Control of Corrosion of Underwater Piles

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Abstract – Structures that are used for the trading of weights from the superstructure to the sub surface strata are known as Establishment. In addition, Heaps are a kind of foundation. For water driven structure, for instance, ranges, dams, etc. And so forth or for surfaces having high water content, the heaps are crashed into the ground and under the water strata. Heaps regularly utilized as a part of submerged structures are subjected to erosion. Erosion decreases the structures security and life span. There is definitely no technique for end of erosion; yet consumption insurance measures can be utilized for controlling the impacts of consumption. Consumption security should be possible in various routes, contingent upon nature and other air and hydrological factors. Sorts of erosion assurance incorporates are treatment of surfaces, use of inhibitors, utilization of coatings and sealants, cathodic and anodic insurance.

Keywords: Stability, Longevity, Protection Measures, Types of Protection.

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I. INTRODUCTION

Consumption implies the harm, annihilation or end of the metals and composites by the synthetic response of the metals and amalgams with the earth. Amid the period of erosion occurring, metals gets changed over to metallic mixes at the best surface and these mixes wear or break down away as consumption item. This procedure may likewise be called as the switch procedure of the extraction of metals from their mineral. It is an issue that must be tended to for a more extensive territory, case, the car business; metals are regularly plated or covered for assurance from the street salt and dampness. In fact, numerous conventional metal parts are directly utilized with polymeric segments which are lighter as well as more financially savvy for generation. Yet, these items are by and large impenetrable to the electrochemical consumption. The choice of the base metals for heaping and very much planned structures will guarantee no ensure for supreme end of erosion. In this way, consumption assurance techniques are used for relief and controlling the impacts of erosion on heaps. Erosion security can be built up in various distinctive routes with numerous techniques connected in various situations. Kinds of consumption insurance incorporate – treatment of surfaces, use of inhibitors, utilization of coatings and sealants, cathodic and anodic assurance Corrosion means the damage, destruction or elimination of the metals and alloys by the chemical reaction of the metals and alloys with the environment. During the phase of corrosion taking place, metals gets converted to metallic compounds at the top surface and these compounds wear or deteriorate away as corrosion product. This process may also be called as the reverse process of the extraction of metals from their ore. It is a problem that must be addressed for a wider range, example, the automotive industry; metals are often plated or coated for protection from the road salt and moisture. Indeed, many traditional metal parts are presently used with polymeric components-which are not only lighter but are also more cost effective for production. But these products are generally impervious to the electrochemical corrosion. The selection of the base metals for piling and well-designed structures will ensure no guarantee for absolute elimination of corrosion. Therefore, corrosion protection methods are utilized for mitigation and controlling the effects of corrosion on piles. Corrosion protection can be established in a number of different ways with multiple methods applied in different environments. Types of corrosion protection include – treatment of surfaces, utilization of inhibitors, use of coatings and sealants, cathodic and anodic protection.

II. LITERATURE REVIEW

[1]. DIVYA PACHAURI et.al: Structures that are utilized for the exchange of burdens from the superstructure to the sub surface strata are known as Foundation.

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the heaps are crashed into the ground and under the water strata. Heaps typically utilized as a part of submerged structures are subjected to consumption. Erosion decreases the structures steadiness and life span.

There is positively no technique for disposal of erosion; yet consumption security measures can be utilized for controlling the impacts of consumption. Erosion security should be possible in various routes, contingent upon the earth and other air and hydrological factors. Kinds of erosion security incorporate – treatment of surfaces, use of inhibitors, utilization of coatings and sealants, cathodic and anodic assurance.

[3] Abhishek Jain, Dr. Trilok Gupta and Dr. Ravi K. Sharma

Structures that are utilized for the Exchange of burdens from the superstructure to the sub surface strata are known as Foundation. What's more, Piles are a sort of establishment. For water powered structure, for example, spans, dams, and so forth or for surfaces having high water content, the heaps are crashed into the ground and under the water strata.

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III. METHODOLOGY

Corrosion Protection Methods:

3.1. Protective Coating:

In order to protect metals from corrosion, the contact between the metal and the corrosive environment is to be cut off. This is done by coating the surface of metals with a continuous non-porous material inert to the corrosive atmosphere.

Surface coatings are broadly classified into three: 1. Metallic 2.Organic. 3. Inorganic Individual coatings are formulated to perform specific functions and must be selected to become components of a total system designed for optimum results considering the environment and service expectations.

3.2. Inorganic Zinc Silicates*: Primers*

Steel structures that are for all time submerged in ocean water, for example, coats in the territory beneath the Splash Zone, are normally not covered for different reasons and ensured exclusively by cathode security frameworks comprising of conciliatory anodes or awed ebb and flow exhibits, which can be kept up as required by submerged contractual workers. Different anticorrosive pigmented ground works are accessible; some that lack of involvement the steel yet the best are inorganic zinc silicate preliminaries which basically wind up anodic to the steel in an erosion cycle. The essential favorable position of this sort of covering is that it will capture rust crawl, or undermining of the coatings encompassing the harmed territory, and bind erosion to the point of the harm. These coatings likewise give a high level of protection from warmth and synthetic spills

3.3. High Build Epoxy Coatings:

Epoxies are generally more abrasion and chemical resistant than primers and topcoats and in this case protect not only the substrate itself, but the zinc primer as well from all of these detrimental factors. However, one drawback with epoxy coatings is very poor resistance to ultra violet from sunlight and most will chalk and fade rapidly. This leads to an erosion of the coatings' film thickness, reducing the barrier protection of the system.

3.4. Aliphatic Polyurethane Topcoats:

Polyurethane finish coats are generally acknowledged as providing optimum resistance to UV and high degrees of flexibility and chemical resistance. They also help to maintain a very high level of cosmetic gloss and color retention and can be cleaned very easily, generally with low pH detergents and fresh water pressure washing. Although polyurethane finishes offer no real anticorrosive or barrier protection to the substrate they do provide a high level of protection to the integrity of the coatings system.

3.5. Zinc Rich Epoxy Primers:

Zinc modified epoxy anticorrosive will provide a high level of service and are more tolerant to compromised surface preparation and ambient weather conditions provided the zinc loading of the formula is sufficient. Zinc rich epoxy is also most effective in maintaining damaged areas and breakdown of the coatings systems applied at new construction as it is compatible with alternate methods of surface preparation such as power tool cleaning and UHP Hydro Blasting.

3.6. Non-Skid Deck Coatings:

Coatings specifically designed with anti-slip properties normally incorporate very course

aggregates for an exaggerated profile. They are applied in very high film builds and normally without a zinc rich primer. When primers are required they are usually epoxy types.

3.7. Cathode Protection:

The preferred technique for mitigating marine corrosion, based on historical performance and measurable results, is cathode protection (CP) – the practice of using electrochemical reactions to prevent the corrosion of steel structures. The reason for increased acceptance: cathode protection prevents corrosion on underwater structures.

In theory and practice, the implementation of a CP system is quite simple. Assuming you already have corroding steel in seawater, all you need is an anode, a power supply, and engineering talent. A protective circuit is accomplished between the anode, steel (cathode), power supply and electrolyte (seawater).

IV. CASE STUDY

4.1. Friendship Trails Bridge:

This is the oldest of the Gandy Boulevard bridges crossing Tampa Bay. It was originally constructed in 1956 and was slated for demolition in 1997. Thanks to community activists, the bridge was saved, refurbished and rehabilitated. In 1999, the bridge was re-opened as a pedestrian bridge and re-christened as the "Friendship Trails Bridge". The 4.2 km (2.6 mile) structure is now the longest over-water recreational trail in the world. The bridge has 275 spans supported by 254 reinforced concrete pile bents and 22 column type piers located at the main channel crossing. Seventy seven percent of the 254 piers supporting this bridge have needed to be repaired indicating that the environment is very aggressive.

4.2. Preparatorywork:

All piles wrapped were 50.8 cm x 50.6 m (20 in. x 20 in.) reinforced concrete piles and wrapped over a depth of 1.5 m that extended all the way to the underside of the pile cap. The waters are approximately 4.88 m (16 ft.) deep. This meant that ladders could no longer be used to apply the FRP in this situation.

Fig 4.1 Mesh flooring around piles

An innovative scaffolding system was designed and fabricated. It was lightweight, modular yet sufficiently rigid when assembled to support 4-6 people. The scaffolding was suspended from the pile cap and extended 2.74 m (9 ft.) below. Its mesh flooring provided a secure platform around the pile that allowed the wrap to be carried out unimpeded in knee deep waters Fig. 4.1

4.3. Instrumentation:

Unlike the Allen Creek Bridge where vandalism was a real concern, the piles of the Friendship Trails Bridge are located in deeper and more turbulent waters. Moreover, as the majority of the piles supporting this bridge had been repaired and some were instrumented, the element of novelty was absent making vandalism less likely. In view of this, an instrumentation system developed by the Florida Department of Transportation was selected. This required both wiring and junction boxes. The scheme uses rebar probes Fig. 4.2 that are installed at different elevations close to the reinforcing steel. Changes in the direction of the corrosion current between these locations can indicate if the FRP is working as expected. Reductions in the measured current compared to unwrapped controls were also expected to provide an index of the efficacy of the FRP wrap. The drawback with this system is that it takes time for the equilibrium state around the probe to be attained. Until this time, data may not be meaningful.

Fig. 4.2 Use of rebar probes

4.4. FRP wrapping:

Two different FRP systems were used. One was the same pre-preg system with a water-activated resin used in the Allen Creek Bridge. The other was Fyfe's system that used resins that cure in water. The pre-preg system was used to wrap four piles – two using carbon and two using glass. The wet-layup system from Fyfe required on-site saturation of the fibers. Two piles were wrapped with fiberglass using this system. Of the two, one was an experimental FRP system that combined wrapping with a sacrificial cathodic protection system. Two other unwrapped piles in a similar initial state of disrepair were used as controls to evaluate the performance of the wrapped piles. Application was facilitated through the use of a scaffolding system mentioned earlier Fig. 4.3.

V. CONCLUSION

Though there is no absolute way to eliminate all corrosion on under water piles, there are some effective measures to control them. The cathodic protection is found to be quite simple to employ and mostly used in marine conditions. The protective coatings are used in vast and expensive structures. The FRP composites have many advantages over conventional methods such that they are light weight, possess high strength and chemical resistance and moreover have incomparable flexibility.

Of the various ways of wrapping of FRP composites, transverse wrapping is found to be the easiest as otherwise, the longitudinal pieces are awkward to handle and difficult to position. Bi-directional material is the best option. Scaffolding measures during the application of materials ensures safety and simplifies installation. Out of the two system of FRP application, the pre-preg system is easier to use. On-site FRP saturation can be problematic. High winds and high tides should be avoided during the process.

VI. REFERENCES

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