Experimental research on debonding in concrete-filled steel tubes columns subjected to eccentric loading

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Summary

Concrete core subjected to confinement effect from steel tube is the main advantage of concrete-filled steel tubular (CFST) column under compression. However, the debonding of concrete to steel tube, which is a common phenomenon in real structures, will have an unfavorable effect on the confinement. In this paper, the influence of debonding on CFST stub columns subjected to eccentric loading was investigated experimentally. The debonding gap was formed by inserting galvanized sheet in the steel tube before the concrete fill and by pulling them out after 5~6 hours. From the test, it was verified that the method to form the debonding gap of specimen is valid. The parameters in the test included the debonding arc-length ratio and steel ratio. All the specimens failed in flexural mode, which indicated that the debonding has no influence on the failure modes. The ultimate load capacity and the ductility of the specimens were significantly decreased with the increased debonding arc-length ratio, while this unfavorable influence would decrease with the steel ratio increase.

Keywords: concrete-filled steel tube, debonding, single tube, eccentrically loading, experiment, ultimate load capacity, ductility.

1. Introduction

Concrete-filled steel tubular (CFST) structures have many advantages over an equivalent steel, reinforced concrete, or steel-reinforced concrete member because of the benign confinement effect between steel and concrete. The compressive strength of the core concrete can be increased by reason of the lateral confinement provided by the steel tube, and the local buckling of steel tube can be delayed and restrained by the concrete fill [1-5]. This beneficial composite action requires force transfer between the steel tube and the core concrete, while the debonding in this structure will have an unfavorable effect on the confinement. Actually, the debonding is almost unavoidable in CFST structures, which had been demonstrated by previous research works. There are two different conditions of debonding in CFST structures in accordance with different causes of formation. One is due to the poor construction quality which can be avoided by improving the construction techniques. And the thickness of it is more significant. The other is due to the shrinkage of concrete, temperature variation, and negative confining force produced during the initial stage of CFST structures subjected to compression and so on. Moreover, the thickness of it is uniform and little with the value of 1~3 mm [6] [7]. This kind of debonding is almost impossible to be avoided and the debonding mentioned in this paper belongs to it.

Research on the effect of de-fill rate (A_d) on ultimate load capacity of debonding CFST columns was conducted experimentally in literature [8]. The de-fill rate is the ratio of debonding area to concrete area in the cross section of specimens, shown as in Fig.1. This kind of debonding is generally produced by poor construction quality. From the result of the test, it was found that when

https://doi.org/10.2749/222137810796012234
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