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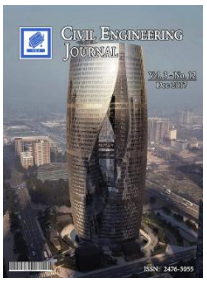

Experimental Study on Bond Stress between Ultra High Performance Concrete and Steel Reinforcement

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Abstract

Due to axial deformations generally caused by flexure, shear stress will be generated across the interface between reinforcement and surrounding concrete. This longitudinal shear stress is called bond stress and coordinates deformation between concrete and reinforcement. With increasing a member's axial deformation, bond stress finally reaches its ultimate value, bond strength, after which deformation of reinforcement and surrounding concrete will be not coordinated any more. Studies have shown that addition of nanosilica into cement-based materials improves their mechanical properties. Considering the unique characteristics of nanosilica, it seems that this material can be used in ultra-high performance concrete. Therefore, further research is needed on how to use it in concrete mixes. Due to the importance of examining bond stress and the lack of exact equations for bond stress of ultra-high performance concrete and steel reinforcement, the present study aimed to assess the bond stress between concrete and steel reinforcement.

Keywords: Bond Stress; Ultra-High Performance Concrete; Steel Reinforcement; Nanosilica.

1. Introduction

High strength and ultra-high performance concrete has many advantages. Due to its better mechanical properties and low permeability, this type of concrete is gradually replacing conventional concrete. Because of its considerable properties, this type of concrete can either be used in structures to resist loads, or in large bridges and several constructions due to being affected by environmental conditions. Micro-silica is widely used as an additive to cement in producing high performance concrete. This matter is used to enhance the strength and efficiency of concrete. Several experiments have shown that replacing part of cement with micro-silica improves sulphate and acid resistance of concrete and reduces chlorine permeability. By addition of microsilica to concrete or cement mortar, due to being fine grained, it fills the space between cement particles, so the existing pores will become smaller. Moreover, due to the reaction between silica and calcium hydroxide remained from cement hydration process, more C-S-H gels are produced and, as a result, more capillary cracks will be covered [1]. Recently, considering the unique characteristics of nanosilica, it seems that this material can be used in ultra-high performance concrete. Therefore, further research is needed on how to use it in concrete mixes. To this end, the present study used Pullout test to assess the effect of nanosilica on the bond stress between steel reinforcement and ultra-high performance concrete. Pullout test is the oldest, simplest, cheapest and less time-consuming way to measure local bond stress of concrete. In this test, a reinforcement is placed into a cylindrical or cube shaped concrete specimen, and then while the concrete is fixed in place, the reinforcement is pulled out. Since the reinforcement is under tension and concrete is under compression, the resultant relative strain will lead to relative slip. Many researchers have studied the bond between streel reinforcement and ultra-high performance concrete. Alkaysi, M., El-Tawil, S. (2016) conducted an experimental study on the bond stress between ultra-high performance concrete and streel reinforcement. They calculated the bond stress between 13, 16 and 19 mm reinforcements and ultra-high

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