INFLUENCE OF MOISTURE ON THE MODE I BOND PROPERTIES OF FRP-CONCRETE INTERFACE

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1. INTRODUCTION

In recent years, FRP (Fiber Reinforced Polymer) materials are being commonly used for structural strengthening, repairing, and seismic retrofit. The FRP-concrete interface bond properties play an important role in those applications. The purpose of this study is to clarify the effect of moisture on FRP-concrete interface bond properties. Three point bending test was conducted on FRP-concrete composite specimen with various water immersion period. The interface failure mode, flexural strength and fracture energy were investigated.

2. EXPERIMENTAL PROGRAM

As shown in Fig. 1, the two concrete prisms with size of 100×100×200(mm) (height×width×length) are bonded together with FRP at interface to form a composite prism. At first, poly-amine hardener epoxy primer was applied on the concrete surface and after drying Carbon Fiber Sheet (CFS) was impregnated with epoxy resin and attached to the concrete surface. Unbonded surface was formed at lower half of interface by using vinyl tape. After the proper curing period, half of specimens were immersed in water with controlled temperature of 20 °C as of WET in Table. 1. The other half of specimens were left in dry place in laboratory condition as of DRY in Table. 1. Three point bending load was applied with an effective span of 350mm. The central deflection was measured with Linear Variable Displacement Transducers (LVDTs). The loading speed was 0.1mm/min with displacement control. The experimental parameters are shown in Table 1. The test was conducted after water immersion period of 0,1,2,3 months, respectively. Specimens without water immersion were also tested at the same period.

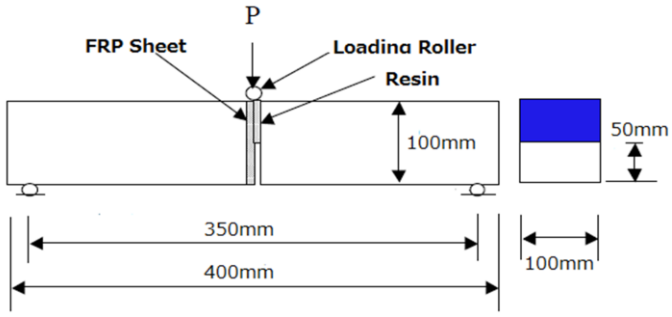

Fig.1 Details of Specimen

Table 1 Experimental Parameters

S. No.	*Specimen Code*	*Exposure condition*	*Time (Month)*
1	TP-N0	DRY	0
2	TP-N1		1
3	TP-N3		3
4	TP-I1	WET	1
5	TP-I2		2
6	TP-I3		3

3. RESULT AND DISCUSSION

Relation between load and deflection of each specimen can be found in Fig. 3. As shown in this figure, non- immersed specimen showed similar load deflection behavior at different time period but in the case of water-immersed specimens, the longer immersion period, the more ductile behavior with smaller peak load can be observed. As Fig. 2 shown, compared to the non-immersion cases of same period, water-immersion cases show clearly decrease of peak load.
Failure mode of the three point bending test can be found in Fig. 4 and Fig. 5. Fig. 4 shows the failure surface of the

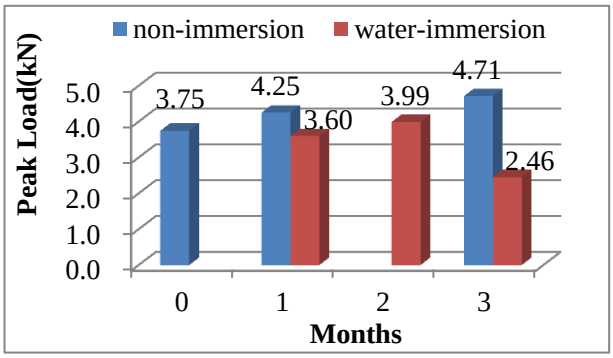

Fig. 2 Peak load

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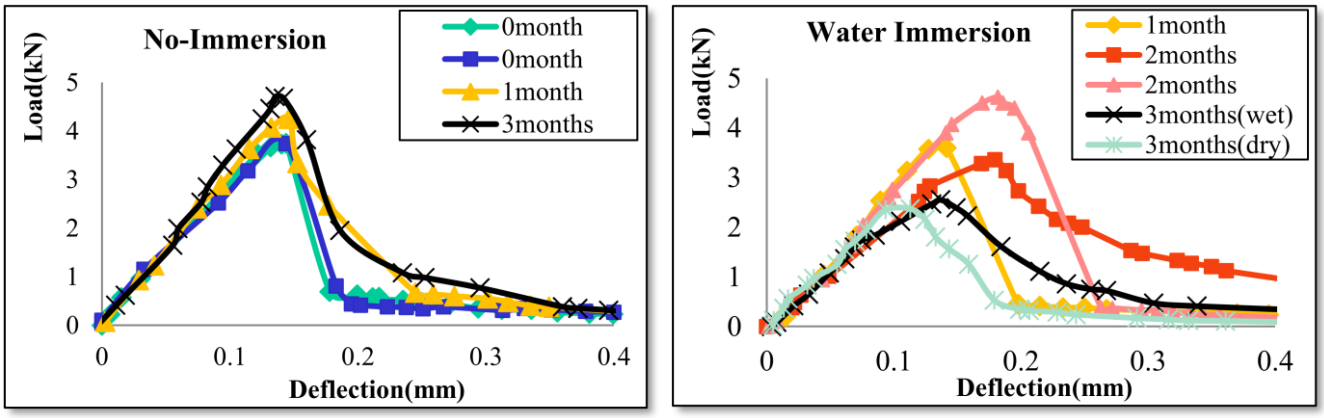

Fig. 3 Load-Deflection curve

non-immersed specimen of 0 month, which is the fracture entirely at the concrete layer and Fig. 5 represents the fracture surface in the case of water-immersed specimen after 3 months, which showed mixed mode of fracture i.e. neither complete concrete cohesion nor fully primer-concrete adhesion failure. In general, the failure mode changed gradually from cohesive failure in concrete in no-immersion case to mixed mode failure in water immersion case with increasing immersion period. It can be concluded that adhesion properties at primer-concrete interface were deteriorated due to the influence of moisture.

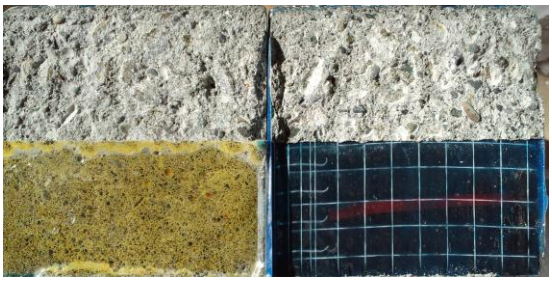

Fig. 4 Failure mode (No-Immersion)

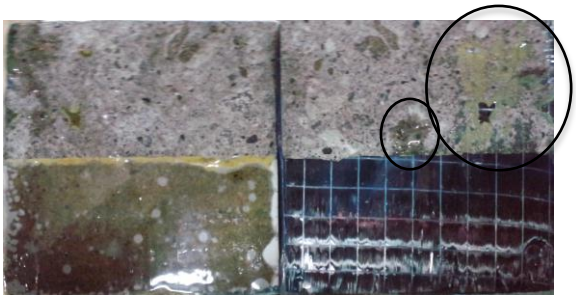

Fig. 5 Failure mode (Water Immersion for 3months)

4. CONCLUSIONS

1) The degradation of the FRP-concrete Mode I fracture properties due to the influence of moisture has been confirmed in the specimens immersed in water for 2 to 3months.

2) Decrease in adhesion strength at the primer-concrete interface due to moisture could have changed the failure mode from cohesive failure in concrete to mixed (cohesive-adhesive) failure.

3) The post peak behavior of load deflection curve in case of water immersion showed more ductile nature than the no-immersion case.

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