4.4 CORROSION PROTECTION METHODS

The following are some of the methods for protecting steel from corrosion Protective coatings for reinforcement

Cathodic protection Corrosion Resistant steel

Corrosion inhibitors

Protective coatings for reinforcement

This is an effective means to combat corrosion in such environment where ordinary concrete with surface coating is not able to protect reinforcement against corrosion. The surface coating for the reinforcement will increase the protection against corrosion.

There are several methods of providing protective coating to the reinforcement. The important ones are:

i. **Cement Slurry Coating**

Cement Slurry Coating provides short-term protection until placement in concrete. Several methods have been developed for an effective corrosion protection using cement slurry. One such coating is a mixture of cement, condensed silica and polymer dispersion. This mixer found to be impermeable to water, chlorides and carbon-di-oxide.

ii. **Epoxy Coating**

Epoxy coating is formed by application of an epoxy resin with appropriate curing agents catalysts, pigments and flow control agents. Fusion bonding using the electrostatic process is the recent development. Fusion bonded epoxy coating provides long-term protection against corrosion. Though the cost is relatively high, it is the one which is the mosteffective in high alkaline and chloride contaminated environment.

iii. **Plastic Coating**

Similar to epoxy coating, the plastic coatings are very effective in preventing corrosion of reinforcement even in high alkaline or chloride contaminated environment.

However, the reduction in bond between plastic coated bar and the concrete is quite substantial and hence plastic coating cannot be considered as a solution for prevention of corrosion which cannot be solved by conventional methods.

Galvanizing

Galvanizing gives protection to the reinforcement against corrosion, by means of metallic coating such as zinc. However, in case of corrosion due to excessive chlorides, the effect of galvanizing protection is reduce and hence is not advisable in highly chloride contaminated environments.

Cathodic protection

Cathodic protection interferes with the natural action of the electrochemical cells that are responsible for corrosion. Cathodic protection can be effectively applied to control corrosion of surfaces that are immersed in water or exposed to soil. Cathodic protection in its classical form cannot be used to protect surfaces exposed to the atmosphere.

The use of anodic metallic coatings such as zinc on steel(galvanizing) is, however, a form of cathodic protection, which is effective in the atmosphere.

There are two basic methods of supplying the electrical currents required to interfere with the electrochemical cell action. They are

1. Cathodic protection with galvanic anodes.
2. Impressed current cathodic protection

Cathodic protection with galvanic anodes

Cathodic protection (CP) is a technique to control the corrosion of a metal surface by making it work as a cathode of an electrochemical cell. This is achieved by placing in contactwith the metal to be protected another more easily corroded metal to act as the anode of the electrochemical cell.

This method is also called sacrificial anode cathodic protection system, where the active metal is consumed in the process of protecting the surfaces, so that corrosion is controlled.

In sacrificial anode systems the high energy electrons required for cathodic protection are supplied by the corrosion of an active metal.

Sacrificial anode systems depend on the differences in corrosion potential that are establishedby the corrosion reactions that occur on different metals or alloys.

For example, the natural corrosion potential of iron is about -0.550 volts in seawater. The natural corrosion potential of zinc in seawater is about -1.2 volts. Thus if the two metals are electrically connected, the corrosion of the zinc becomes a source of negative charge which prevents corrosion of the iron.

In application where the anodes are buried, a special backfill material surrounds the anode in order to insure that the anode will produce the despired output. Sacrificial anodes are normally supplied with either lead wires or cast-m straps to facilitate their connection to the structure being protected.

The lead wires may be attached to the structures by welding or mechanical connections. These should have a low resistance and should be insulated to prevent increased resistance or damage due to corrosion. When anodes with cast-in straps are used, the straps can either be welded directly to the structure or the straps can be used as locations for attachment.

A low resistance mechanically adequate attachment is required for good protection and resistance to mechanical damage. In the process of providing electrons for the cathodic protection of a less active metal the more active metal corrodes. The more active metal (anode) is sacrificed to protect the less active metal(cathode). The amount of corrosion depends on the metal being used as an anode but it is directly proportional to the amount of current supplied.

The anodes in sacrificial anode cathodic protection systems must be periodically inspected and replaced when consumed.

Impressed current Cathodic protection

In impressed current cathodic protection, an alternative source of direct electrical current, usually a rectifier that converts alternating current to direct current is used to provide the required electrical current. In this system, the electrical circuit is completed through an inert anode material that is not consumed in the process.

Low energy electrons that are picked up at a non-reactive anode bed are given additional energy by the action of a rectifier to be more energetic than the electrons that would be produced in the corrosion reaction.

The energy for the “electron energy pump” action of the rectifier is provided by ordinary alternating current. The effect of these electrons at the structure being protected is the same as that derived from the sacrificial anode type of cathodic protection system. However, the anode materials (such as magnetic, platinum, and newly developed ceramic materials) have been successfully used.

For buried anodes, a backfill of carbonaceous material is used to surround the anode to decrease the electrical resistance of the anode, to provide a uniform, low resistivity environment surrounding the anode and to allow gasses produced at the anode surface to vent.

In practice, materials such as graphite are used for impressed current cathodic protection system anodes that are slowly consumed. Anodes in impressed current systems must be inspected and replaced if consumed or otherwise damaged.