Properties of Fresh Concrete

Fresh concrete is a transient material with continuously changing properties. It is, however, essential that these are such that the concrete can be handled, transported, placed, compacted and finished to form a homogenous, usually void-free, solid mass that realizes the full potential hardened properties.

Fresh concrete has to include the following qualifications:

1- A suitable consistency so it can be transformed, reform and pressed by reasonable amount of efforts**.**

2- The strength of concrete of give mix proportion is very affected by the degree of its compaction, therefore that the consistence of the mix be such that the concrete can be transported, placed and finished easily and without segregation.

Consistency of concrete

The consistence of concrete expresses the degree of concrete wetness and it had to be specified to insure we have a concrete that is capable of being working.

Consistency of concrete classification

1- Dry
2- Stiff
3- Medium or plastic
4- Wet
5- Sloppy

Consistency Tests are:

1- Flow Test
2- Kelly Ball Penetration Test

1- Flow test

- It is a lab test to estimate the cohesion of the elements of the concrete mix
- it can be done according to the American specifications (ASTM C- 124).
- Whenever the amount of flowing is high the degree of concrete will increase as you **may notice in the following table:**

Consistence of concrete	Flowing percentage %
Dry	0-20
Stiff	15-60
Plastic	50-100
Wet	90-120
sloppy	110-150

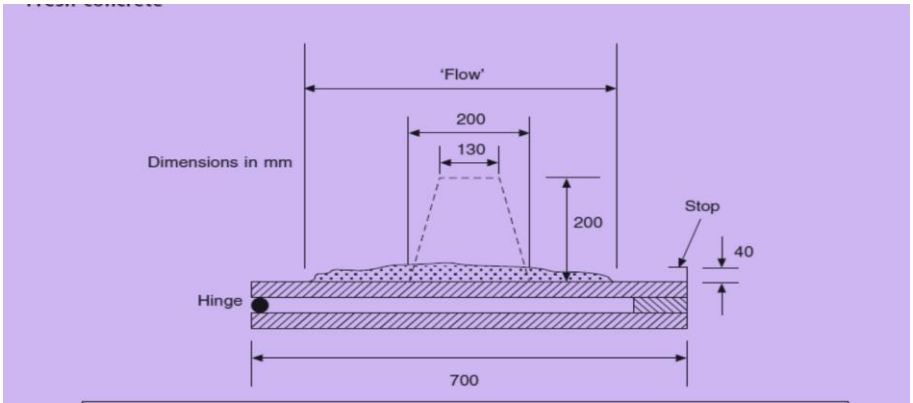

Figure 1.4 The flow table test (BS 1881 Part 105: 1984, BS EN 12350-5: 2000).

2- Kelly ball penetration test :

- It is simple field test
- It is useful in measuring the changes that may happen in the elements of concrete during production.
- It can be done according to the American specifications (ASTM C- 360)

- It can be calculated by measuring the penetration in fresh concrete to a metal tool like a half of a ball.
- The penetration increase by the increasing of concrete wetness.

Workability of concrete

Definition:

The amount of useful work necessary to produce full compaction**.** Mixed quantity of concrete with minimum loss of homogeneity). Is the necessary internal work to get a full compaction to the fresh concrete.

The exerted work to compact the concrete can be classified into:

1- Useful work

Which is the needed work to get over first the internal friction between the aggregate particles line concrete and secondly the surface friction between the concrete and the steel reinforcement and mould from the other side.

2- Lost work

Is the work that has been done to the mould and full compacted concrete.

The need for sufficient workability

The need for compaction becomes apparent from a study of the relation between the degree of compaction and the resulting strength. It is convenient to express the former as a density ratio, i.e. a ratio of the actual density of the given concrete to the density of the same mix when fully compacted. Likewise, **the ratio of the strength of the concrete is actually (partially) compacted to the strength of the same mix when fully compacted can be called the strength ratio.**

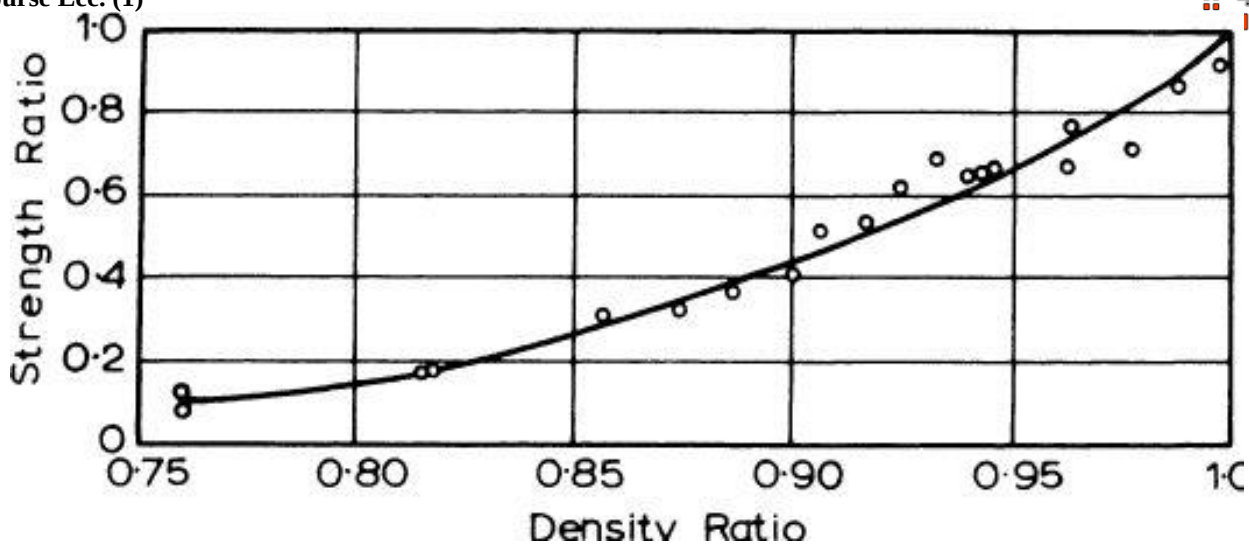

Fig. shows the relation between strength and density ratio.

Voids (5%) can lower strength by as much as 30%

Voids (2 %) can result in a drop of strength 10%**.**

Workability Tests are:

1- Slump test

- It is lab and field tests
- it can be done according to the American specifications (ASTM C-143) or the British specifications (B.S1881).
- this test dose not measure workability but it is useful in exposing the changes in the consistent of the concrete
- Slump can be divided into three states. As shown below, the types of expected slump during test are:
  1- **True slump**: in these types of slump, the concrete settles down equally.
  2- **Shear slump**: in this slump, the concrete settles down below by an inclined plane
  3- **Failure slump**: in this slump, the concrete settles down quickly so it become with specific figure any more.

  Slump test dose not used for the stiff concrete or the dry consistency concrete because it doesn't expose the changes in workability.

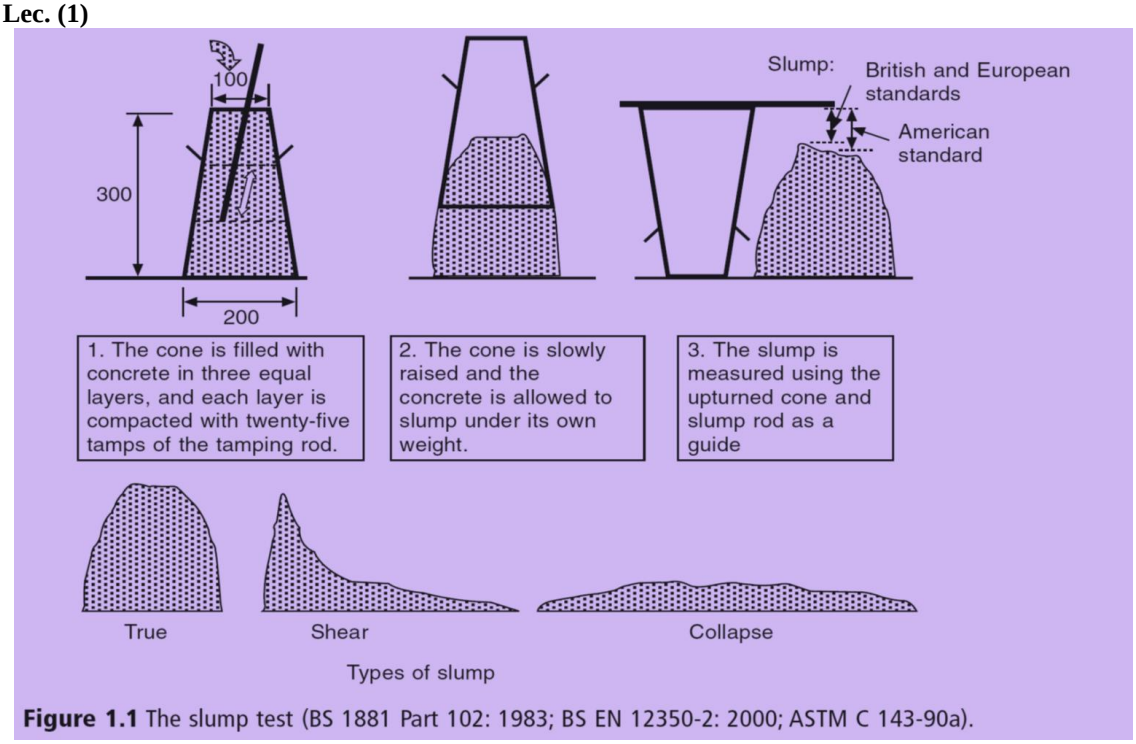

Figure 1.1 The slump test (BS 1881 Part 102: 1983; BS EN 12350-2: 2000; ASTM C 143-90a).

Compacting Factor Test:

- It is a laboratory test to measure the ratio for the weight of partial compacted concrete (because due to the free fall from specific distances) to the weight of full compacted concrete under standard conditions
- Can be done according to the British standard (BS 1881).
- It is very sensitive in the low limits of workability to the high limits of it, because the change in workability in the dry concrete will cause a big change in compacting factors.

The following table shows a comparison between the flow values and compacting factors for a various degrees of workability.

Workability	Flow (mm)	Compacting factors
Very low	0-25	0.78
Low	25-50	0.85
Medium	50-100	0.92
High	100-175	0.95

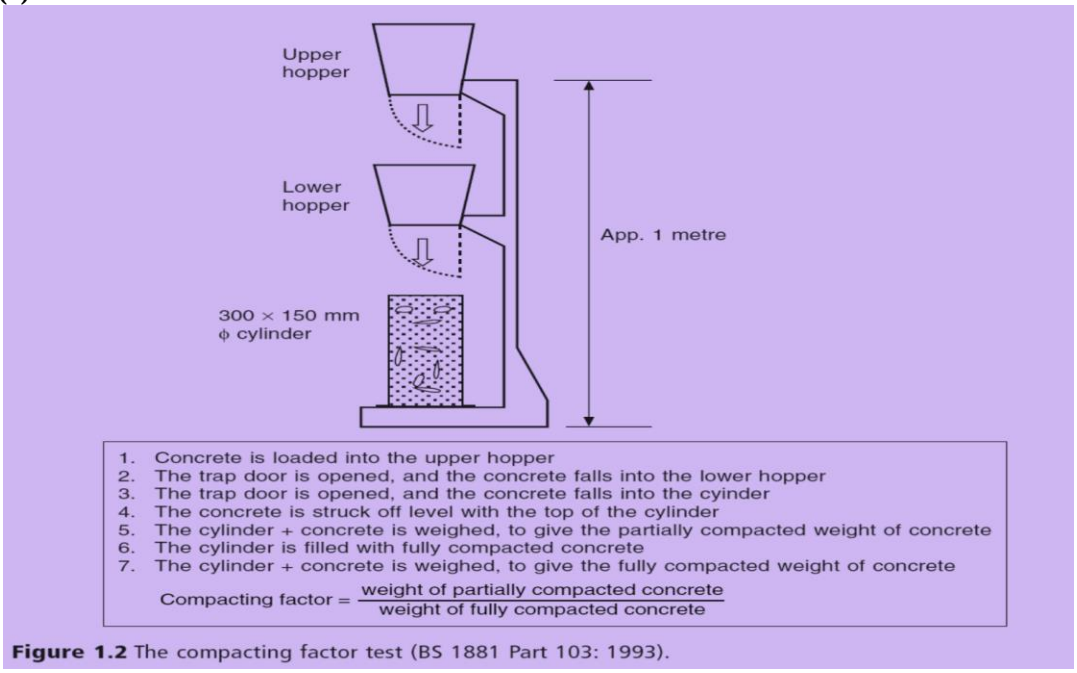

Figure 1.2 The compacting factor test (BS 1881 Part 103: 1993).

3-Ve - be time

- A laboratory test
- Can be done according to the British Standards (BS 1881)
- This is a good and suitable method for the stiff & very stiff concrete
- Not suitable method for wet and humid mixture because it may collapse during the vibration
- As a figure shows, this test measures the necessary time for the cone concrete to transform into a plane shape in a vessel by facing a frequent vibrations on the concrete (by shaking table).

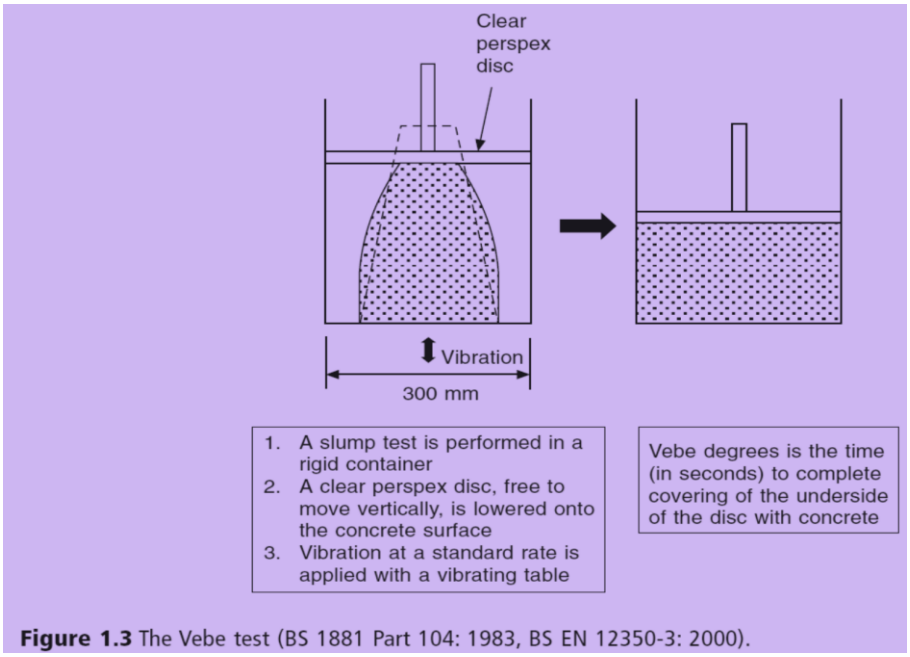

Figure 1.3 The Vebe test (BS 1881 Part 104: 1983, BS EN 12350-3: 2000).

Summary for tests

Table 1.1 Common single-point workability tests

Test	Principle	Comments
Slump (Figure 1.1)	measures a flow property of concrete under self-weight after standard compaction	• suitable for medium and high workability concrete • sensitive to small changes in water content • very simple, suitable for site use • heavily operator dependent
Compacting factor (Figure 1.2)	measures the effect of a standard amount of work (height of fall) on compaction	• suitable for low, medium and high workability mixes • fairly simple, but requires scales • less operator dependent than slump
Vebe (Figure 1.3)	measures the amount of work (time at constant vibration) for full compaction	• suitable for very low and low workability mixes • greater relation to concrete placing conditions than slump • more complex than other methods, requires standard vibrating equipment • sometimes difficult to define end point
Flow table (Figure 1.4)	measures the effect of a standard amount of work (bumps) on spread	• suitable for high and very high workability mixes • gives some indication of tendency of mix to segregate • fairly simple, but, like slump, operator dependent