



# Experimental and numerical study on the seismic performance of irregularly concrete-filled steel tube column to steel beam joints with inner semi-diaphragm

Wang-Hui Liu, Yan-Lin Guo

Tsinghua University, Beijing, China

Contact: [liuwangh19@mails.tsinghua.edu.cn](mailto:liuwangh19@mails.tsinghua.edu.cn)

## Abstract

This paper studies a new kind of irregular-shaped concrete-filled steel tube column to H-shaped steel beam joints with inner semi-diaphragm (ICFSTC-Joint), which exhibits excellent seismic performance, bearing capacity and stiffness in the engineering structures. Firstly, the experiments of four ICFSTC-Joint specimens under cyclic loading are carried out to investigate their hysteretic behavior and failure mode. It is found that the axial compressive ratio has significant negative influence on the hysteretic behavior of ICFSTC-Joint. Secondly, the finite element (FE) models of ICFSTC-Joint are established and verified by the experimental results. The hysteretic curves and skeleton curves of FE model are obtained and agree well with the experimental results. Thirdly, a parameter analysis on the size of diaphragm is carried out by using established FE model. This paper can provide guidance for the engineering design of CFST column to beam joints under earthquake.

**Keywords:** Concrete-filled steel tube; Joint; Seismic performance; Hysteretic curve; Finite element

## 1 Introduction

Irregular-shaped concrete-filled steel tube column has attracted widespread concern of researchers and been used in residential buildings for its superiority in spatial shape, which enables it to avoid the protrusion of the column relative to adjacent wall and increase the available area and aesthetic of indoor space [1]. However, for its irregular-shaped and multi-cell section, the irregular-shaped concrete-filled steel tube column to beam joint is complex in terms of construction method and mechanical performance, which has been a focus of current research in the field of building engineering.

In authors' previous paper [2-3], we proposed a kind of irregular-shaped CFST column (ICFSTC)

formed by I-shaped steel, U-shaped steel and infilled concrete. In this paper, to match the proposed irregular-shaped CFST column, proposes a new kind of irregular-shaped CFST column to H-shaped steel beam joints with inner semi-diaphragm (ICFSTC-Joint), as shown in *Figure 1*. The flange of H-shaped steel beam is welded with the outer surface of column wall, and the web of H-shaped steel beam is connected with the plate welded with the column wall by bolts. The inner semi-diaphragm is placed inside the joints and its three sides are welded with the inner surface of column wall. The inner semi-diaphragms stand directly opposite to the top and bottom flanges of H-shaped steel beam. The inner semi-diaphragm has two small round holes to facilitate ventilation during the concrete pouring. The inner semi-diaphragms can increase the bearing capacity of