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Seismic Performance of Concrete-Filled Double-Layer Steel Tubular Column under High Axial Load

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Abstract

Concrete-filled steel tubular (CFT) columns have been widely used in building structures because of excellent earthquake-resistant properties such as high stiffness, high strength, good ductility and large energy absorption capacity. In past years, a special cross-section of column with the concrete-filled double-skin steel tubes (CFDSTs), was proposed by several researchers due to some advantages in respect of CFT column, which include reducing total dead load of structure, lowering concrete consumption, increase in section modulus and improving cyclic performance. However, the hollow part of cross-section can lead to significant axial compressive strain under high axial load. In this study, a different cross-section of column with concrete-filled double-layer steel tubes (CFDLTs), transforming from the CFDST column by filling the hollow part of cross-section with concrete, is proposed to decrease the axial compressive strain. Quasi-static cyclic tests of the CFDST and CFDLT column specimens were carried out under constant axial force ratio of 0.5 to investigate the effect of hollow section of column and solid section of column on the seismic performance. The experimental results showed that the CFDLT column specimen exhibits higher lateral load capacity and ductility. It is clarified that progress of axial compressive strain can be remarkably prevented for the CFDLT column specimen.

Keywords: CFT column; CFDST column; CFDLT column; hollow section; solid section; seismic performance; high axial load; axial compressive strain.

1 Introduction

Concrete filled steel tube (abbreviated as CFT hereinafter), which is a kind of composite structural member consisting of an steel tube infilled with concrete, has a number of distinct advantages over an equivalent steel, reinforced concrete, or steel-reinforced concrete member, because combined effects of the steel and concrete in the cross section optimize the strength and stiffness of the section. The main combined effects of the steel and concrete for the CFT structural member and merits of the CFT structural member can be listed as follows:

1. The steel laying at the outer perimeter performs most effectively in resisting bending moment and makes the greatest contribution to the moment of inertia.
2. The steel tube prevents spalling of the concrete.
3. The steel tube serves as formwork in construction, which decreases labour and material costs.
4. The steel tube confines the concrete core, which increases the compressive strength and the ductility.

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