The 2023 World Congress on
Advances in Structural Engineering and Mechanics (ASEM23)
GECE, Seoul, Korea, August 16-18, 2023

Active Retrofit of Shear Critical RC Components Using Self-Prestresssing Iron-Based Shape Memory Alloys

Miguel González Góez[1)], Johanna Pinargote-Torres[1)], Trevor D. Hrynyk[2)] and *Eugene Kim[2)]

[1), 2)] *Department of Civil and Environmental Engineering, University of Waterloo, Canada*
[*] kekim@uwaterloo.ca

ABSTRACT

The National Research Council Canada (NRCC) estimates that more than one-third of bridges in Canada are at least 40 years old, with many requiring structural rehabilitation or replacement. Concrete deterioration in bridge infrastructure can be attributed to deficient maintenance, cyclic loading, extreme freeze-thaw cycles, and accelerated reinforcement corrosion due to global warming. Further, existing reinforced concrete (RC) bridge components are also prone to shear damage and degradation, and practical shear strengthening presents a challenge. Recently developed low-cost iron-based shape memory alloys (Fe-SMAs) possess a distinctive thermomechanical property known as shape memory effect (SME). The SME allows a prestrained (plastically deformed) alloy to return to its undeformed state when heated to its activation temperature. Restraining and activating this strain recovery can generate high recovery stresses (> 300 MPa) at moderate activation temperatures (~ 200ºC) which can be harnessed to effectively prestress structural elements without the use of jacking tools or anchorage devices. This study will assess a novel active retrofit technique for shear-critical RC components using externally restrained Fe-SMA strips to apply transverse prestressing. The effectiveness of the retrofit is tested on classical Z-shaped RC push-off specimens which have been commonly used to evaluate the shear response and shear transfer mechanisms along a cracked concrete plane (see Fig. 1). The experiments were designed to replicate shear crack development in larger RC structures (e.g., bridge components) that are shear sensitive, to contribute to future field-scale studies. The results show that Fe-SMA presents high recovery stress for shear strengthening and crack mitigation in RC elements.

[1)] Graduate Student
[1)] Graduate Student
[2)] Assistant Professor
[2)] Assistant Professor

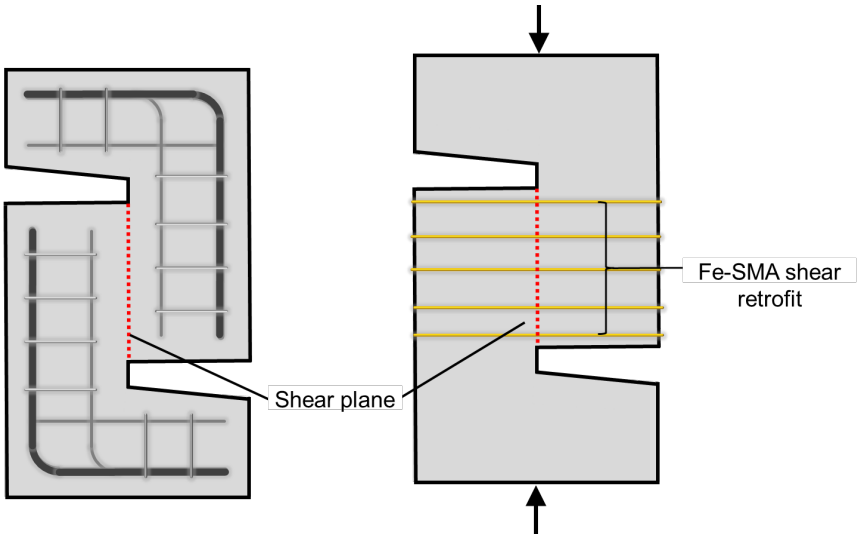

Fig. 1. Reinforced concrete push-off specimens with external Fe-SMA retrofit.

REFERENCES

Jeong, S., Kim, K.-H. E., Lee, Y., Yoo, D., Hong, K., Jung, D., Jeong, S., Kim, K.-H. E., Lee, Y., Yoo, D., Hong, K., & Jung, D. (2022). Compressive behavior of concrete confined with iron-based shape memory alloy strips. Earthquakes and Structures, 23(5), 431. https://doi.org/10.12989/eas.2022.23.5.431