

Numerical Analysis of the Constitutive Model of Concrete-Filled Double Skin Tube

F.-C. Su^{1,2}, H.-T. Hu³ and S.-H. Tsai³

¹Department of Hydraulic and Ocean Engineering, National Cheng Kung University

²Department of Mechanical Engineering, National Cheng Kung University

³Department of Civil Engineering and Sustainable Environment Research Center, National Cheng Kung University

Abstract

Proper constitutive model for the concrete-filled double-skin tube (CFDST) beam-columns are proposed. The cross-sections of the inner and outer tubes of CFDST beam-columns are circular. The constitutive model of CFDST is simulated by nonlinear finite element program ABAQUS and verified against experimental data. The ratio of the diameter of the outer tube to the thickness of outer tube (D_o/t_o), ratio of the diameter of the inner tube to the thickness of the inner tube (D_i/t_i), and the percentage of axial loading of axial ultimate strength of CFDST beam-columns (P_n) are the main factors that control the ultimate strength and fracture strength of concrete in CFDST beam-columns. Small D_o/t_o , and D_i/t_i ratios and large percentage of axial loading of ultimate strength of CFDST beam-columns (P_n) lead to good confinement of concrete. Empirical equations are proposed to predict the lateral confining pressure of the concrete core for CFDST beam-columns.

Keywords: concrete-filled double-skin tube, lateral confining pressure

1. Introduction

A concrete filled tube (CFT) column consists of a steel tube filled with concrete. The moldboard is need not in CFT unit of structures since the steel tube can serve as one, reducing construction time and costs will be saved. The steel tube provides longitudinal and lateral reinforcement to confine concrete and the concrete delays the local buckling of the steel tube. CFTs have high strength, high ductility

and high energy absorption, making them suitable for offshore structures, high-rise buildings and bridges (Ge *et al.* 1992, Boyed *et al.* 1995, Bradford 1996, Schneider 1998, Roeder *et al.* 1999, Huang *et al.* 2002, Elchalakani *et al.* 2002 Hu *et al.* 2003, Lu et al. 2007, Hu *et al.* 2010).

A concrete-filled double-skin tube (CFDST) (Fig.1) consists of two tubes (an inner tube and an outer tube) with concrete between