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Numerical Study on Composite Structural Connection with Steel Studs Embedded in SFRCC Slab

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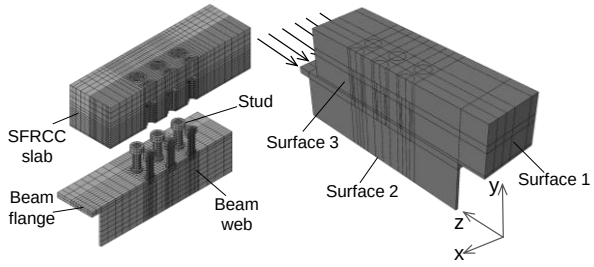
The stud connection behavior in solid SFRCC slab, such as is investigated by the push-out tests. The objective of this research is to simulate the behavior of headed stud connectors in the SFRCC slab by the finite element analyses. The analytical simulation is to provide us insight into the stress and strain distributions in the studs and slab, which is difficult to directly observe in physical tests.



(a) (b)

Fig.1 Finite element model: (a) Model mesh; (b) Boundary conditions

Detailed finite element models, using ABAQUS as shown in Fig.1, are developed to reproduce the experimental behavior of physical push-out test and estimate the maximum strength of shear stud connectors in SFRCC slab. A fairly good agreement is observed from the comparison of load-slip relationship curves and maximum strength obtained from the test and analyses. The differences in the maximum strength obtained from the tests and analyses range from 2% to 14 % as shown in Fig.2.

A series of parametric analysis are conducted to investigate the effect of the presence of weld collar, pitch length between studs, and SFRCC fiber volume on the behavior and strength of the connection.

To gain a deeper understanding on the force distribution of the studs according to the varieties of the parameters, the section force output method are used to obtain the shear bearing force that each stud sustain (Fig.3) and the section shear bearing load along the height of the stud.

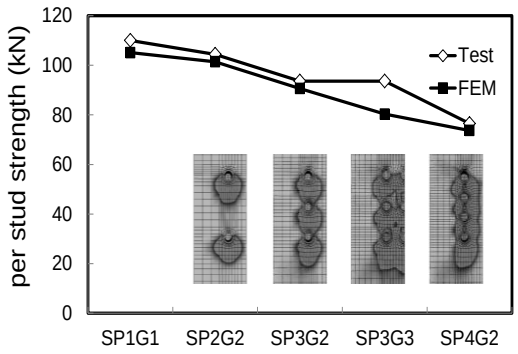


Fig.2 Comparison on experimental results and numerical results

The analyses reveal that the bottom collar portion of the stud significantly contributes to shear strength of headed stud connectors in SFRCC. This is because of the highly shear force concentration in the bottom of stud when embedded in SFRCC, and this lead to a strength much larger than the design strength. The mechanism that the strength of stud connection decreases as the studs spacing decreases is also numerically illustrated in the analysis.

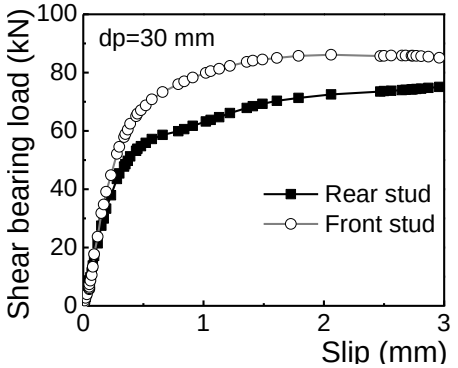


Fig.3 Shear bearing force that each stud sustains