2.5 EFFECT OF CORROSION

Formation of white patches

CO_2 reacts with $Ca(OH)_2$ in the cement paste to form $CaCO_3$. The free movement of water carries the unstable $CaCO_3$ towards the surface and forms white patches. It indicates the occurrences of carbonation.

Brown patches along reinforcement

When reinforcement starts corroding, a layer a ferric oxide is formed. This brown product resulting from corrosion may permeate along with moisture to the concrete surface without cracking of the concrete.

Occurrence of cracks

The increase in volume exerts considerable bursting pressure on the surrounding concrete resulting in cracking. The hair line crack in the concrete surface lying directly above the reinforcement and running parallel to it is the positive visible indication that reinforcement is

Formation of multiple cracks

As corrosion progresses, formation of multiple layers of rust on the reinforcement which in turn exert considerable pressure on the surrounding concrete resulting in widening of hair cracks. In addition, a number of new hair cracks are also formed. The bond between concrete and the reinforcement is considerably reduced. There will be a hollow sound when the concrete is tapped at the surface with a light hammer.

Snapping of bars

The continued reduction in the size of bars results in snapping of the bars. This will occurin ties/stirrups first. At this stage, size of the main bars is reduced.

Buckling of bars and bulging of concrete

The spalling of the cover concrete and snapping of ties causes the main bars to buckle. This results in bulging of concrete in that region. This follows collapse of the structure. When corrosion of reinforcement starts, the deterioration is usually slow but advances in geometrical progression. Corrosion can also cause structural failure due to reduced C/S and hence reduced load carrying capacity. It is possible to arrest the process of corrosion at any stage by altering the corrosive environment in the vicinity of the reinforcement.

Effects of corrosion:

Strength will reduce.

Structural failure.

Eccentricity.

Cracks, spalling of concrete.

The cross section of reinforcement progressively reduces.

Reduction of cover.

To control the corrosion of steel reinforcement:

Metallurgical ecological method.

Corrosion inhibitors.

Coating to reinforcement.

De-rusting, Phosphating, Coating to concrete.

Cement coating, Sealing, Fusion bond, Epoxy coating.

Galvanized reinforcement, cathodic protection.

Metallurgical method:

Steel can be made more corrosion resistance by altering its structure through metallurgical process.

There are many situation were stainless steel reinforcement are used for long tern durability of concrete structure.

Corrosion inhibitors:

Corrosion can be prevented by chemical methods by using certain corrosion inhibiting chemicals such as Nitrates, Phosphate, Benzoates, etc.,

A most widely used admixture is based on calcium Nitrates. It is added to the concrete during mixing of concrete.

The steel is protected by a layer of ferric oxide on the surface of the steel.

Coating to reinforcement:

The object of coating to steel bar is to provide a durable barrier to aggressive material such as chlorides.

The coating should be robust to with stand fabrication of reinforcement cage and pouring of concrete and compaction by vibration needle.

De – rusting:

The reinforcement is cleaned with a de-rusting solution.

This is followed without delay by cleaning the rods with wet waste cloths and cleaning powder.

The rods are then rinsed in running water and air dried.

Phosphate

Phosphate is applied to the surface And in inhibitors solution is then brushed over the phosphate surface.

Cement coating

Slurry is made by mixing the inhibitor solution with water and cement and applied on the bar.

The sealing solution is brushed after the rods are air cured.

The sealing solution as an inside curing effect.

The second coat of slurry is then applied and the bars are air dried.

Sealing(solution)

Two coats of sealing solution are applied to the bars in order to seal the micro pores ofthe cement coat and to make it impermeable to corrosive salt.

Epoxy coating:

It is one of the effective method of coating the debars.

The epoxy coating is specialized sob carrying out in a factory and not at site of work.

The plant are designed to coat the straight bars is a continuous process.

The epoxy powder particles are deposited evenly on the surface of the bars.

The epoxy coated bars have an excellent protection to corrosion in aggressive environment.

After treatment, cutting and bending may injure the steel.

The coating may get damaged during vibration of concrete.

Galvanized reinforcement:

Galvanized reinforcement consists of dipping of steel bar in molten zinc.

The coating of zinc bonded to the surface of steel.

The zinc surface reacts with the calcium hydroxide in the concrete to form a passive layer and prevent corrosion.

Cathodic protection:

Cathodic protection is one of the effective, well known and extensively used methods for preventing of corrosion in concrete method.

It is high case and long term monitoring required for this method.

The catholic protection comprises of application current to an elected laid on the concrete above steel reinforcement.

Coating to concrete: (purpose)

Reduction of Environmental pollution.

Protection from Industrial fumes and contamination .

The reduction in depth of carbonation.

Design , cover thickness and cracking:

The structural designer should take all precaution in designing and detailing with respect to spacing between reinforcement.

To facilitate vibration of concrete.

To given proper cover to the steel reinforcement.

To restrict the crack width etc.

The first object is achieved the stipulated minimum strength and durability.

The second object is making the concrete in the most economical manner.

A permeability of concrete is governed by the quality and continuity of the waste.

Design of concrete mix needs not only the knowledge of material property and properties of concrete in plastic condition.

Mix proportion:

Water cement ration.

Cement content.

Cement aggregate ratio.

Gradation of aggregate.

Consistency.

Cover thickness:

The nominal cover is applicable to all steel reinforcement including links.

The longitudinal reinforcement bars in a column, nominal cover in any case not less than 40mm or less than the diameter of bar.

In the column of min dimension of 200mm, whose reinforcing bar do not exceed 12mm, a nominal cover of 25mm may be used.

The nominal concrete cover in mm not less than mild steel 20mm, moderate steel 30mm, severe steel 45mm, very sever 50m, extreme 75mm.

Errors in construction:

Poor workman ship. Vibrator is not applicable.

Laying and patching, curing. Poor formwork.

Delay processing work Mix proportion (ratio)

Improper mix design of concrete.