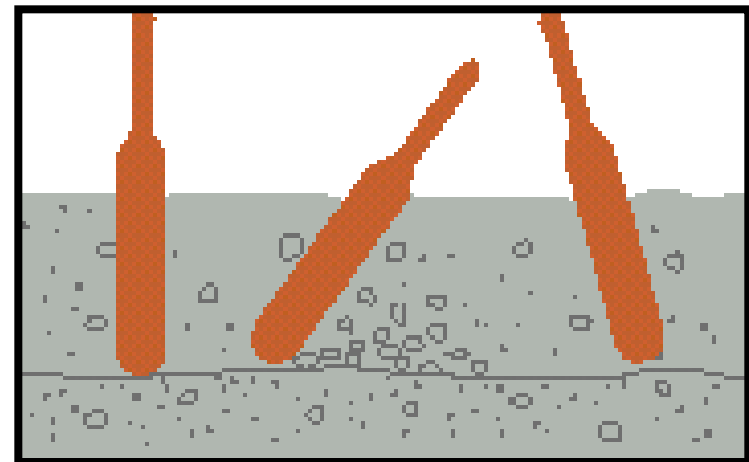


Systematic Vibration



CORRECT

Vertical penetration a few inches into previous lift (which should not yet be rigid) of systematic regular intervals will give adequate consolidation



INCORRECT

Haphazard random penetration of the vibrator at all angles and spacings without sufficient depth will not assure intimate combination of the two layers

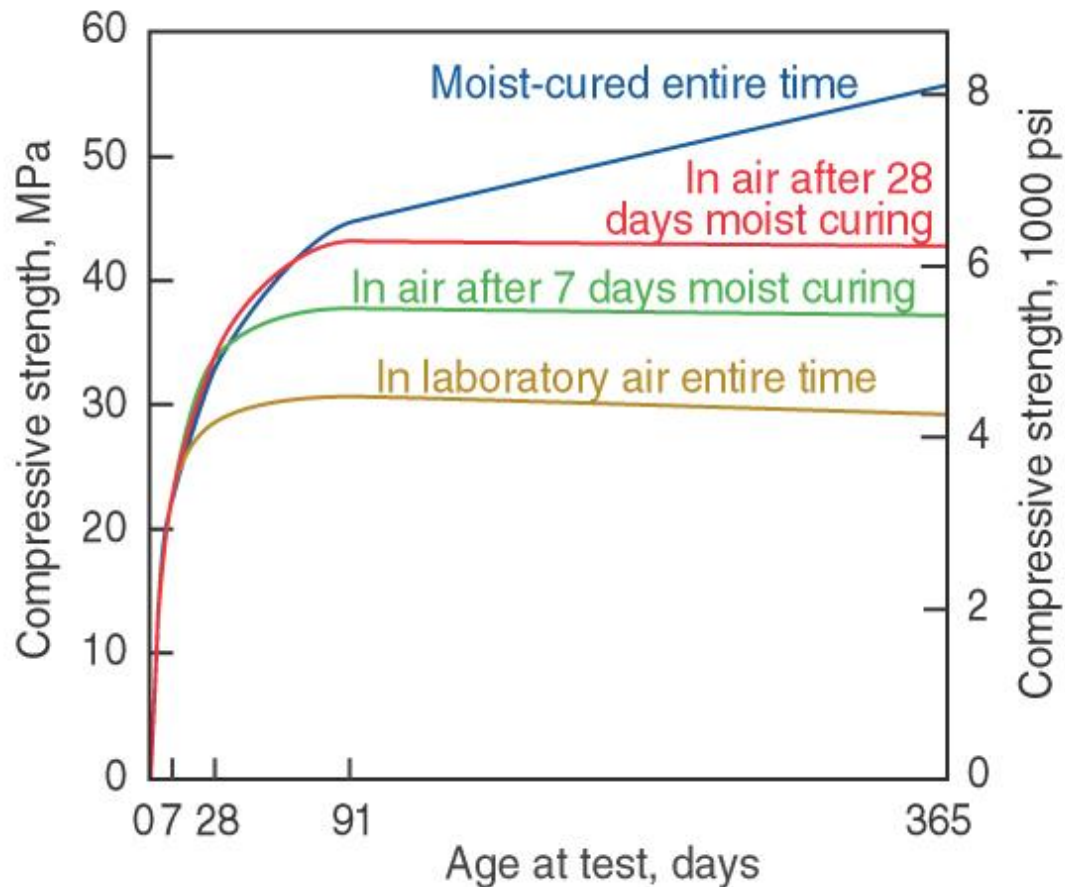
External Vibrators



CURING OF CONCRETE

- Curing is the operation by which moist conditions are maintained on finished concrete surface, to promote continued hydration of cement.
- If proper curing is not done, complete hydration of cement will not take place, with the result that concrete will not acquire its full intended strength.
- Moreover, shrinkage cracks will develop.
- Curing brings improvement in durability, impermeability, wear and weather resistant qualities.

CURING OF CONCRETE



Curing Methods

1. Methods which supply additional water to the surface of concrete during early hardening stages.
 - ▣ Using wet covers
 - ▣ Sprinkling
 - ▣ Ponding



Curing Methods

2. Methods that prevent loss of moisture from concrete by sealing the surface.
 - Water proof plastics
 - Forms left in place



Curing Methods

3. Methods that accelerate strength gain by supplying heat & moisture to the concrete.
 - ▣ By using live steam (steam curing)
 - ▣ Heating coils.



PROPERTIES OF HARDENED CONCRETE

- ▣ Compressive strength
- ▣ Tensile strength
- ▣ Impermeability
- ▣ Resistance to wear, weather and chemical attacks
- ▣ Shrinkage
- ▣ Creep
- ▣ Thermal expansion
- ▣ Elasticity

PROPERTIES OF HARDENED CONCRETE

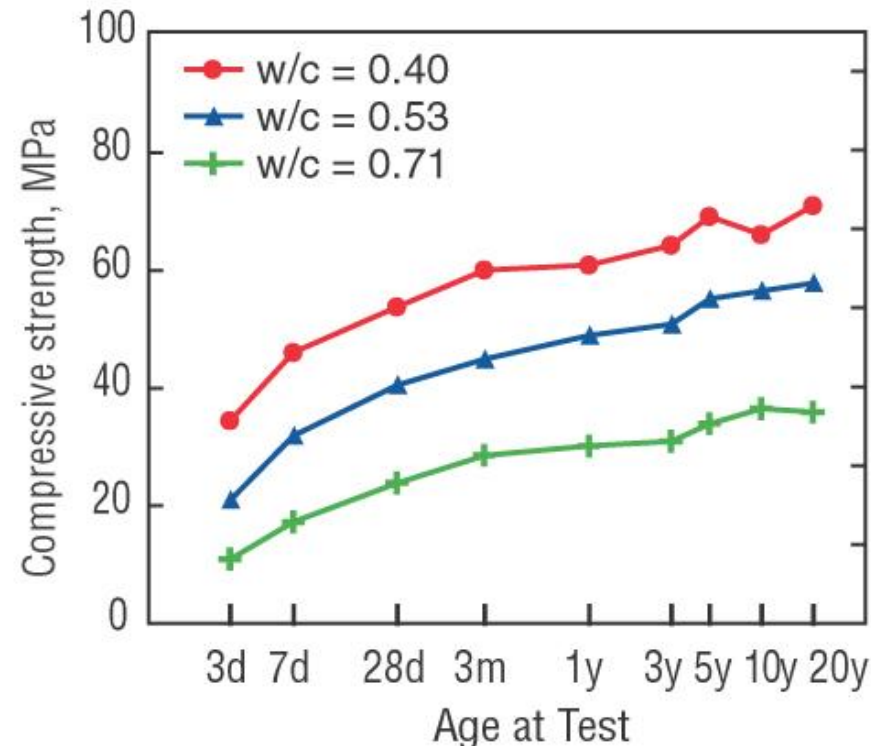
Of the abovementioned hardened properties compressive strength is one of the most important property that is often required, simply because;

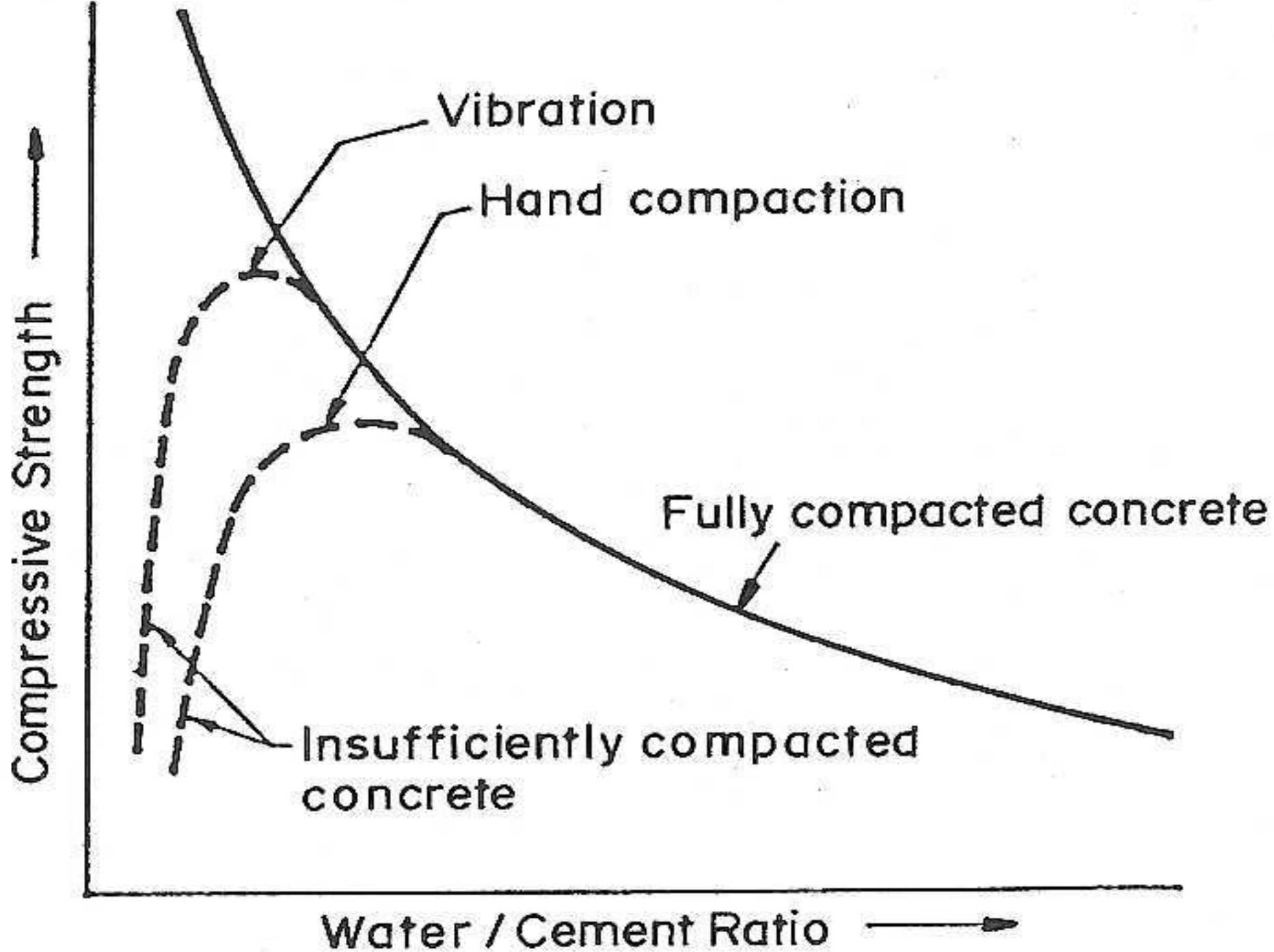
- ▣ Concrete is used for compressive loads
- ▣ Compressive strength is easily obtained
- ▣ It is a good measure of all the other properties

STRENGTH OF CONCRETE

- The strength of a concrete specimen prepared, cured and tested under specified conditions at a given age depends on:

- ▣ w/c ratio
- ▣ Degree of compaction





COMPRESSIVE STRENGTH

- Cube
- Cylinder: $h/D=2$

COMPRESSIVE STRENGTH



Bonded sulphur capping



Unbonded neoprene pads

COMPRESSIVE STRENGTH



STRESS-STRAIN RELATIONS IN CONCRETE

