

## DETERMINATION OF LOCOMOTIVE DERAILMENT STABILITY CONDITIONS IN EMERGENCY COLLISIONS

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This paper discusses the behavior of a locomotive in its collision with a movable obstacle on the railway track. Movable obstacles of different masses were considered: a freight train, a similar locomotive, and an empty freight car. Initially, the obstacle was motionless, and after the collision it began to move along the track. The aim of this study is to determine conditions for locomotive wheelset stability against derailment in the emergency situation under consideration.

To solve this problem, use was made of the authors' mathematical model of spatial vibrations of a six-axle locomotive equipped with a passive safety system and anticlimbing devices and the authors' software that allows one to investigate dynamic processes occurring both in the normal operation of railway vehicle and in emergencies.

First, we considered accidents for the case where the forces occurring in the collision of a moving vehicle with an obstacle act only in the longitudinal direction, which coincides with the track axis. In this case, the longitudinal axis of the locomotive body remains parallel to that of the track, and the locomotive wheelsets do not derail. This is possible only if the track condition is ideal. When a locomotive moves along a real track with irregularities of different types, vehicle vibrations are set up, which leads to the occurrence of a time-varying angle of rotation of the locomotive body about the vertical axis in the horizontal plane. In such a situation, a collision with an obstacle produces not only longitudinal forces, but also lateral forces of interaction of the colliding vehicles. In its turn, this results in an increase in the lateral wheel/rail interaction forces, which greatly affect the derailment stability of the locomotive wheelsets.

The calculations showed the locomotive wheel derailment probability increases with the mass of the obstacle and the locomotive speed at the collision instant. The derailment stability of a locomotive equipped with a passive safety system in emergency collisions also depends significantly on the railway track technical state. The higher is the level of rail irregularities, the higher is the derailment probability.

**Keywords:** *emergency, dynamic index, locomotive, mathematical simulation, derailment.*

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Received 17.05.2018,  
in final form 15.06.2018