Fresh State Properties

Slump Cone Test

Principle : The effect of gravity on the behaviour of compacted concrete.

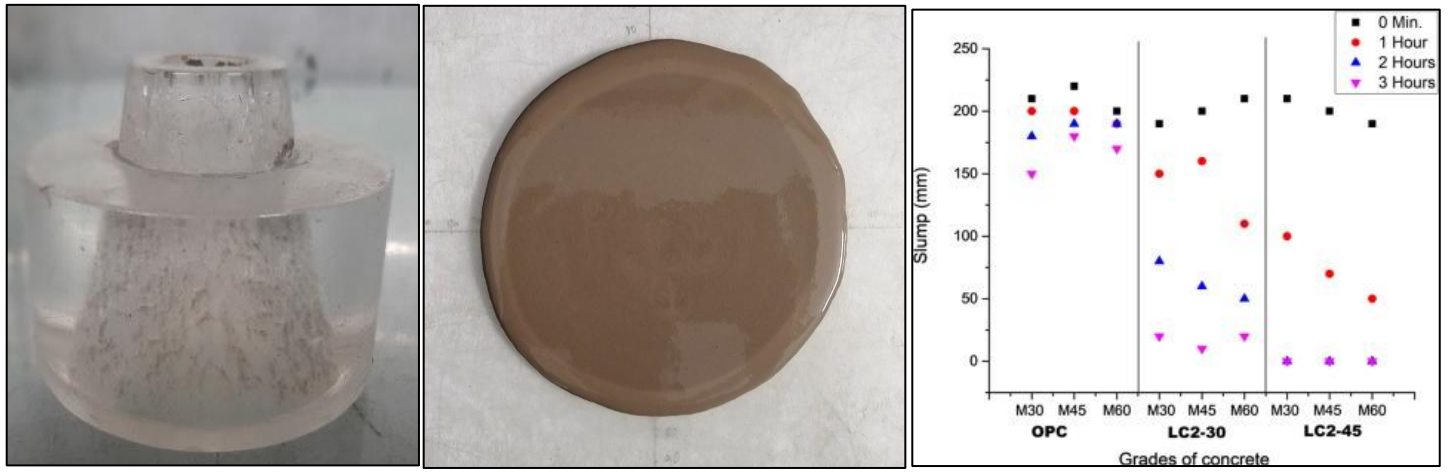
Codes : IS 1199 -1959

Major use : To measure consistency and workability of concrete. To determine effect of admixtures on workability over time by slump retention test.

Mini – Slump cone Test

Principle : The cement flows under gravity, the spread is also measured to correlate with rheological properties.

Major Use : To determine early stiffening and consistency of cement, compatibility of different plasticizers and super plasticizers.



Mini-slump cone (left), spread (centre) and plot for compatibility of PCE based HRWRA on different cementitious binders (right) (Nair et al. 2020)

Flow Table Test

Principle: To measure the spread due to repeated drops of 12.5 mm for 25 times in 15 seconds.

Codes: ASTM C1437-15

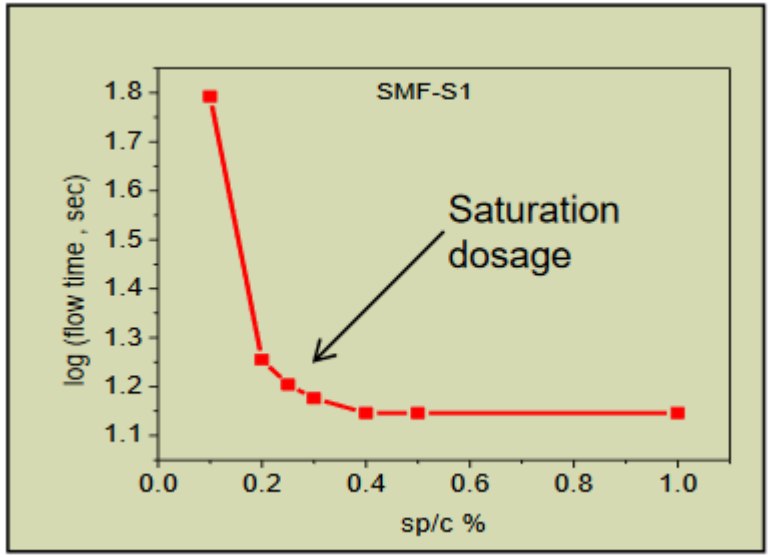
Major Use : To determine consistency, cohesiveness and probability of segregation of concrete and mortar.

Marsh Cone Test

Principle : Flow of cement pastes and grouts under gravity through the orifice.

Codes : ASTM 939

Major Use : To determine fluidity, optimum dosage of plasticizer and super plasticizer, rheological parameters like yield stress and viscosity etc.



Determination of Saturation SP dosage

Compaction factor study

Principle: The compaction factor is the ratio of weight of partially compacted material (by gravity) to fully compacted material (tamped).

Codes : IS 1199-1959

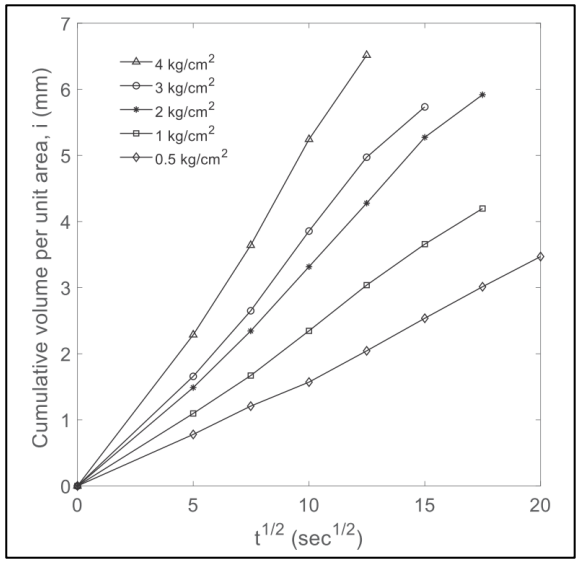
Major Use : To determine workability of stiff mixes of concrete with low slump values.

Pressure Bleed test/ Pressure filter test

Principle : The segregation of water (bleeding) under a static pressure.

Codes : ASTM C 1741 - 18

Major Use : to determine stability of grouts, segregation potential under pumping pressure, extrudability of 3D printable concrete.



Bleed value under different static pressure (Rahul et al. 2020)

Rheology

Vane shear apparatus (top left), Rheometer (top right), Brookfield viscometer with spindle (bottom)

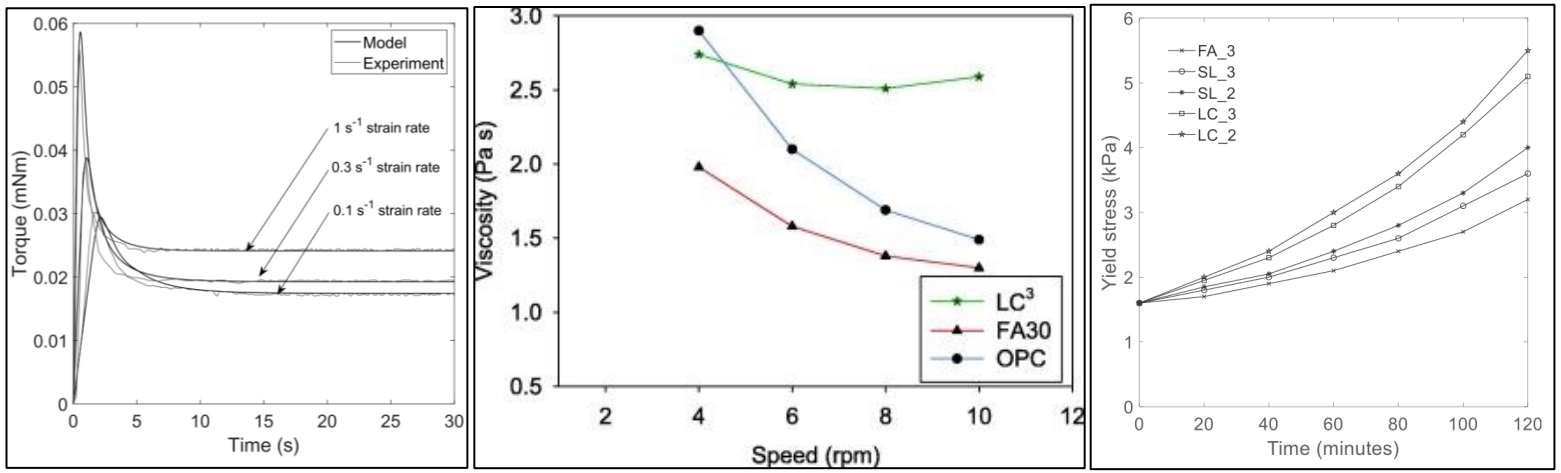
Principle : The cement/ concrete is a yield stress thixotropic material. The parameters like static shear yield stress, dynamic shear yield stress, thixotropy and viscosity governs the flow of concrete. The rheological models widely used are Bingham model or Herschel-Bulkley model.

$\tau = \tau_0 + \eta\Upsilon^n$

where τ is shear stress, τ_0 is yield stress, η is viscosity (constant for Bingham model), Υ is shear rate (n is 1 for Bingham fluid)

Codes : Vane shear apparatus – IS 2720-30

Major Use : To determine basic flow parameters for cement and concrete mortar.

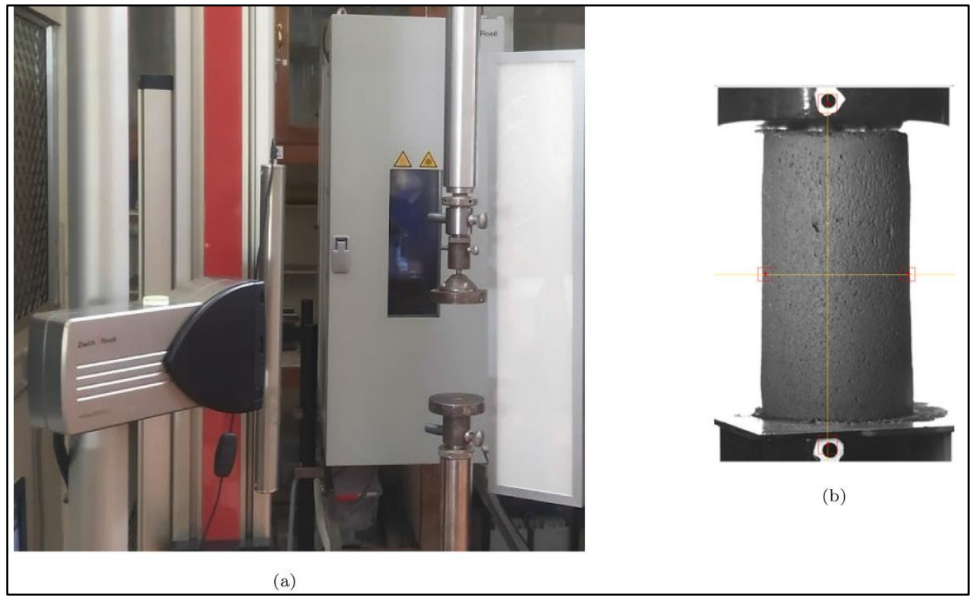


Evaluation of torque for cement using rheometer (left), Viscosity for different binder system using Brookfield viscometer (centre), Static Yield stress evolution using vane shear apparatus (right)

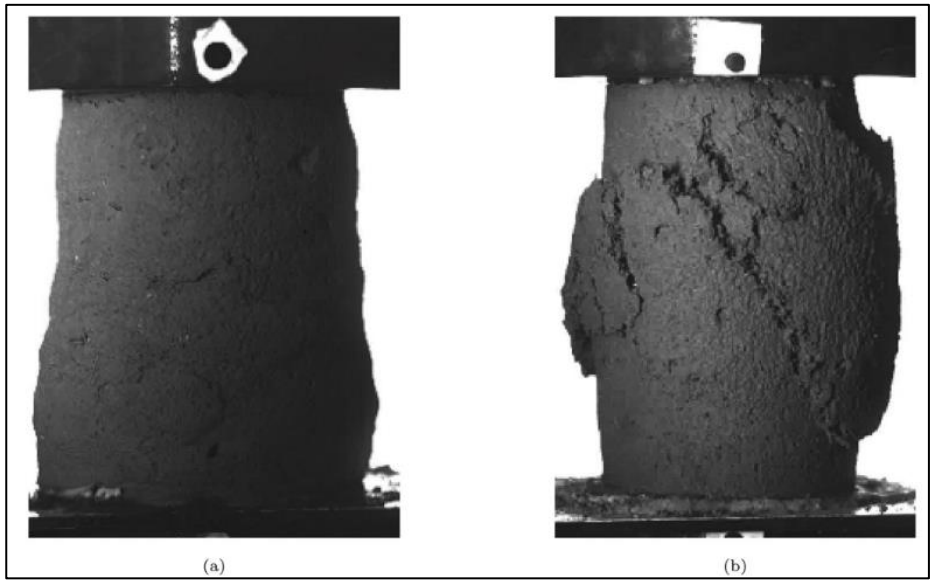
Green Strength Study

Principles: The uniaxial compressive strength and young's modulus evolution of concrete at early ages (0 hour to 24 hours).

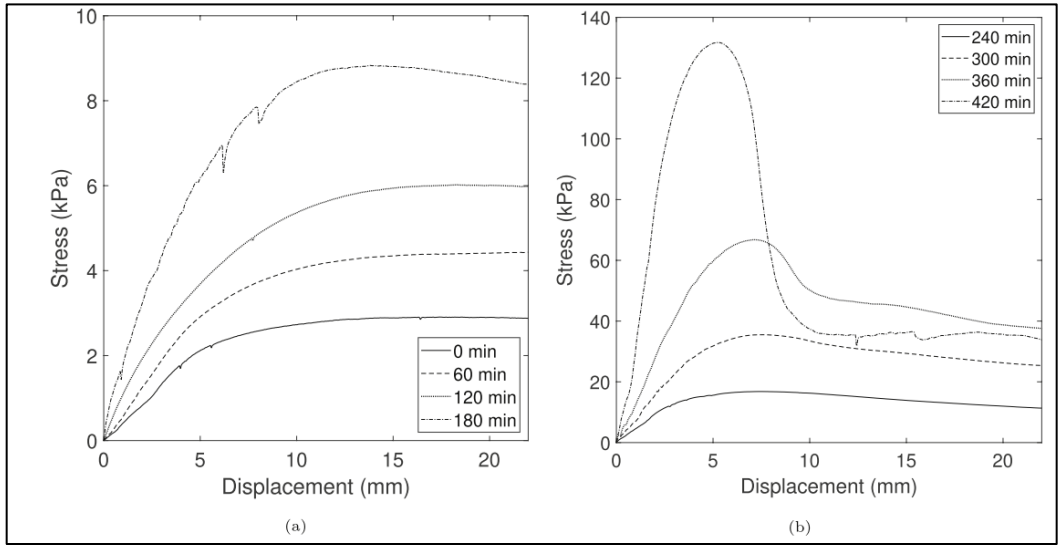
Major use : Determination of yield strength in 3D concrete printing



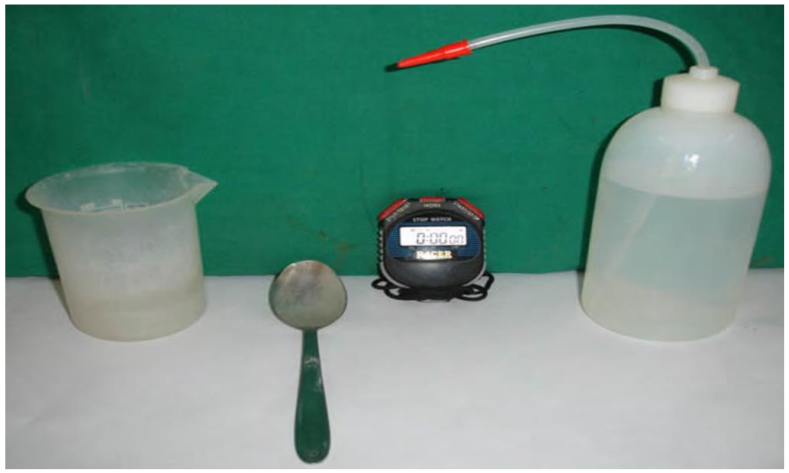
Uniaxial compression test setup with the video extensometer system (a) Gauge point detection in the video extensometer system (b)



Failure modes of control mix specimen at the age of (a) 0 min (b) 420 min.



Stress vs displacement graph for CA30 mix at different ages from (a) 0–180 min (b) 240–420 min.



Apparatus for Puntke test (top), mix before saturation limit (bottom left), mix after reaching saturation limit (bottom right)

Puntke Test

Principle: The excess water after completely filling the voids appears at surface of the mix. This indicates the saturation limit.

Major Use : Optimisation of powder composition. Used for SCC and 3D printable concrete.

Packing of aggregates (Ternary packing diagram)

Principle : Maximum Packing density of aggregates

Major Use : Ready mixed concrete plant, large scale construction, SCC