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## Design Properties of Insulated Precast Concrete Sandwich Panels with Composite Shear Connectors

Wonchang Choi,<sup>1</sup> Seok-Joon Jang,<sup>2</sup> and Hyun-Do Yun<sup>2\*</sup>

<sup>1</sup> Dept. of Architectural Engineering, Gachon University, Gyunggi, 13120, South Korea

<sup>2</sup> Dept. of Architectural Engineering, Chungnam National University, Daejeon, 34134, South Korea

<sup>2\*</sup> Author to whom correspondence should be addressed; e-mail: [wiseroad@cnu.ac.kr](mailto:wiseroad@cnu.ac.kr);

Tel: +82-42-821-5622

### Abstract

Researchers have developed various types of shear connectors to enhance shear transfer in insulated concrete sandwich panels. The shear transfer capacity of a precast concrete sandwich panel (PCSP) system that is composed of two precast reinforced concrete wythes separated by a layer of insulation wythe is influenced by the degree of composite behavior/action. This paper presents experimental results of push-out tests of concrete sandwich panels that use a grid type of glass fiber-reinforced polymer shear connector and then compares these results with previous research results that are based on corrugated shear connectors. A design equation (ICC-ES) was modified for this work to determine the shear strength of PCSPs with various configurations. For this study, 22 double-shear (push-out) specimens were fabricated and tested using two types of insulation materials, three insulation wythe thicknesses, and two grid spacings for the shear connectors as the variables. The test results were used to calculate toughness index and shear modulus values and to calibrate the modified ICC-ES equation. Increasing the thickness of the insulation wythe had a decreasing effect on the maximum shear flow and shear modulus of the PCSP system.

**Keywords:** Precast concrete sandwich panel, glass fiber-reinforced polymer (GFRP) shear connector, push-out test, shear flow

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