



# Experimental behaviour of partially loaded concrete filled double-skin steel tube (CFDST) sections

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## ABSTRACT

The experimental behaviour of concrete filled double-skin steel tube (CFDST) sections subjected to partial compression is reported in this paper. Fourteen specimens with outer and inner steel tubes of circular hollow section (CHS) and fifteen specimens with outer and inner steel tubes of square hollow section (SHS) were tested. The test parameters included: 1) hollow ratio, 2) top endplate thickness, and 3) partial compression area ratio. The test results indicated that the CFDST columns under partial compression behaved in a ductile manner. The partial compressive behaviour and the failure modes of partially loaded CFDST stub columns were significantly affected by the parameters investigated. Finally, a simplified model for predicting the bearing capacity of partially loaded CFDST sections is proposed.

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## 1. Introduction

The advantages of concrete filled double-skin steel tube (CFDST) column over traditional concrete filled steel tube (CFST) column have been introduced in Han et al. (2004) [1]. CFDST columns have been considered as the high-rise bridge piers over deep valleys (Yagishita et al. 2000) [2], and thus the CFDST column may be subjected to partial compression through the bearing over the piers.

In the past, several series of tests have been performed on CFDST columns loaded on the entire section as summarised in Han et al. (2004, 2006) [1,3] and Zhao and Han (2006) [4]. Recently, Huang et al. (2010) [5] and Han et al. (2009) [6] developed numerical models for the static and cyclic behaviour of CFDST columns, and the interaction between sandwiched concrete and steel tubes was analysed. Uenaka et al. (2008) [7] experimentally investigated the flexural behaviour of CFDST, and both the outer and inner steel tubes were circular hollow section (CHS). The studies on fire performance of CFDST columns exposed to standard fire were reported in Yang and Han (2008) [8] and Lu et al. (2010) [9]. The tests on CFDST stub columns with outer and inner CHS were carried out by Uenaka et al. (2010) [10], and based on the test results a simplified formula for the strength of stub CFDST columns was suggested. Zhao et al. (2010)

[11] experimentally studied the behaviour of CFDST stub columns under large axial deformations.

The behaviour of CFST columns under partial compression has been studied previously (Han et al. 2008a; Yang and Han 2009; 2011; 2012) [12–15], and the simplified design formulae for partially loaded CFST columns have also been presented in EC4 (2004) [16] and Han et al. (2008b) [17]. However, it seems that no information is available for the behaviour of CFDST columns under partial compression.

A series of tests was conducted on concrete filled double-skin steel tube (CFDST) columns under axially partial compression as reported in this paper, and the test parameters included the hollow ratio, the top endplate thickness and the partial compression area ratio. The objectives of the research are threefold: first, to experimentally investigate the behaviour of partially loaded CFDST columns, second, to compare the behaviour between CFDST and CFST columns under axially partial compression, and finally, to study the evaluation method for the bearing capacity of partially loaded CFDST sections.

## 2. Experimental investigations

### 2.1. Test specimens

Twenty-nine CFDST column tests, including 14 specimens with outer and inner tubes of circular hollow section (CHS) and 15

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