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Beam-column connection of steel structures using steel fiber reinforced cementitious composites
Part I Push out tests on stud connection

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1. Introduction

Many steel moment-resisting connections suffered extensive damage during the 1994 Northbridge earthquake and 1995 Hyogoken-Nanbu (Kobe) earthquake. The welded beam-to-column connections mainly failed in brittle fracture in the groove welding portion (mostly in the beam bottom flange). In this study, an innovated weld-free beam-to-column connection was proposed. In such innovated connection, steel shear studs embedded in SFRCC slab to transfer the flange loads to the sides of the column.

Shear studs are used in steel building construction to allow for the composite action of the steel beams and concrete slabs. The capacity of these studs had traditionally been determined through monotonic push-out tests, in which a progressively larger unidirectional force is applied until failure. The requirements for shear studs in current design code are based on the research of studs embedded in concrete slab. Since SFRCC has better material characteristics compared than concrete (e.g. high compressive/tensile strength), the requirements could be released.

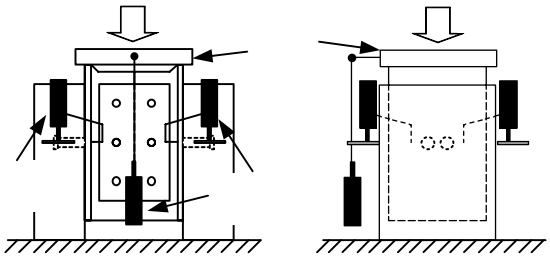

Fig. 1 Test setup: (a) front view; (b) side view

To investigate the load-carrying capacity of steel shear studs embedded in SFRCC slab, a series of push-out tests were conducted as the preliminary investigation for the innovated weld-free connection.

2. Specimens

Four specimens were tested along with one stud specimen as the reference specimen. Head studs in 22 mm diameter and 80 mm height were used. The spacing between studs was set as 50 mm, the limitation of stud welding equipment. Such value is far beyond the requirement of current code. The arrangements of studs are shown in Fig.2.

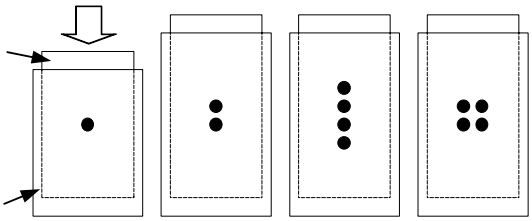

Fig. 2 Specimens:
(a) S; (b) P50; (c) 4P50; and (d) PG50

3. Test Results

Two different failure modes, stud fracture (S, P50, and PG50) and slab split (4P50), were observed during tests. As indicated in Fig.3, the maximum load transferred by one stud is 216 kN. However, the load-carrying per stud reduced around 10%, when studs were set crowd. In addition, studs fracture at 7mm slip.

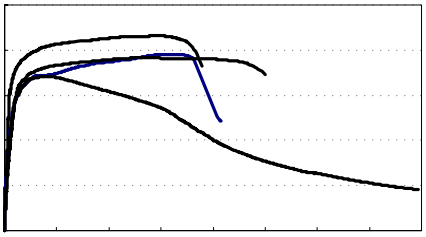

Fig. 3 Load- slip relationship