Modelling dynamic response of concrete filled steel tube columns

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Normal aggregate concrete filled steel tube (NACFST) columns are used in many structural applications such as bridge piers, high buildings, seismic-resistance constructions and offshore structures. Concrete filled steel tube (CFST) column has more advantages than conventional reinforced concrete and steel column, namely high speed of construction work as the results of the omission of formwork and reinforcing bars, low structural costs and high dissipation energy ability. CFST offers good damping properties and excellent seismic resistance. This paper presents 3D nonlinear finite element models on CFST columns subjected to lateral impact loading. The modelling was carried out to simulate CFST columns with different concrete types, projectile configurations and strengthening by carbon fibre reinforced plastic (CFRP). The models developed were validated against the experimental results with good correlation, in terms of load-displacement trace and deformation mode. Using the validated models, further studies were undertaken to examine the influence of material properties, impact energy, D/t ratios, boundary conditions, bond length of the CFRP and the impact location on the impact response. The numerical predictions show that increasing the impact energy induces the columns to exhibit higher impact force for all CFST columns. Reducing the D/t ratio and increasing the steel tube strength contribute to the increase of the impact force and the decrease of the displacement due to the enhanced stiffness of the tube. The results also show that increasing the CFRP wrapping from the length of 1/3 of the clear span of the tube to the length of 2/3 improves the impact resistance behaviour by reducing the lateral displacements and increasing the columns stiffness, whilst the full length of CFRP wrapping has almost the same enhancement of the 2/3 length.