

# Effect of Orientation on the Shear Strength of Perfobond Shear Connectors

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## Summary

In this paper, three perfobond rib (that is a perforated plate) orientations in concrete, that is, normal orientation, invert orientation and lateral orientation were selected to invest the effect of perfobond rib orientation in concrete on shear strength by conducting a serial of push-out tests. By push-out tests, shear capacities of perfobond rib shear connectors with different orientation are obtained. The test results indicate that the shear bearing capacity of perfobond rib in normal orientation is the largest, in invert orientation is medium and in lateral orientation is the least. Also the reason of the effect of perfobond rib orientation on shear strength is analyzed.

**Keywords:** composite structure; perfobond rib connector; experiment; bearing capacity

## 1. Introduction

Comparing to headed studs shear connectors, perfobond rib shear connectors are behaving higher shear bearing capacity, smaller obstacles during erection and easier welding to steel girder, no fatigue and so on. Perfobond rib shear connectors are widely adopted in composite structures and hybrid structures increasingly. In steel-concrete composite beam, perfobond ribs were welded with steel girder and concrete was poured form up to down, so the position of perfobond rib is normal orientation in concrete. While in steel-concrete hybrid structure, such as hybrid girders, hybrid pylon, hybrid ribs of arch bridge, although casting concrete is same as that in composite beam, the orientations of perfobond ribs in these structures are various, either normal orientation, invert orientation or lateral orientation, arbitrary orientation and so on. Therefore the qualities of concrete in the hole of perfobond ribs are different with different rib orientations in concrete, and can affect the bearing capacity of shear connectors. In this paper, three perfobond rib orientations in concrete, that is, normal orientation, invert orientation and lateral orientation, were selected to invest the effect of perfobond rib orientation on shear strength by conducting a serial of push-out tests.

## 2. Test and results

In this paper three groups, named ES1, ES2 and ES3 (each group including three specimens) are for perfobond rib in normal orientation, invert orientation and lateral orientation in concrete respectively. Fig.1 shows the load-slip curves for totally nine push-out test specimens of groups ES1, ES2 and ES3. In the figure, the abscissa is average slip from four linear variable differential transducers and ordinate is applied load of per perfobond rib shear connector.

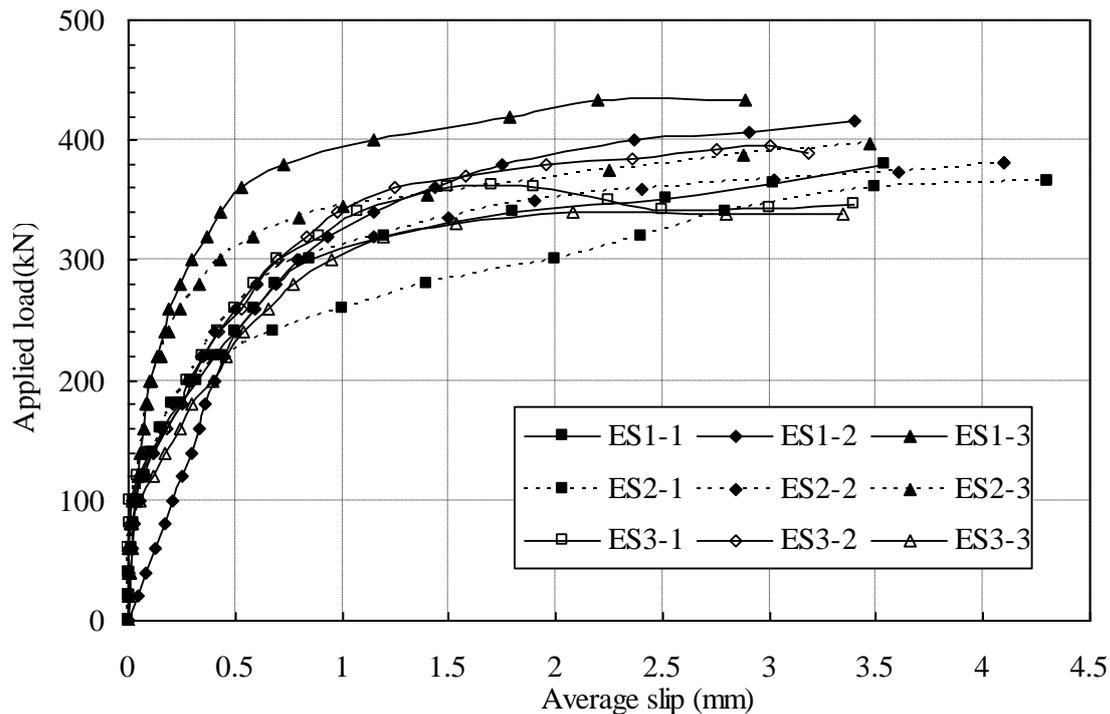


Fig.1: Load-slip curves for push-out specimens

Comparing the average value in every group with three specimens, the perfbond rib in normal orientation has the largest ultimate load, with 419.3 kN per perfbond connector, the perfbond rib in invert orientation has middle ultimate load, with 380.8 kN per perfbond, and the lateral orientation has the smallest ultimate load, with 366.5 kN per perfbond. Comparing to the average ultimate load of the normal orientation, the value of invert orientation and lateral orientation is decreased 9.2 percent and 12.6 percent respectively.

### 3. Tests result analysis

The difference of average ultimate load of groups ES1, ES2 and ES3 can be mainly attributed to the segregation of concrete in the hole with different rib orientations. The segregation induces the separation between concrete and steel in the hole and decreases their contacting areas. The distributions of contacting normal pressure between concrete and steel in holes are different in groups ES1, ES2 and ES3. The decreased normal pressure and contacting area by segregation in the hole of perfbond rib in lateral orientation is more than that of in normal orientation and in invert orientation. Therefore the ultimate shear load of groups SE3 is the minimum.

### Conclusion

The shear capacity of perfbond rib shear connector considering three orientations of the perfbond rib in concrete was conducted by the push-out test. The test results show the perfbond rib orientation affects the shear capacity in some degree, and the normal orientation perfbond rib has highest shear capacity, the invert orientation has middle value and the lateral orientation has lowest value.

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