

Flow Test

The table then raised and dropped 12.5 mm 15 times in about 15 seconds. The diameter of the spread concrete is measured in about 6 directions to the nearest 5 mm and the average spread is noted.

$$\text{Flow, per cent} = \frac{\text{Spread diameter in cm} - 25}{25} \times 100$$



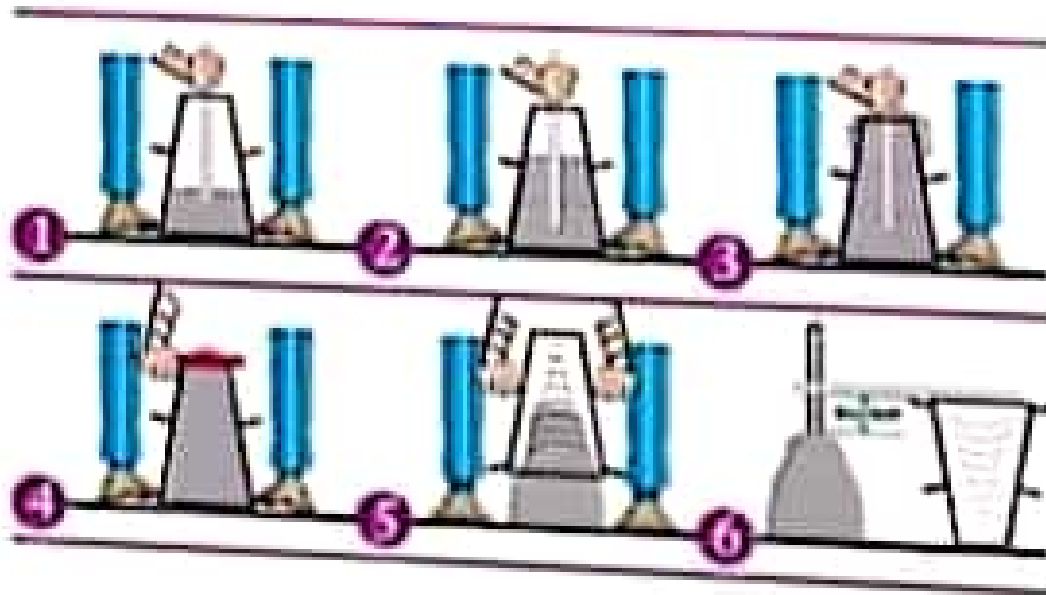
Flow Test

- ▶ This is a laboratory test, which gives an indication of the quality of concrete with respect to consistency, cohesiveness and the proneness to segregation
- ▶ The table top is cleaned of all gritty material and is wetted. The mould is kept on the centre of the table, firmly held and is filled in two layers
- ▶ The mould is lifted vertically upward and the concrete stands on its own without support

Measurement of Workability

- ❖ Slump Test
- ❖ Compacting Factor Test
- ❖ Flow Test
- ❖ Vee Bee Consistometer Test

Slump Test

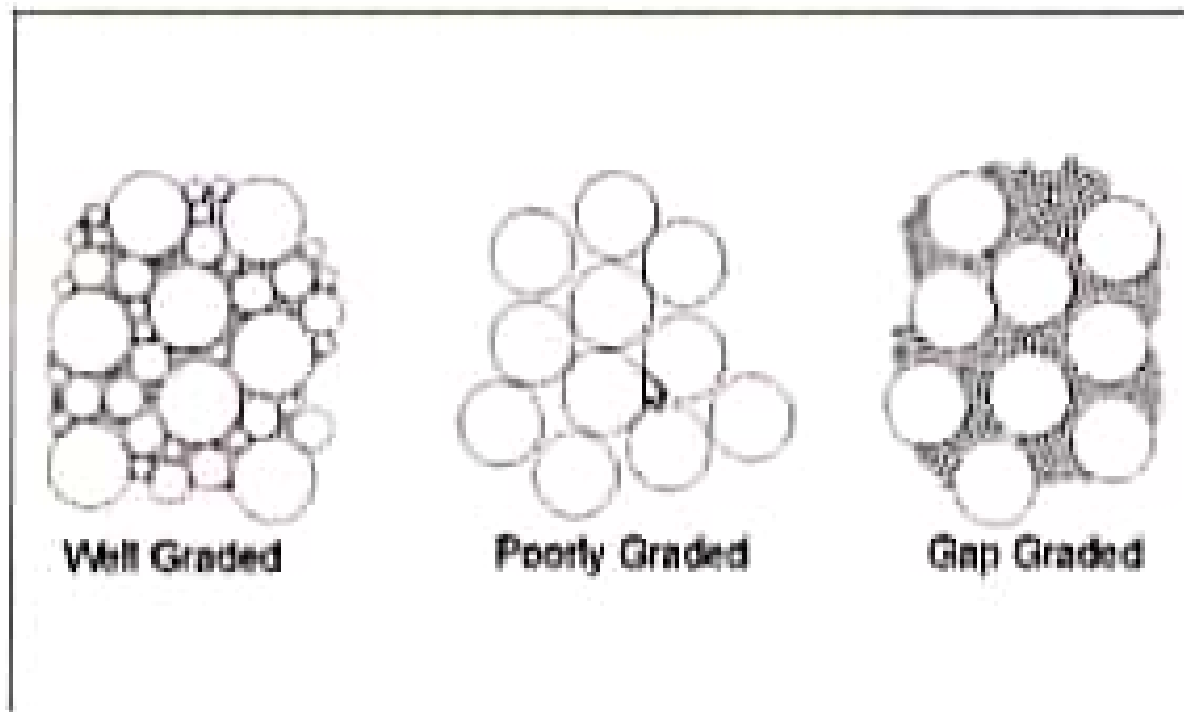


Use of Admixtures

- ▶ Chemical admixtures can be used to increase workability
- ▶ Use of air entraining agent produces air bubbles which acts as a sort of ball bearing between particles and increases mobility, workability and decreases bleeding, segregation
- ▶ The use of fine pozzolanic materials also have better lubricating effect and more workability

Grading of Aggregate

- ▶ A well graded aggregate is the one which has least amount of voids in a given volume and higher the workability
- ▶ Other factors being constant, when the total voids are less, excess paste is available to give better lubricating effect
- ▶ With excess amount of paste, the mixture becomes cohesive and fatty which prevents segregation of particles



Shape of Aggregate

- ▶ Angular, elongated or flaky aggregate makes the concrete very harsh when compared to rounded aggregate or cubical shaped aggregates
- ▶ Contribution to better workability of rounded aggregate will come from the fact that for the given volume or weight it will have less surface area and less voids than angular or flaky aggregate
- ▶ Not only that, being round in shape, the frictional resistance is also greatly reduced. This explains the reason why river sand and gravel provide greater workability to concrete than crushed sand and aggregate

Mix Proportions

- ▶ The higher the aggregate/cement ratio, less quantity of paste is available for providing lubrication, per unit surface area of aggregate and hence the mobility of aggregate is restrained
- ▶ On the other hand, in case of rich concrete with lower aggregate/cement ratio, more paste is available to make the mix cohesive and fatty to give better workability

Size & Surface Texture of Aggregate

- ▶ The bigger the size of the aggregate, the less is the surface area and hence less amount of water is required for wetting the surface and less matrix or paste is required for lubricating the surface to reduce internal friction
- ▶ Greater size of Aggregate- less water is required to lubricate it, the extra water is available for workability
- ▶ Porous aggregates require more water compared to non absorbent aggregates for achieving same degree of workability

Water content or w/c Ratio

- ▶ More the water cement ratio more will be workability of concrete. Since by simply adding water the inter particle lubrication is increased
- ▶ High water content results in a higher fluidity and greater workability. Increased water content also results in bleeding. another effect of increased water content can also be that cement slurry will escape through joints of formwork
- ▶ More water can be added, provided a correspondingly higher quantity of cement is also added to keep the water/cement ratio constant, so that the strength remains the same

Workability

Workability of concrete is the property of freshly mixed concrete which determines the ease and homogeneity with which it can be mixed, placed, consolidated and finished' as defined by ACI Standard 116R-90 (ACI 1990b)

The amount of useful internal work necessary to produce full compaction

Factors Affecting Workability

1. Water Content
2. Mix proportions
3. Size of aggregate
4. Shape of aggregate
5. Surface texture of aggregate
6. Grading of aggregate
7. Use of Admixture

Remedy of Bleeding

- 1.** Bleeding can be reduced by proper proportioning and uniform and complete mixing
- 2.** Use of finely divided pozzolanic materials reduces bleeding by creating a longer path for the water to traverse
- 3.** Air-entraining agent is very effective in reducing the bleeding
- 4.** Bleeding can be reduced by the use of finer cement or cement with low alkali content. Rich mixes are less susceptible to bleeding than lean mixes
- 5.** By delayed finishing operation
- 6.** Revibration

Problems with Bleeding

- ❖ Produces dust in summer and mud in rainy season
- ❖ Develops higher shrinkage cracks
- ❖ A plane of weakness forms continuous channel and makes flow path causes higher permeability
- ❖ Bleeding may be intercepted by aggregates and steel causes bond loss between reinforcement, paste and aggregate

Bleeding

Bleeding is sometimes referred to as **water gain**. It is a particular form of segregation, in which some of the water from the concrete comes out to the surface of the concrete, being of the **lowest specific gravity** among all the ingredients of concrete.

Bleeding is predominantly observed in a highly wet mix, badly proportioned and insufficiently mixed concrete.

In thin members like roof slab or road slabs and when concrete is placed in sunny weather show excessive bleeding

Laitance

In the case of bleeding along with water, certain amount of cement also comes up to the top surface. Formation of this cement paste is known as Laitance

Remedy of Segregation

1. Segregation can be controlled by maintaining proper proportioning, transporting, placing, compacting and correct finishing of the mix
2. Remixing for a short time will make concrete homogeneous
3. Adding air entraining agents, admixtures and pozzolanic materials in the mix segregation controlled to some extent

Causes of Segregation

6. Too wet mix if excessively vibrated
7. If vibration is done continuous for a long time
8. While finishing the concrete floors or pavements, a mason works too much with trowel, float or tamping immediately on placing concrete



Causes of Segregation

1. Badly proportioned mix where sufficient matrix is not there to bind and contain the aggregates
2. Insufficiently mixed concrete with excess water content
3. Dropping of concrete from heights as in the case of placing concrete in column concreting
4. When concrete is discharged from a badly designed mixer, or from a mixer with worn out blades
5. Conveyance of concrete by conveyor belts, wheel barrow, long distance haul by dumper, long lift by skip and hoist are the other situations promoting segregation of concrete

Means of Segregation

It is difficult to measure quantitatively, but it can be easily observed at the time of concreting operation

The pattern of subsidence in slump test/ pattern of spread in flow test gives idea on quality of concrete with respect to segregation

Segregation

- ❖ Segregation can be defined as the separation of the constituent materials of concrete
- ❖ A good concrete is one in which all the ingredients are properly distributed to make a homogeneous mixture
- ❖ There are considerable differences in the sizes and specific gravities of the constituent ingredients of concrete
- ❖ Therefore, it is natural that the materials show a tendency to fall apart

Function of Aggregate

- ❖ Cheap filler
- ❖ Hard materials
- ❖ Provide for volume stability
- ❖ Reduce shrinkage
- ❖ Provide abrasion resistance

Function of Water

- ❖ Helps to form gel which is primary contributor to strength
- ❖ The agent that cement uses to bind the other two main components together
- ❖ Gives pleasure working on concrete mix

Concrete

Concrete is a construction material composed of cement, fine aggregates (sand) and coarse aggregates with or without chemical and mineral admixture mixed with water which hardens with time.

Concrete technology deals with study of properties of concrete and its practical applications.

