Formulation for Load-Slip Relationships of Headed Stud Connector

Hiroshi SHIMA
Professor
Kochi University of Technology
Kochi, JAPAN
Shima.hiroshi@kochi-tech.ac.jp

Hiroshi Shima, born 1958, received his doctoral degree from the Univ. of Tokyo in 1987. He worked at Tokushima University and became professor at Kochi University of Technology in 1997. His main research area is related to reinforced concrete and hybrid structures.

Seiji WATANABE
Engineer
Seiyu Co., Ltd.
Matsuyama, JAPAN

Seiji Watanabe, born 1985, received his civil engineering degree from Kochi University of Technology

Summary

A formulation for shear force-slip relationship of shear connector is necessary for more rational design method of steel-concrete hybrid structures. Equations for shear strength of headed stud connector were proposed by many researchers and design codes. However, the equation for shear force-slip relationship which takes account of important factors such as stud diameter has not been proposed. Pushout tests of headed stud connector were carried out under various stud diameter, stud tensile strength, stud height/diameter ratio and concrete strength. Shear force-slip relationship can be represented by one equation with dividing shear force by shear strength and slip by stud diameter although stud diameter is different. The form of shear force-slip relationship curve depends on concrete strength, stud height/diameter ratio and stud strength. An equation was proposed for the enveloped curve of shear force-slip relationship taking these effects into account.

Keywords: Headed stud; Load-slip relationship; Enveloped curve; Ultimate slip; Pushout test; Stud diameter; Stud strength; Concrete strength; Stud height/diameter ratio

1. Introduction

Steel-concrete hybrid structures are the structures which make the most of merits of steel and concrete. Forces should be transferred between steel and concrete in this type of structures. Shear connectors which connect both materials mechanically are generally used. In design of hybrid structures, a design method is generally used on the condition that the slip of shear connectors is negligible small to apply the plane remains plane assumption. However, more rational design method can be established by taking the amount of slip into account. On the other hand, a shear force-slip equation is necessary in order to use nonlinear finite element analysis in design works. Therefore, experiments of headed stud connector with parameter of stud diameter, concrete strength, stud tensile strength and stud height/diameter ratio were carried out and shear force-slip relationships were formulated in this research.

2. Present situation

2.1 Shear strength

Equations for shear strength of stud were proposed by many researchers. Guidelines issued by Japan Society of Civil Engineers [1] describes a smaller one of Eq.(1) or Eq.(2) as the shear strength.

$$V_{su} = 31 A_{ss} \sqrt{\frac{h_{ss}}{d_{ss}} f'_c} + 10000 \quad (1)$$

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