

**Talk on Reinforced Concrete Corrosion Evaluation and Mitigation****By Ir. Assoc. Prof. Dr Low Kaw Sai**

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The talk on 'Reinforced Concrete Corrosion Evaluation and Mitigation' organised by The Institution of Engineers, Malaysia (IEM) Civil & Structural Engineering Technical Division and sponsored by Estop Sdn. Bhd. was held on 18 June 2012 at Wisma IEM, Petaling Jaya. The talk was attended by 57 participants and was chaired by Ir. Boone Lim. Being a registered professional engineer of Ontario, Canada, the speaker, Mr. Liao Haixue, is a Certified Cathodic Protection Specialist cum member of the National Association of Corrosion Engineers (NACE) International.

At the beginning of his talk, the speaker shared with the audience his vast experience in cathodic protection on concrete in Canada, United States of America, United Kingdom and his last 10 years of involvement in Asia including Malaysia. During the subsequent presentation, he focused on areas such as the corrosion of steel in concrete, corrosion evaluation, galvanic protection, corrosion management strategies and levels of protection, corrosion protection for marine structures and lastly, the new concrete protection measures.

A flowchart depicting the concrete repair process was shown before chlorides, carbonation and dissimilar metals which resulted in the destruction of the passive oxide layer were put forward as the causes of steel corrosion in concrete. Consequently, some interesting pictures showing the corrosion cell in concrete, chloride-induced corrosion, patch accelerated corrosion, chip and patch repairs, and halo effect on reinforced concrete road were presented.

Next, corrosion potentials of steel within concrete with and without the presence of chloride were compared and discussed before the speaker went on to explain the various methods that can be employed to evaluate the extent of concrete steel corrosion in order to define the scope of structural repairs required. Illustrated by pictures, some of the methods highlighted include visual inspection, delimitation survey, concrete cover survey, chlorides sampling and analysis, pH and chemical testing for carbonation, corrosion potential and corrosion rate measurement and mapping, and so forth.

As the speaker moved on to the topic on protection or prevention of corrosion, the principle of the technique known as Galvanic Protection Systems which involves two dissimilar metals connected in the same electrolyte (concrete) was explained. In this case, the more 'active' metal would be the anode while the more 'noble' metal the cathode. The anode would then corrode to protect the cathode. As such, the electric potential that causes current flow between zinc and steel (in concrete) was illustrated. Subsequently, a number of slides were shown on how the galvanic anodes were embedded discretely in the concrete to achieve corrosion protection in practice.

Interestingly, Forensic Analysis on the 10-year monitored results such as those involving current density, polarization measurements and approximate zinc consumption for a concrete cross beam of a bridge were also discussed during the talk. In addition, considerable time and effort was given to illustrate how the galvanic protection method can be applied at the joints and interfaces within the concrete to reduce or stop on-going corrosion activity. Hence, many pictures of different jobs were shown to demonstrate the effectiveness of this method.

Touching on the Cathodic Protection method, it was hailed as the "almost certain corrosion protection" which can "reduce corrosion rate to approximately zero". Then, the most widely used criterion and method of installation were given with the support of a considerable pictorial illustration. Apparently, this method

has been widely adopted in marine piles where tidal and splash zones create the most severe corrosion environment. Again, many images were shown to portray how the cathodic protection system is applied on marine piles of various marine structures in different parts of the world. Nevertheless, a special technique which involves the use of “Activated Line Anodes” for pile cap repair was also described. Apart from that, many successful applications of cathodic protection technique in various marine structures worldwide were presented through numerous illustrations and photographs.

In addition, corrosion protection and prevention for new constructions, such as the installation of embedded anodes in newly constructed structures was also dealt with alongside the damaged post-tensioned cables. Finally, brief accounts on post-tech corrosion evaluation and post-tech cable-drying techniques by inspection of air flow were explained before the talk ended.

The talk was followed by an encouraging interaction between the speaker and the participants where a number of practical questions raised by the participants were satisfactorily answered by the speaker. Thus, overall it was indeed a successful informative event.