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STRESS-STRAIN STATE OF CELLULAR FLOORS

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Problem statement. With the active development of the construction industry, new efficient designs are always required, which will make it possible to realize what was previously difficult or impossible. Taking into account the tendency to erect tall multi-storey buildings for the most dense distribution of living space within the existing site, problems often arise with the superstructure of an already built structure without significant load on the supporting structures or for savings in new construction. Also, during the reconstruction of old structures, the supporting structures do not carry new loads, but there is no way to significantly strengthen them. Many works have been devoted to the problem of high-rise construction and reconstruction, but key difficulties remains [1; 2].

Purpose of the study. The main idea is to offer options for lightweight rigid structures that can be used for multi storey construction and renovation. However, this design option is extremely unexplored and has a complex stress-strain state that cannot be calculated in the current realities, except with the help of finite element modeling.

Maine results. The proposed design can be used not only in construction, but also in many other industries. Its feature is incredible rigidity at a low weight, which can be useful in many cases. It is based on a patent for a cardboard structure [3]. The structure consists of profiled sheets connected by layers located perpendicular to each other with stiffeners. This ensures the spatial rigidity of the structure and significantly increases the stability of the corrugated walls. The format of the structure allows you to safely work with external sheets, because most of the mechanical damage will not affect the bearing capacity of the structure due to good opportunities for redistribution of forces. The cavity of the structure ensures its lightness and the possibility of laying it inside any communications. In construction, the natural rigidity allows the final finishing of the floor after the construction of the structure is made of concrete or other suitable material. This project was simulated in the ANSYS software environment. The influence of the shape and load on the bearing capacity of various types of slabs has been analyzed. For comparison, standard floor types were analyzed under the same conditions. A layer-by-layer analysis was carried out, which provided a lot of useful information about the redistribution of forces in complex extended structures, and the effectiveness of the selected type of slabs was confirmed.

Conclusion. Ultralight cellular floors are the lightest of the rigid boards. On insulating concrete, they lose half of their strength, and the deflections are doubled, but the weight per square meter is reduced by more than 4 times. For comparison: when using insulating concrete, a monolithic floor accumulates 5 times more stresses, although it loses the same amount in weight, but the deflections of this structure increase 8 times. Cellular floors can be used as a lightweight analogue of a monolithic floor, instead of higher loads and, accordingly, smaller dimensions. From an economic point of view, although very aggregated calculations show a significant superiority of honeycomb floors over monolithic floors and about the same economic efficiency for slab floors. An interesting concept, it takes a lot of careful research and experimentation before launching them into mass production. They are nevertheless necessary because, as this study has shown, the potential for such a design is enormous.

References

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