CERIS Civil Engineering Research and Innovation for Sustainability

Strengthening of flat slabs with reinforced concrete overlay – analysis and development of the solution

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Summary

Strengthening of concrete structures with a new concrete layer has been commonly used for columns, beams and slabs. This technique is economic and efficient for structural strengthening since it uses the same base materials, steel and concrete. It is usually applied on the compressed face of the concrete element due to concrete's recognized behaviour under compression, posing several challenges to control cracking and resistance when applied on the tensile face.

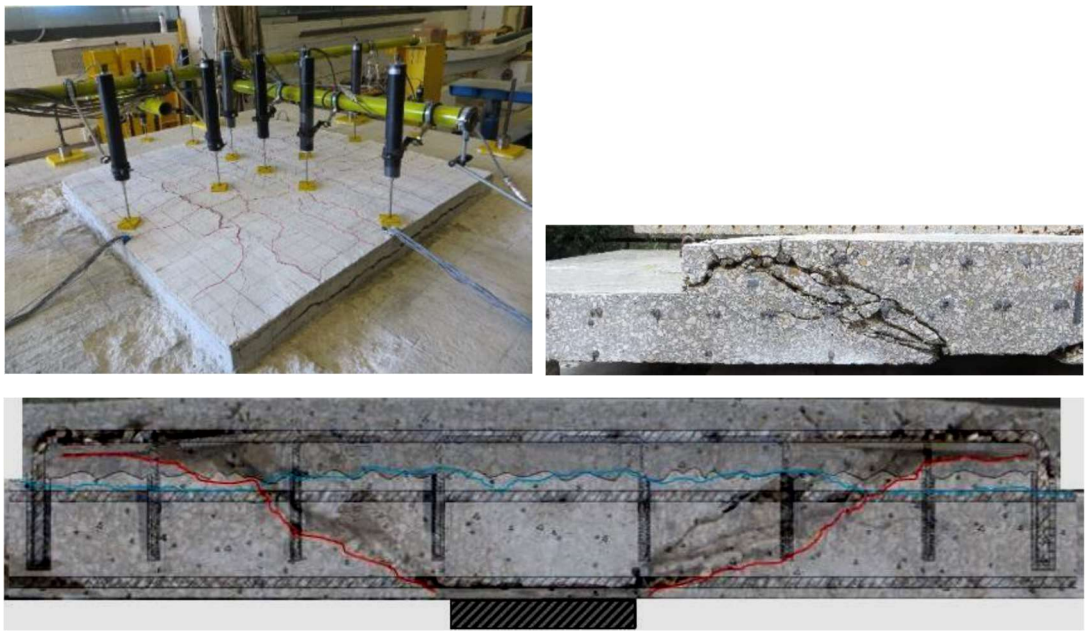
Strengthening of concrete structures with a new concrete layer applied on the tensile face requires controlling the debonding phenomenon of added concrete for service and ultimate limit states. Designing such strengthening solution requires the consideration for the strength of the global structure and the local interface capacity for maintaining structural integrity throughout the load history. Such requirement leads to the need for interface detailing solutions between the two concrete layers that improve the behaviour of the composite section, namely the roughening of the existing surface and stitching reinforcement. The knowledge from studying such interface was applied to the strengthening of slab specimens.

This work presents the study performed on concrete unidirectional slab specimens and on column-supported slab specimens. All specimens were strengthened with a reinforced concrete overlay on the tensile face. The former consisted on the flexural monotonic loading of the specimens until failure, and the latter consisted on specimens loaded monotonically and concentrically until failure. The calibration of numerical models based on experimental test results was also performed with the nonlinear analysis software ATENA 3D®.

All results were then compared to current codes and regulations, and some guidelines were defined for the correct application of strengthening with a reinforced concrete overlay on existing structures.

Keywords

Structural strengthening, reinforced concrete, concrete-to-concrete bond, concrete-to-concrete interface, numerical modelling, punching.



Detail of specimen S3D-STANC.