CONCRETE

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 is concrete 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 provide mass/volume to the concrete and reduce shrinkage effects.

Advantages & Disadvantages

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
- Unit Weight
- Uniformity

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

WORKABILITY

- Workability is the most important property of freshly mixed concrete.
- There is no single test method that can simultaneously measure all the properties involved in workability.
- It is determined to a large extent by measuring the "**consistency**" of the mix.

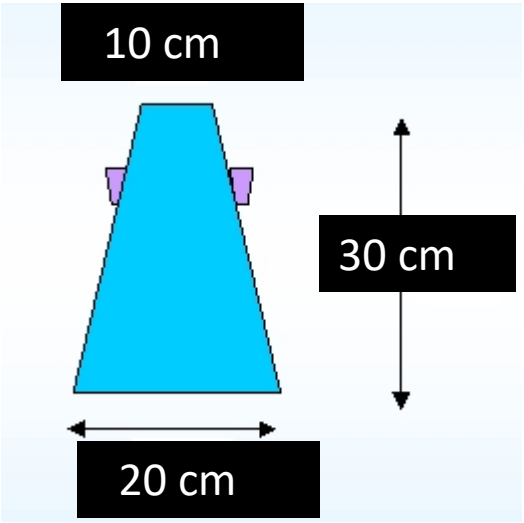


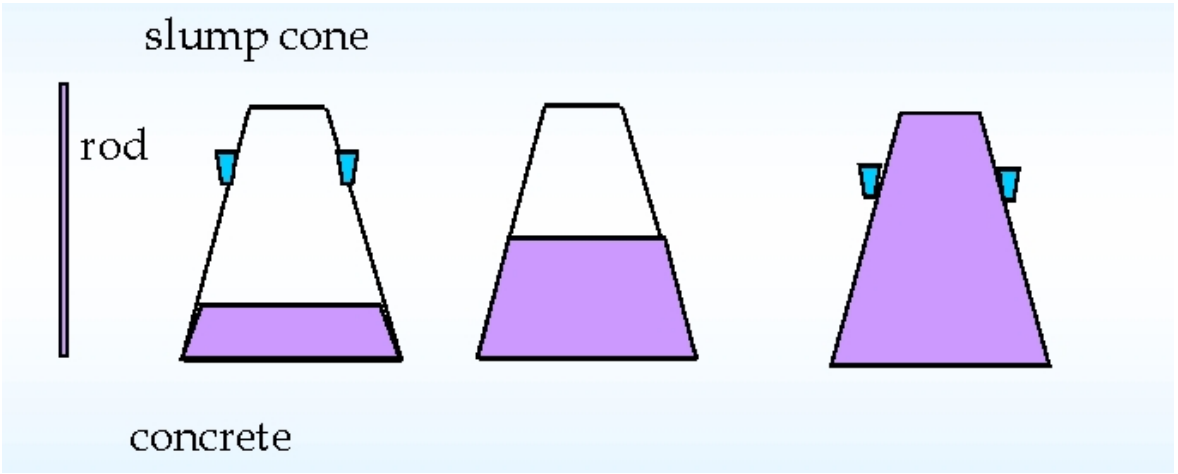
SLUMP TEST

- Workability is measured by Slump Test.

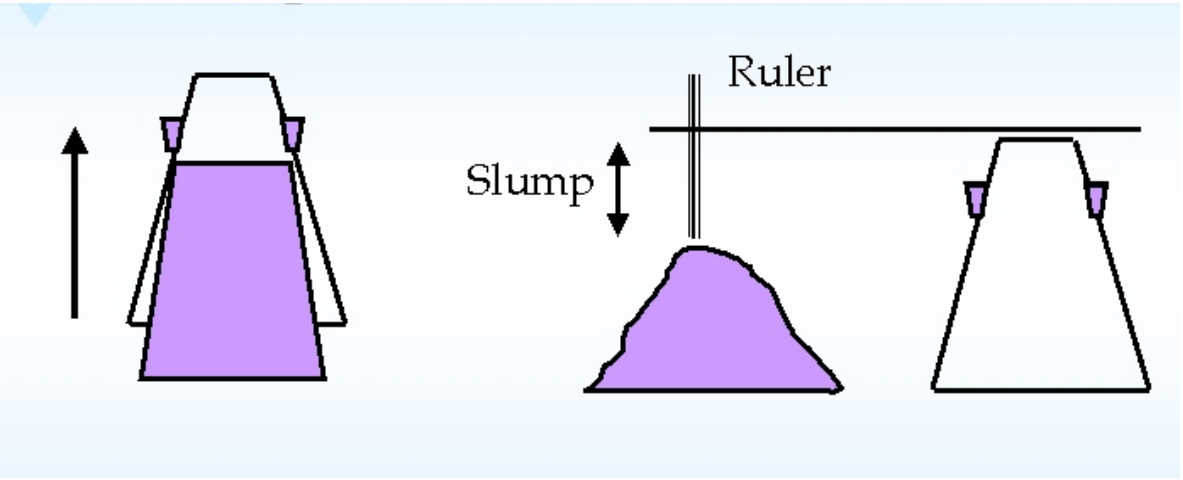








The slump cone is filled in 3 layers.
Every layer is evenly rodded 25 times.



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.

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 be allowed to fall from larger heights.



Segregation


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BLEEDING

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



Bleeding

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.

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

CEMENTING MATERIAL

Any substance which acts as a binding agent for materials.

1. Portland Cement

- Ordinary Portland Cement
- Rapid Hardening Portland Cement
- Low Heat Cement
- White/Colored Portland Cement
- Water Proof Portland Cement

2. Special Cement

- Quick Setting Cement
- Expansive Cement

STORAGE OF CEMENT

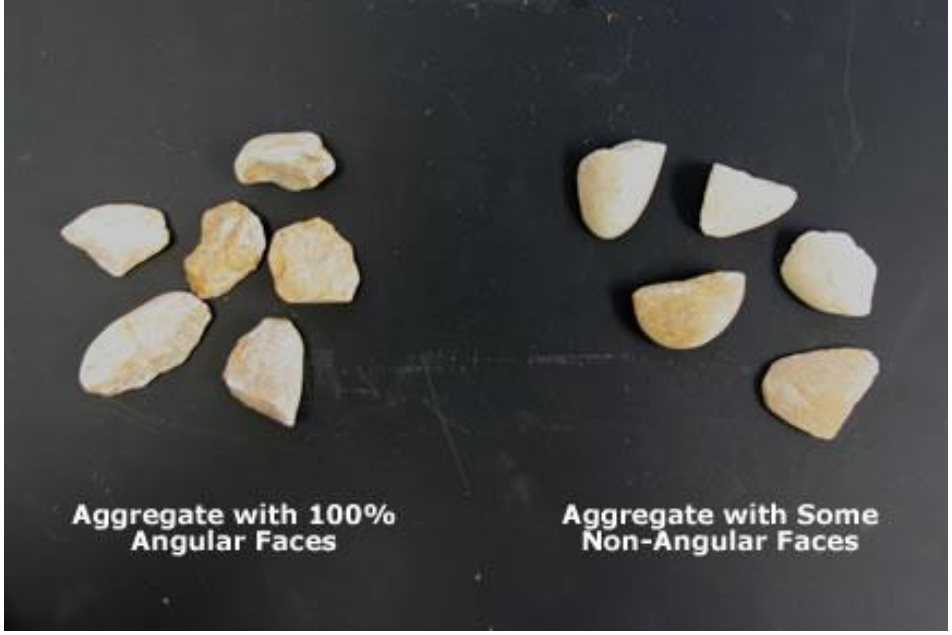
- Protection from rain, sun, winds and moisture
- Stored in dry, leak proof and moisture proof sheds
- Stacked on wooden planks placed about 150-200 mm above the floor of the shed.
- Space of 450-600 mm should be kept between the exterior wall and the stacks
- The maximum height of the stack should not exceed 15 bags
- The width of stack should not be more than four bags or 3 m
- In monsoon when cement bags need to store for very long period, cement stacks should be completely enclosed by polythene sheet or some other water proofing membrane
- The stacks should be arranged in such a manner that cement bags can be removed on principle of first come first served.

AGGREGATE

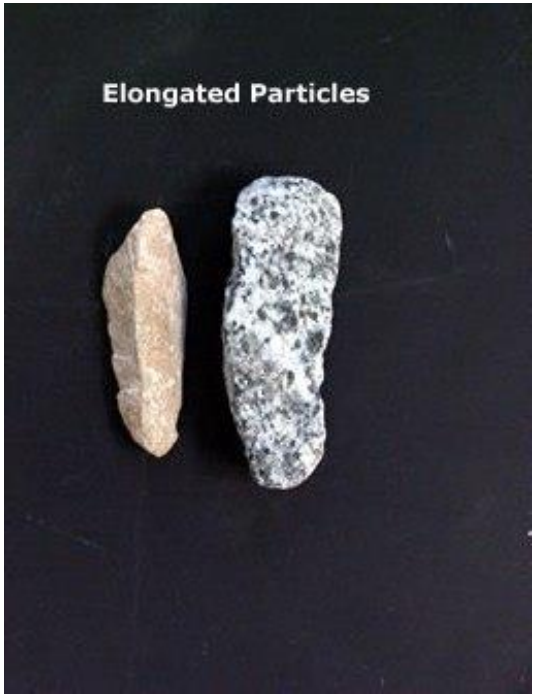
- Course Aggregate (CA)
- Fine Aggregate (FA)
- Silt
- Loam: A soft deposit consisting of sand, silt and clay in about equal proportion



Rounded



Angular: well defined edges



Elongated

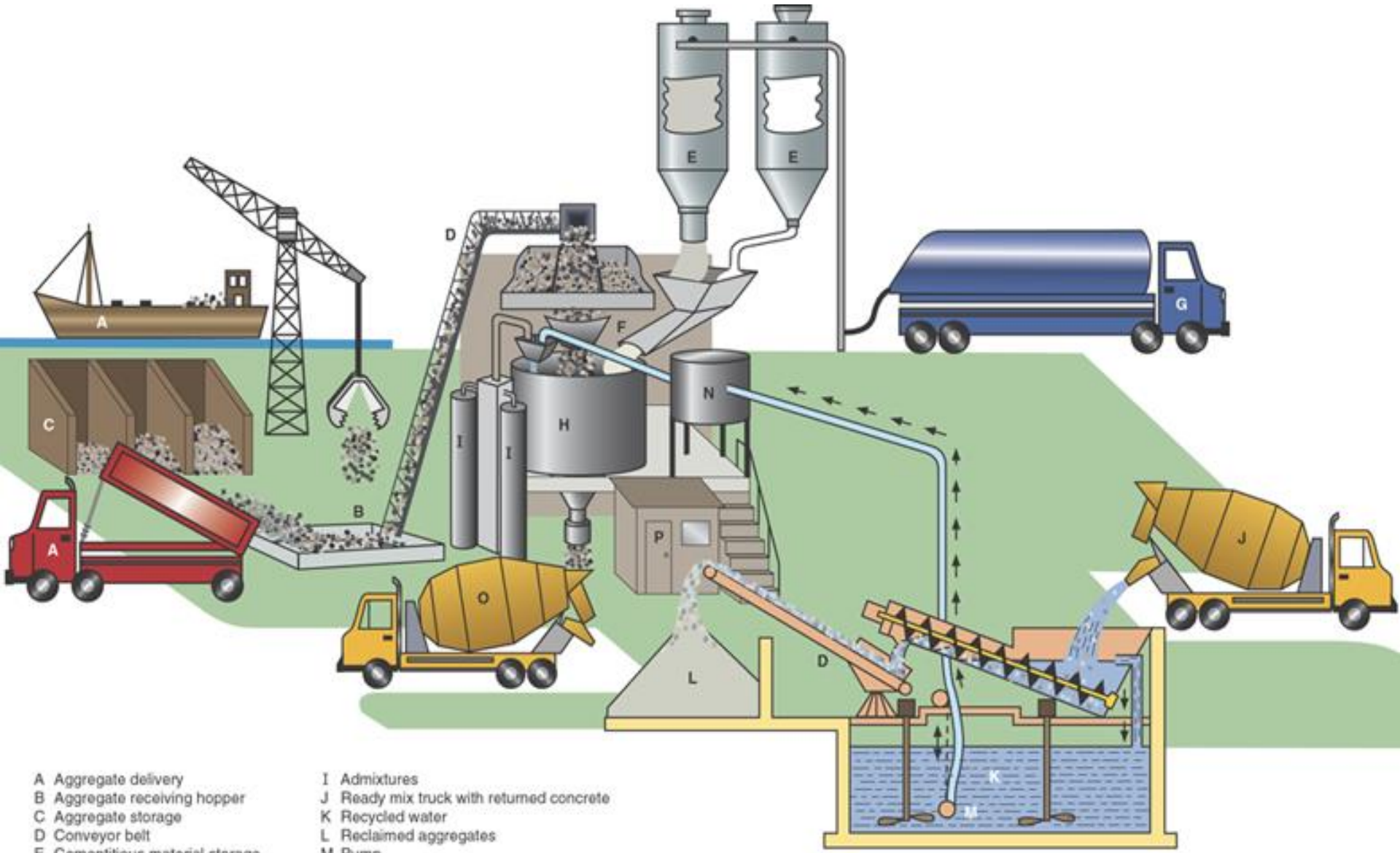


Flaky

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





ADVANTAGES & DISADVANTAGES OF RMC

Advantages:

- Reduced construction cost and time
- Ensured Quality
- Reduced maintenance cost
- Useful for densely populated area

Disadvantages:

- The traveling time from the plant to the site
- Generation of additional road traffic.
- Admixture is added to increase the time span before setting and to increase workability.

RMC Companies in Bangladesh

- NDE Ready Mix Concrete
- ABC Ready Mix Concrete
- Shah Cement Ready Mix Concrete
- Concord Ready Mix Concrete
- SEL Ready Mix Company etc.

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.

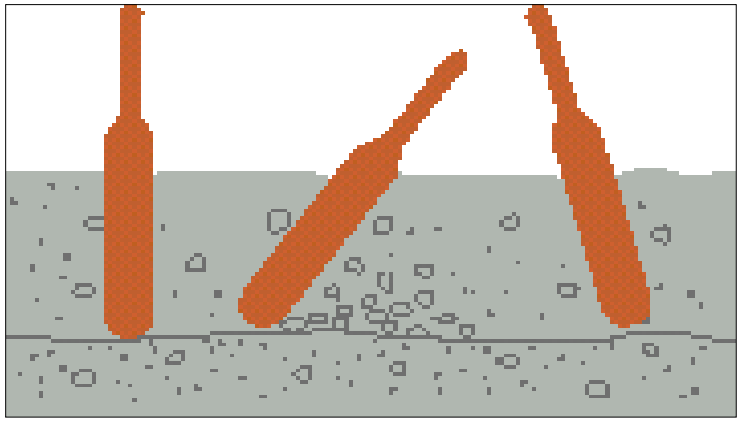
PLACING OF CONCRETE

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

COMPACTION OF CONCRETE

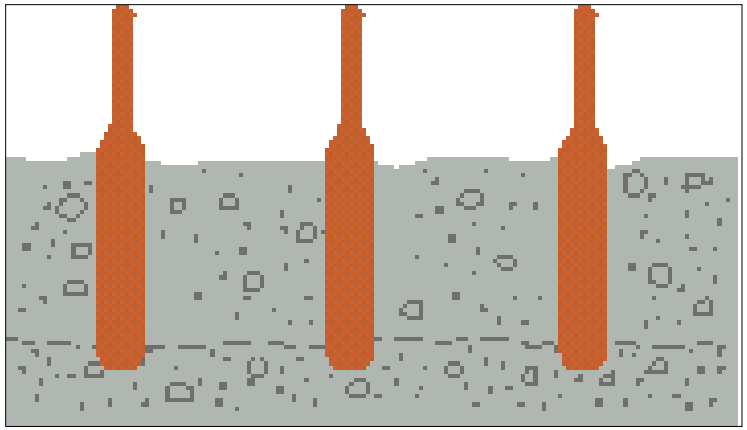
The process of compacting concrete consists essentially of the elimination of entrapped air. This can be achieved by:

- Tamping or rodding the concrete
- Use of vibrators



INCORRECT

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



CORRECT

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









CURING OF CONCRETE

- Using wet covers
- Sprinkling
- Ponding
- Water proof plastics



Wet covers



Sprinkling



Ponding



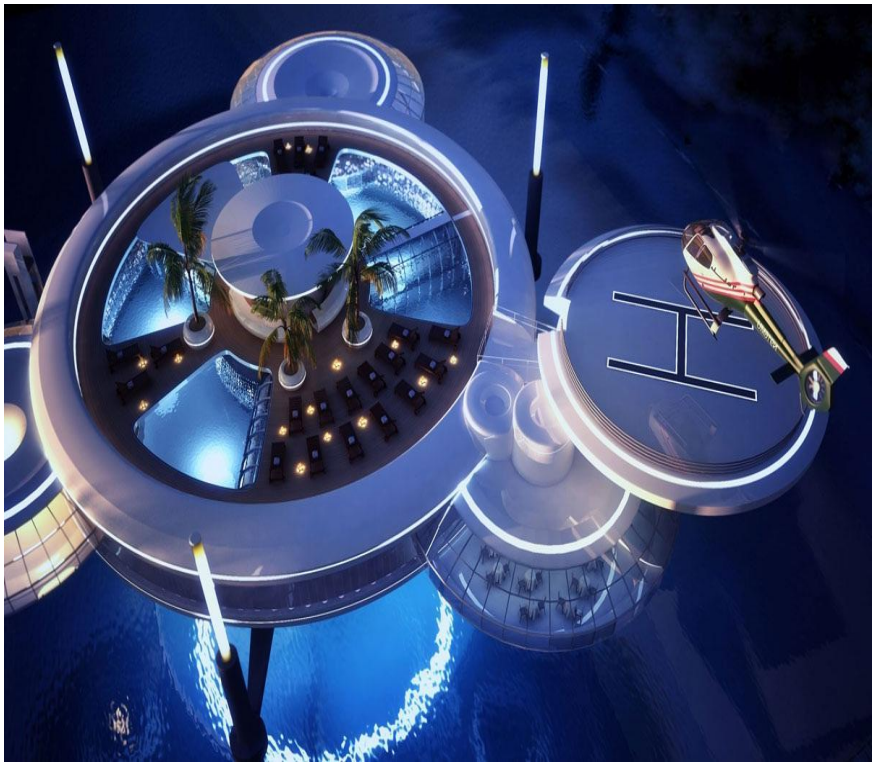
Water proof plastic

Under Water Concreting

Required when concrete has to be placed under water



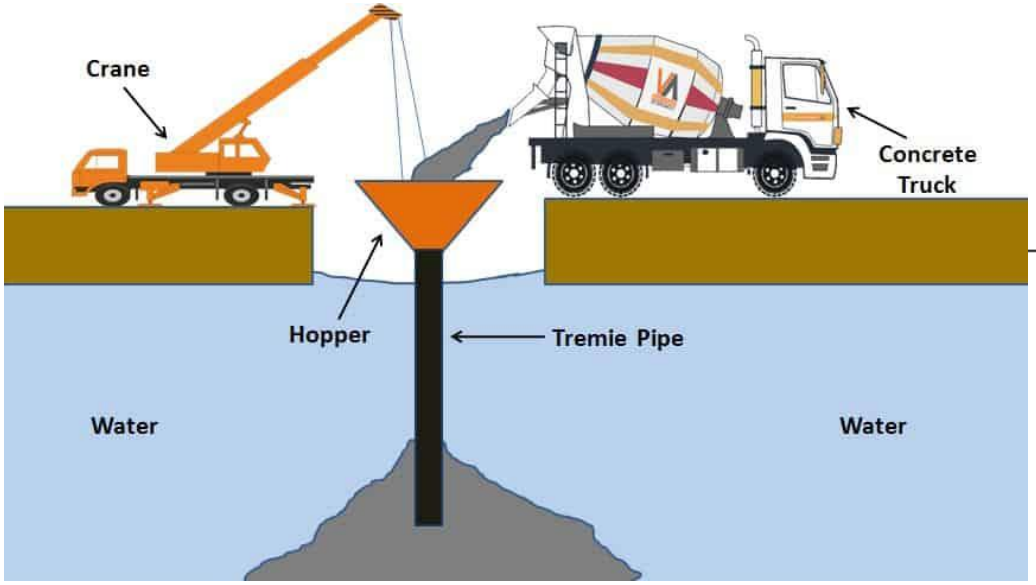
Palm Island, Dubai

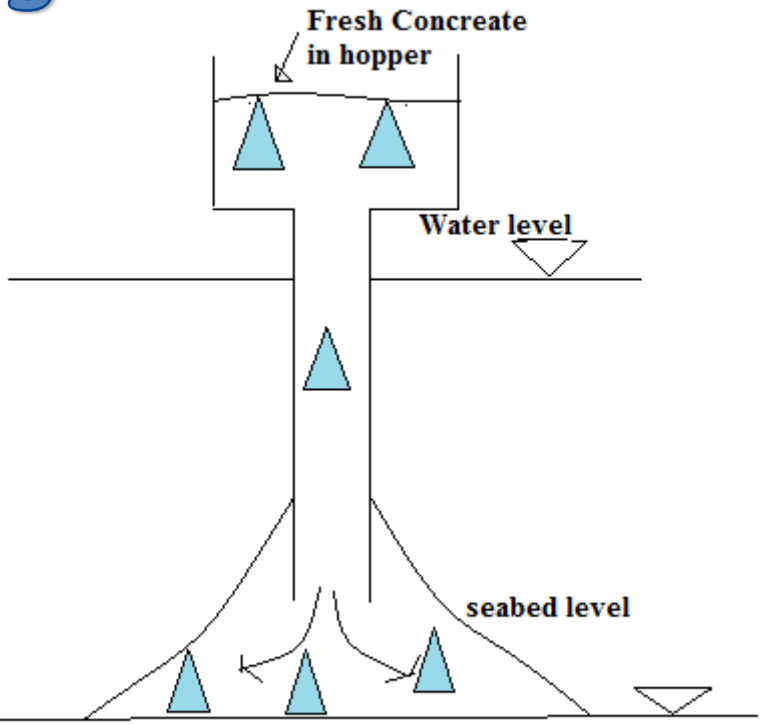


Under Water Hotel, Dubai

Problems of Under Water Concreting

- Cement wash out
- Segregation
- Water entrapment





Characteristics of Under Water Concrete

- **Flowability**

Concrete must be able to flow out easily under water and completely fill the placement area without trapping water inside.

- **Self Compaction**

As it is impractical to use mechanical vibrator under water, the concrete must compact itself by its own weight.

- **Rapid Hardening**

Concrete is required to harden quickly under water to prevent cement wash out.

Concrete Production

Offshore concrete production

Concrete production from a floating batch plant



Concrete Production

Onshore concrete production

Concrete delivery on transit mixer



Concrete Placement

Mainly two method for placing concrete under water

- **The tremie method**: places concrete solely by gravity in an open air environment.

- **Skip/Bottom opening bucket:** a bottom bucket equipped with a rolling gate is used

Tremie Method

- Consists of a rigid pipe suspended vertically below water and a hopper fixed at the top of the pipe to receive concrete.

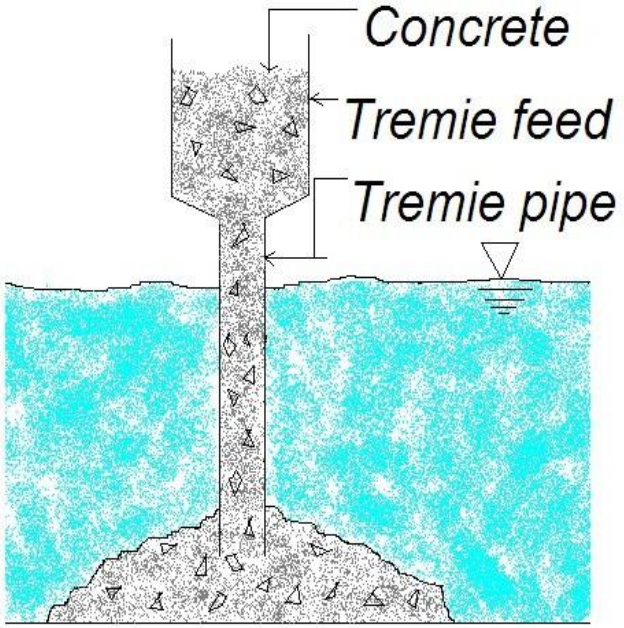


Fig:Placing concrete Under Water

Tremie Method

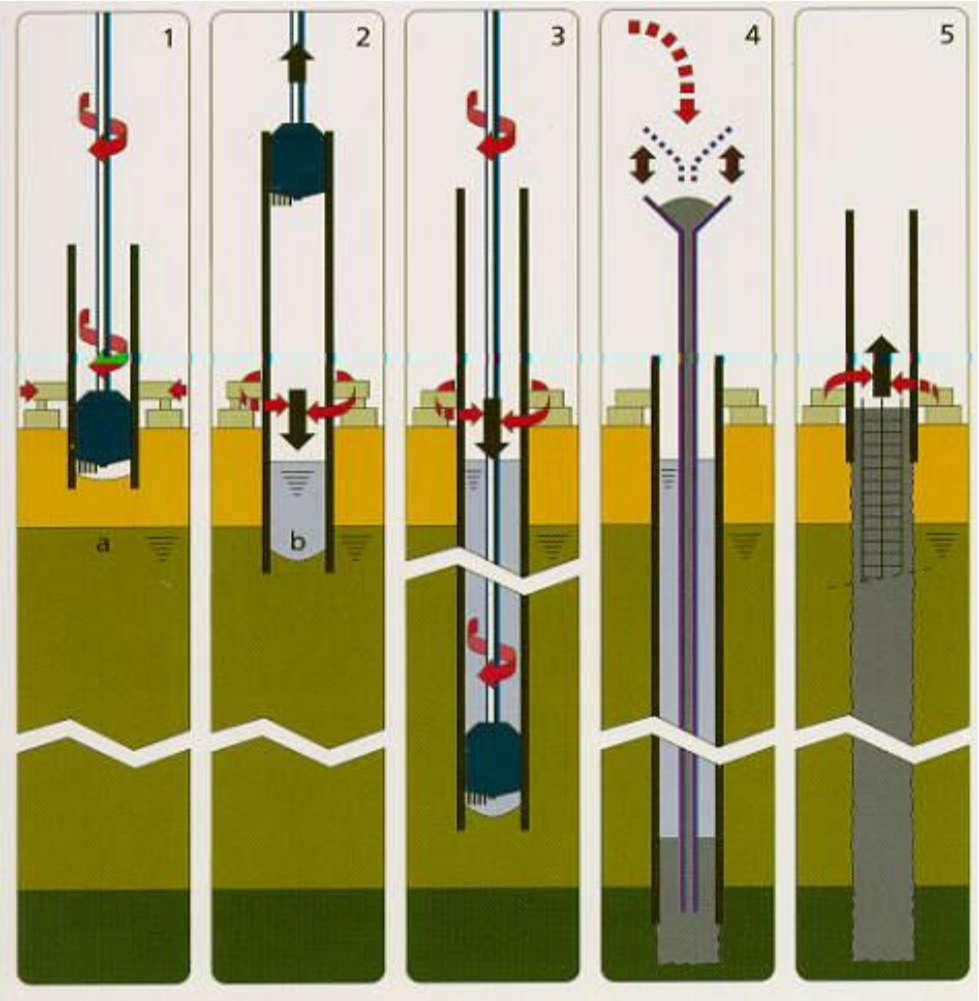
Advantages:

- Most reliable way of placing high quality concrete

- Concrete can be deposited in a continuous and controlled flow speed with little turbulence

Tremie Method

- The tremie pipe is embedded in fresh concrete to a minimum depth of 2 ft
- Vertical movement of tremie pipe should be limited
- Horizontal movement is generally prohibited



Construction procedure

Tremie Method



Placement of tremie pipe

Tremie Method



Tremie pipe placement

Concrete Protection

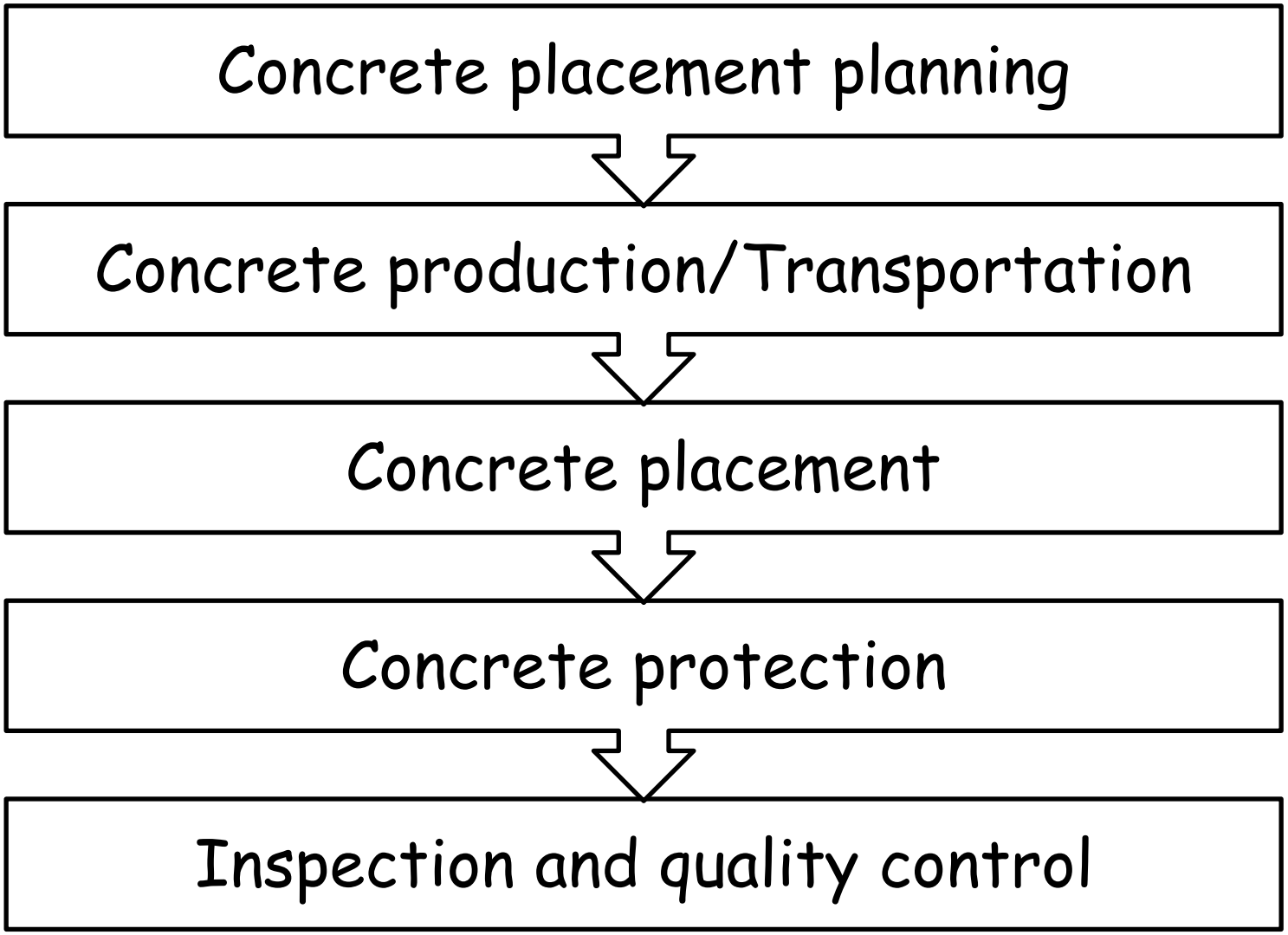
- It needs special protection from water current before it gain strength
- No pipe driving is allowed near concrete placement before it sets
- Sand bags can be used to shield the concrete
- Curtains of heavy canvas can be used to control the current

Quality Control

The following five critical items needs continuous monitoring throughout the concrete placement:

1. The rate of concrete placement
2. The depth of concrete at various locations
3. Volume of concrete produced vs volume of in place concrete measured
4. Concrete delivery system
5. Embedment depth of the tremie

Steps of Under Water Concreting



ASSIGNMENT

With suitable diagrams briefly explain the two methods of placing concrete underwater described in class.