The Evolving Metropolis
2019 IABSE Congress
New York City

IABSE 90 YEARS

Pullout Behavior of Steel Beam-Concrete Wall Pinned Joints with T-shaped Connectors

He Zhao
PhD candidate
Tsinghua University
Beijing, China
zhaohe0626@163.com
Main Research Interests/Field: composite structures; seismic analysis; new structural systems; efficient numerical modelling

Xin Nie
Assistant Professor
Tsinghua University
Beijing, China
xinnie@tsinghua.edu.cn
Main Research Interests/Field: composite structures; vibration of railway bridge; structural dynamics; numerical method

Dan Zhu
M.S.
Tsinghua University
Beijing, China
541871110@qq.com
Main Research Interests/Field: composite structures; connections between steel and concrete; bridge engineering

Mu-Xuan Tao
Associate Professor
Tsinghua University
Beijing, China
taomuxuan@tsinghua.edu.cn
Main Research Interests/Field: composite structures; slab spatial effect; numerical method; structural performance evaluation

Contact: zhaohe0626@163.com

1 Abstract

Nowadays, reinforced concrete core wall-steel frame hybrid structural systems are widely used in mid-rise and high-rise buildings. In this type of structural system, the pulling resistant behavior of the steel beam-concrete wall joints (SBCW joints for short) plays a very important role in the seismic behavior. In this study, the pullout behavior of a new type of SBCW pinned joints with T-shaped steel connectors is tested, and the load-displacement curves and failure modes of the specimens are analyzed. Two failure modes are observed in the experiments: one is punching shear failure mode characterized by the pullout of concrete pyramid with lower strength and stiffness, and the other is web yield failure mode characterized by the yield of the web plate of the connector with higher strength and stiffness. The key factor to determine the failure mode is the embedded depth of the connector. Additionally, finite element models for the SBCW joint are established and nonlinear elastic-plastic analysis is carried out, which can predict the failure modes and pulling resistant capacity of the specimens with good accuracy. Based on the numerical model, a parameter analysis is conducted to study the influence of more factors on the capacity of the SBCW joint.

Keywords: pinned joint; steel beam; concrete wall; T-shaped steel connector; pulling resistant capacity; experimental study; finite element analysis.

2 Introduction

Reinforced concrete core wall-steel frame hybrid structural systems are widely used in mid-rise and high-rise buildings because of high seismic performance and low construction cost [1]. In this type of structural system, the SBCW joint connecting the reinforced concrete core tube and the steel frame is quite important in the lateral force transfer system, especially under the seismic condition [1-3]. Therefore, substantial researches have been conducted on the mechanical performance of the SBCW joint. However, the pulling resistant behavior of the SBCW joint has not been researched much in previous literature, which is important in the lateral force system. And it is indicated that the axial force is the main cause of the damage of the SBCW joint by the results of shaking table test [4].

Based on the deficiency of existing studies and the demand of engineering application, a new type of SBCW joints with T-shaped steel connectors is proposed and monotonic pullout tests on six specimens are carried out to investigate the pullout performance of the joints. Furthermore, finite element models of the specimens are built and

https://doi.org/10.2749/newyork.2019.1747
Distributed by Structurae