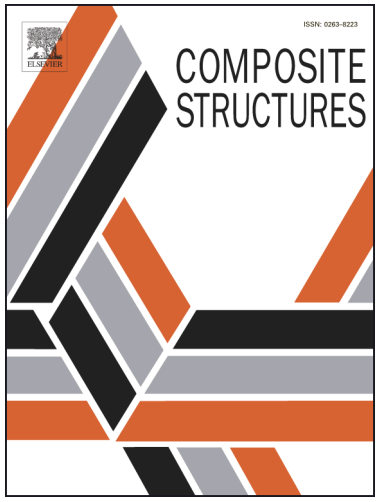

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PII: S0263-8223(18)30236-8
DOI: https://doi.org/10.1016/j.compstruct.2018.05.008
Reference: COST 9647

To appear in: *Composite Structures*

Received Date: 15 January 2018
Revised Date: 27 March 2018
Accepted Date: 2 May 2018

Please cite this article as: Gholampour, A., Ozbakkaloglu, T., Understanding the Compressive Behavior of Shape Memory Alloy (SMA)-Confined Normal- and High-Strength Concrete, *Composite Structures* (2018), doi: https://doi.org/10.1016/j.compstruct.2018.05.008

Understanding the Compressive Behavior of Shape Memory Alloy (SMA)-Confined Normal- and High-Strength Concrete

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ABSTRACT

This paper presents the first experimental study on the axial compressive behavior of high-strength concrete (HSC) confined by shape memory alloy (SMA) wire. Concrete cylinders that were prepared using two different grades of concrete, namely normal-strength concrete (NSC) and HSC, were confined with Nitinol (Ni-Ti) SMA spirals having a pitch spacing of 36 and 20 mm, respectively. Preliminary material tests were performed on SMA wires to investigate the tensile strength and strain of SMA in martensitic and austenitic phases and the effect of the temperature on the recovery stress. The confining pressure was applied on concrete cylinders by SMA spirals that were prestrained at 0, 5.5, and 9.5%. The material test results show that an increase in the prestrain level from 5.5% to 9.5% leads to an increase in the recovery stress of SMA wire at temperatures higher than the austenitic finish temperature (90°C). The compression test results on SMA-confined concrete specimens show that an increase in the prestrain level leads to an increase in the peak axial stress and corresponding axial strain of SMA-confined concrete. Confinement of NSC and HSC specimens by 9.5% prestrained SMA spirals results in a 38.1% and 23.6% higher peak axial stress and a 333% and 346% higher corresponding axial strain, respectively, compared to those of unconfined specimens. It is also shown that because of the more brittle behavior of HSC specimens, SMA-confined HSC fails at a lower axial strain compared to SMA-confined NSC. The lower ultimate axial strain of HSC specimens is also attributed to the lower confinement ratio of the HSC specimens of the current study compared to that of NSC specimens. The promising

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