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To Decrease the Negative Effect of Railway Trains Waves to Buildings

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ABSTRACT: The article examines the propagation of vibration waves in the ground and building structures during the movement of railway trains. In order to reduce the level of vibration waves, the terrain of the railway track was changed and the barrier was placed. The problem was solved for three different cases and its effectiveness was analyzed. The problem is solved by the finite element method, leading to a flat problem of the theory of elasticity.

KEY WORDS: vibration waves, harmonic load, half-plane, relief, soil, structure, theory of elasticity, amplitude, building, model, transient boundary conditions.

I.INTRODUCTION

Nowadays, as a result of population growth, the construction of buildings and structures, manufacturing enterprises is growing rapidly. This will lead to an increase in demand for convenient means of transport especially rail transport for people and goods.

Railway transportation systems are a convenient means of transport to serve people and transport all types of goods. Therefore, the demand for them has increased, the number of trains has increased year by year, and modern types have appeared, that is, there is an increase in capacity and speed.

The increase in rail traffic leads to an increase in the level of vibration in the ground around the road as a result of the increase in speed. Vibration of residential, industrial buildings and structures occurs as a result of the impact of traffic and road surface vibrations on the foundations of buildings and structures. Under the influence of vibration leads to changes in the internal structures and surface layers of materials, a decrease in the strength of structures. Vibration of buildings affects people's life activities, health, productivity and create negative consequences.

II. SIGNIFICANCE OF THE SYSTEM

This study aims to decrease the level of waves generated by rail traffic. For three different cases, the efficacy was analyzed.

- located on the surface of the railway canvas;
- the railway line is located 2 feet above the ground;
- An open trench is placed 2 m above the ground and 10 m from the axis of the railway with a depth of 5 m and a width of 1 m.

A reinforced concrete (panel) building is designed at a distance of 20 m from the railway line. The foundation of the building is located 2m below the road level line, the building is designed as two-storey and full of land. In 3 different options, we analyze the propagation of vibration waves generated by the movement of a railway train on the ground and in building structures. (Picture 1)

To do this, we bring the problem to the flat problem of the theory of elasticity. According to the results of the experiment, the vibration of the soil obeys the harmonic law, and since the amplitude of the vibration is very small, we consider the problem to be linear.

III. LITERATURE SURVEY

We determine the displacements in the floors and columns of buildings, taking into account the physical and mechanical characteristics of the material under the influence of a pair of harmonic loads placed on the free boundary of the half-plane. In this case, we replace the infinite half-plane with the finite sphere [10, 8, 9]. In this case in the

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borders AC, СД and ДМ (Picture 1) the following conditions are set which allow the waves to aspire to infinity in AC and СД [6, 7].

$$AC\ \text{да}\ \left.\begin{matrix}\sigma=\alpha\ \rho\ V_p\ \dot{v}\\ \tau=\beta\ \rho\ V_S\ \dot{u}\end{matrix}\right\}, \qquad СД\ \text{да}\ \left.\begin{matrix}\sigma=\alpha\ \rho\ V_p\ \dot{v}\\ \tau=\beta\ \rho\ V_S\ \dot{u}\end{matrix}\right\}$$

IV. METHODOLOGY

In this place σ and τ – normal and experimental voltages; $\dot{u}$ and $\dot{v}$ – projections of velocities of boundary points on axes; V_P and V_S – P and S velocities of waves; α and β – dimensionless parameters; ρ – density of the material.
We use the finite element method to solve this problem.

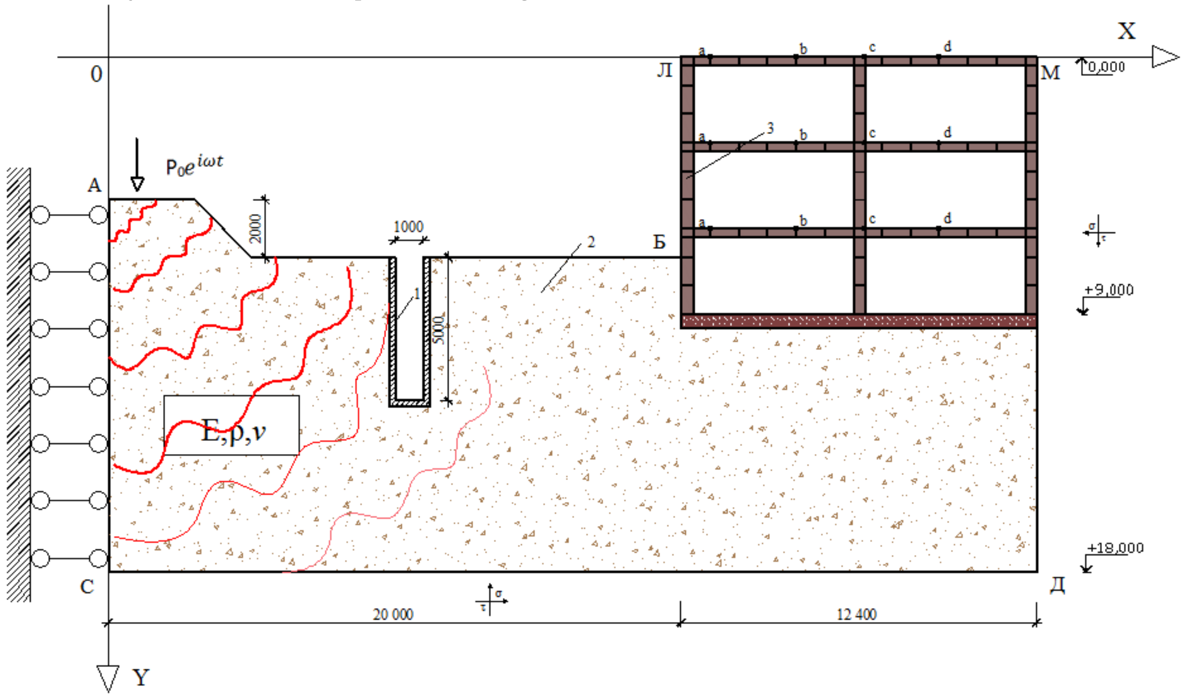
We write the equation of motion as follows:

$$[M]\left\{\ddot{u}(t)\right\}+[C]\left\{\ddot{u}(t)\right\}+[K]\left\{\ddot{u}(t)\right\}=\left\{P(t)\right\}-[\Gamma]\left\{\ddot{u}\right\} \quad (1)$$

In this place: $[M]$, $[C]$ and $[K]$ – mass, damper and virginity matrices of the system, respectively; $\{u(t)\},\{p(t)\}$ – vectors of node displacement and impact forces; $[\Gamma]$ – a diagonal matrix that takes into account the boundary conditions [1, 2, 3, 4, 5].

V. EXPERIMENTAL RESULTS

A finite dynamic model of the problem-solving area is shown in Picture 1.



Picture 1. Schematic of a finite dynamic model of the problem-solving area

The 1,2,3 s material types which is shown here (listed in Table 2).
a,b,c and d nodes being checked.
Suppose the frequency of the force acting externally ω given in the form of a harmonic function

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$$\{P(t)\} = \{P_o\} e^{i\omega t} \tag{2}$$

The reaction of the system for a stable process is as follows

$$\left.\begin{aligned} \{u(t)\} &= \{\bar{u}\} \cdot e^{i\omega t} \\ \left\{\dot{u}(t)\right\} &= i\omega \{\bar{u}\}\ e^{i\omega t} \\ \left\{\ddot{u}(t)\right\} &= -\omega^2 \{\bar{u}\}\ e^{i\omega t} \end{aligned}\right\} \tag{3}$$

Now if we put (2) and (3) in the equation of motion (1), we have a system of complex algebraic equations independent of time.

$$[K]\{\bar{u}\} = \{P_o\}. \tag{4}$$

In this place $\{\bar{u}\}$ – vibration amplitude of the vector; $\{P_0\}$ – the amplitude vector of the acting force.

Solve equation (4) in Gaussian method, the constant complex amplitude vector of the system is determined

$$\{\bar{u}\} = \{\bar{u}_1,\ \bar{u}_2, \bar{u}_3, \ldots, \bar{u}_N\} \quad . \tag{5}$$

In this place N – the degree of freedom of the industry.Real movements are determined by the following formula.

$$\{u(t)\} = \mathrm{Re}\{\bar{u}\}\cos \varpi t + \mathrm{Im}\{\bar{u}\}\sin \varpi t \tag{6}$$

The amplitude of oscillations on the surface of the ground is fading and non-monotonous as the winding moves away from the canvas axis.

Taking the nodes shown in Figure 1 from each floor of the buildings being inspected,the load frequency of the displacements in themω= 40 гц considered for the case.

Table 1

№	Thenodesbeingchecked	When the rail is located on the ground	When the railway line is located 2 m above the ground	When designing a barrier between a building and a railway line
1st floor	a	0,02275	0,02357	0,00301
	b	0,00878	0,00451	0,00085
	c	0,01617	0,01129	0,00206
	d	0,01181	0,00978	0,00176
2nd floor	a	0,03328	0,02503	0,00244
	b	0,0271	0,00538	0,00099

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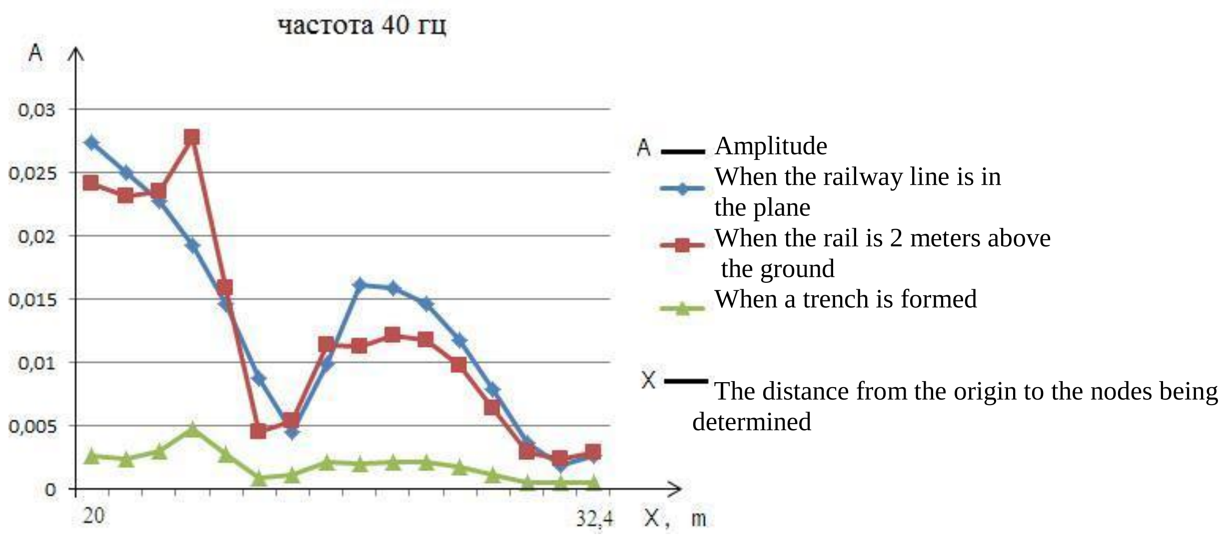
	c	0,0008	0,01246	0,00245
	d	0,00226	0,0123	0,00233
ontheroof	a	0,03563	0,02686	0,00257
	b	0,02122	0,00688	0,00089
	c	0,01666	0,01329	0,00263
	d	0,01635	0,01377	0,00257

The oscillation frequency of the matter ω=10 ÷ 50 гц examined at intervals, it was observed that the migrations had a similar pattern.

The following graphs show the distribution of the amplitudes of displacement generated by the movement of trains in the structures of buildings when the design of the railway line is in the above 3 different cases.



Picture 2. Movements on the first floor of buildings

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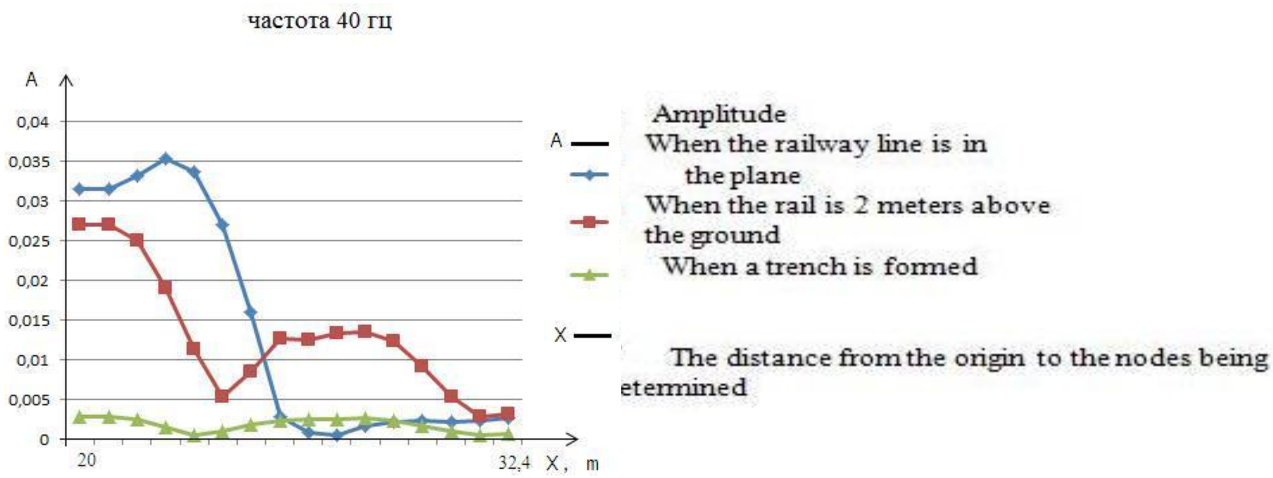
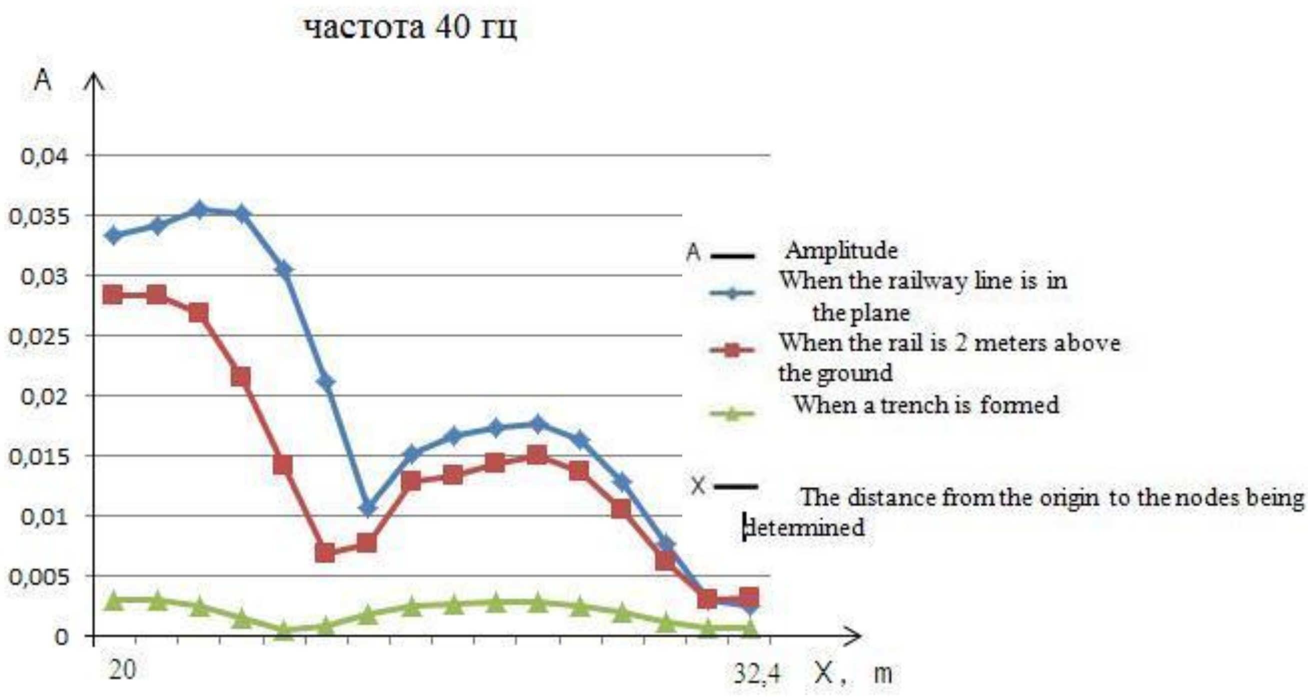


Picture 3. Movements on the second floor of buildings



Picture 4. Movements of buildings on the roof floor

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VI.CONCLUSION AND FUTURE WORK

The figures show the variation of the displacement amplitude along the length of the building for 3 different states, as shown in the graph,after the formation of the trench, the amount of migration of nodes in the floors of the building decreased several times.From the above analysis, it can be concluded that the location of the railway and the installation of vibration barriers can be seen to be highly effective in reducing vibration waves.

The physical and mechanical properties of the materials in solving the problem are obtained in the form of the following table.

Table 2

№	The type of materials	Elasticity module - E, N/sm^2	Puasson's coefficient - ν	Specific gravity – ρ, кг/м^3
1	space	0	0	0
2	sandy - gravellygrunt	2850	0,35	1800
3	reinforcedconcrete	200000	0,15	2500

REFERENCES

[1] Ribes-Llario F., MarzalS.,ZamoranoC., Real J.Numerical Modelling of Building Vibrations due to RailwayTraffic: Analysis of the Mitigation Capacity of a Wave Barrier// HindawiShock and Vibration. Volume 2017.Article ID 4813274.11 pages.
[2]Yang Y.B., Hung H.H. Soil Vibrations Caused by Underground Moving Trains.// Journal of Geotechnical and Geoenvironmental Engineering. 134(11) November 2008.*with*565 Reads.
[3]Connolly D. P., Alves Costa P., Kouroussis, G., Galvin, P., Woodward, P. K., Laghrouche O. Large scale international of railway ground vibrations across Europe.// Journal.SoilDynamicsandEarthquakeEngineering.Volume 71.April 2015.Pages 1-12
[4]Nils Persson. Predictingrailway-inducedgroundvibrations.// dissertation.Division of Structural Mechanics,Faculty of Engineering LTH, Lund University. Sweden. Printed by Media-Tryck LU. Lund. Sweden. June 2016. P. 76.
[5]RicardoFerrara. A numerical model to predict inducedvibrations and dynamic overloads.// dissertation phD. Universite Montpellier II - Sciences etTechniquesdu Languedoc, 2013. English.P. 158.
[6]Huan Feng. 3D – models of railway Track for Dynamic Analysis.// Dissertation.Department of Transport Sciency.School of Artichecture and the Built Environment.Royal institute of Dechnology. Stockholm. November 2011. P. 92.
[7]Hameed A.S.,Shashikala A.P. Suitability of Rubber Concrete for Railway Sleepers.// Perspectives in Science.Volume 8.September 2016, P. 32-35.
[8] Kaevunruen S., Remennikov A. Dynamic Properties of Railway Track and Its Components: A state-of-the-art review.// New research on acoustics. Nova science Publishers.Inc. NewYork. 2008. P. 199-217.
[9] Bo Qiu. Numerical study on vibration isolation by wave barrier and protection of existing tunnel under explosions // Dissertation. 23 January 2014. P. 206.