Mechanical Behavior of Square CFST Columns with Embedded Steel Plate Reinforcement

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***Abstract*—Concrete filled steel tube (CFST) columns have been gradually adopted in modern civil engineering structures mainly in high-rise buildings and bridges. Past research have shown that circular CFST columns were far more superior to its square or rectangular counterparts. Besides lower confinement effect, square and rectangular steel tubes with large width-to-thickness ratio were prone to suffer from local buckling. In order to improve the ultimate load carrying capacity of the these columns, the CFST columns were reinforced by longitudinal steel plate embedded into the concrete core. The mechanical properties such as ultimate strength, stiffness and ductility of the square CFST columns with and without longitudinal plate reinforcements were compared and studied.**

***Index Terms*—CFST columns, eccentricity, reinforcements, stiffeners, slender**

I. Introduction

Square and rectangular CFST are increasingly used as one of the main structural elements either in resisting vertical or lateral loads in civil engineering structures due to the fact that they have high moment capacities, easy beam-to-column connection and also aesthetic consideration. In order to overcome the low confinement effect and local buckling issue, lots of researches have been done in order to enhance the interaction between the steel tube and concrete core and increase the resistance of square and rectangular CFST columns. The modifications done on square and rectangular CFST columns are by incorporating the use of longitudinal plate stiffeners, reinforcing bars, anchor or binding bars, tensile strips, shear studs and also using steel fiber reinforced concrete.

The use of longitudinal plate stiffeners is the most well known method on improving the resistance of a square or rectangular CFST column. Usually longitudinal plate stiffeners are welded on the inner surface of the steel tubes. Experimental tests [1], [2] have shown that the longitudinal stiffeners can delay local buckling, improves the confinement pressure on the concrete core and thus increasing the resistance and ductility of the CFST columns. The improvement on the ultimate load of square and rectangular CFST columns with one longitudinal stiffeners on each steel tube surface were 9 and 10% higher than unstiffened sections respectively [3].

Hsu and Juang [4] and Cai and He [5] investigated the effect of using binding bars arranged at spacing along the longitudinal axis of the steel tube as stiffening scheme in CFST columns. The use of binding bars was able to improve the confinement of concrete beyond the corner region, delay or even prevent local buckling and hence improve ultimate strength and corresponding strain of square CFST columns when coupled with appropriate spacing and diameter of binding bar. Huang et al. [6] studied the use of inclined steel bar (also known as tie bars) welded at regular spacing along the longitudinal axis of steel tube to strengthen the lateral confining pressure on the concrete core. They conclude that the tie bars help enhancing the behavior of square CFT columns in terms of ultimate strength and ductility. These type of stiffening scheme i.e. binding bars and tie bars make better use of steel tension property and were able to improve the mechanical properties of square CFST column by restraining the plate deformations.

Wang et al. [7] and Yang et al. [8] investigated the possibility of using various configurations of reinforcement-stiffeners and tensile strips on square CFST in order to improve its mechanical behaviors such as resistance and ductility. The introduction of the reinforcement stiffeners was able to delay or prevent local buckling of steel tubes and enhance the constraint effect on the concrete core. Therefore the use of reinforcement stiffeners was able to increase the sectional strength, stiffness and ductility of square CFST columns. While the tensile strips, oblique battlement-shapes reinforcement and welded circular stirrup contribute to little improvement on ultimate load but can contribute significant improvement in ductility. A parametric study based on numerical model [8] showed that the mechanical behaviors of square CFST columns could be enhanced by decreasing the depth-to-thickness ratio, increasing the concrete and steel tube compressive and yield strength respectively,

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