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, 15, 49005, ; e-mail: sobmb@i.ua

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The importance of this work for Ukraine stems from the need for efficient freight transportation technologies, freight car fleet renewal, introducing swap-body freight cars, and increasing their operating safety. Swap-body cars are an innovation in freight services. Traditionally, versatile and specialized freight cars consist of an undercarriage part (running gear, automatic couplers, and automatic braking devices), which, as a rule, is versatile, and a body part (an underframe and a body). The cost of the former and the latter is 80 and 20 per cent, respectively, of the total car cost. The idea of a swap-body car is to separate the underframe from the car body and include the former into the undercarriage part, thus leaving only the car body in the body part. Thus, the undercarriage part of a car of this type is a flat car for swap bodies, which consists of an underframe, running gear, automatic couplers, automatic braking devices, and body fasteners. A new type of freight rail vehicles for unimodal railway transportation is the swap-body car, whose bodies can be replaced according to seasonal freights. For the Ukrainian railways, it is expedient to develop a swap-body car design of their own. This calls for scientific and technical support at the design and the operational development stage. The aim of this work is to determine the maximum loads on the load-bearing structural elements of swap-body cars in normal operation and to work out recommendations on a prospective home design of a swap-body freight car. This paper presents a mathematical model of 3D vibrations of a swap-body freight car in its normal motion along a track of arbitrary alignment, which accounts for the technical condition of the car undercarriage and the track. This model underlies the scien-

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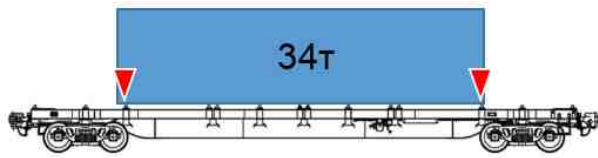


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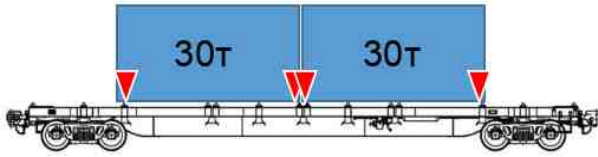
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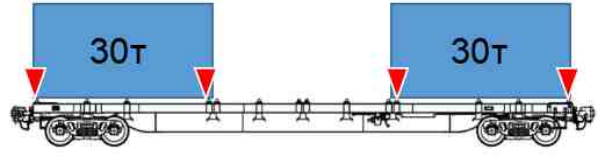
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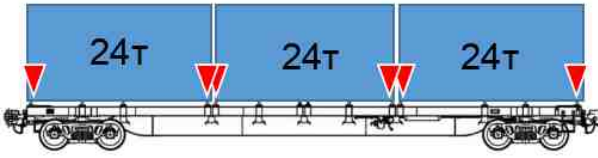
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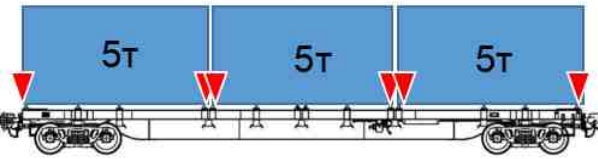
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$$\begin{aligned}
 & \left( \frac{40}{300} - \frac{120}{650} \right) v \left( \frac{1}{300} - \frac{1}{650} \right) \\
 & [17] \quad \frac{1}{300} - \frac{1}{650} = -150 \left( \frac{1}{300} - \frac{1}{650} \right)
 \end{aligned}$$

[18].

$$\begin{aligned}
 & (11+n) - n \\
 & \left( \frac{1}{300} - \frac{1}{650} \right)
 \end{aligned}$$

[19].

$$\begin{aligned}
 & 6 \times 11 + 2 \times 8 - 52 + 6 \times n = 52 \\
 & [18 - 19].
 \end{aligned}$$

[19]:

$$\frac{d}{dt} \left( \frac{\partial T}{\partial \dot{q}_i} \right) - \frac{\partial T}{\partial q_i} + \frac{\partial}{\partial q_i} + \frac{\partial}{\partial \dot{q}_i} = Q_i, \quad (i = 1, \dots, 30 + 6n). \quad (1)$$

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$S_z,$

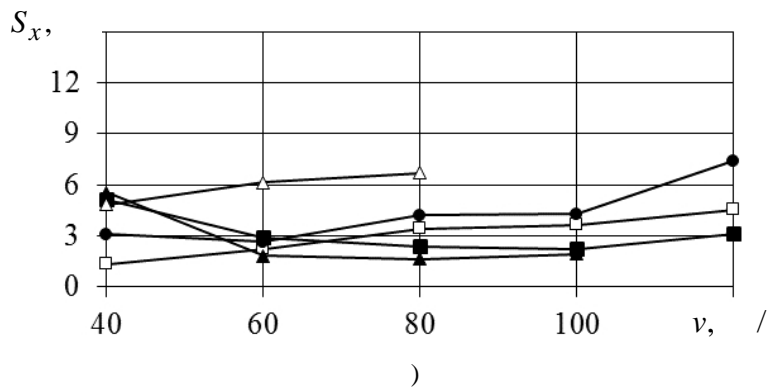
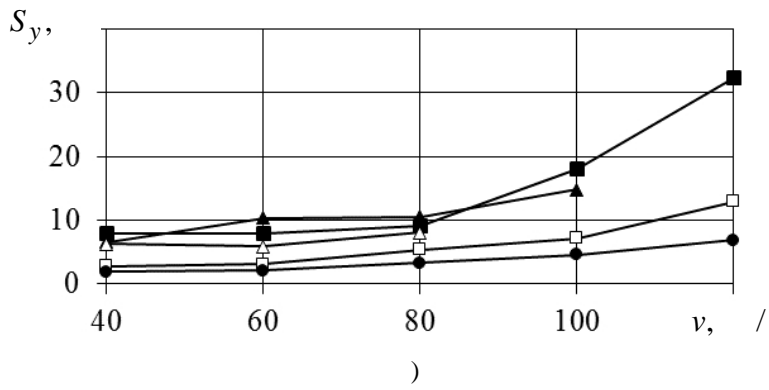
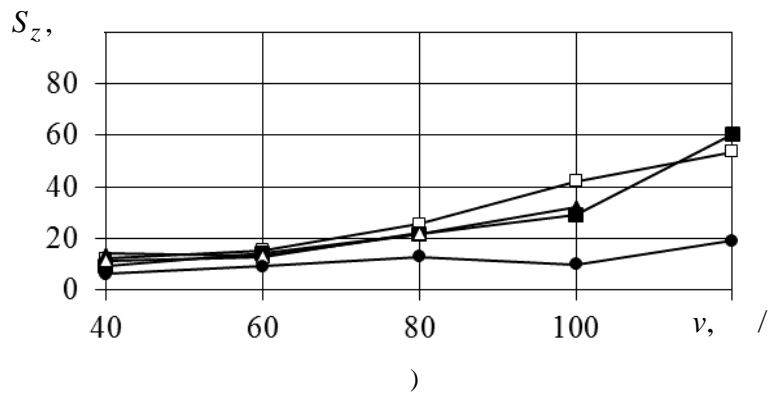
$S_y$

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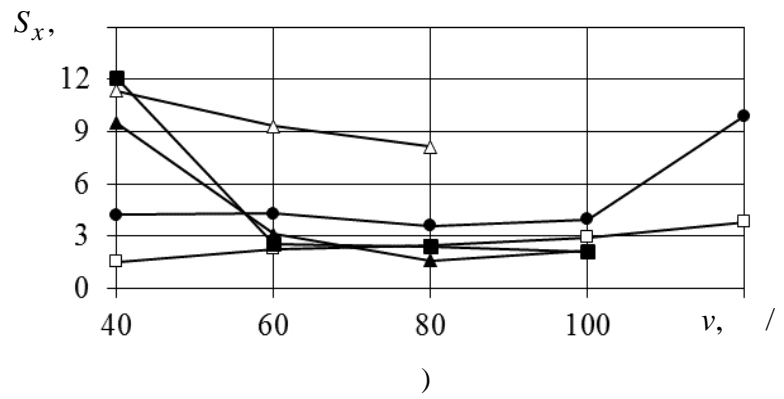
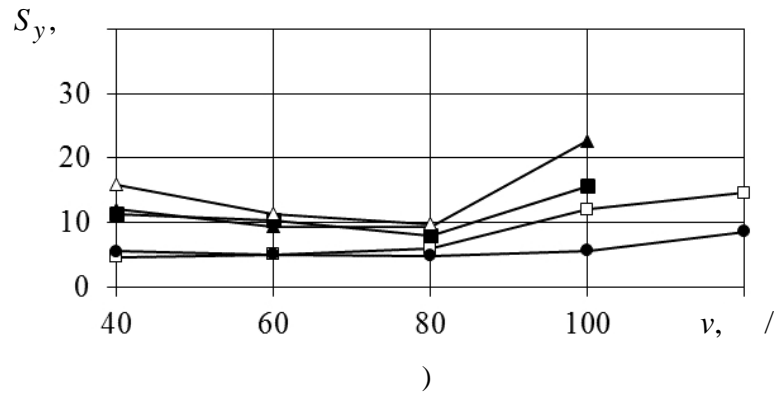
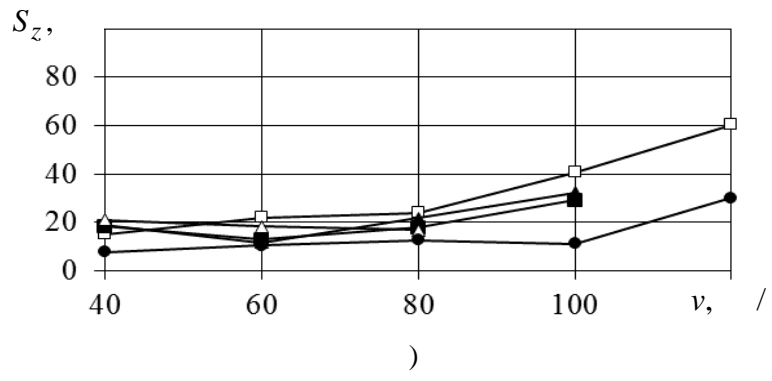
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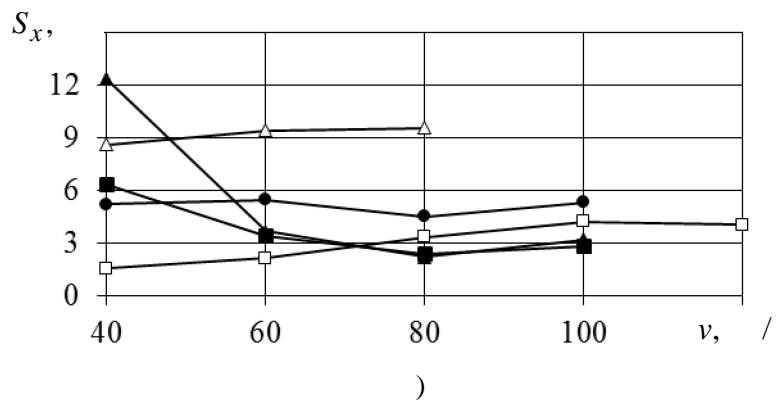
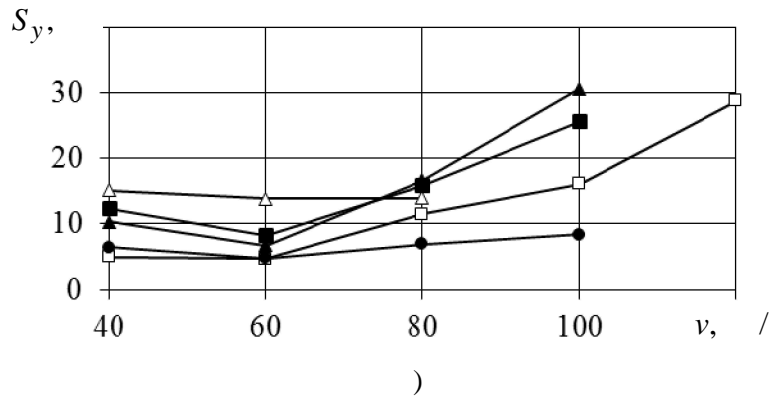
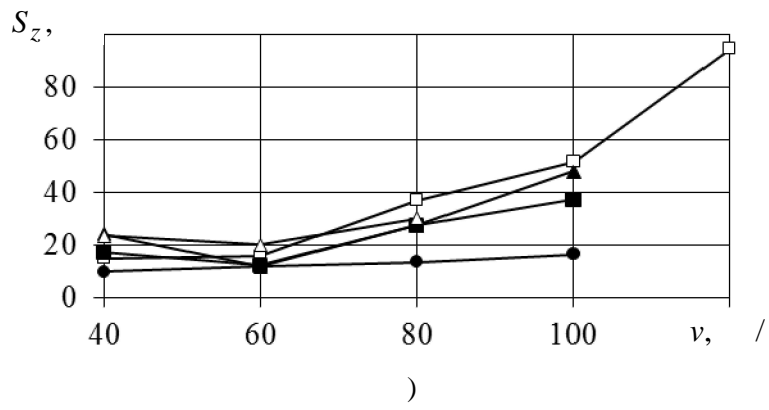
.2-  $S_y$  ( )  $S_x$  ( ) ,  $S_z$  ( ) ,





- — варіант 1;
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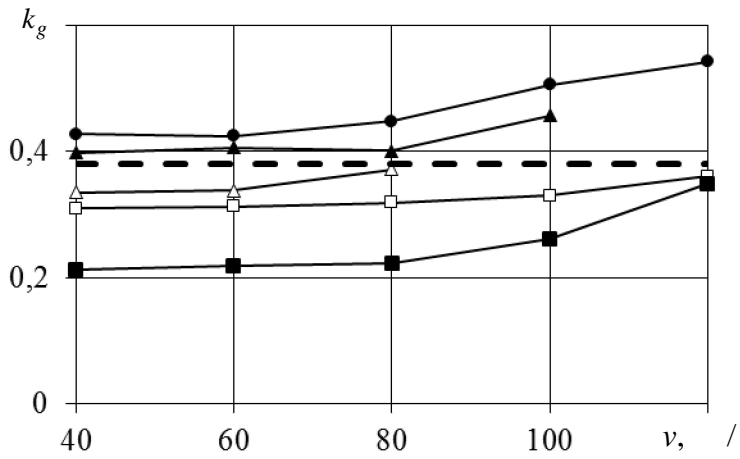
.3 —  $S_y$  ( )  $S_x$  ( )  $S_z$  ( ) ,  
 $R = 650$



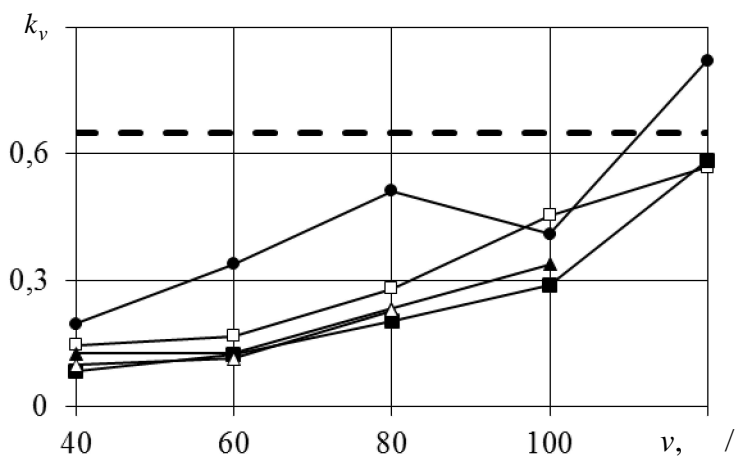
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- — варіант 5

. 4 —  $S_y$  ( )  $S_x$  ( ) ,  $S_z$  ( ) ,  
 $R = 300$





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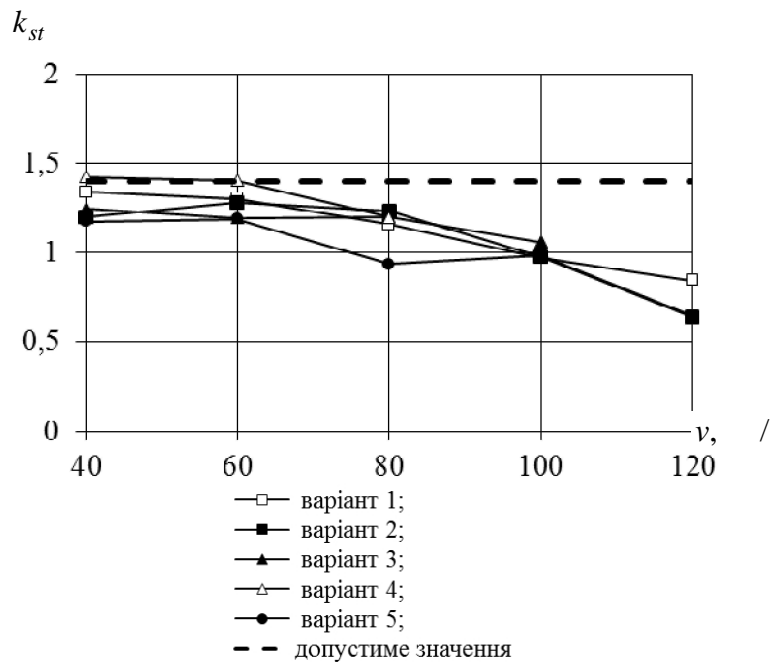
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- — варіант 1;
- — варіант 2;
- ▲ — варіант 3;
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- - - допустиме значення

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$k_v$  ( )



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