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CONTENTS

tax and customs services. This will allow monitoring the movement of goods throughout train and going to electronic document management.

Given the large untapped potential in practice, there are numerous obstacles to the implementation of solutions using Big Data technology. However, at present, more than ever, railways should take into account a large number of external factors when solving this problem - to understand the consequences of changes in weather conditions, possible traffic jams, restrictions on transport hours, maintenance schedules and many other factors.

Thus, the use Big Data technology for the transportation of goods will help to make a breakthrough in the technological development of country, as well as save money, facilitate and improve transportation technology.

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THE OPTIMIZED CARRYING STRUCTURE OF A HOPPER CAR FOR TRANSPORTATION OF PELLETS AND HOT AGGLOMERATE

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Effective operation of the transport industry requires innovative transportation means. As far as rail transport constitutes the basic segment of transportation process, special requirements should be set for modern train designs. Particularly, it refers to carrying structures.

One of the most widely-used types of cars in service for industrial enterprises is a hopper car for transporting pellets and hot agglomerate (700°C). Besides, hopper cars are used for transportation of bulked materials which do not require protection from weather. These cars are discharged on both sides of the track through discharge doors.

Operational loading and heat loads from the transported cargo on the carrying structure of a hopper car damage the body elements. It requires appropriate technical service and repair, which leads to additional expenses. Moreover, damages in the carrying structure of the body can threaten the traffic safety.

An important issue for the prospective hopper car design is optimization of the bodies [1 – 3]. It may increase the material capacity, while ensuring the required carrying capacity, for the appropriate prototype car designs. Such a solution favors lower costs for construction and operation of cars, thus improving the transportation efficiency.

To study a possibility to optimize the carrying structure of a hopper car, the authors made the strength calculation with the finite element method in CosmosWorks [4]. A 20-9749 hopper car manufactured by Ukrspetsvahon (Ukraine) was taken as a prototype car.

The calculation made it possible to conclude that the carrying elements of the car body had a considerable reserve capacity. A lower material capacity of the carrying structure of a hopper car can be achieved by optimization based on the appropriate reserve capacity.

Optimization of the carrying structure of a hopper car was conducted with one of the most prospective and innovative methods – optimization by reserve capacity. The material capacity of the body can be reduced by applying circular tubes for the carrying elements.

An optimized model for the carrying structure of a hopper car was designed by the results of the research (fig. 1, 2).

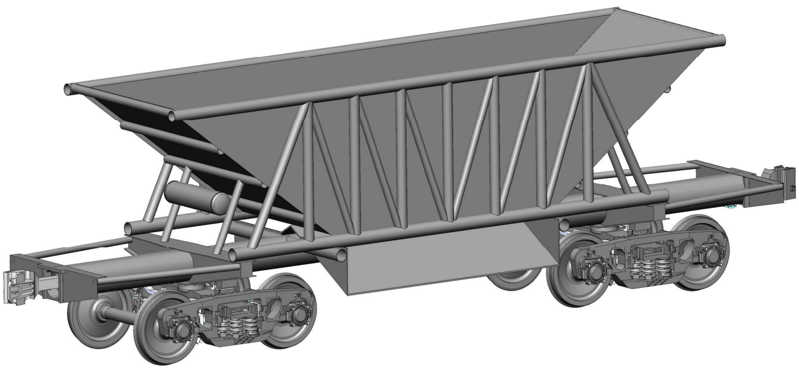

Fig. 1. Optimized model for the carrying structure of a hopper car

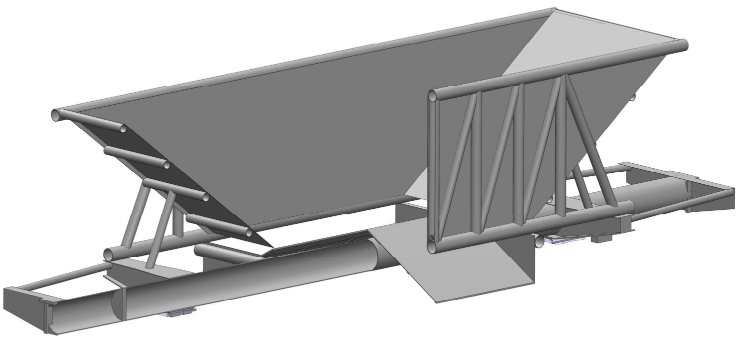

Fig. 2. Carrying structure of a hopper car

The dynamic loads on the car body at shunting impacts were defined by mathematical modeling.

It was established that accelerations on the carrying structure of a car at shunting impacts (the greatest operational loading) were 42.4 m/sec^2 (4.3 g).

The capacity of the carrying structure of a hopper car of circular tubes was defined by the finite element method.

And the maximum equivalent loads in the carrying structure of a hopper car were about 270 MPa; they were concentrated in the contact area between the center sill and the body bolster, and did not exceed the admissible values [5 – 7]. The maximum displacements in the carrying structure of a hopper car emerged in the discharge doors and accounted for about 5.2 mm. The maximum deformations were $5.7 \cdot 10^{-5}$.

The research into vertical dynamics of the optimized carrying structure of a hopper car showed that the car run can be assessed as excellent according to the regulations.

The research encourages construction of innovative hopper cars and improvements in rail transport efficiency.

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MATHEMATICAL MODELING OF LONGITUDINAL LOADS FROM A RAIL TRAIN WITH A NEW CONCEPT COUPLER MECHANISM

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Effective operation of rail transport as a leading transport industry is based on implementation of innovative rolling stock. And competitive rolling stock implies better engineering-and-economic performance, and also interoperability under certain operational conditions [1 – 3].

As known, one of the most heavily loaded structural units of a train is the automatic coupling device. In operation this unit bears considerable longitudinal dynamic loads achieving 3.5 MN (at shunting impacts). Besides, operational loads greatly impact tracks of main-lines (at braking, taking off, etc.).

A typical automatic coupling device SA-3 ensures coupling of cars and locomotives, places them at a certain distance from each other, and transfers longitudinal forces in trains intended for the 1,520-mm gauge. Nowadays there are modernized models of the device.

It should be mentioned that one of its basic shortcomings is a high cost subject to a great amount of structural elements, such as coupler and absorber).