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Experimental Study of the Strength Properties of Rail Ballast on the Sandy Parts of the Railway

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ABSTRACT: The article presents the results of experimental studies on the dependence of the strength characteristics of the ballast layer on the level of sand pollution at different speeds of the rolling stock.

KEYWORDS: crushed stone, amplitude, vibrations, railway, vibrodynamic load, ballast prism, train movements, velvet sand.

I.INTRODUCTION

Theoretical studies have allowed to prove the identity of the impact of high-speed train seismic vibrations in an earthquake and depend on the speed, condition of the rolling stock, the degree of wear of the roadway [1].

Therefore, it is reasonable to determine the strength properties of rail ballast from the clogging sand sand for high-speed trains was the technique used for the experiments using the seismic platform and machine of centrifugal modeling, which is able to reproduce the amplitude – frequency oscillations that have been obtained in field experiments [2,3].

The results of model experiments allowed us to judge the degree of reliability of theoretical results and field experiments. The seismic platform and centrifugal simulation machine of the Institute of mechanics and seismic stability of structures of the Academy of Sciences of the Republic of Uzbekistan were used in experimental studies of ballast prism of different layer height and degree of sand contamination.

The most acceptable accuracy of the experiment obtained by centrifugal modeling machine – Fig. 1. The centrifugal unit with a rotation radius of R= 1.75 m consists of a centrifugal chamber, a vertical shaft with a support, two identical carriages, current collectors, a pulley and an electric motor [3]. Control of the centrifugal unit is located in a special room equipped with various equipment and devices that provide Central control and monitoring of all mechanisms and measuring devices. In a force field similar to gravity, a centrifugal force field is used, which is created by a centrifugal machine and has an n-times greater intensity, where – n is the linear scale of the simulation:

$$n = \sqrt{\frac{\omega^2 R_{EF}}{g} + 1} \qquad (1)$$

where: R_{EF} – the effective radius of rotation;
ω –the angular velocity of the centrifuge;
g – acceleration of gravity.
Scaling relations for centrifugal modeling equal:

$$L_н = n \cdot L_м;\; S_н = n^2 \cdot S_м;\; V_н = n^3 \cdot V_м;\; P_н = n^2 \cdot P_м;\; \sigma_н = \sigma_м;\; T_н = T_м;\; t_н = n \cdot t_м;$$

$$\gamma_н = \frac{\gamma_м}{n};$$

where: L – length; S – area; ν – volume; P – force; σ – voltage; ɣ –volume weight; T –temperature; t – time; н, м –indexes that match the nature and models.

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When modeling the motion of a mechanical system, the time – t in centrifugal modeling will be n – times less than in kind.From equation (1), changing the speed of rotation of the centrifuge, the necessary scale of modeling is selected.In the measuring part of the experiments on the centrifuge oscilloscopes, to record the readings of strain data, replaced by a personal computer and created a special program of these experimental results.It is possible to observe the course of the experiment in the form of graphs on a computer monitor.The results of the experiment in numerical and graphical form is obtained after the experiment.

This data is stored as files and can be reused.A four-channel measuring system has been developed.Three strain gauge channels are required to record the sensor signals installed on the model under study, and one channel to record the number of revolutions of the centrifuge using an optical sensor.The experiments were carried out at the working scale of modeling n=10. carriage with dimensions: L=35.2 cm, B=23.8 cm. Heightoftheworkingarea – 30cm.

The base of the roadbed – moving sand with a particle size distribution of 10 times less ballast prism of granite rubble with the size of the granules 10 times smaller than the layer of ballast prism, the thickness of the layer model h=3; 6; 9 cm.

During the experiments, the thickness of the layer and the degree of contamination of the ballast prism changed.

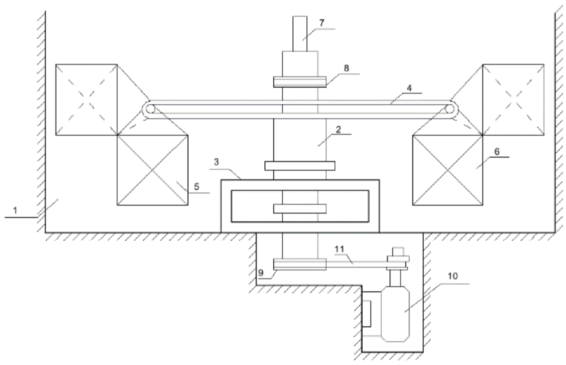

Fig.1. General View of centrifugal machine

1 – a centrifugal chamber, 2 – shaft of a centrifuge; 3 – bearing; 4 – yoke; 5 – to 6 – carriage;7 – 8 – current collectors; 9 – pulley; 10 – electric motor; 11 – belt.

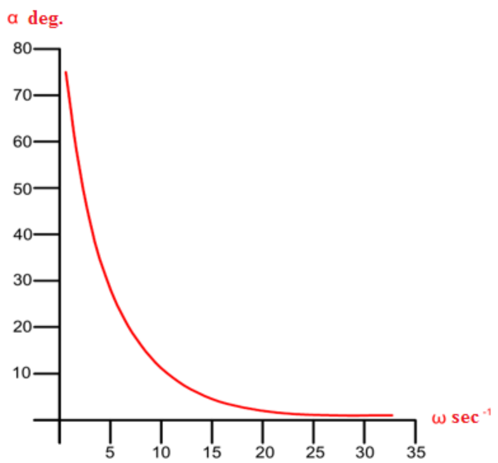

Fig.2. Dependence of the force field on the speed of rotation of the centrifuge

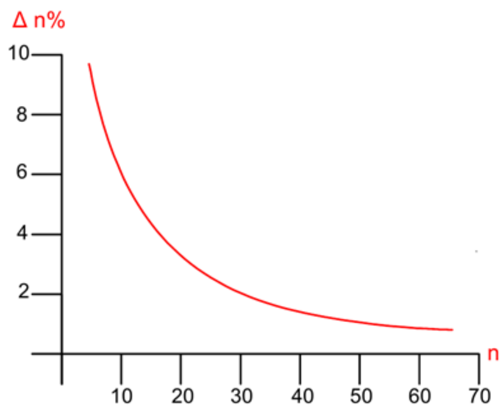

Fig.3. The dependence of the relative error on the scale of modeling

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From Fig. 3 it can be seen that at our scale of modeling n=10, the error in the experimental results will be Δn = 9.6%, which is quite acceptable for such complex experiments.

Device for modeling dynamic processes and its electrical circuit – Fig.4. The results of the experiments are shown in Fig. 5,6,7.

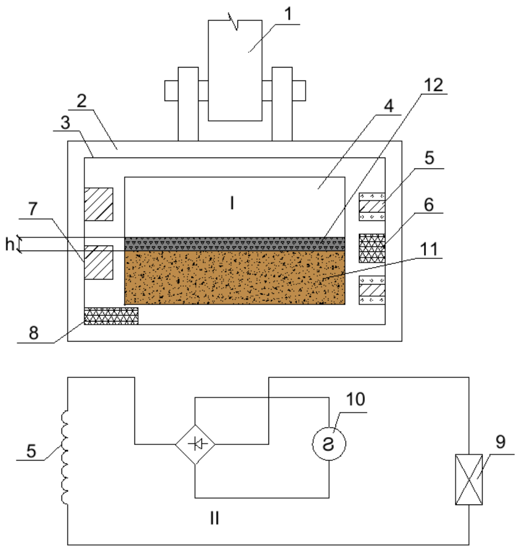

Fig.4. Device for the reproduction of dynamic effects – I – II – its electrical circuit

1. Rocker;
2. Carriage;
3. Container;
4. Platform;
5. Electromagnets;
6. Elastic element;
7. Elastic element;
8. the regulator of the amplitude;
9. Breaker;
10. current source;
11. Base – movable sand;
12. Ballast prism made of crushed stone.

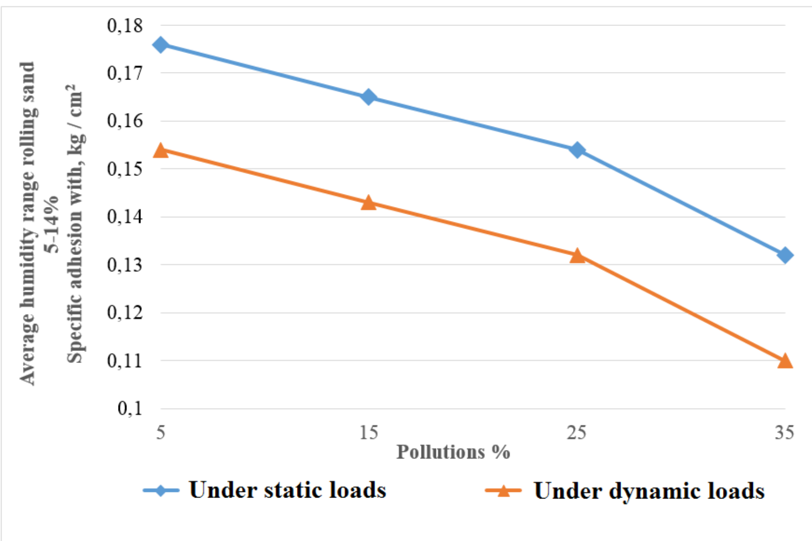

Fig. 5. Dependence of change specific adhesion with the percentage clogging of the gravel moving sands

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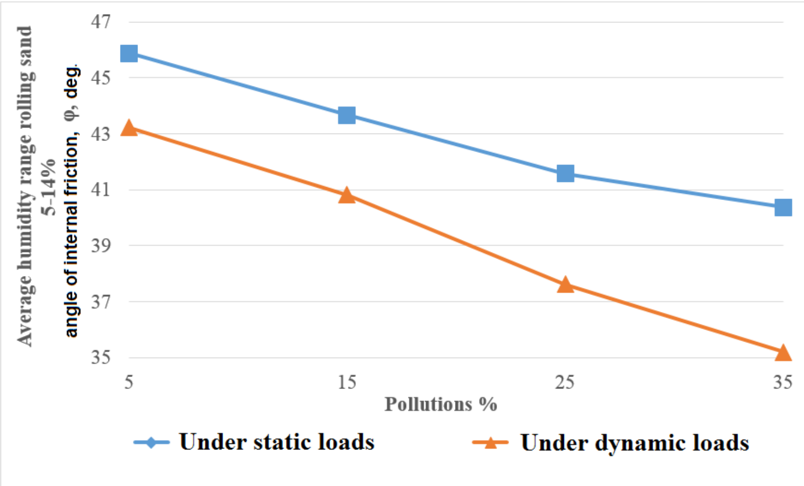

Fig. 6.The dependence of the change in the angle of internal friction of the percentage of blockage of gravel moving sands

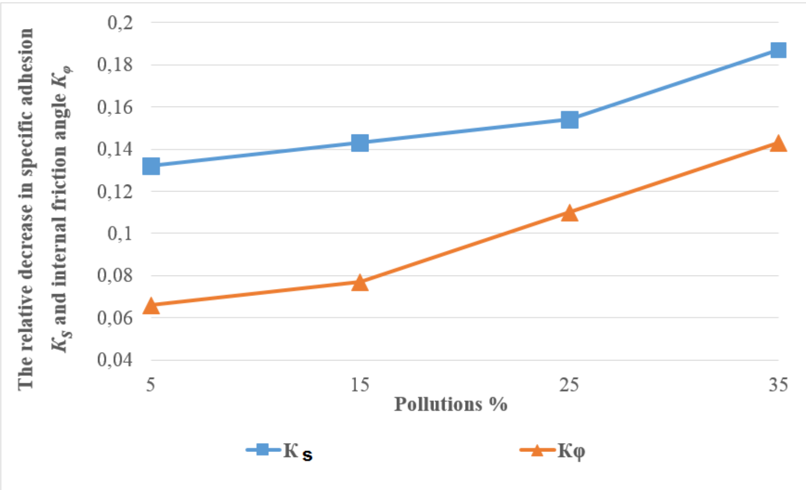

Fig. 7. The dependence of the change in the relative reduction of specific adhesion $K_s$and the angle of internal friction of the$K_\varphi$of the percentage of blockage of rubble moving sands

The results of our model experiments on the study of the strength properties of the ballast prism at different degrees of contamination by mobile Sands have a convergence with the results of field experiments within 12 – 19 %, which is sufficient confirmation of the reliability of the studies.

REFERENCES

1. Abdujabarov A.H. "The Impact of high-speed movement of trains on the avalanche a protective" proceedings of the First International scientific – practical conference. CATIC. Almaty. 2000. p. 96 – 100.
2. Abdujabarov A. H. Design subgrade in seismic areas of railways "Transport construction M. 1991 No. 7 s 21 – 22».
3. Teshaboyev Z. R. Experimental study of underground pipelines with wall connections under the action of dynamic loads. g... "Problems of mechanics" Tashkent 2003. No. 4. p. 16 – 18.