

Application of PSM Maintenance Technology to Indonesian Bridge Structures

— Indonesia’s First Cathodic Protection Application —

Headquarter	Research & Development Division	Rahmita Sari RAFDINAL
Headquarter	Research & Development Division	Toshituki AOYAMA
Headquarter	Research & Development Division	Yuichi SHIRAMIZU
President of PT. Komponindo Betonjaya (KOBE)		Hirotake KOGA

1. Introduction

This joint research is a pilot project between P.S Mitsubishi Construction (PSM) and the Indonesian Institute of Road Engineering (IRE). The purpose of this research is to observe the effectiveness of Zinc Cartridge as bridge repair method of sacrificial anode cathodic protection and the remote monitoring system by using Titanium Wire Sensor, and Information and Communications Technology (ICT) applied to the PC bridge structures in Indonesia against corrosion damage.

In this paper, the construction process and effectiveness of the Zinc Cartridge and remote monitoring system by ICT at the beginning of exposure time is reported.

2. Overview of Bridge Structures

There are three deteriorated prestressed concrete (PC) girder bridges that were observed in this research namely Cikoneng, Sirih, and Ciwidig Bridge. All those bridges exposed to corrosion hazards due to located close to the sea environment in Java Island Indonesia as shown in Figure-1.

3. Research Outline

3.1. Durability Assessment

Prior to the start of any works, all bridge structures underwent a full durability assessment to establish their current condition. The following test methods were used in the initial investigations of the structures namely visual examinations, rebar detection, carbonation depth, homogeneity testing of concrete surfaces with the hammer test, half-cell potential test, chloride contamination in concrete, and reinforcement continuity.

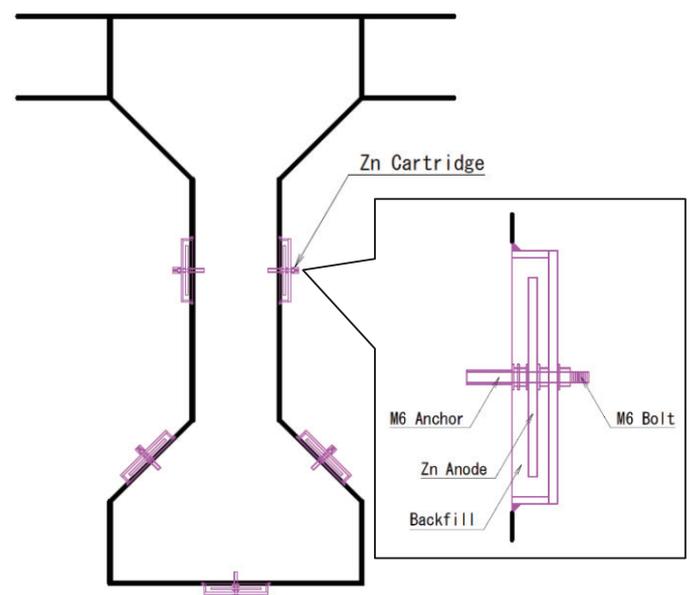
3.2. Repair and Monitoring Design

Zinc Cartridge is a discrete zinc anodes system to protect the rebar against corrosion. The feature of this system is easy to install, easy to replace and it has an anti-corrosion target for the rebar. Figure-2 shows the design position of

surface type of Zinc Cartridge on the Sirih Bridge. This design is typical same for Sirih and Ciwidig Bridge. The Zinc Cartridge system contains a \varnothing 110mm zinc anode and covers by backfill material. Zinc Cartridge designed to embedded in the web, lower flange, and bottom position of PC girder. There are 450mm and 600mm distances for each position in the girder to observe the effectiveness of protection of zinc anode in those distance types.



Figure-1 Locations of three-PC bridge in Java Island



(a) Girder cross section (b) Zinc Cartridge

Figure-2 Position of Zinc Cartridge on the Sirih Bridge

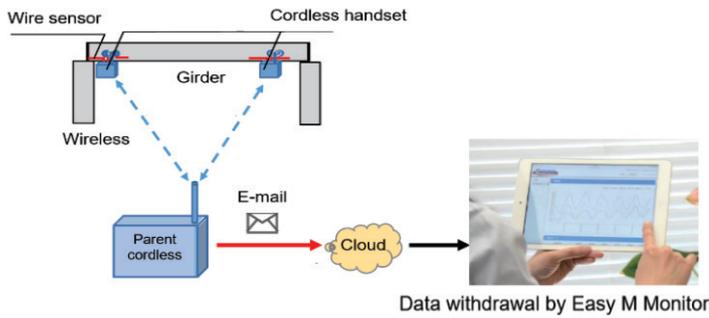


Figure-3 Remote monitoring system by ICT



Photo-1 Corrosion damage on PC girder

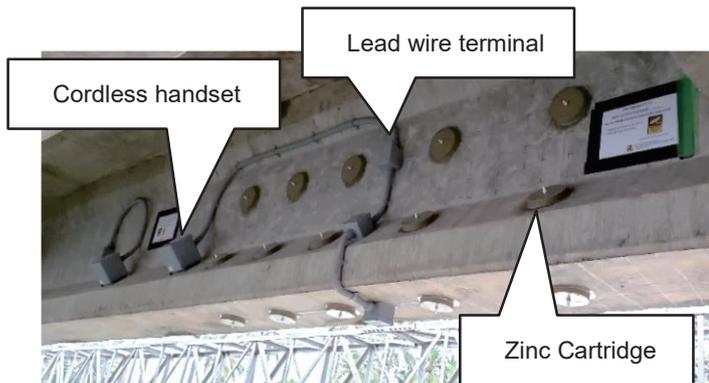


Photo-2 Zinc Cartridge and remote monitoring system by ICT at Sirih Bridge

Meanwhile, Figure-3 describes the remote monitoring system by ICT through a wire sensor as a monitoring sensor, parent, and cordless handset devices as a remote data distribution system, and Easy M Monitor as a mobile remote monitoring system of concrete structures.

4. Results and Discussion

Overall, the results of the durability assessment indicated that the observed deterioration in the three PC bridges was chloride induced as shown in Photo-1. After durability assessment, it continued to the repair construct process. The application results from the repair and monitoring stage in the PC bridges represented by Sirih Bridge as shown in Photo-2.

Figure-4 shows the depolarization value of rebar protect by Zinc Cartridge. Depolarization test is a method to observe the effectiveness of Zinc Cartridge performance as

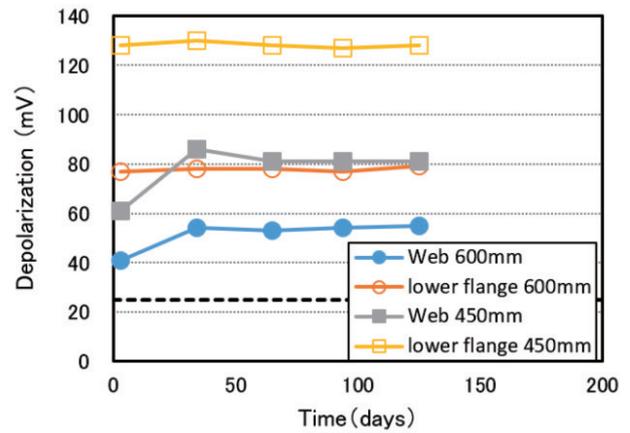


Figure-4 Real-time data related to performance of Zinc

sacrificial anode cathodic protection system. It has four categories namely corrosion protection category with the value standard over 100mV: high corrosion mitigation level with the value standard 50-99mV: medium to low corrosion mitigation level 25-49mV, and low corrosion mitigation level for the value less than 25mV. From the Figure-4 it was observed that Zinc Cartridge is effective to protect and mitigate the rebar in PC girder against corrosion.

5. Summary

Overall, data shows the remote monitoring system particularly effective in transmits the real-time data of Zinc Cartridge performance and condition of corrosion protection in concrete time dependency. From the real-time data, it was observed that Zinc Cartridge perform incredibly good corrosion protection and corrosion mitigation levels.

Acknowledgment

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Key Words : Zinc Cartridge, cathodic protection, corrosion protection, remote monitoring, ICT



Rahmita Sari
RAFDINAL
Toshiyuki
AOYAMA
Yuichi
SHIRAMIZU
Hirotake
KOGA