UDC 331.45:656.2(477)

IMPLEMENTATION OF THE RISK-BASED APPROACH AS A CRITERION FOR IMPROVING SAFETY IN CONSTRUCTION

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Problem statement. In modern conditions, the design and operation of production units at enterprises of the construction industry, which have workplaces (WP) with harmful working conditions, should take into account levels of industrial risk, which is due to the presence of harmful and hazardous production factors throughout the unit and the combined effect of these factors of different classes based on the integral index.

Purpose. The aim is to develop a method of determining the level of industrial risk, characterizing the level of hazard in conditions of joint exposure to harmful factors of different classes, for workers not only in their working area, but also on the territory of the whole enterprise of the construction industry. It is known that the effect of harmful and hazardous production factors is not limited only to the working area, which is defined as the space in which the WP of permanent or temporary stay of workers during their work activities, but spreads in space in accordance with established patterns.

Result. The theoretical basis for the formation of a new concept of safety in organizational and technical systems can be the axiom of potential danger, the Farmer principle, the principle of minimum Libich, Weber-Fechner law, Shelford law of tolerance [1]. Justification of expediency of using the method of determining the level of hazard for workers in the work area, based on the transformation of "dose − effect" taking into account the nature of the causal relationship in the sequence "action − feeling − reaction" and allowing to calculate the total risk for this sequence in the presence of joint exposure to harmful factors of different classes, was given in previous studies [2].

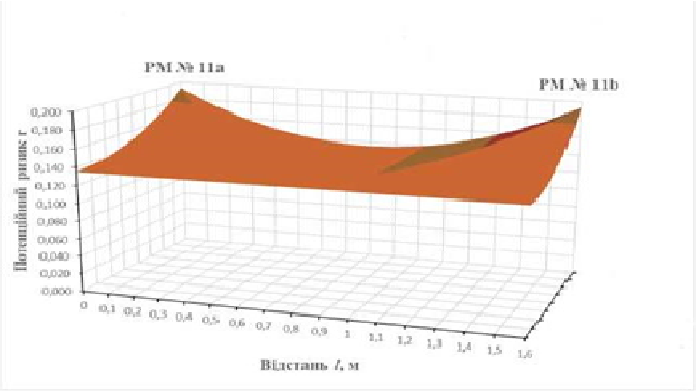

Fig. 1. The level of industrial risk for adjacent WP employees of the repair shop (WP № 11a, WP № 11b)

Recalculation of environmental indexes into risk indexes for the working zones of electric welders, located next to each other at a distance of 1.6 m (WP 11a, WP 11b), and the formation of a three-dimensional model of changing the levels of industrial risk for these WPs (Fig. 1) shows that simultaneous work around these WPs creates a zone with an excessive risk level ($R_{int} > 10^{-1}$), in which being there is undesirable for any of the other employees of the enterprise.

Taking as a basis the obtained values of the integral index of industrial risk, we built a three-dimensional model of changes in the values of industrial risk in the space between the WP of the maintenance shop fitters. The resulting model provides a picture of the hazards for these workers (Fig. 2).

Analysis of the obtained data indicates that there is an increase in mutual harmful effects when taking into account the joint impact of hazardous and harmful industrial factors on workers of the repair shop. The nature of the work performed, which is a change of modes when testing diesels, involves the emergence of powerful reverberation. The safest area in the premises of the diesel department of the enterprise is the space between the WPs. But during the operation of the test benches, the situation changes radically. As a result, there is a general excessive industrial risk for the workers of the repair shop.

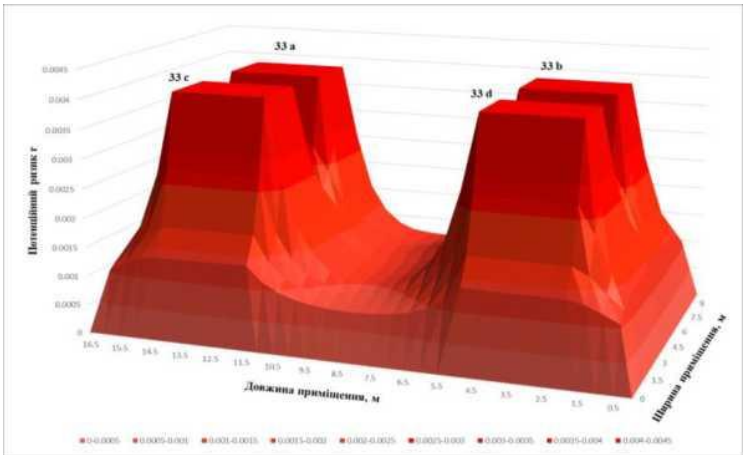

Fig. 2. The level of industrial risk for adjacent WP employees of the repair shop (WP № 33a, WP № 33b, WP № 33c, WP № 33d)

Conclusion. It has been established that the development and improvement of risk-oriented approach consists not only in withdrawal of harmful and hazardous industrial factors, which are insignificant in their influence. It is necessary to thoroughly consider risk factors and mechanisms that cause the occurrence of accidents at enterprises engaged in construction.

The application of the proposed approach makes it possible to estimate the values of potential industrial risk at any number of harmful and hazardous factors on the WP of employees of the enterprise. Also mutual influence of harmful and hazardous factors is taken into account. It is possible to determine zones with the largest levels of industrial risk between WPs and at any distance from them, which creates conditions for determining the optimal and most hazardous routes of employees' movement through the territory of repair shops. Thus, the application of risk-oriented approach as a criterion for improving safety in the construction industry is justified.

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UDC 550.30:69.07:338.2

NONLINEAR SOIL MODELS IN CALCULATION OF THE WHARF STRUCTURE BY FINITE ELEMENT METHOD

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Problem statement. The development of computer technology has led to the widespread use of the finite element method as the main method for determining the stress-strain state of structures. At present, the adequacy of the use of the finite element method is determined by the reliability and accuracy of load models, models of work of materials and soils, models of destruction. Modern software packages used to solve engineering geotechnical problems, such as Plaxis and Midas GTS NX, have more than 20 models of materials.

Some recommendations for the use of these models and the definition of appropriate parameters have been developed and proposed in the works of some scientists [1−5].

Purpose of the study. The issue of selection and application of soil models used in computer modeling of the foundations of buildings and structures, as well as the theoretical justification and methods for determining their parameters, is quite acute. Each of the models has its advantages and disadvantages. Understanding the intricacies of use is sometimes quite difficult.

One of the methods that helps to determine the most successful soil model is validation, comparison of calculation results with field experiments.

Maine results. To perform validation necessary to choose an analog design, from which the numerically obtained data will be compared in the future. Validation of the use of soil models in determining the stress-strain state by the finite element method in Midas GTS NX is performed by comparison with the results of experimental studies performed by V.M. Rengach [6] and shown in Fig. 1.

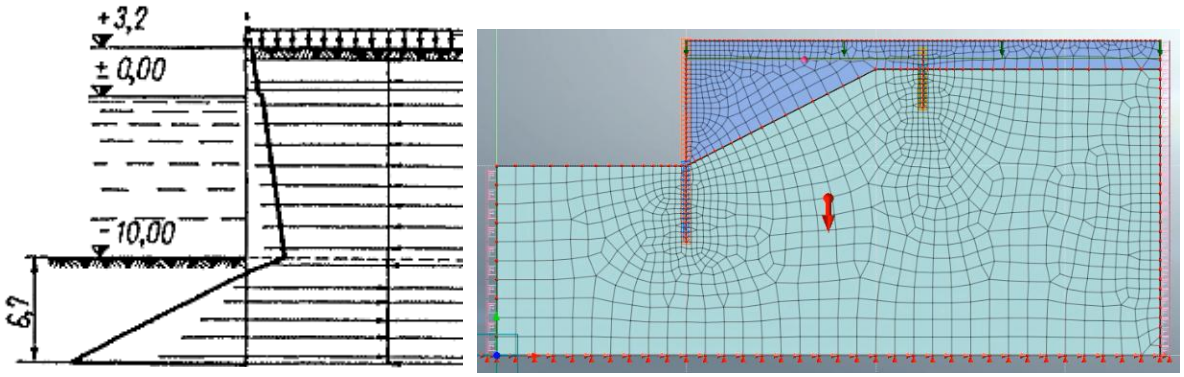

Fig. 1. Experimental studies performed by V.M. Rengach [6] and the calculation scheme of Midas GTS NX

For comparison with experimental data has been performed calculation of the berth wall with a depth near the berth of 10 m, from the tongue Larsen 5 UM, backfilling of sand with a porosity coefficient of 0,7.

The process of constructing a calculated model includes:
- determining the size of structures and the calculation area;
- construction of a geometric model;
- task of materials and properties of elements;
- creating a network of finite elements;
- loads and influences;
- taking into account the water level;
- imposition of boundary conditions.

The analysis of calculation results using different soil models has performed: Mohr-Coulomb; Hardening Soil model; the model of the strengthened soil taking into account small deformations of Hardening Soil (small strain stiffness). It`s also compared with experimental data.

Conclusion. The analysis of the obtained data showed that the greatest coincidence of the calculated and experimental data was obtained using the soil model Hardening Soil Small Strain with a deviation in the value of bending moments of 11 %, and deformations of 20 %. The results of the calculation on the model Mohr-Coulomb showed that its use in the design of the wharf type "bolverk" should be very careful, it is better to use soil models in accordance with the recommendations given [7].

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