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DETERMINATION OF THE CHARACTERISTICS OF OBSTACLES FOR NORMATIVE SCENARIOS OF PASSENGER TRAIN – OBSTACLE COLLISIONS

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At present, the main trends in the development of the Ukrainian railway transport are passenger car renewal, a train speed increase, and an orientation to European standards. An integral part of all high-speed passenger cars of new generation must be passive safety systems (PSSs), which operate in an emergency collision with the aim to absorb the kinetic energy of the impact, save the lives of the passengers and the train crew, and minimize the consequences of the accident. In 2016, Ukraine adopted by approval Ukrainian State Standard EN 15227:2015 (EN 15227:2008), which corresponds to European Standard EN 15227 on passenger train crashworthiness. The standard specifies four crash scenarios for a reference train, which are used in the design and experimental development of PSS-equipped railway vehicles. The aim of this work is to determine the characteristics of obstacles in the crash scenarios with account for the features of the Ukrainian rail vehicles (combined draw-and-buffer gears, different overall dimension and mass limitations, other normative requirements, etc.). Emphasis is on the determination of the obstacle characteristics in Scenario 2 (impact on a freight car equipped with combined draw-and-buffer gears) and on Scenario 3 (impact on a lorry at a grade crossing), which is the basic scenario in assessing the design parameters of a PSS-equipped driver cabin. The lorry in Scenario 3 is a deformable obstacle with given geometric parameters which stands free at a grade crossing. Standard EN 15227 formulates a criterion for the development of a deformable obstacle model. The development of such a model envisages the construction of a geometrical model of the obstacle and of its finite-element scheme and the determination of its physical and mechanical parameters. This paper proposes a geometrical model of obstacle that consists of three components (a casing, a core part, and a lower part). The novelty of this work is a solid finite-element model of obstacle plastic deformation on impact with a ball. A comprehensive study of the effect of the physical and mechanical obstacle parameters on the contact force characteristics was conducted. An obstacle model meeting the criterion of Standard EN 15227 was developed. The model may be used in designing PSS-equipped driver cabins and in assessing compliance with the requirements of Standard EN 15227 in emergency collisions of reference trains by Scenario 3.

Keywords: *high-speed passenger train, lorry, grade crossing collision, finite-element simulationконечно-элементное моделирование, модель деформируемого препятствия.*

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