Numerical Study on Performance of Cable Barriers System Subjected to Van Truck Impact

Huidong Cao[1,2], Tat-Seng Lok[3], Chunwei Zhang[1,2]

[1] School of Civil Engineering, Qingdao University of Technology, [2] Multidisciplinary Center for Infrastructure Engineering, Shenyang University of Technology, [3] PHM Technologies Pte Ltd

Barriers on Highways can be classified into rigid barriers (concrete barriers), semi-rigid barriers (wavy plate barriers), and flexible barriers (cable barriers). There are a few design standards of highway barriers from different countries, including the International Organization for Standardization 22343-1 (ISO 22343-1) in Europe, the National Cooperative Highway Research Program 350 (NCHRP 350) in the United States, and the Standard for Safety Performance Evaluation of Highway Barriers (JTG B5-012013) in China. These standards impose limits on the impact velocity and impact angle of vehicles during collisions, as well as the maximum horizontal displacement of the barriers. However, in actual highway collisions, the impact angle and impact position of barriers are unpredictable, especially the deformation restrictions. There exists a critical challenge to the application of cable barrier systems. Therefore, the deformation characteristics and the buffer performance of the cable barrier should be studied systematically. The authors develop a highway cable barrier system consisting of steel cables, main (secondary) steel column, and reinforced concrete piles. Finite element analysis is used to study the impact of van truck (Ford F800) on the cable barrier system, analyzing the influence of the cable barrier system on the buffering effect to the vehicle and the trajectory of the truck. By analyzing the motion patterns, barrier failure mechanisms, and peak impact force characteristics of the truck under various impact situations, the protective effect of the cable barrier was summarized. The simulation results indicate that the impact force of the truck on the cable barrier system primarily depends on the cargo impact; when the truck collides with the steel post, the barrier mainly undergoes bending-shear-torsion deformation; the addition of stiffeners to the steel column can enhance its torsional stability and the buffering performance of the cable barrier. This research provides promising application value for future projects.

Keywords: Vehicle Collision; Finite Element Analysis; Cable Barrier System; Buffering performance