Punching Shear Strength of Concrete Slabs by Overlay of UHPC with Textile Reinforcement

Sung-Gul Hong, Hyun-Soo Youm, Namhee K. Hong

Department of Architecture, Seoul National University, Seoul, South Korea

Contact: sglhong@snu.ac.kr

Abstract

This paper presents the test results on 5 flat slab-column connection specimens with Ultra High Performance Fiber-Reinforced Concrete (UHPFRC) overlay to investigate the retrofitting effect of UHPFRC overlay on the punching shear capacity. The test parameters were the thickness of the UHPFRC overlay and the reinforcement ratio in the overlay. All specimens failed in punching shear mode with softening failure modes. The test results showed the increases in global punching shear resistance up to 82% and structural rigidity by a thin layer of UHPFRC over the reinforced concrete (RC) substrates. Furthermore, the cracking patterns in the composite systems by two failure modes control the ultimate strength: 1) diagonal shear failure in RC section and 2) debonding failure at the interface.

Keywords: Punching shear strength, retrofit, slab-column connection, UHPFRC, UHPFRC overlay.

1 Introduction

THE flat plate system is subjected to the combination of locally high negative bending moments and shear forces around the columns, which increases the susceptibility of this zone to brittle punching shear failure [1], [3], [4], [6]. As can be seen in many collapse accidents, it may eventually lead to a hazardous progressive collapse of the entire structures, accompanied by a truncated cone above the column [5], [7], [8]. Additionally, many existing buildings constructed with flat plate systems are becoming obsolete. In this trend, it is significantly emphasized to investigate retrofitting the RC slab-column connections against punching shear failure.

To date, various methods have been proposed and applied [6] for strengthening existing RC slab-column connections against punching shear failure; 1) enlargement of column section and slab thickness, or use of shear capital and drop panel, 2) post-installed shear reinforcement such as stirrups and shear bands, 3) pre-stressing, and 4) increasing of the amount of flexural reinforcement. This last method among them has been widely investigated to increase the punching shear resistance of deficient RC slab-column connections by attaching CFRP (Carbon Fiber-Reinforced Polymer), GFRP (Glass Fiber-Reinforced Polymer), and steel plate to the tensile surface. However, much longer construction processes and a lot of labor have to be accompanied using the above mentioned methods. In addition, these methods are not capable of reducing permeability of concrete that causes corrosion of steel re-bars placed in RC section and cracking due to expansion [2]. Furthermore, the organic binder used for FRP attachment can significantly degrade the structural performance of the RC members through chemical reaction at the interface.

Alternatively, placing a thin layer of cementitious composite material on top surface of RC members can be the most efficient and practical method for in-situ application among several retrofitting methods. However, in architectural point of view, the conventional NSC

https://doi.org/10.2749/nantes.2018.s21-53
Distributed by structurae