

DEPENDENCE OF THE LEVEL OF VIBRATIONS GENERATED ON THE GROUND BY THE MOVEMENT OF RAILWAY TRAINS ON THE POSITION OF THE ROAD SURFACE

TECHMIND-2021

Boytemirov Muhammadbobir Boyjo'ra Ugli

Lecturer of the department "Resistance and Mechanics of Materials" Namangan engineering - construction institute,

E-mail: boytemirovm@gmail.com

Xoldarov Samandar Rahmonjon o'g'li

Master of Namangan Engineering - Construction Institute



Annotation.

The article examines the propagation of vibration waves in the ground and building structures during the movement of railway trains. The position of the railway track was changed in order to reduce the level of vibration waves. The railway was placed 2 m above the canvas level and its efficiency was analyzed. The problem is solved by the finite element method, leading to a flat problem of the theory of elasticity.

Keywords:

Vibration waves, semi-plane, relief, ground, construction, theory of elasticity, amplitude, buildings, ground model, conductive boundary conditions, finite elements.

Introduction.

At present, there is an increase in population, construction of buildings and structures, as well as a sharp increase in industrial production. This, in turn, leads to an increase in demand for vehicles carrying people and goods. Rail transport is a convenient means of transport for the transportation of various 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 has been an increase in capacity and speed.

The increase in rail traffic leads to an increase in the level of vibration in the soils 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 human life activities and productivity and has negative consequences.

This study aims to reduce the level of waves generated by rail traffic. To do this, its efficiency was analyzed by placing the railway transport liner in the plane and rising above the plane. Two identical reinforced concrete buildings are located 20 meters from the railway line. The foundations of the buildings are 2 m below the road level line, the buildings are designed as two-storey and full of land.

The railway line is located 2 m above the plane. (Figure 1) To do this, we bring the problem to the flat problem of the theory of elasticity. According to the results of the experiment, it is assumed that 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 [4,5,6].

Method.

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 [1,7,8]. In this case, where the following conditions are set that allow the waves to infinity at the **CD** and **DE** boundaries (Fig. 1). [2,11].

$$\text{on } CD \quad \left. \begin{aligned} \sigma &= \alpha \cdot \rho \cdot V_P \cdot \dot{v} \\ \tau &= \beta \cdot \rho \cdot V_S \cdot \dot{u} \end{aligned} \right\}, \quad \text{on } DE \quad \left. \begin{aligned} \sigma &= \alpha \cdot \rho \cdot V_P \cdot \dot{v} \\ \tau &= \beta \cdot \rho \cdot V_S \cdot \dot{u} \end{aligned} \right\}$$

Where σ and τ are normal and experimental voltages; $\dot{u}$ and $\dot{v}$ – projections of velocities of boundary points on axes; V_P and V_S are – velocities of waves P and S ; α and β – are dimensionless parameters; ρ – density of the material [2].

We use the finite element method to solve the current sum.

Equation of motion as follows:

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

Here : $[M]$, $[C]$ and $[K]$ – mass, damper and Stability matrix 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 [3,9,10].

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

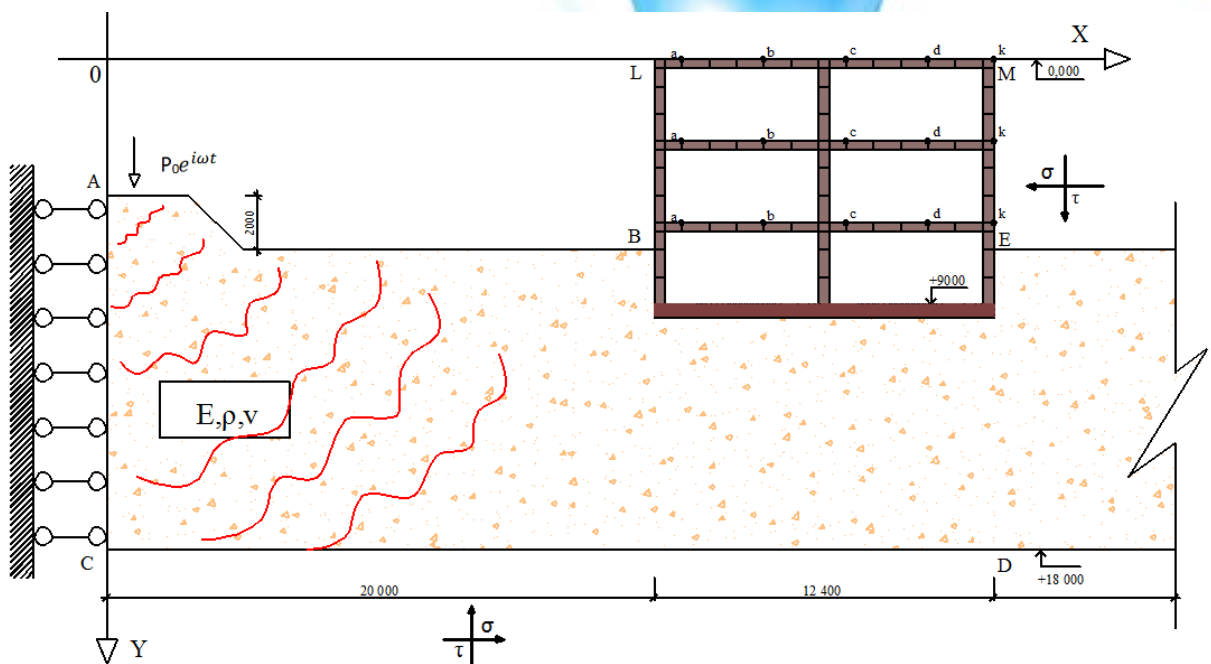


Figure 1. The railway line is placed at a height of 2 m from the plane.

In this case, the type of soil is taken as the same for both cases. Material types (listed in Table 1). **a, b, c, d, k** are the points to be checked.

The modulus of elasticity and Poisson's coefficients in solving the problem are obtained in the form in the table below.

Table-1

No	Material type	Elasticity module - E, N/sm ²	Poisson's coefficient - ν
1	sandy - gravelly grunt	2850	0,35
2	Reinforced concrete	200000	0,15

Suppose that the external force is given in the form of a harmonic function with frequency

ω

$$\{P(t)\} = \{P_0\}e^{i\omega t} \quad (2)$$

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

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

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

$$[K] \cdot \{\bar{u}\} = \{P_0\} \quad (4)$$

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

By solving the equation (4) by the Gaussian method, the constant complex amplitude vector of the system is determined.

$$\{\bar{u}\} = \{\bar{u}_1, \bar{u}_2, \bar{u}_3, \dots, \bar{u}_N\} \quad (5)$$

Here N – free degree of field. Real displacements are determined by the following formulas.

$$\{u(t)\} = \text{Re}\{\bar{u}\} \cos \omega t + \text{Im}\{\bar{u}\} \sin \omega t \quad (6)$$

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

Results.

Taking the points shown in Figure 1 from each floor of the buildings being inspected, the displacements in them were considered for the case where the load frequency was $\omega = 20$ Hz (Table 2).

Table 2

No	Checked nodes	Vertical displacements at building nodes when the rail is placed on the ground	Vertical displacements at the nodes of the building when the rail is placed at a height of 2 m above the ground	Difference (4/3)
1	2	3	4	5
1st floor, frequency at 20 Hz	a	0,17126	0,07057	0,41
	b	0,02154	0,03692	1,7
	c	0,11169	0,05521	0,49
	d	0,03397	0,02465	0,72
	k	0,01044	0,00153	0,14
2nd floor, frequency at 20 Hz	a	0,18061	0,06715	0,37
	b	0,04138	0,0358	0,86
	c	0,07741	0,05465	0,7
	d	0,01693	0,02036	1,2
	k	0,00792	0,00259	0,32
on the roof covering, at a frequency of 20 Hz	a	0,19068	0,06639	0,34
	b	0,08796	0,03715	0,42
	c	0,02568	0,05449	2,12
	d	0,00244	0,00245	1
	k	0,00773	0,00224	0,29

As can be seen from the results in Table 2, when the condition of the railway tracks is 2 m above the ground, there is a 1,5 to 3,5 times decrease in displacements on the floors of the building compared to the plain. The results were obtained by substituting sandy - gravelly soils such as suglinok, lyoss, supes.

The results showed that in the above-mentioned areas, the displacements in the structures of the building were reduced by up to 5 times compared to the location of the railway train at a height of 2 m above the ground.

Examining the problem in the range of oscillation frequency $\omega=10 \div 50$ Hz, it was found that the displacements have a similar pattern.

The following figures show a graph of the displacements generated up to the building and on the first floor of the building at a frequency $\omega = 20$ Hz.

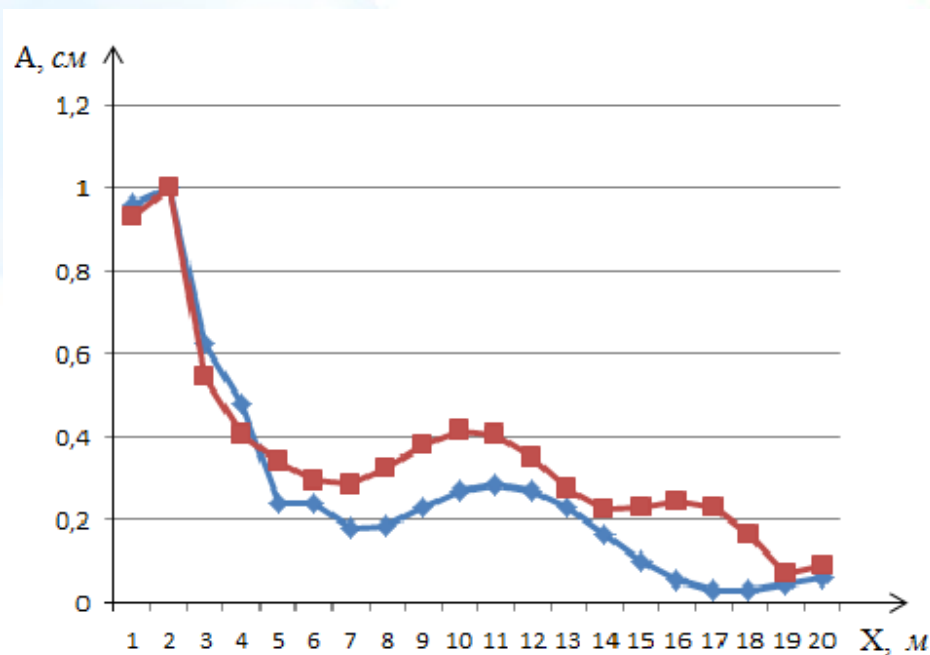
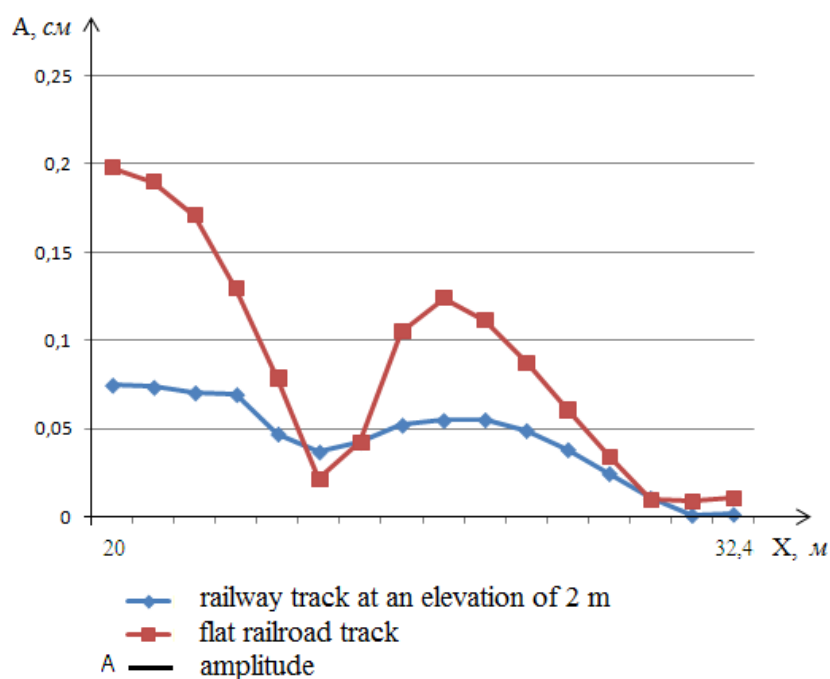


Figure 2. Amplitude modulus of displacement of ground nodes along the "Y" axis to the



building

Figure 3. Amplitude modulus of displacement of nodes on the "Y" axis on the first floor of the building

Conclusion.

It has been proved that the level of harmful vibrations spreading around can be drastically reduced by raising the railway line above ground level. In particular, it was found that when the railway line is placed 2 m above ground level, the level of vibrations propagating to the environment decreases from 1,5 to 5 times, depending on the frequency of the force.

References

1. Ильичев В.А., Юлдашев Ш.С., Саидов С.М. Исследование распространения вибрации при прохождении поездов в зависимости от расположения железнодорожного полотна // Основания, фундаменты и механика грунтов. М., 1999. № 2.
2. Lysmer J., Kyhlemeyer L. Finite Dynamic Model for Infinite Media // Jour Engineering Mechanics Division. ASCE. 1969. Vol. 95. No. EM 4. August. P. 859 – 887.
3. Юлдашев Ш.С., Маткаримов П.Ж. Распространение вибраций в грунтах от транспортных средств и виброзащитные системы. Ташкент, “Фан ва технологиялар маркази”, 2014 г., 188 с.
4. Ribes-Llario F., Marzal S., Zamorano C., Real J. Numerical Modelling of Building Vibrations due to Railway Traffic: Analysis of the Mitigation Capacity of a Wave Barrier // Hindawi Shock and Vibration. Volume 2017. Article ID 4813274. 11 pages.
5. 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.
6. 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. Soil Dynamic and Earthquake Engineering. Volume 71. April 2015. Pages 1-12
7. Nils Persson. Predicting railway-induced ground vibrations. // dissertation. Division of Structural Mechanics, Faculty of Engineering LTH, Lund University. Sweden. Printed by Media-Tryck L. U. Lund. Sweden. June 2016. P. 76.
8. Ricardo Ferrara. A numerical model to predict induced vibrations and dynamic over loads. // dissertation PhD. Universite Montpellier II - Sciences et Techniques du Languedoc, 2013. English. P. 158.
9. Huan Feng. 3D – models of railway Track for Dynamic Analysis. // Dissertation. Department of Transport Sciency. School of Architecture and the Built Environment. Royal institute of Dechnology. Stockholm. November 2011. P. 92.
10. Hameed A.S., Shashikala A.P. Suitability of Rubber Concrete for Railway Sleepers. // Perspectives in Science. Volume 8. September 2016, P. 32-35.
11. 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. New York. 2008. P. 199-217.