

## DURABILITY OF CONCRETE

### SHRINKAGE:

#### Setting shrinkage:

- Plastic shrinkage
- Chemical reaction
- Cracks occurs soon after placing and under moist conditio
- Drying shrinkage:
- Drying shrinkage
- Rapid drying while setting occurs
- Cracking of exposed surface due to high wind, low humidity
- Temperature differences
- Proper protection

#### Drying shrinkage:

- Loss of water
- Cracking of buildings slabs and walls
- Dense mixes with low cement and water content adequate curing

#### Chemical action:

- Concrete and steel
- Expansion of internal mass resulting in cracking of external skin
- Reactive aggregate
- Corrosion of reinforcement
- How alkali cement and non-reactive aggregate
- Thick and dense layer at productive concrete

#### Temperature:

##### Internal:

- Differential expansion and contraction
- Heat of hydration of cement
- Aggregate of abnormal thermal expansion
- Low heat cement and control of temperature rise
- Aggregates of normal thermal expansion

##### External:

- Climate changes, frost action
- Large slabs (or) walls without adequate joints

- Spalling of surface
- Adequate expansion, contraction joints
- Air entrainment and sound concrete

**Structural failure:**

- Excessive tensile stress due to load
- Building settlement, excessive load , vibration earthquakes and insufficient reinforcement

**Effects of temperature:**

- Fire resistance
- Freezing and thawing
- Effects of salts
- Moisture movement

**Fire resistance:**

- Concrete though not a refractory material is in combustible and as good fire resistance.
- The heating of reinforcement aggravates the expansion of both laterally and longitudinally of the reinforcement bars, resulting in loss of strength of reinforcement.

**Freezing and Thawing:**

- The lack of durability of concrete on account of freezing and thawing action of frost is not of great importance to Indian conditions.
- Frost action is one of the most powerful weathering actions on the durability of concrete.
- The durability of concrete is affected by alternative wetting and drying, heating and cooling.
- Freezing is one of the very important factors affecting the durability of concrete in the cold countries.
- It is very well known that fresh concrete should not be subjected to freezing temperature.
- Fresh concrete contains considerable quantity of free water.
- The fully hardened concrete is also damaged particularly to the effect of alternate cycle of freezing and thawing.
- A freezing starts at a surface in the largest cavities and gradually extend to smaller cavities.

**Effects of chemical action:**

**Sulphate attack:**

- Most soil contains some sulphate in the form of calcium, sodium, magnesium and ammonium sulphate.
- Sulphate attack is a common occurrence in natural industrial situation.
- In calcium sulfo-aluminate forming within the frame work of hydrated cements paste.

Methods of controlling sulphate attack:

- Use of sulphate resisting cement.
- Quality concrete.
- Use air entrainment.
- Use of pozzolona cement.
- High pressure steam curing.
- High alumina cement.

**Alkali aggregate reaction:**

- Hydroxyl ions in the pore water within concrete.
- Alkali silica reaction in the aggregate.
- Alkalis come from sand containing sodium.

Chlorides, admixtures, mixing of water, sea water penetration, fly ash, blast furnace slag.

**Acid attack:**

- Concrete is not fully resistance to acids.
- Portland cement concrete depending upon the oxalic acid and phosphoric acid.
- With the sulphuric acid, calcium sulphate, calcium aluminates, calcium sulpho-aluminate which on crystallization can cause expansion and disruption of concrete.

