第V部門 **Application of Electrochemical Corrosion Monitoring to Reinforced Concrete with Conductive Layer**

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1. INTRODUCTION

This research aimed to study the effect of conductive epoxy resin, used to bond the strengthening material on the concrete surface, to the electrochemical steel corrosion monitoring (half-cell potential, HCP and polarization resistance, PR) by direct measurement on the surface of the strengthening materials. The effect of hole on the strengthening material to concrete surface and the effect of gap were also taken into accounted.

2. METHODOLOGY

The specimens with the dimension of 100x50x400mm were cast with a D10 steel placing at the center as shown in Fig.1. Experiment factors are shown in Table 1. The resistivity of conductive epoxy resin is $5x10^{-3}$ KΩ.cm. Each type of conductive layer was connected with the electrical lead wire because the layer itself was used as the counter electrode in PR measurement. A week after bonding strengthening material, the holes were drilled on the conductive layer to concrete surface as shown in Fig.2. In order to accelerate corrosion, 3.0kg/m^3 of Cl^- was mixed. Moreover, the wet and dry cycle, 3days-wet and 4days-dry cycle, was employed by submerging the specimens in 3% of NaCl solution to the top of reinforced steel in wet cycle. Two types of corrosion monitoring techniques, HCP and PR, were employed in this research as shown in Table 2. HCP measurement was automatically obtained when PR was measured by AC impedance method. PR was measured by double rectangular pulse method and AC impedance method. For AC impedance method was measured by using SRI machine so that the effect of guard-on and -off was taken into account. The PR measurement by AC impedance method was done in the 1st day of dry cycle and by double rectangular pulse method was done in the 2nd day of dry cycle

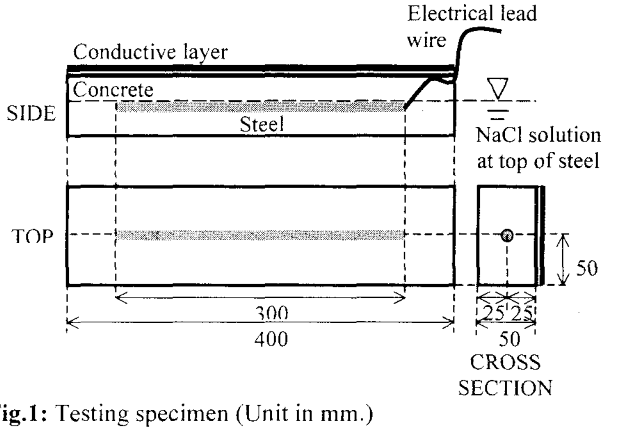
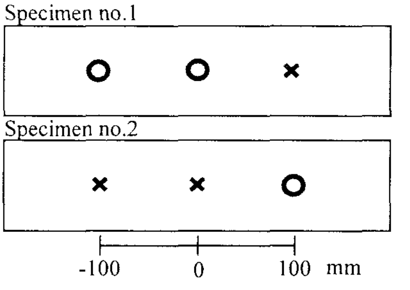


Fig.1: Testing specimen (Unit in mm.)

Table 1: Experiment's factor

W/C	0.45,0.65
Surface type	A: no attaching B: Coating with conductive epoxy resin C: Conductive CFs D: Conductive AFs E: Steel plate F: Steel plate with art.gap G: Conductive CFs with art.gap
Hole	2 holes in specimen no.1 and a hole in specimen no.2 (See Fig.2)



O: 6mm-diameter drilled hole on conductive layer to concrete surface, **X**: No hole

Fig. 2: Drilled hole of specimens in series B to E (For F and G, the central hole was not drilled)

3. EXPERIMENTAL RESULTS

(1) Visual observation (both surfaces): The cracks do not appear on the concrete surface. The steel plate bonded on the specimen severely corroded while no obvious change was

observed on resin/FRPs

(2) HCP (both surfaces): The results obtained on conductive layer are in the same tendency, but different in magnitude from one obtained on concrete surface as shown in Fig.3 (a). The difference varies from small to large by depending on type of conductive layer.

(3) PR by AC impedance method (both surfaces): The values obtained on conductive layer were fluctuation and some came out in negative value and/or enormous value both in case of guard-on and guard-off. Before plotting the graph as shown in Fig.3 (b), the negative value and/or enormous value were omitted. The readings on conductive layer in all cases are much larger than one reading on concrete surface at the beginning and gradually decrease with time. On the other hand, PR obtained at hole on the conductive layer is steadier and closer to the one of concrete surface than one of conductive layer without hole as shown Fig.3 (c). The results show that the relation between the PR reading on conductive layer (with hole and without hole) and one reading on concrete surface can be obtained. The conductive layer with gap did not give the obvious difference from the conductive layer.

(4) PR by double rectangular pulse method (both surfaces): The results obtained on conductive layer are steady, and have the same tendency with one obtained from concrete surface both in case of conductive layer with hole and without hole as shown in Fig.3 (d). PR of one with hole is closer to one of concrete surface than one without hole. In case of steel plate, the PR obtained on conductive layer in all conditions are in the same tendency and magnitude. And similar to the AC impedance method, gap does not show the obvious difference from the simple conductive layer.

Table 2: Measurement Method

1) HCP
2) PR with AC Impedance method, Guard-ON
3) PR with AC Impedance method, Guard-OFF
4) PR with Rectangular pulse method

Note: The measurement was done 3 points both on top (conductive layer) and bottom (concrete surface)

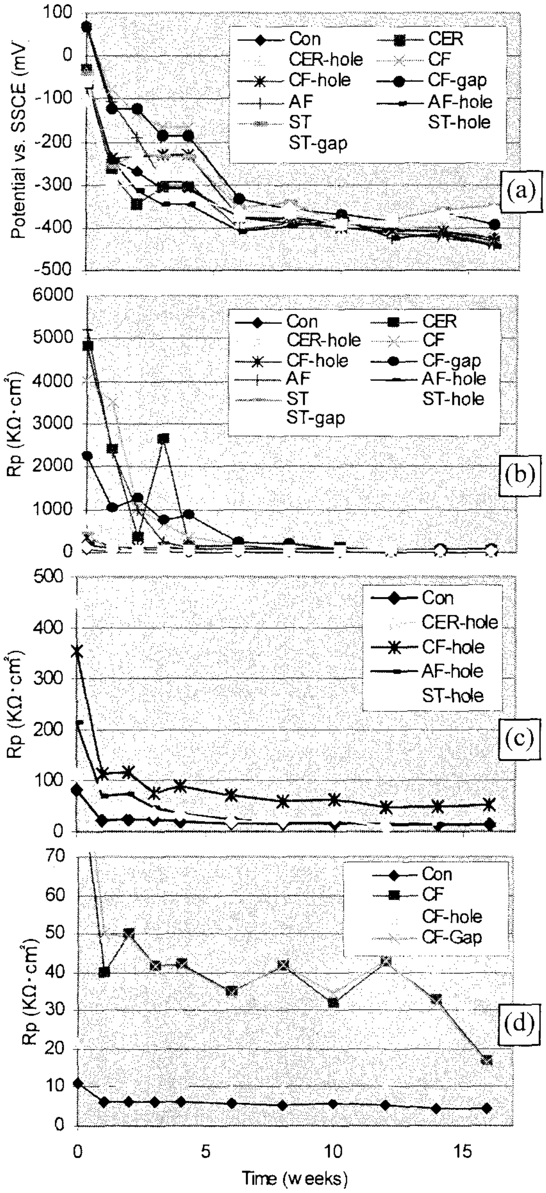


Fig.3: Experimental results

4. CONCLUSIONS

(1) HCP obtained on conductive layers, both hole and without hole, used in this research are in the same tendency but different in magnitude to the one obtained from concrete. Gap has no obvious effect in HCP measurement.

(2) PR obtained by AC impedance method, some relation between PR reading on conductive layer (with hole and without hole) and one of concrete surface can be obtained after omitting the negative and/or enormous values.

(3) PR obtained by double rectangular pulse method, PR obtained on conductive layer is in the same tendency but different in magnitude with the one obtained from concrete. PR obtained at hole is closer to the one obtained from concrete than the one obtained on conductive layer without hole.