Crack-damage mitigation of RC structures layered with strain-hardening cement-based composites (SHCCs)

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Recently, interest on the repairing and retrofitting of infrastructure has been growing due to social needs to elongate its service life. There may be some economical reasons or preservation needs to strengthen a structure instead of demolishing it. Unfortunately, available literatures on repair methods to improve the service life of infrastructure are little while strengthening methods to enhance structural performance of infrastructure have been widely studied. This study focuses on the layered and patched repairing methods with strain-hardening cement-based composites (SHCCs) which exhibit multiple cracking and strain-hardening behavior under direct tension to improve the crack-damage mitigation of RC infrastructures.

The objectives of this research are four-fold. The first objective is to provide comprehensive laboratory data on the resistance of SHCC to freezing and thawing and evaluate the effects of freeze-thaw cycles on the mechanical properties of SHCC material. The second objective is to investigate the cracking-damage mitigation and flexural behavior of SHCC-layered concrete beams before and after freezing and thawing exposure. The third objective is to evaluate the cracking-damage mitigation of shear-and flexure-dominant RC beams layered with SHCC materials under cyclic loading. The fourth objective is to propose the new concept SHCC, i.e. an expansive SHCC, and evaluate the crack-damage mitigation and structural performance of one-way RC slab with an expansive SHCC layer.

SHCC materials used in this study provide superior resistance to deterioration in a rapid freezing and thawing environment within 300 cycles. The freezing and thawing exposure within 300 cycles has little effect on the mechanical properties, such as compressive, flexural and direct tensile behaviors, of SHCC materials.

The application of a SHCC layer on the tensile side of a plain concrete beam increased both load carrying capacity and ductility of the beams compared to those of plain concrete beam. In shear-and flexure-dominant RC beams, layered and patched repair methods mitigated the crack-damage of these RC beams. Crack-damage mitigation of RC beams depends on repair method and SHCC’s tensile performance. The addition of a layer of SHCC material at the bottom of one-way RC slabs increases flexural strength and flexural stiffness before and after initial crack. The improvement of the flexural performance increases according to the layer thickness.
and SHCC’s tensile performance. Specifically, RC slabs with a layer of expansive SHCC show higher initial crack strength and flexural stiffness after initial cracking compared to the normal SHCC-layered slabs. This is phenomenon is remarkable for high-strength SHCC material.

The SHCC materials exhibited satisfactory performance as repair materials to mitigate the crack-damage of RC members.

After oral presentation, with faculty of civil engineering at Gifu Univ.; Prof. Yun at the fifth person from right, Prof. Rokugo at the second person from right

Prof. Yun at oral presentation