Investigating the Effect of Concrete Confinement Towards the Lateral Performance of Concrete Filled Steel Box Columns

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Elevated highways and bridges have become a major part of modern transportation networks. In such structures, piers play a major role in transferring loads into the substructures and foundations. These structures should be able to withstand both vertical and horizontal loads such as earthquakes. Several materials and design criteria have been practiced and structural steel has been identified as the most suitable and economically viable material for the seismic performance of the piers. In steel piers, it can be identified that there are several practices to improve the lateral performance such as positioning stiffeners and diaphragms to prevent local buckling of side plates, using high strength materials, double column arrangements and concrete filling. In both numerical and experimental studies, it has been identified that the Concrete Filled Steel Tubular (CFST) columns have comparatively better performance than steel hollow piers. Lateral restraint of concrete increases its ductility, strength, and energy absorption capacity, which is known as the confinement effect. The focus of this study is to numerically investigate the effect of confinement of concrete towards the overall performance of the pier and to propose methods to increase the confinement of concrete in CFST columns by altering the stiffener arrangement and the dimensions of the stiffeners. First, A comprehensive finite element model has been developed and validated against previous experimental data under lateral cyclic loads. Next, by adopting the same modelling procedure, a parametric study was conducted by using ten numerical models of stiffened CFST columns with different cross sections where the stiffener arrangement is varied. Results revealed that the "T" arrangement gives the most effective stiffener arrangement towards the confinement effect. Then, the flange to web ratio of the T-shape stiffeners varied and the section with width to flange ratio of 2.0 was identified as the best performing section for the strength and energy dissipation capacity.

Keywords: Steel Piers, Concrete Confinement, Cyclic Loads, Finite Element Modelling