

A FUNDAMENTAL STUDY ON REGAIN OF FLEXURAL STRENGTH OF MORTARS BY USING A SELF-REPAIR NETWORK SYSTEM

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ABSTRACT

Cracking in reinforced concrete (RC) structures is an inevitable phenomenon, which may occur due to tensile loads, shrinkage and or thermal loads etc. These cracks in RC structures are one of the most prominent reason for the durability loss by corrosion of reinforcing steel by forming channels for CO₂, water and Cl⁻ ions to penetrate into the concrete easily. The service life span of RC structures is drastically shortened by these cracks in concrete. The objective of this research work is to develop a self-repair system for cracks of reinforced concrete structures by using a network system. In this study, the regain of flexural strength of ordinary cement mortars by the self-repair system using a repair material in the network system and the storage period of the repair material in the network was taken into consideration. In addition to this, the influence of viscosity of the repair material injected in the network on the regain of flexural strength by self-repair system was also evaluated. In order to prolong the storage period of the repair material in the network, several types of surface treatment techniques were applied and tested.

Fig. 1 shows the autonomic self-healing or self-repair system used in this to repair the cracks and the strength regain was obtained at the first (before crack repair) and the second loading (after crack repair). Mortar specimens were prepared having a hollow network in the specimens and loaded to develop by using a fully-automatic load controlled machine to generate cracks of 0.05~0.20mm. Photo 1 shows the mortar specimen with crack injection system into the network. Table 1 shows the one-component epoxy resin used as crack repair material through the network system. Fig. 2 shows the test program to investigate the effect on epoxy resin as repair material by pre- and post injection, and curing conditions on the regain of flexural strength at 2nd loading(after crack repair). Furthermore, in order to prolong the storage of epoxy resin in the network, several types of surface treatments were adopted to prevent the hardening in the network.

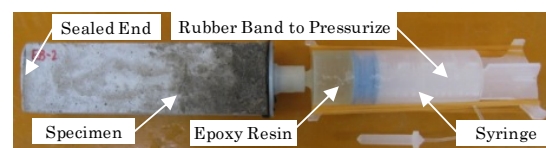
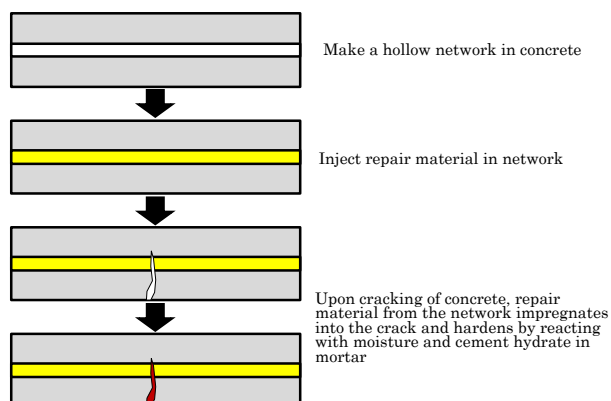


Photo 1 View of crack injection system

Fig.1 Concrete self-repair system

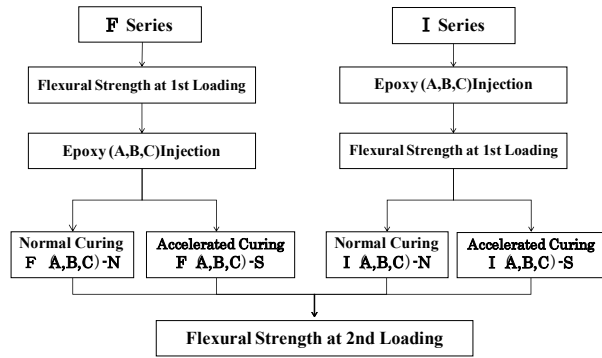


Table 1 Properties of epoxy resin

Type of Epoxy Resin	Hardening Mechanism	Thixotropic Index	Specific Gravity	Viscosity (mPa · s,23°C)
A	Moisture Sensitive	6.5	1.07	14000
B		2.2	1.07	1900
C		1.0	1.15±0.05	150±100

Fig.2 Test program to investigate the basic conditions of repair material and curing conditions

Fig. 3 shows the influence of viscosity of epoxy resin and crack width of the mortar specimens in consideration to the regain of flexural strength of mortars at second loading. Fig. 4 shows the influence of surface treatment of network on the regain of flexural strength of mortars at second loading.

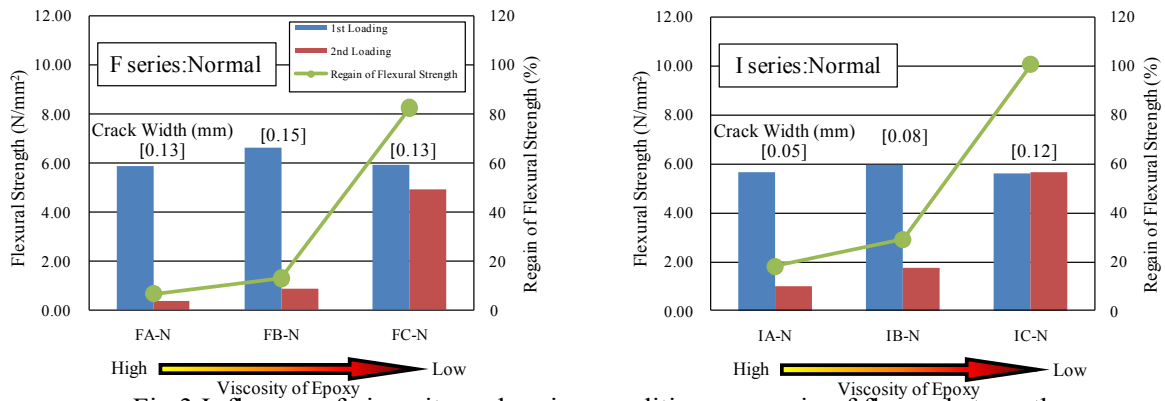


Fig.3 Influence of viscosity and curing condition on regain of flexural strength

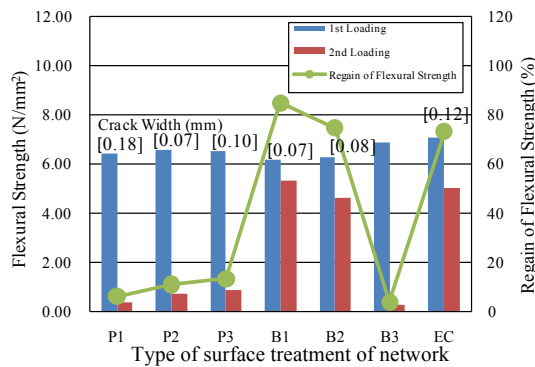


Fig.6 Influence of surface treatment of network on regain of strength after 28d storage on regain of flexural strength

From the test results, it was found that the repair material with a lower viscosity epoxy was more effective as a repair material and showed a remarkable regain of flexural strength of mortar specimens. Furthermore, the internal network surface treatment techniques helped to increase the storage period of the repair material in the networks.

REFERENCES

[1] *Technical Committee Report on Evaluation and Application of Self-Healing Mechanism in Cementitious Materials*, Japan Concrete Institute, 2008.