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Investigation on Behavior of concrete filled steel tube (CFST) columns under compressive axial load

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Abstract

Applying multi-axial stress to the concrete causes its strength and ductility to increase that this fact is due to the restraint of lateral strain of concrete. One method to create a multi-axial stress is to confine the concrete with the steel tube. In this paper, concrete filled steel tube (CFST) columns was modeled by using the finite element method using the ABAQUS software and then the effect of parameters such as the diameter -to-thickness of the steel tube, compressive strength of concrete core and yield strength of the steel tube on the CFST column behavior including compressive strength, modulus of elasticity and force–displacement curve was investigated.

Keywords: Composite column, Confined concrete, Compressive strength, Confinement, Steel tube.

1. INTRODUCTION

Confinement of concrete leads to a three-axial compressive stress which causes an increase in strength and ductility of concrete [1-5]. CFST columns are a kind of composite columns used in steel structures which have better structural performance and are more economical than just steel columns or just concrete ones. Schneider [6] conducted some research about CFST columns under an axial load to investigate the effect of shape and thickness of tubes on the strength of composite columns. He concluded that tubes with circular cross-section offer more post-yielding ductility compared to rectangular or square cross-section tubes. Also, confining pressure is not effective until the axial load reaches 92% of column's yield strength. In his samples, unconfined concrete was modeled for the concrete material in ABAQUS. Giakoumelis and Lam [7] studied experimentally on the circular CFST columns behavior and it was concluded that with increasing the concrete strength, the role of the interaction between the concrete core and the steel tube becomes more important. In the study conducted by Evirgen et al. [8], CFST columns were employed and the results showed that the relative increase in axial compressive strength for this type of column is almost 168% compared to that of unconfined column and this value increases with increase of the thickness of steel tube and decrease of concrete core strength.

2. STUDY PROCEDURE

In order to validate the finite element simulation, results of numerical analysis were compared to the experimental results of Giakoumelis and Lam [7]. After that, CFST columns were modeled in ABAQUS and the effect of the parameters including compressive strength of concrete (f_c), diameter-to-thickness ratio (D/t) and steel yield strength (f_y) on compressive behavior of these columns was investigated.

3. MODELING (SIMULATION)

3.1 STEEL MATERIAL BEHAVIOR