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THE EFFECT OF COLUMN WALL THICKNESS ON THE SEISMIC PERFORMANCE OF NEW BOLT JOINTS

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ABSTRACT

A connection method of the beam-column joint of a new type of full bolt is proposed in this paper, which can be used to conveniently connect the square steel column with the H-shaped steel beam by full bolt. Pseudo-static test is carried out on two beam and column joints to study their bearing capacity, hysteresis performance, skeleton curve, ductility performance and energy dissipation capacity, and to study the influence of the column wall thickness of the joint area on its seismic performance. The study shows that the column wall thickness in the joint area has a significant impact on the failure form and the seismic performance. As the thickness of the column wall increases, the bearing capacity, ductility, stiffness and energy dissipation performance of the joint increase significantly. As for the connection method of the new joint, when the thickness of the column wall is different, its failure form is different, but its seismic performance, such as ductility and energy dissipation capacity, is better.

KEYWORDS: Square Steel Tube, Full-bolt Joint, Seismic Performance, Column Wall Thickness

INTRODUCTION

The beam–column connection significantly affects the bearing capacity, deformation capacity and seismic performance of a structure. Typical welded steel frame connections in the California seismic belt failed to provide the expected ductility behavior, which was a result of the 1994 northridge earthquake in Los Angeles, California. The failure occurred at the joint of the beam, including full penetration weld fractures. Bolt joints have been used for decades and have performed well in past earthquakes. The existing research mainly focuses on high-strength T-shaped joints[1-4] adopted in H-shaped steel columns and H-shaped steel beams. Box columns are often used in high seismic hazard areas because of their good resistance to bidirectional bending. However, only a few researchers have developed and tested high strength bolts adopted in H-shaped steel beams and box columns[5-8].

A novel type of joint that is suitable for H-shaped beam and box column is proposed in this paper. The joint structure is simple and its bearing capacity is reasonable, which makes up for the disadvantages of traditional nodes: slow construction speed and poor on-site welding quality. The beam and column joints are composed of box column and H-shaped beam, and the side plate and beam end plate of the column are connected on site by high-strength bolt without nut, and the thread is directly made on the side plate of box column. This structure is shown in Figure 1. Box column and H-shaped beam are connected by high strength bolt, which contributes to quick and economic assembling on site. In order to estimate the ultimate tensile strength of high strength bolts without nuts, in the preliminary study of this project, the relevant force mechanism and experimental research were carried out with the parameters of plate thickness, thread shape, plate strength and bolt diameter[9, 10]. The results showed that the wall thickness of the column was an important factor in the bearing capacity of the new bolt joints.

Through the pseudo-static loading test, this paper studied the influence of the wall thickness of the joint area on its seismic performance when the new single-sided bolt joint is used for square steel pipe columns and steel beam joints, which provides a reference for further research.