Static Behavior of Composite Beam according to the Degree of Shear Connection considering the Stud Shear Connection

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Summary

In the construction of composite beam, two kinds of materials which have different properties require connector helping each other to behave similarly. For this purpose it's necessary to use the shear connector which takes a role of bonding both materials. Composite materials can classify the connection of both materials as full interaction, and partial interaction. And it is full interaction that able to demonstrate the best efficiency of composite section. In this study, to evaluate the bending capacity of stud, which is popularly used in composite beam, the studs of different dimensions is installed in the each specimens and push-out test was taken for investigating the variation of shear strengths when the degree of shear connection changes. Also to evaluate ultimate loads when the degree of shear connection changes, three composite beams which have same section and different stud dimensions were manufactured. Compared the results of each experiment with those of the Finite Element Analysis, the effect of degree of shear connection to the composite beam and relationship between ultimate loads and the variation of degree of shear connection are estimated.

K e y w or d s : Degree of shear connection, Ultimate loads, Bending capacity, Partial interaction, Full interaction, Shear strength of stud

1. Introduction

In this context, it is necessary to identify the behaviour of the shear connectors in the composite beam. The main objective of this study is to evaluate the behaviour of the composite beam according to the degree of shear connection. For this objective, loading test was conducted to verify the effect of it by arranging various stud dimensions. From the experiment results, evaluating the load carrying capacity and ultimate strength of composite beam were concluded.

2. Degree of shear connection

In composite beam, composite action is conducted by the shear connector which resists the shear force. Composite action can be described as degree of shear connection from the shear strength and shear stiffness of the composite beam. The degree of shear connection in terms of the shear strength of composite beam deals with the equilibrium of the axial strength between the steel element or the concrete element and shear connection in the composite section

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3. Static loading test on the composite beam

In this study, three specimens were fabricated to evaluate the behaviours and load-resistant characteristics of the composite beams. Different stud diameter was applied to each specimen. There are three kind of stud diameter: 13mm, 16mm, and 19mm. 36 stud shear connectors were welded on the upper side of top flange for every specimen.

4. Loading test results

Figure 6 presents the load-deflection curves at center of composite beam specimens. In the case of yield loads, it was varied as the specimens. Yield load of SCB-13D was 165.67kN, SCB-16D was 173.42kN, and SCB-19D was 214.19kN. The yield load of specimens increased 4~29% as the degree of shear connection. In the case of stiffness, SCB-13D of it was 19.18kN/mm, SCB-16D was 20.39kN/mm, and SCB-19D was 22.59kN/mm. the elastic stiffness of specimens increased 6~17% as the degree of shear connection. In the case of ultimate strength, however, for SCB-13D it was 302.25kN, SCB-16D was 302.43kN, and SCB-19D was 302.41. The ultimate loads of specimens were not changed as the degree of shear connection. From Fig. 7, it can be known that stiffness of the structure is also changed as variation of the degree of shear connection. In lower degree of shear connection, the more stiffen behaviour can occur.

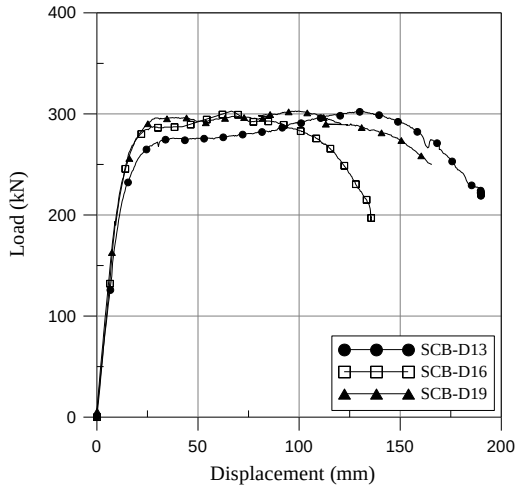

Fig. 6: Load-displacement relationship at the center of composite specimens

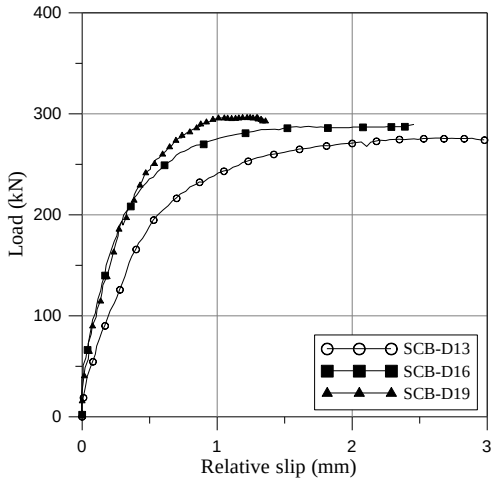

Fig. 7: Load-relative relationships at support of composite specimens

5. Conclusions

(1) It can be estimated that the degree of shear connection affect the structural stiffness of the composite beam. It affects ultimate strength slightly. Because stud shear connector is designed with enough safety factor. Therefore if the degree of shear connection of composite beam is greater than 0.8, the composite beam will be behaved like full shear connection.

(2) It can be known that the less stiffened behaviour is conducted in lower degree of shear connection than in larger one. It means if the degree of shear connection increase, the stiffness of composite beam will increase.