Initial And Final Setting Times

- ***Consistence*** is defined as the degree of thickness or solidity or viscosity of something made by mixing with water.
- The consistence of standard paste is measured as the water content of the paste, expressed as a percentage by weight of the dry cement.
- Standard consistence is indicated by the ***Vicat apparatus***.

- In the Vicat apparatus, a 10mm diameter plunger is allowed to settle down into the paste under a standard force.
- The usual range of values for the standard consistence is between 26 and 33%.
- As a fist attempt, the paste is made by adding 26% water and is placed in the mold of the apparatus.
- The penetration of the plunger is measured in terms of the distance between the bottom of plunger and the bottom of the mold.

- A lesser value indicates more consistence and vice versa.
- The moisture content is adjusted such that the reading becomes 5 to 7mm from bottom of the mold.
- ***Consistence of standard paste*** is indirectly useful for the determination of the initial and final setting times of cement and for the Le Chateliar soundness test on cement.

- The term ***setting*** is used to describe the stiffening of the cement paste.
- In other words, setting refers to change of state from a fluid to a rigid one.
- It is opposite to plasticity or workability of the paste.
- The speed of setting and the rapidity of hardening (gain of strength) are entirely independent of each other.
- Hardening is the gain of strength due to chemical reactions.

- Although the paste acquires some strength during the setting, it is convenient to distinguish setting from hardening.
- C_3S is the main component responsible for the setting of cement.
- Set of cement occurs earlier due to rapid formation of the crystalline products, the development of films around cement grains and the mutual coagulation of components of the paste.

- ***False set*** is the name given to the premature stiffening of cement within a few minutes of mixing with water.
- This occurs without evolution of heat and any significant reactions.
- Remixing with additional water restores the plasticity without any loss of strength.
- In case of ***flash set,*** appreciable heat is evolved and remixing produces loss of strength.
- Flash set is caused by C_3A component in the absence of gypsum.

- **Initial setting time** is defined as that degree of setting after mixing water in the cement beyond which remixing can cause decrease of strength.
- The initial setting must be sufficient to allow proper mixing, placing, transportation and compaction of concrete.
- A minimum time of 45 minutes for initial set is prescribed by BS 12 for ordinary and rapid hardening Portland cements.
- According to BS1370, the minimum setting time is 60 minutes for low heat Portland cement.

- A minimum setting time of 60 minutes is specified by ASTM C150 for Portland cement.
- For the determination of the ***initial setting time***, paste of standard consistence and the same apparatus fitted with a round or square needle at the bottom of the plunger having a cross sectional area of 1mm2 is used.
- The readings of the plunger from the bottom of the mold are taken at regular time interval and when the reading becomes in-between 5 to 7 mm the time is recorded as the initial setting time.

- Initial and final setting times are important in design of formwork, mixing and placing concrete, and in start of curing.
- ***Final setting time*** is defined as the degree of setting where the cement material changes completely into a solid, setting ends and only hardening continues.
- It is determined exactly in the same way as the initial setting time with the difference that now the bottom of the plunger is fitted with a 1mm square needle fitted with a 5mm diameter attachment in the form of a cutting edge installed 2.5mm behind the tip of the needle.

- The edge is projected out by 0.5 mm from the base of the attachment.
- Final set is obtained when the needle sinks into the paste but the plunger does not make any impression on the paste surface.
- Lesser final setting time is advantageous because the hardening and strength gain of the cement may be started earlier and formwork may be reduced in a lesser time.

- Final setting time should not be more than 10 hours for ordinary, rapid hardening, low heat and blast-furnace Portland cements.
- The temperature during all of these tests must be between 14 and 18° C and relative humidity of air should not be less than 90 percent.
- An approximate relationship between the initial and final setting times is as under:

  Final setting time (min)

  = 90 + 1.2 × Initial setting time (min)

Apparatus

- Weigh / mass determining instrument.
- Vicat apparatus.
- Required plungers.
- Graduated glass cylinder.
- Spatula.
- Glass or impervious plate.
- Trowel.
- Thermometer.

Cement Required For One Filling

- Cement required for one filling = 500 gm.
- Mixing time = 4 ± ¼ min.
- Initial setting time reading may be taken at an interval of 10 min.
- Each test must be performed at least 5mm away from previous penetration and at least 10 mm from the mold.
- Readings of the standard consistency test may be recorded in the following table:

S. No.	Cement (gms)	Water (gms)	Percentage water	Vicat Reading	Time of adding water
Standard consistence = _____ %age.					

GENERAL OBSERVATIONS

- Type of cement.
- Name of manufacturer.
- Delivered by:
- Date of delivery:
- Delivery receipt no.
- Packing: air-tight / not air-tight
- Samples taken by: