UDC 629.4:62-788.2

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ASESSMENT OF DYNAMIC LOADS ON A MOTOR-CAR TRAIN WITH A PASSIVE SAFETY SYSTEM IN ITS COLLISION WITH A LARGE ROAD VEHICLE

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A topical problem of the home railway transport is motor-car train renewval, speed increase, and safety improvement in accordance with the Ukrainian State Standards DSTU EN 12633 and DSTU EN 15227, which specify the passenger car crashworthiness and passive safety, respectively, in emergency collisions with various obstacles. Relying on the world experience, researchers of the institute of Technical Methanics of the National Academy of Sciences of Ukraine and the State Space Agency of Ukraine developed a passive protection concept for home high-speed passenger trains in emergency collisions according to the DSTU EN 15227 requirements, proposals on the passive propection of a home motor-car train head car, lower- and upper-level honeycomb energy-absorbing devoces (EAD 1 and UL EAD, respectively) for the head car front part, and EAD 2 and EAD 3 low-level devices to be installed in intercar connecteions. The upper- and lower-level protective devices for home motor-car trains were developed based on finite-element simulation results using previous experience in the development of a passive protection device for a high-speed passenger locomotive and the results of a successful crash test of its proptotype. For Scenario 3, which chraracterizes a collision of a reference motor-car train at 110 km/h with a 15 t large road vehicle at a railway crossing, a model of a large deformable obstacle (LDO) was developed in compliance with the DSTU EN 15227 requirements. Finite-element models were developed to determine the force characteristics of interaction between the proposed head car passive protection devices and an LDO. The aim of this paper is to determine dynamic loads on a motor-car train equipped with passive protection devices in its collision with a large road vehicle. Based on a mathematical collision model for identical motor-car trains, a mathematical model was developed for a collision of a reference train with a large road vehicle at a railway crossing (Scenario 3) with account for the determined force characteristics of obstacle – two EAD 1 low-level devices and obstacle – two UL EAD upper-level devices interaction and the in-collision work of the head car structure. Dynamic loads on the cars of a reference train with a passive safety system (a head car mass of 80 t and intermediate car masses of 50 t or 64 t) were analyzed for its collision by Scenario 3. Two EAD layouts in the head car front part were studied. It was found that the proposed passive protection of the reference train cars meets the DSTU EN 15227 criteria for Scenario 3 for both EAD layouts and the determined variants of lower- and upper-level EAD use according to the intermediate car masses. The proposed mathematical model of dynamic loads on a passenger train with a passive safety system in its collision with a large road vehicle and the results obtained may be used in designing an up-to-date high-speed motor-car train to the DSTU EN 15227 requirements.

Keywords: *motor-car train, emergency collision, large road vehicle, head car, passive protection devices, dynamic load.*

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Received on March 28, 2022,
in final form on April 12, 2022