Литература

1. Беляев В.В. Отчет по предварительной разведке месторожде-ния темноцветных пород Узбекистан и белого мрамора Кахралысай как облицовочного камня и крошки в Республике Каракал-пакстан за 1978-1981 г.г. Экспедиция "Химгеолнеруд" ПГО Ташкентгеоло-гия, 1981 г. Госгеолфонд, Ташкент.

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INFLUENCE OF THE INERTIA FORCE OF UNDERGROUND PIPELINE SYSTEMS UNDER SEISMIC LOADS

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The article provides research on assessing the degree of influence of inertial forces when solving problems of seismodynamics of underground polymer pipelines. The problems of the stress-strain state of underground pipeline systems under seismic impact are considered. The tasks are solved by analytical methods. Dangerous points of occurrence of maximum normal stresses under the influence of seismic loads on the underground pipeline of elastic interaction in the "pipe-soil" system are determined.

Key words: inertial force, seismodynamics, interaction in the "pipeline - soil" system, underground pipelines, normal stress.

Extensive structures - pipelines, tunnels, bridges, foundations of extended buildings, etc. during earthquakes behave differently in comparison with high-rise structures - buildings, towers, and therefore the former, in addition to inertial forces, also experience forces caused by soil deformation. The development of the pipeline system cannot be realized without ensuring a high level of reliability of structures. Thus, world experience shows that almost every major earthquake leads to damage to pipelines.

Influence of the inertia force of underground pipeline systems under seismic loads.

The seismic action on an underground pipeline is the field of soil displacement determined by seismic waves with a finite velocity of their propagation. Seismic waves are represented by a spectrum of similar waves of different lengths, each of which dominates in different periods of the earthquake impact. Underground structures are mainly destroyed by inertial forces caused by earthquakes. In this case, the interaction of the structure with the base can also affect the properties of the stress state. Damage and destruction of a structure does not affect the neighboring life, such as underground support systems (primarily pipes), where the force of inertia only slightly affects the mutual forces in the "pipe-ground" system, in some cases they can be ignored simplifies some tasks. At the same time, the collapse of part of the underground structures (piping systems) leads to the failure of the entire system.Seismic action on an underground pipeline is the field of soil displacement determined by seismic waves with a finite velocity of their propagation. Seismic waves are represented by a spectrum of similar waves of different lengths, each of which dominates in different periods of the earthquake impact. Therefore, in some cases, the forces caused by soil deformation during an earthquake can play a major role than inertial ones. It should be noted that for overground structures inertial forces play a leading role, and for underground structures, these forces are insignificant in some cases.

Differential equations of underground pipelines without taking into account inertia forces under seismic loads

$$\frac{\partial^2 u}{\partial x^2} - p^2(u - u_0) = 0\,, \tag{1}$$

boundary conditions

$$u\big|_{x=0} = u^0,\ EF\frac{\partial u}{\partial x}\bigg|_{x=l} = 0. \tag{2}$$

Knot equations

$$m_1\frac{\partial^2 u^0}{\partial t^2} + \pi D_H k_x^{uz} H_{uz}\left(u^0 - u_0\right) = 0, \tag{3}$$

Consider an analytical solution to the inhomogeneous equation (3). Analytical solution of differential equation (3).

It can be seen from the results that an increase in the value of the parameter k_x^{uz} leads to a decrease in the value of the stresses of the underground pipeline in all sections, and an increase in the value of the parameter at the nodes leads to an increase in the value of the stresses of the underground pipeline. It was revealed that the force of inertia does not always have the same effect on the dynamics of the system of underground structures. Only in some cases does the quasi-static formulation allow one to obtain satisfactory results. Analysis of numerical results shows that viscoelastic interaction has a significant impact on the stress-strain state of underground pipelines. In the examples considered, the difference between the results of elastic and viscoelastic solutions in stresses is 15 - 20%. The carried out computational and experimental studies solve the problems of assessing the stress-strain state of pipelines under seismic loads, which is important for practical calculations.The results obtained using quasi-static calculations should be considered as the first approximation. It is necessary to provide for sufficient safety margins of the pipeline structures, or check the results of a quasi-static calculation using a more accurate, dynamic one.

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