UNIT :- 1

DURABILITY OF CONCREATE STRUCTURES

* Deterioration :- Freezing & Thawing :-

The lack of durability of concreate on account of freezing & thawing action of frost is not of great importance to india conditions. But it is of greatest consideration in most parts of the world. However the certain regions in India the experience the sub-zero temperature in winter. The concreate structures particularly the one of which are exposed to atmosphere, are subjected to cyles of freezing and thawing and as such suffer from the damaging action of frost. The frost action is one of the most powerful weathering action on the durability of concreate.

In the extreame conditions, the life span of concreate can be reduced to [cost] just a couple of years. The damage from freezing and thawing is the most common and is such, it is one of the extensively studying field on preserving of concreate in the united states of America, Russia, North and European countries like as Germany, UK & France.

* Sulphate attack

Most soils containing some sulphate in the form of calcium, sodium, potassium, magnesium. They occur in soil & ground water because of solubility of the calcium sulphate is low, ground water contain more of other sulphates and less of calcium sulphate. Ammonium sulphate is frequently present in agricultural soil and water from the use of fertilizers are from sewage and industrial effluents, Decay of organic matter & of marshy land, shallow lakes often leads to the formation of H_2S which can be transformed into sulphuric acid by bacterial action. water used in concrete coating tower can also be a potential source of sulphate attack on concrete cracking.

* Acid Attack :-

Concrete is not fully resistant to acids most acid solutions will slowly & rapidly disintegrated port land cement. Concrete depending upon the type and constitution of acid. Certain acids, such as oxalic acid and phosphoric acid are harmless the most part of the cement hydrate is $CaOH_2$ but C-S-H gel can also been attacked. Concrete can be attacked by liquids with pH value less than [2] 6.5. But the attack is severe only at a pH value below 5.5. If a pH value below 4.5 the attack is varying severe as the attack proceed all the cement compounds are eventually broken, doms & leads to leached away, together with any carbonate aggregate material.

* Carbonation :-

Carbonation of concreate is the process by which carbondioxide from the air penetrate into concreate and react with calcium hydroxide to form calcium carbonates. we have seen earlier that the conversion of $CaOH_2$ into $CaCO_3$ by the action of CO_2, results in a small shrinkage. Now we shall see another aspect of carbonation. CO_2 by itself is not reactive. In the presence of moisture, CO_2 changes into dilute carbonic acid which attacks the concreate and also reduces the alkalinity of concreate. Air contains CO_2 the concentration of CO_2 in rural air may be about 0.03% by volume of larger cities the content may go upto 0.3%.

* Chloride Attack :-

Chloride attack is one of the most important aspects for consideration when we deal with the durability of the concreate. Chloride attack is particularly important because it primarly causes corrosion of concreate reinforcement. statistic have indicated that over 40% failure of structure is due to corrosion of reinforcement. the protective layer can be losed due to the presence of chloride in the presence of water and oxygen.

* Aggregate Reactions :-

Alkali aggregate reaction is basically a chemical reaction between the hydroxide ions in the water which exits in concreate and certain types of rock materials which sever time occur as a part of the aggregate.

since reactive silica in the aggregate is involved in this chemical reaction it is often called alkali silica Reaction [ASR].

Deterioration of Concrete by Abbrasion and Erosion and Cavitation :-

Concreate is used in certain situations it required to exhibit good abbrasion and erosion properties. Abbrasion refers to wearing away the surface by friction. Erosion refers to the same action by the fluids. The cavitation refers to the damage due to non-linear flow of water at velocities more than the 12 mts per a second.

The concreate used in the roads, floors and pavements & the concreate used in the hydraulic structures should exhibit resistance against abbrasion, erosion and cavitation.

The resistance against the is closely connected with the compressive st of the concreate. The more the compressive strength the higher is the resistance to the abbrasion. Hardness of concreate of aggregate particularly the coarse aggregate is importan to abbrasion resistance.

Although for concreate of strength of "56MPA" and above the effect of aggregate hardness is not so important.

This is the deterioration of concreate by Abbrasion, erosion and cavitation.

- Construction movement
  - Sub grade
    - Settlement of sub-grade
    - Moisture changes in subgrade or lack of compaction of sub-grade.
    - Control of sub-grading.
  - Formwork
    - Movement of formwork
    - Settling of wood or pressure of wet concrete
    - Constriction of adequate forms.
- Settlement shrinkage
  - Reinforcement or form work obstruction
  - Settlement of concrete during settling
  - Settlement of around obstruction mix too fluid.
  - Dense mixes with low water content & adequate compaction of low lifts.
- Settling shrinkage
  - Plastic shrinkage
    - Chemical reactions
    - Cracks will occur soon after placing and under moist conditions
    - Remedy not clear but refloating eliminates the cracks.
  - Drying shrinkage (Cracking)
    - Rapid drying while setting occurs.
    - Cracking of exposed surface due to high wind, low humidity or temperature differential.
    - Proper protection.

maintain const
pressure for 3hr

In OPC elongation
should not be more than
0.8%.
500 + P% w

<u>Crack</u>

A crack is a complete (or) incomplete separation of concrete into 2 (or) more parts produced by breaking (or) fracturing.

Cracks in buildings:

Cracks in a building are of common occurrence. A building component develops cracks whenever stress in the component exceeds its strength. Cracks are classified in to (1) structural & (2) non-structural categories:

Structural cracks due to faulty design, faulty construction (or) over loading which may endanger safety of buildings.

Non-structural cracks due to internally induced stresses) force developed in materials due to moisture (Depending on width of cracks {environmental changes variations, temp", effects of gases, due to temp, rain etc & liquids etc.

Causes of occurrence

1. Moisture changes
2. Thermal variations
3. Elastic deformations
4. Creep
5. foundation movement & settlement of soils.

Scanned by CamScanner

1) Moisture movement :-

Most of the buildings materials having pores in their structure in the form of inter-molecular (example concrete, mortar, bricks etc) expand on absorbing moisture & shrink on drying. These movements are reversible.

2). Thermal movement :-

Due to variation in atmospheric temp., there will be thermal movement in building components. When there is some restraint to movement of building component, internal stresses are generated resulting in cracks due to tensile (or) shear stresses.

③ Elastic deformations :-

Structural components of a building such as walls, columns, beams & slabs, generally consisting of materials like masonry, concrete, steel etc, undergo elastic deformation due to load in accordance with Hook's law, the amount of deformation depending upon elastic modulus of the materials, magnitude of loading & dimensions of the components.

④ Movements due to creep :-

In concrete, extent of creep depends on a number of factors, such as water & cement content, water cement ratio, temp., humidity, use of admixtures & pozzolanas, age of concrete at the time of loading & size & shape of the component.

⑤ foundation movement & settlement of soil :-

Shear cracks in buildings occur when there is large differential settlement of function either due to unequal bearing pressure under different parts of the structure (or) due to bearing pressure on soil being in excess of safe bearing strength of the soil (or) due to low factor of safety in the design of foundation.

Affacts of cracks :-

① Carbon dioxide penetrates into the concrete through the cracks & speed up carbonation around the cracks, thus shortening the structure usage.

② The cracks in the concrete wall would cause the leakage of the building it reduces the stiffness, durability & seismic performance of buildings.

③ Cracks on the wall surface damage to the latter rendering, will affect to the appearance.

Types of cracks

① structural
② non-structural
③ Based on width
i) Thin - less than 1mm in width
ii) Medium - 1 to 2 mm in width
iii) wide - more than 2mm in width

drilled holes

→ Roots of fast growing tree under the foundation of compound wall.

Techniques to cure cracks

① Epoxy injection
① Cracks as narrow as 0.002 in (0.05mm) can be bonded by the injection of epoxy
② The technique generally consists of establishing entry & venting ports at close intervals along the cracks, sealing the crack on exposed surfaces & injecting the epoxy under pressure.

③ However, unless the cause the crac[k] has been corrected, it will probab[ly] recur near the original crack.

② Routing & sealing :-

① This method involves enlarging the crack along its exposed face & filling & sealing it with a suitable joint sealant.

② The procedure is most applicable to approximately flat horizontal surfaces such as floor & pavements.

③ However, routing & sealing can be accomplished on curved surfaces (pipes, piles & pole).

③ Stitching :-

① The stitching procedure consists of drilling holes on both sides of the crack, cleaning the holes & anchoring the legs of the staples in the holes, with either a non-shrink grout (or) an expoxy resin-based bonding system.

(2) Stitching may be used when tensile strength must be reestablished across major cracks.

(4) Drilling & plugging :-

(1) Drilling & plugging a crack consists of drilling down the length of the crack & grouting it to form a key.

(2) This technique is only applicable when cracks run in reasonable straight lines & are accessible at one end.

(3) This method is most often used to repair vertical cracks in retaining walls.

(5) Gravity filling :-

(1) Low viscosity monomers & resins can be used to seal cracks with surface widths of 0.001 - 0.08 in by gravity filling.