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Research of derailed wheelset impact marks on the concrete sleepers

Badania uszkodzeń podkładów kolejowych w wyniku wykolejenia

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(Oryginalny artykuł naukowy)

Abstract. The process of destruction of reinforced concrete sleepers under the railway wheel impact loading is being studied. The article proposes the impact test method of sleepers using a pendulum impact machine. It was developed a device to measure the parameters of impact marks. Using the proposed device it was analyzed the form of the impact marks left by the railway wheel.
Keywords: wheelset, reinforced concrete sleepers, track, derailment, profilograph, measurement

Streszczenie. W artykule przeanalizowano charakter uszkodzenia żelbetowych podkładów kolejowych poddanych działaniu dynamicznego obciążenia udarowego od kół taboru kolejowego (na bazie badań z użyciem kafara wahadłowego). Przeprowadzono badania laboratoryjne żelbetowych podkładów kolejowych aż do zniszczenia. Opracowano urządzenie do pomiaru geometrycznych parametrów śladu uderzeń koła pociągu.
Słowa kluczowe: zestaw kołowy, żelbetowe podkłady, ślad, wykolejenie, profilograf, pomiar.

The rolling stock derailments followed by the movement of derailed wheelset along the track panel leaving characteristic marks on the surface of reinforced concrete sleepers often take place at the Ukrainian railways. At this, the train movement resistance affecting the results of traction calculations, which take place during investigation of railway accident is increased [2, 7].

The methodology of determining the additional train movement resistance caused by the wheelset movement along the track panel is currently under development [1]. One of the components of this movement resistance is the impact resistance and the following wheel rolling along reinforced concrete sleepers. The value of this resistance is equivalent to the energy absorbed by the sleeper and should be connected with the parameters of the marks left on the sleepers. The destruction of reinforced concrete sleeper is a stochastic process; after the wheel impact on the sleeper surface there appear irregularities of different forms and depths.

One of the methods to study the reinforced concrete sleepers is the impact loading test [3, 4]. During the test various types of impact machines are used. They make it possible to determine the energy with which the striker affects the sleeper. Using such impact machines it is possible to simulate the actual processes taking place in the railway track with no need for experiments on the track.

Design of measuring device (profilograph)

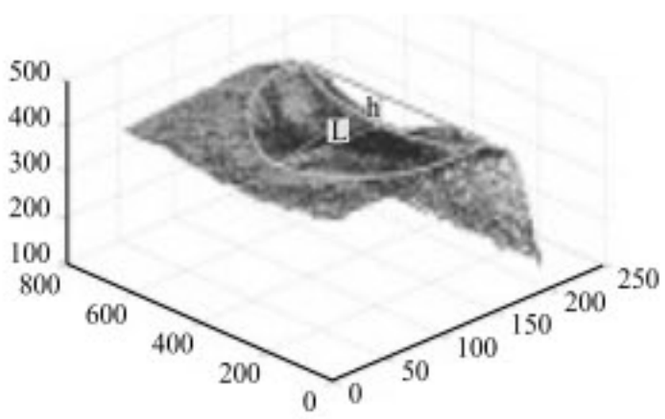
To measure the parameters of the impact marks it was designed and manufactured the profilograph. The operation of the device is based on the destruction surface scanning by the laser beam, its position on the destruction surface is fixed by high-resolution digital camera. As a result of the scanning the spatial position of surface points of the destruction surface is obtained.

Scanning the surface of impact mark

Before scanning it is measured the length of the mark formed on the reinforced concrete sleeper. It determines the maximum distance of the laser and camera movement that defines the number of scanning steps. Commands from the PC to the stepper motor are transmitted through the microcontroller programmed in Matlab 10.0. According to the commands the stepper motor moves laser and camera along the horizontal guide bar at the given distance, as a result of this it is shott he profile surface of the impact mark with the given step of the camera and laser movement. The camera records the graphic representation of the laser beam on the surface of the mark (Photo 1).

Using the developed software according to the developed algorithms for automatic recognition and measurement of bitmap images it is determined the parameters of scanned laser trail on the surface of sleeper that are transferred to the computer memory and displayed on the monitor. After measuring the cross-section of the impact mark surface of the sleeper in the given number of steps of longitudinal movement of measuring system, the results of individual measurements are connected and the mathematical model of the impact mark surface is being formed (Figure).

Photo 1. Scanning the surface of reinforced concrete sleeper
Fot. 1. Skanowanie powierzchni podkładu kolejowego



Surface of the impact mark on the reinforced concrete sleeper
Powierzchnia śladu uderzenia na żelbetowym podkładzie kolejowym

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