PROPERTIES OF HARDENED CONCRETE

- The major properties of hardened concrete are:
  a) Strength
  b) Modulus Of Elasticity
  c) Durability
  d) Creep
  e) Shrinkage
  f) Watertightness (impermeability)
- The properties of hardened concrete depends on:
  a) Mix proportions (have greatest effect)
  b) Curing conditions
  c) Environment

Compressive Strength

- Generally considered in the design of most concrete mixes.
- Strength properties of concrete in a structure usually estimated using test performed on a small samples, made from fresh concrete as it is placed in the structure, which are cured in the labaroatory in a standard manner. (Cube test)
- Compressive strength is by many factor.

- Compressive strength of can be affected by the following factors such as:
  a) Quantity of cement
  b) Amount of water
  c) Types of ingredients
  d) Mix proportions
  e) Curing
  f) Temperature
  g) Age
  h) Size & Shape of specimen
  i) Test conditions

Effects Of The Type & Amount Of Cement

- Alteration of the quantity & makeup of the paste by varying the amounts and water will give concretes with different compressive strength.
- Rate of hydration is not same for all type of cement.
- Example:
  Cements containing high precentage if Tricalcium Silicate gain strength much faster than do cements containing more Dicalcium Silicate.

Effects Of Aggregate

- Strength of concrete improves with increase in the fineness modulus of the fine aggregate.
- A higher number of fineness modulus means a coarser gradation
- Increase in fineness modulus, the surface area of particles goes up, requiring less mixing water at the same consistency.
- Decrease in amount of water improves the compressive strength of concrete.

- Larger max. size coarse aggregate with lower water requirement can produce strong concrete. Reduction in w/c ratio improves the strength of concrete.
- Using larger aggregate without decrease in amount water decreases the compressive strength
- Strength of concrete could also be affected by the type and size of coarse aggregate.
- Angular & rough surface texture particles granite aggregates may contribute to an increment in compressive strength of up to 20% compared to concrete made with river gravel at the same w/c ratio.

Effects Of Water-To-Cement Ratio

- The w/c is the ratio between the weight of water and cement in a concrete mix.
- For proper hydration, w/c ratio should be 0.35
- In practice, w/c 0.55-0.65, for workable concrete
- Increase in amount of mixing water, while keeping the cement content constant would lead to increase in the void content and the concrete strength drops.
- Increase water lead to decrease of concrete strength

Influence Of Voids

- Increase in water content increase the voids in concrete, lowering the durability, watertightness and compressive strength.
- Good dense concrete requires a sufficient amount of cement to achieve strength, suitable gradation to minimize the void content & proper consolidation to remove air bubbles trapped within the mass.
- Amount of water should just be enough to guarantee the hydration of all cement grains.

- Any excess water in the mix (water that doesn't participate in hydration process) hikes the amount of voids that will be filled with air or water depending on moisture content.
- Increase in voids, diminishes the quality of concrete.
- A good quality concrete need to be considered on the following aspects during concrete making such as:
  a) sufficient amount of cement
  b) well-graded aggregate
  c) ample compaction
  d) minimum mixing water.

Benefits Of Curing

- Concrete ripen and grow stronger with age & curing
- The strength of properly cured concrete at 1 day after mixing is about 10-15% of its 28 days strength. At 7 days, it is about 50-60 percent.'
- Improvement in strength of concrete beyond a year is small
- Increase of water temperature, either at mixing stage or during curing, augments the rate of gain in strength.