Experimental Study on PBL Shear Connector Composite Structures

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Summary

38 perfobond leisten (PBL) shear connector specimens and 2 anchorage specimens containing PBL shear connector array are designed in 3 successive experimental tests in the laboratory in order to investigate the functions and work mechanism of PBL shear connectors. The experimental test results manifest that PBL shear connectors show a characteristic of concrete when the slip is relatively small whereas, however, seem to be fairly ductile as the bearing capacity is nearly approached. The load-slip relation of PBL shear connectors with a relatively small slip can be simulated with a power function.

Keywords: Composite structures; PBL shear connector; ultimate bearing capacity; experiment.

1. Introduction

Leonhardt et al. proposed PBL shear connectors and apply them to the composite girders in 1980's [1, 2]. From then on, a lot of associative experimental works were carried on [3-6]. Most of these works investigated the ultimate bearing capacity of PBL shear connectors through push-out tests.

For some composite structures, the work condition is different from that for a composite girder. For instance, the upper portion of the pylons of 3rd Yangtze River Bridge in Nanjing is made from steel while the lower portion is made from concrete [8]. The loads are transferred from the upper portion to the lower one through a steel-concrete composite portion. In these cases, the composite structures are distinct from composite girders. Since the steel components in the steel-concrete composite portion are embedded in concrete, such composite structures can be named as "embedded composite structures".

The shear connectors with relatively lower stiffness and larger slip at ultimate bearing state are suitable to use in the embedded composite structures loaded at one end.

2. Test Profile

The whole test is divided into 3 stages. In the first stage, different parameter combinations are compared; the second stage is the function test of two series of optimized PBL shear connectors; the third stage is the function test of a type of chosen PBL shear connector. 12 PBL shear connector specimens are designed in the first test stage whereas 11 specimens and 15 specimens are studied in the second and third stage, respectively.

The specimen group ID is "SBxx-yyA" or "SBxx-yyB" where "xx" denotes the dowel diameter in mm, "yy" denotes the perforating rebar diameter, "A" at the end means that there are 2 shear connectors in a specimen and "B" at the end means that there is only 1 shear connector in a specimen. If the rebar diameter is 0, it means that the shear connector contain a plain concrete dowel. A B-type specimen is illustrated in Fig.1 while the A-type specimen is similar to it except

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that there are 2 shear connectors assigned along the loading direction.

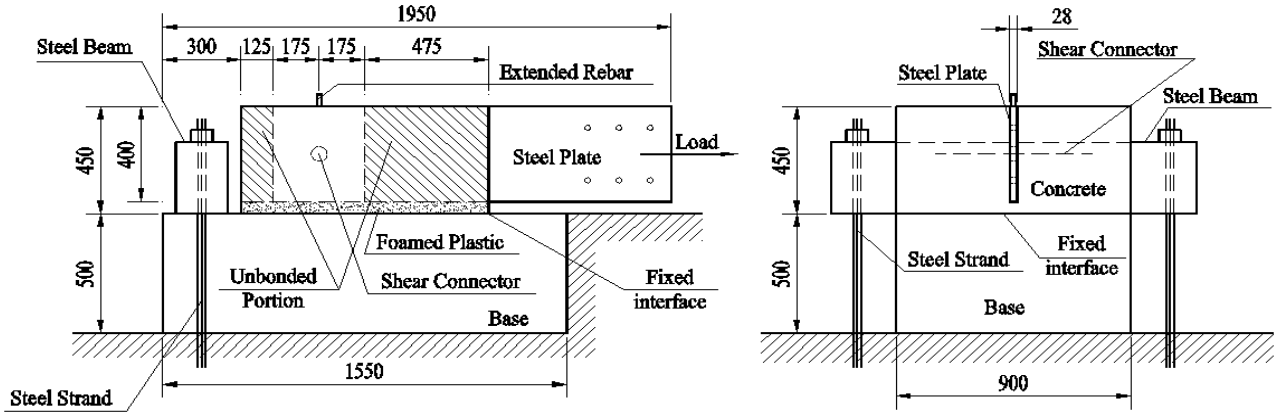

Fig.1: Illustration for PBL specimens

3. Conclusions

The working process of embedded PBL shear connectors consists with 4 stages.

When the slip is relatively small ($\Delta \leq 1$ mm), there is few cracks in the concrete dowel, the mechanical behaviour of embedded PBL shear connectors shows evident characteristics of concrete and the stiffness of shear connectors is relatively high.

When the slip is relatively great, the concrete dowel has broken, the mechanical behaviours of embedded PBL shear connectors show plastic characteristics. Because of the scratching or friction effect between the broken concrete dowel and the steel plate and concrete surface, the concrete dowel can still provide some resistance to the load.

The embedded PBL shear connectors can undergo a large deformation before the ultimate state and the ductility is nice. When the shear connectors are ruptured, the perforating rebars break. The ultimate bearing capacities of embedded PBL shear connectors with the same rebar diameter are almost consistent if the concrete strength is same.

The ultimate bearing capacity of embedded PBL shear connectors subjected by the combined tensile and shearing background stress is lower than that under the compressive background stress.

The ultimate bearing capacity of embedded PBL shear connectors with the higher volume fraction of transverse reinforcement is higher than that with the lower volume fraction.

If the rebar diameter matches the dowel diameter appropriately, the load-slip relation of embedded PBL shear connectors is consistent with the power function.

References

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