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Shock Loads on the Bridge Supports and the Upper Structure of the Track from Irregularities on the Rails of Railways

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ABSTRACT: Experimentally, the limits of the influence of path unevenness, which have convergence with the results of theoretical calculations. The speeds of the rolling stock at which the greatest influence of the roughness of the path.

KEYWORDS: upper structure of the track, rolling stock, bridge support, rail grating, high-speed movement of trains.

I.INTRODUCTION

Irregularities arising on the rails of Railways during the movement of rolling stock create additional shock loads on the bridge supports and the upper structure of the track, which are not taken into account in the design of roads. With the increase in the speed of trains, the need to determine these loads is obvious, because they can create conditions for premature destruction of the bridge structure and the upper structure of the track. Analysis of research in this direction leads to the conclusion that scientific research to identify the degree of influence of the irregularities of the path on the supports of bridges and the superstructure is made insufficient and figure not obtained, which is extremely important in the design of these complex engineering structures, especially in high-speed movement of trains.

As is known, irregularities create in the rolling stock when moving galloping and Bouncing cars, which leads them to amplitude-frequency oscillations. To determine the amplitude-frequency characteristics of the irregularity, we conducted field experiments on the section of the railway Tashkent-Angren, Samarkand-Bukhara, which were tested with the help of theoretical developments [1,2,3,4].

To determine the amplitude-frequency characteristics of the program (algorithmic language Fortran-IV), implemented on a computer [2,4]. The unevenness is given by a numerical series {y (h)}, where N=1,2,3...n, n is the number of discrete values of the functions y=f (T) at a given time interval of integration – Ti. Step discretely roughness N=0,66225 m, corresponding to one pulse of the timer speed.

The values of the irregularity were introduced into the computer, where the centering of the process y (N) was performed by the expression:

$$A_i = (y_i - \overline{x}\ )\mu, \qquad i = 1,2,3 \dots n, \qquad (1)$$

where: μ is the scale of oscillographic recording;
A_i - search value of the centered process;
(x) – mean value –y;
i is the conditional number of the instantaneous value of the unevenness quantized along the path.

The value of the perturbing function, attributable to the K–th wheel of the rolling stock (EC), was calculated through the mileage, which was calculated:

$$S_k = v\,(T - \tau_\kappa\ ) + L_n; \qquad (2)$$

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where: v-speed, m / s;
T-current time, s;
τ_κ=L_k/v transport delay, with;
L_k – distance between the axles of the car;
L_n-distance between the extreme axes of the rolling stock, m.
To calculate EC nN:

$$n_N = \frac{v(T-\tau_k)+L_n}{H}; \qquad (3)$$

H-amplitude-frequency response

E_k – equivalent to the random geometric roughness of the path (sum of bumps under the left and right wheels of one wheelset).

The current EC value was determined by interpolation:

$$E_k = A_{N+1}(N_c+1)(n_N+N_c) - A_N(N_c)(n_N-1-N_c) \qquad (4)$$

$$E_k = \cos\omega\,(T-\tau_\kappa);$$

where: Nc is an integer part of nN;
AN-EC value at the corresponding value of the pulse number.

The results of theoretical calculations of amplitude-frequency characteristics with respect to vertical movements of rolling stock from irregularities are shown in Fig-1.

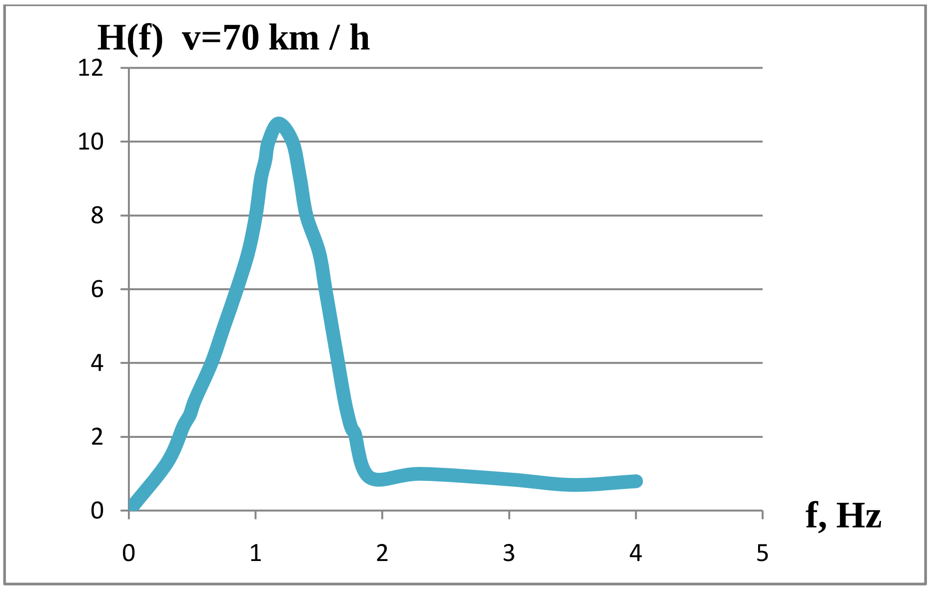

Figure 1.Calculated amplitude-frequency characteristics by the Runge-Kutta method.

To clarify pochetnyh on field experiments data of amplitude-frequency characteristics when galloping and jumping of the rolling stock made by comparison with theoretical calculations – pic2, which indicates sufficient accuracy the experimental studies of the effect of roughness on the supports of the bridges and the superstructure.

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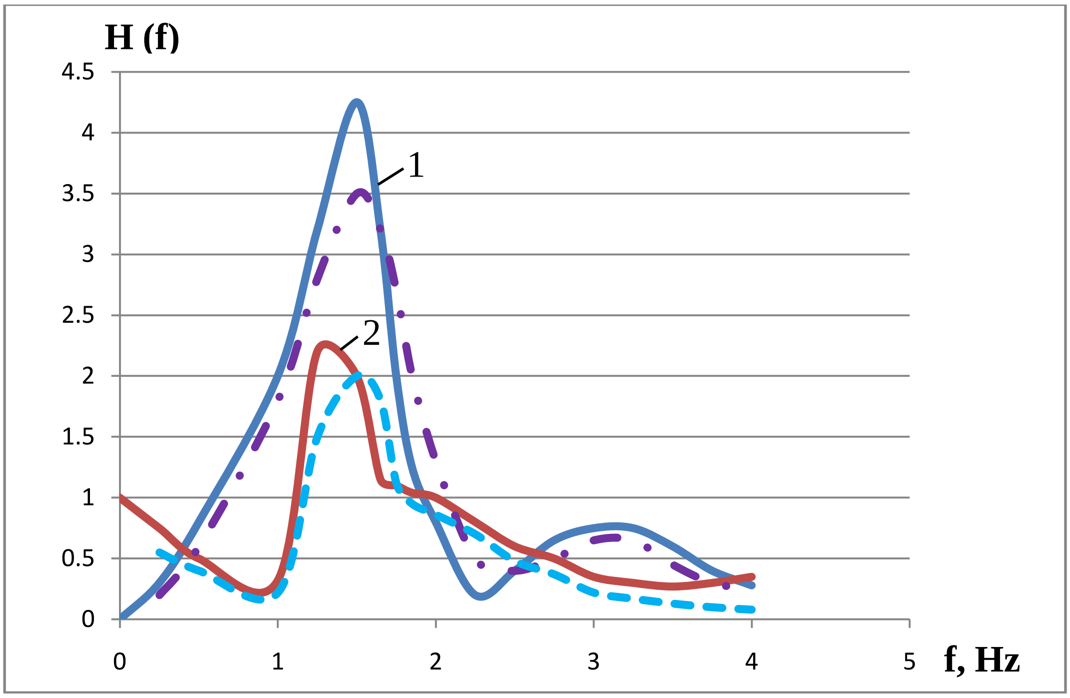

Figure 2. Amplitude-frequency characteristics of galloping -1, and Bouncing -2, from irregularities at a speed of 130 km/h.

——— – theoretical calculation values
-·-·- – experimental values of galloping
- - - - · – experimental values are jumping.

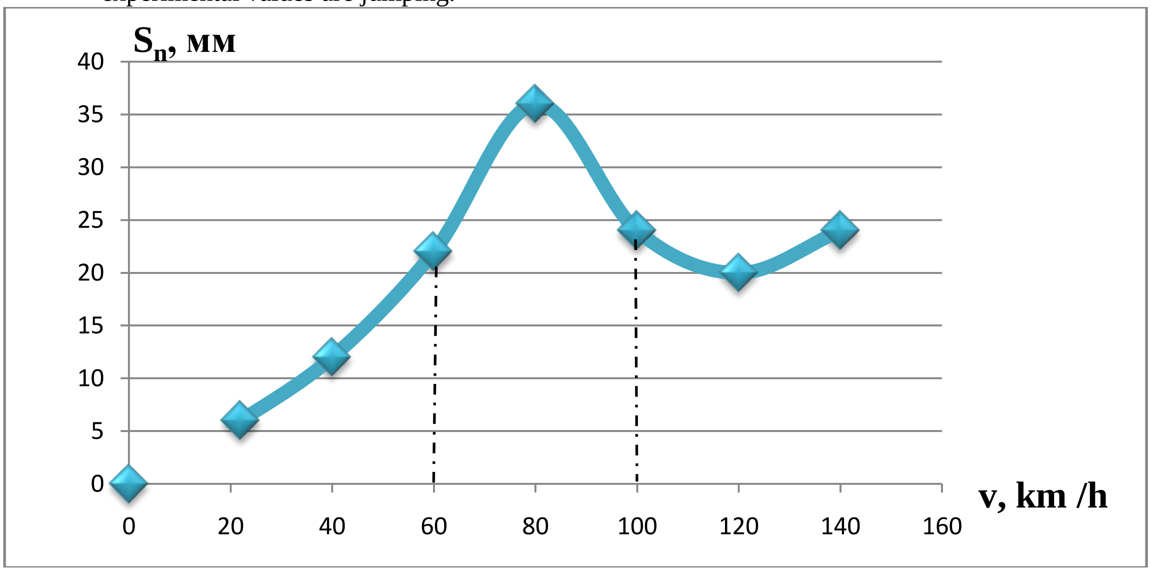

Figure 3. The dependence of the vertical movements of the car on the speed of the train.

On the chart of Figure 3. The vertical values of the movement of the car from the speed of the train are obtained. Hence it can be concluded that the shock loads that accompany the vertical movement of the track roughness have a maximum value in the speed range from 60-100 km/h, i.e. the speed of the train must be either up to 60 km/h or more than 100 km / h to avoid heavy loads from the track roughness.

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The degree of unevenness of the path, with the accepted designs of the rail grating, is difficult to reduce. To avoid large shock loads, it is necessary to create a system of additional depreciation between the wheel pair and the frame of the car, which will be able to extinguish vibrations within 1-2 Hz. A plate base instead of a rail grating significantly reduces the unevenness of the path, but it is a very complex and expensive design, the implementation of which will require a large amount of metal.

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