Mechanical properties of square tube reinforced with rivets using non-linear finite element method

Zhonggang Wang[1,2,3,4], †*Xinxin Wang[1,2,3,4]

[1] School of Traffic & Transportation engineering, Central South University, Changsha, Hunan, China.
[2] Key Laboratory of Traffic Safety on Track， Ministry of Education; Changsha, Hunan, China.
[3] Joint International Research Laboratory of Key Technology for Rail Traffic Safety, Changsha, Hunan, China.
[4] National & Local Joint Engineering Research Center of Safety Technology for Rail Vehicle, Changsha, Hunan, China.

*Presenting author: wxx741125829@163.com
†Corresponding author: wxx741125829@163.com

Abstract

Finite element method has been widely employed in the transport industry to analyze plasticity deformation problems. In this study, deformation mode of square tube reinforced with rivets subjected to axial impact was investigated numerically by means of ABAQUS/Explicit. To calibrate the numerical model, the conventional square tube and rivet were modeled. And a good agreement between numerical simulations and experiments was observed. Then detailed collapse behaviors were analyzed for kinds of square tube reinforced with rivets with different geometric configurations. Their deformation processes were determined by contrast with conventional square tube. The folding number under axial loading was found to be dependent largely on the rivets' arrangement. Subsequently, matching relationships between square tube and rivets have been observed. The size of rivet and length-thickness ratio of square tube were closely related to deformation pattern of square tube reinforced with rivets. Finally, parametric investigation was carried out to further analyze the influences of materials and velocities on the folding pattern. As the results confirmed that, the matrix material properties and axial impact velocity have significant influence on the deformation mode. Meanwhile, the method of stiffness reinforcement design was brought forth to provide new orientations for developing light-weight structures.

Keywords: Finite element method, Deformation mode, Matching relationships, Stiffness reinforcement.