

# *Fresh Concrete*

***Workability***



## Definition of Workability

**Workability Definition: Ease with which concrete can be easily mixed, compacted, transported, placed, and finished without segregation.**

**Another Definition: It is the amount of useful internal work necessary to produce full compaction; to overcome friction forces between aggregate particles. In addition, additional energy is needed to overcome friction with Formwork without segregation.**

**Strength =  $f$ (full compaction)**



**To achieve high density, concrete must be compacted properly; more voids in concrete reduces the density and greatly reduces the strength.**

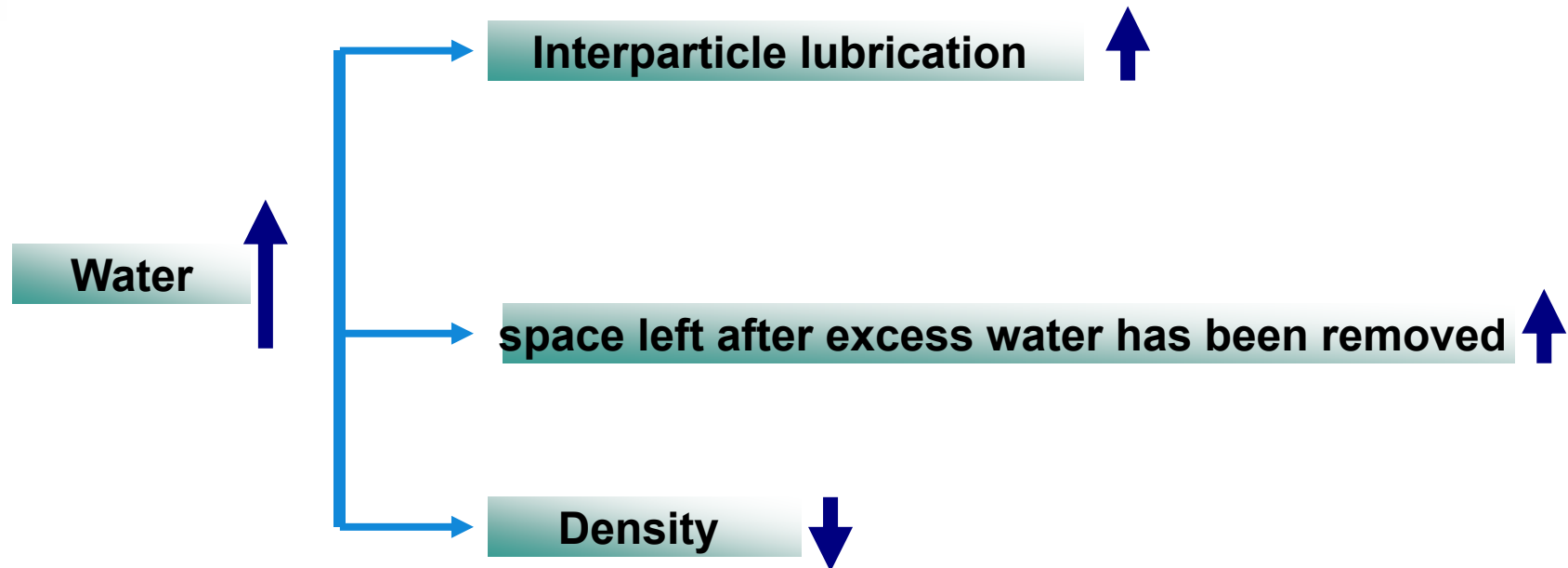
### **Two Types of Voids:**

- **Bubbles of Entrapped air: governed by fine particles grading and wetness of the mix.**
- **Space left after excess water has been removed: This depends on the w/c ratio**

**There is no optimum water content, since the later depends on the amount of compaction.**

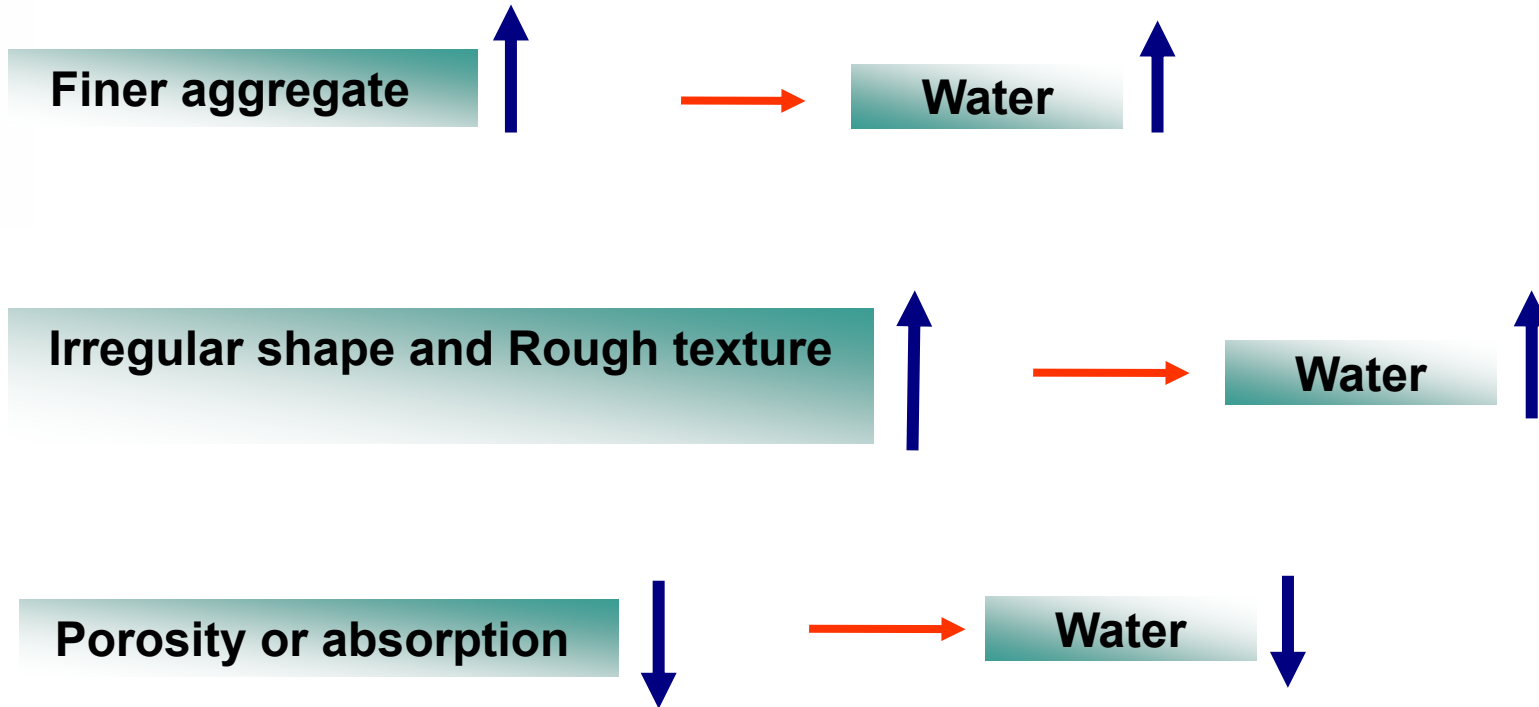
## *Factors Affecting Workability :*

**A. Water Content :** increase water content , increase workability , and decrease strength



*Factors Affecting Workability depends on :*

**B. Aggregate type and grading**



*Factors Affecting Workability depends on :*

**C. Aggregate:Cement Ratio: Constant W/C ratio**

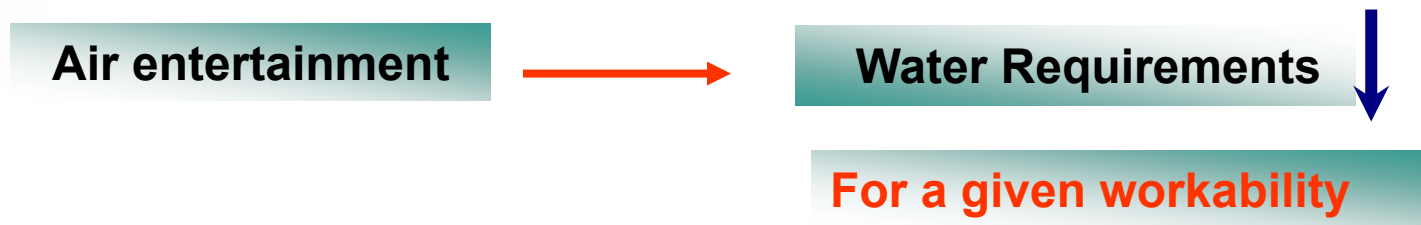


**Harsh Mix: Not Easily Finished**



*Factors Affecting Workability depends on :*

**D. Presence of admixtures**



**E. Cement Fineness** has a minor influence on workability



*Factors Affecting Workability depends on :*

**F. Time and Temperature**

Time or Temperature



Stiffening (not setting)



workability



*Water is removed by evaporation, absorption of aggregate, and some by initial reaction.*



## ***Cohesion and Segregation***

**Absence of Segregation → Full compaction (Mix cohesive)**

**Segregation:** Separation of the constituents of a heterogeneous concrete mixture so that their distribution is no longer uniform. In concrete, it is the difference in particle size or difference in the specific gravity of the mix constituents that could cause segregation; but its extent can be controlled by:

- **Choice of suitable grading**
- **Care in handling.**

## ***Cohesion and Segregation***

- ***Segregation Forms :***

- Segregation resulting from coarse particles that travel along a slope or settle more than finer particles (occurs mostly in dry mixes).
- Separation of grout (cement + water) (occurs mostly in wet mixes)

- ***To prevent or Reduce Segregation***

- Good Grading
- Appropriate handling and placing
- Proper vibration; needed to achieve good compaction:  
*not under nor over vibration.*
- Using of air entrainment
- Close specific gravities for coarse and fine aggregate -

## ***Cohesion and Segregation***

- ***Segregation Measurement***

**Difficult to measure quantitatively, but easily to detect.**

**Could be evaluated by :**

- **Measuring cohesion: evaluated by flow Table Test, or**
- **Over vibrating a cube or cylinder for 10 minutes, then observe segregation extent .**

## ***Bleeding***

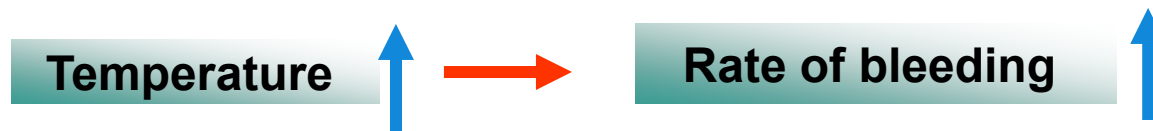
Form of segregation in which some of the water in the mix tends to rise to the surface of freshly placed concrete, caused by the inability of the solid constituents of the mix to hold all the mixing water when they settle down. Creating a weak and non-durable surface → it should be removed by brushing the surface carefully.

*Bleeding depends on:*

### **A. Water Content**



### **B. Temperature**



## *Bleeding*

**C. Properties of cement (largely affects bleeding)**

**D. Rich mixes are less prone to bleeding**

**E. Addition of Pozzolan and Aluminum powder**

bleeding



**F. Air entrainment**

bleeding



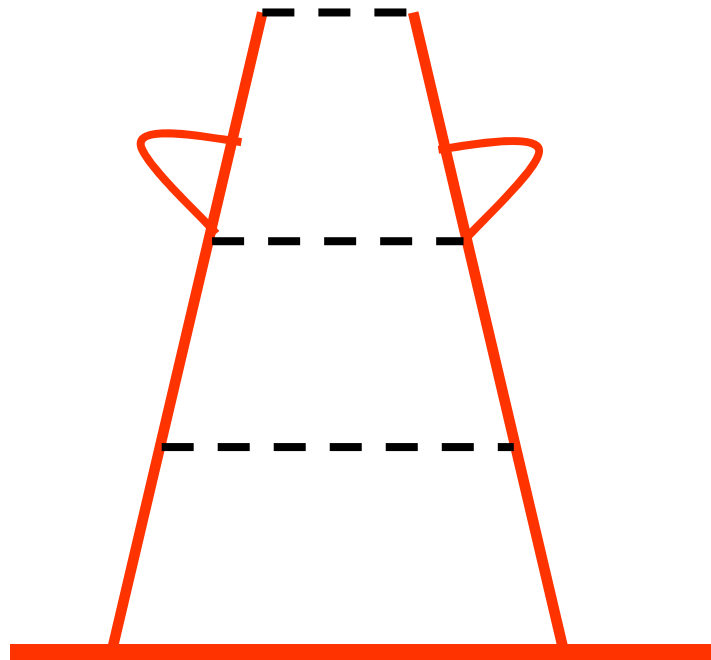
## *Workability Tests*

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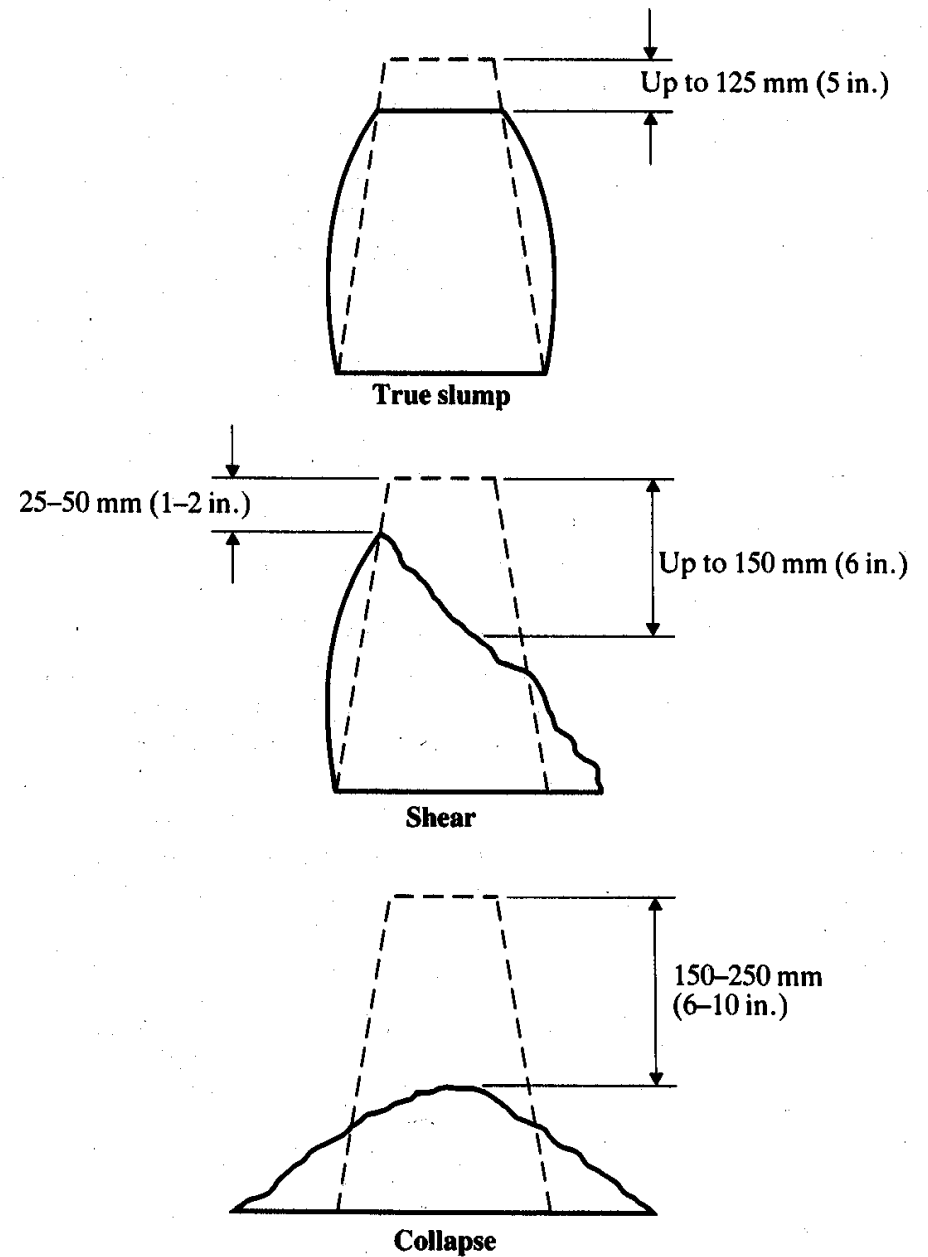
**There is no acceptable test which measures directly the workability.**

- **Slump Test**
- **Compacting Factor Test**
- **Vebe Test (From V Bahrner)**
- **Flow Table Test**
- **Ball Penetration Test**

# Slump Test



the cone is filled with concrete in three layers. Each layer is tamped 25 times with a standard 16 mm diameter steel rod.



## ***1. Slump Test***

***Is a measure of consistency of freshly mixed concrete***

***Apparatus : frustum of cone***

- **The slump is insensitive to low workability mixes (dry ones).**
- **The slump is sensitive to variation in workability of rich mix.**
- **The slump test is unreliable for lean mixes:  
True slump could easily change to Shear slump *or* Collapse slump.**
- **Routine test for checking variation and consistence of concrete mixes.**



- For each job requirement there is a certain value of slump requirement.
- Slump is **not** a measurement of the quality of the concrete

Degree of workability	Slump values (mm)
Very low	0-25
Low	25-50
Medium	50-100
High	100-175