

Experimental Study on Shear Behavior of Prestressed Ultra-High Performance Concrete I-girders

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Summary

As a new generation of concrete, UHPC(Ultra-High Performance Concrete) has attracted great research attention for its ultra-high strength and high durability. In the present paper, experimental results from tests on eight prestressed UHPC I-section girders failing in shear are reported herein. The beams with UHPCof 120 MPa in compression were designed to assess the ability to carry shear stress in thin webbed prestressed beams with stirrups. The test variables were the level of prestressing, shear span-depth ratio (a/d)and stirrup ratio. Shear deformation, shear capacity and crack pattern were experimentally investigated in detail. The equation based on ACI 544.4r-R1999 Code could better predict the shear strength than ACI 318-11 Code. The mean test to calculation ratio value of ACI 544.4r- R1999 Code was about 1.82. RPC, as a new high performance concrete, was different from high concrete and fiber reinforced concrete.

Keywords:Prestressed concrete; UHPC(Ultra-High Performance Concrete), RPC (Reactive powder concrete); Concrete beams; Shear strength

1. Introduction

As a new generation of concrete, UHPC(Ultra-High Performance Concrete) has attracted great research attention for its ultra-high strength and high durability, RPC (Reactive Powder Concrete), one type of UHPC, is a better alternative to High Performance Concrete and has the potential to structurally compete with steel. RPC, which was developed in the mid-1990s by Bouygues' laboratory in France, is a special type of ultra-high strength cementitious composite reinforced with short fibers^{[1][2]}.

RPC has been used worldwide for a number of structural applications including the first prestressed RPC Pedestrian Bridge with single span of 60meters and crossing the river of Magog in Sherbrooke in Canada^[3]; the Seonyugyo in South Korea with a single arch spanning 120meters and supporting a 30mm thick RPC deck^[4]; the first RPC highway traffic bridge constructed by VSL at Shepherd's Gully Creek in NSW, Australia^[5]; a kind of high-durability panel entirely made of RPC was used for railway bridge walkways in Qinghai-Tibet railway in China^{[6] [7]}; Wapello County Mars Hill Bridge, the first highway bridge (in North America) built with Ductal was successfully completed and opened to the public in 2006.^[8] This bridge is a significant step toward "The Bridge of the Future".