SIMULATION STUDIES THE DYNAMICS OF RAIL - ROAD CROSSINGS
IN ORDER TO MINIMIZE THEIR ENVIRONMENTAL IMPACTS

TRANSPORT is accompanied by broadly understood inherently dynamic impact on the environment causing mechanical vibrations of foundations, ground and engineering structures. Striving to minimize their harmful effects is a necessity, and led to the development of both new construction transport equipment with limited energy emissions and complex vibro-acoustic vibration isolation systems which preclude the spread of vibrations in the environment. Destroyed surface on many journeys threatens liquidity and safety of traffic. One of the most critical locations are a railway crossings. The results of simulations of dynamic interactions of two types of construction of rail road crossings are presented. On this basis, one can determine the effectiveness of the used vibration isolation system.

INTRODUCTION

Large technical progress at the present time, closely associated with the development of technology and industry, on the one hand contributed to the creation of many modern technical solutions, on the other hand has exacerbated phenomena constitute a threat to humans and the environment. One of the areas of industry, which has a significant share in this threat is constantly evolving at a rapid pace transport, both in terms of rail transport (railway, tram) as well as the car. The constant development of the road network and rail vehicles and the increasing number of applications for transport equipment vibration inherent interference with the natural environment. Transport by rail and road, which clearly divides the area through which it runs occupies large areas of land, and by its intensity has a negative impact on the environment as a source of vibration and noise. Since broadly understood transport accompanied by the inherent dynamic effects on the environment causing mechanical vibrations of foundations, ground and engineering structures, striving to minimize their harmful effects is a necessity and led to the creation of both new construction transport equipment with limited emissions of vibro-acoustic energy and complex vibration isolation systems which preclude the spread of vibrations in the environment. Destroyed surface at many crossings threatens the liquidity and safety of traffic. One of the most critical places is a cross roads for cars from the road for rail vehicles, and in particular from junction station.

1. SIMULATION RESEARCH DYNAMICS OF PASSAGE RAIL CAR.

The object of the simulation tests were one-level crossings on the crossroads of rail transport with road transport, which mathematical models presented in [6]. The aim of the study was to determine the vibration level structural elements crossing, generate waveforms load certain parts and to prepare a mathematical model which can be used further simulations, whose task is to generate as optimal design of way.

2. DESCRIPTION OF ITEM ANALYSIS OF PASSAGE BY FIRST CONCEPT

For this purpose, a model was built passage in CATIA, the approach is shown in Figure 1. When the moments of inertia of the individual elements of the journey, and based on data from experimental studies and information obtained from earlier studies on railway crossings and tram stops, the model of dynamic ride station LMS DADS, which was used to simulate the operating system loads and the level of vibration building elements pass.

Fig. 1. Model railroad crossing is made in the system Catia

2.1. CHARACTERISTICS OF THE MODEL AND THE ENVIRONMENT LMS DADS

The simulation model railroad crossing was built using software LMS DADS. All part of the journey has been modeled as a rigid body, which is fully sufficient for the simulation carried out, as they relate to interactions between the various components of the railway crossing, ie. Substructure, rails and the passage. In this model all the lumps were connected by ties of kinematic parameters of which modulus and damping determined in accordance with the actual values that exist in this type of connections. Also included is a skid car, providing various options eg. ice, pouring water, etc. In order to simulate the built models of vehicles such as passenger car, van and truck weighing 18000 [kg]. In each model, is modeled contact between the tire and the ground. The model was parameterized,
enabling easy operation. Variants dynamics simulations as well as to build a database of components passage. Figures 2 and 3 show the pictures made with the dynamic simulation passing car and truck.

2.2. The simulation results on the traditional vibroisolation crossing rail-road

During the construction of the model, the following description of the individual elements of the railway crossing, the section shown in Figure 4.

Parameters that can be changed during the next simulation ride is:

- stiffness of the suspension rubber reinforced concrete slabs,
- attenuation values occurring in the rubber elements,
- the degree of twisting threaded spindle individual plates,
- vehicle speed invading the passage,
- mass of the vehicle,
- stiffness of the suspension of the vehicle,
- uneven asphalt surface before passing through (the introduction of the vehicle swinging),
- type of pavement,
- wheelbase of the vehicle,
- track vehicle,

In the simulation tests we are limited to the analysis of a few cases where the parameters are shown in Table 1. The results of the simulation are shown in graphs in Figures 5 and 6.

<table>
<thead>
<tr>
<th>Simulation</th>
<th>Velocity (km/h)</th>
<th>Vehicle Weight (kg)</th>
<th>Vehicle Type</th>
<th>Inequalities in Roman Screw (N)</th>
</tr>
</thead>
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<tr>
<td>05</td>
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<td>1400</td>
<td>car</td>
<td>absence</td>
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<td>18000</td>
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<td>08</td>
<td>40</td>
<td>18000</td>
<td>truck-3-axis</td>
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</table>

Fig. 5. Graphs of vertical displacements rubber-reinforced concrete slabs for the passage of a truck weighing 18000 kg, the traveling speed of 40 and 70 km/h

Fig. 6. Graphs of vertical displacements rubber-reinforced concrete slabs for the passage of a truck weighing 18000 kg, the traveling speed of 40 and 70 km/h

In Figures 5 and 6 show the amplitude of the displacements obtained by simulation center plate (solid lines) and the plates outside the left and right (dashed lines) of the first concept of passing rail-car, depending on the type of vehicle (car about mass 1400 and 2000 [kg], van weighing 2500 [kg], three-axle truck about 18000 weight [kg]).

Based on the results of simulation ride of a passenger car with a weight of 1,400 [kg] and 2,000 [kg] and a delivery 2,500 [kg] at 100 [km / h] after crossing the rail-car can be concluded that the displacement amplitude of the intermediate plate depends on the mass of the vehicle and it is the greater the greater the weight of the vehicle. In case of invasion (right outer plate) and exit (External disc
left) amplitudes of these boards are comparable and are smaller than the amplitudes of the central panel. Using the simulation whose results have not been presented in the work, it can be concluded that substitutions of up to 40 [%] limits the amplitude of displacement of the intermediate plate and frame plates during invasion (ceramic outer right) and exit (ceramic outer left), but not this affects very important. Also, the speed of travel does not affect the amplitude of the displacement plates. Decide design of travel and the use of elastomeric elements. Based on the simulation results, 4 and 8 (Fig. 6) passing truck with a mass of 18000 [kg] at a speed of 40 and 70 [km / h] after passing rail - the car can be said that the amplitudes of the intermediate plate and the cover plate and right the left outer plates are almost identical. It may be noted, however, that the traveling speed is effect vibroisolation on the response of the journey, it is almost instantaneous when the speed of 70 [km / h] and the delayed approximately 1.5 [sec.] if traveling at a speed of 40 [km / h]. The impact of changes in the value of damping by 40 [%] is the same as in the case of a passenger car and supply, which is insignificant.

2.3. Characteristics of the facility analysis of the passenger of the second concept

For this purpose it was built model transit system SolidWorks, which shot image shown in Figure 7. After determining the moments of inertia of the individual elements of the journey, and based on data from experimental studies and information obtained from earlier studies on railway crossings and tram built dynamic model level crossing system MSC Visual Nastran 4D, which was used to simulate the operating system loads and the level of vibration building elements pass.

Rys.7. Model railroad crossing is made in the system SolidWorks.

In the simulation tests we are limited to the analysis of a few cases where the parameters are shown in Table 2.

<table>
<thead>
<tr>
<th>No. simulation</th>
<th>type car</th>
<th>mass of car [kg]</th>
<th>speed car [km/h]</th>
<th>Coefficient of damping rubber element [Ns / m]</th>
<th>Tension rods [kN]</th>
<th>Strength in Roman bolts [N]</th>
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<td>70</td>
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<td>500</td>
</tr>
</tbody>
</table>

The results of simulation studies are presented in the form of graphs in Figures 8 and 9 for the speed of travel of vehicles of 70 and 100 [km / h].

Fig.8. Displacement of center plate with the car speed of 70 [km / h]
In the figures 8 and 9 are shown simulations of displacement of the intermediate plate in the transit passenger car with a weight of 1300 [kg] of a van with a mass of 2500 [kg] according to the running speed from 70 to 100 [km / h]. Based on these simulations it can be concluded that the displacement amplitude of the intermediate plate depends fundamentally on the weight of the vehicle. Also conducted a simulation function of tension ropes for center plate during the passage of a passenger car and delivery van at a constant speed of 70 [km / h] as a function of the tendon tension. Based on these characteristics, you can find a clear effect of tension on the tendon amplitude displacements center plate. That is, in the case of the implementation of such a model it is possible to affect the performance of vibration isolation system in a discrete or using automatic control systems on a continuous basis by adjusting the tension ties to the dynamic parameters of vehicle.

CONCLUSIONS

Based on the simulation effects of the use of elastomeric elements crossings in rail traffic can be stated that:

- In the case of rail-road crossings traditional and rigidity to the adjusting eg. The line, the impact on the amplitude is above the mass of a motor vehicle,
- the amplitude of the forces transmitted to the environment are smaller than runs without vibration isolation,
- In the case of passing rail-road with regulating element stiffness there,
- Significant potential to reduce the amplitude of vibration as well as the forces transmitted to the surroundings.

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BIBLIOGRAPHY


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