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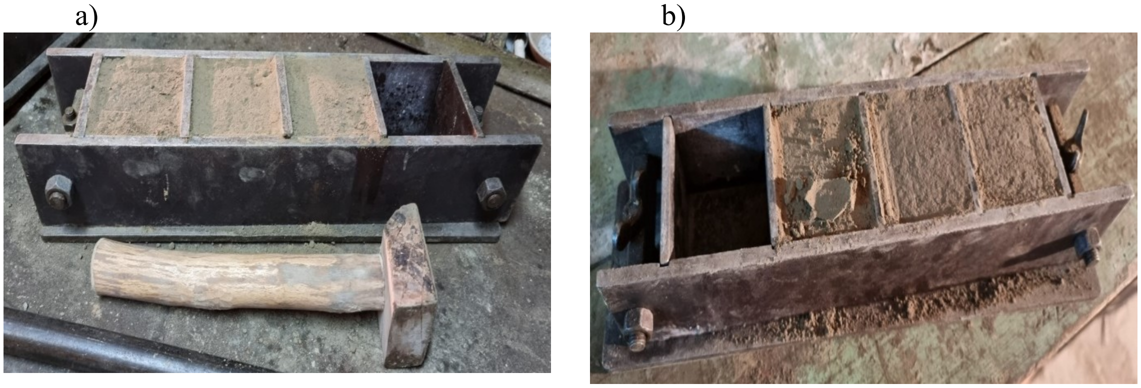
STUDY OF SOIL CONCRETE SAMPLES USING RECYCLING PRODUCTS

We continue to study the physical and mechanical properties of soil concrete samples for low-rise buildings. Taking into account the results of previous studies, such as the selection of the optimal composition of soil concrete, the study of the strength characteristics of soil concrete, which are given in scientific papers [1, 2], it was decided to introduce aggregate for increasing the strength characteristics of soil concrete. The experiment was carried out in the Research Laboratory of the Department of Reinforced Concrete Structures of the PGASEA. In previous studies, the maximum mortar grade for different types of binder was established, namely Heidenberg cement M100 and M75 for Kamianets-Podilskyi cement M75. Since concrete itself requires aggregate, and Ukraine is currently experiencing active hostilities, there is no shortage of recycled products. And after the end of hostilities, there will be a great need to dispose of construction waste, it was decided to use these materials in further research.

At the next stage, the experiment was set up as follows: the type of binder was Kamyanets-Podilsky PC M500, the test cubes were 70x70x70 mm in size, and the aggregate was the recycled products with a fraction of 5-7 mm. The method of manufacturing the samples, the conditions of sample aging, and the test method remained the same as in previous studies [1, 2]. Three aggregate indicators in percent by weight of dry soil and binder, namely: 10%, 20%, 30% aggregate were used (Fig. 1).

a) b)



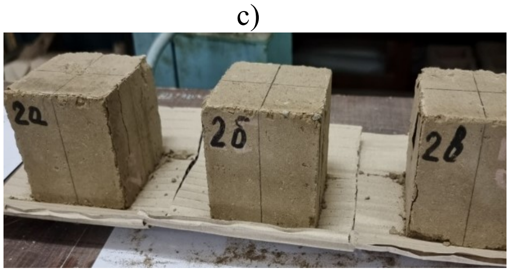

c)

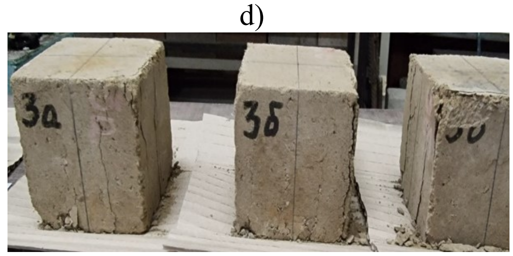
Fig. 1 Production of soil concrete specimens with dimensions of 70x70x70, using recycled products: a) cubes; 10% aggregate content; b) 20% aggregate content; c) 30% aggregate content.

The cubes were tested at 28 days of age on the UMM-20 press. The general view of the cube tests is presented in Fig. 2, for all three variants.

a)


b)


c)


d)


e)


Fig. 2. Ground concrete specimens with dimensions of 70x70x70: a) general view of the specimens; b) specimens with 10% aggregate content after testing; b) specimens with 20% aggregate content after testing; d) specimens with 30% aggregate content after testing; e) general view of the compression test of the specimen.

The tests showed that the strength of the soil concrete specimens using recycled products as aggregate is lower than that of the soil concrete specimens without fine and coarse aggregate. The low strength of the specimens is explained by the poor adhesion of fine and coarse aggregate to the binder and soil. The failure pattern of the specimens is fully consistent with that of concrete cubes. Compared to the results of previous tests, the strength of soil concrete specimens using recycling products as aggregate is 56.4 kgf/cm^2, while the strength of soil concrete specimens without fine and coarse aggregate is 69 kgf/cm^2. Thus, for further research and field tests of soil concrete beams of composite t-beams, a combined concreting system was adopted, namely, to use conventional heavy concrete in the edge of the compressed zone of the section and soil concrete in the overhangs.

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STRUCTURAL HEALTH MONITORING IN GUARANTEEING THE STRUCTURAL SAFETY OF BUILDINGS

Ensuring the safety of buildings and structures is a critical aspect of their design and operation. The damages of structures can lead to changes in their properties and a reduction in their service life [1]. Therefore, there is a need to implement Structural Health Monitoring (SHM) systems for civilian buildings and infrastructure to detect damage in time and avoid accidents. Considering the end-of-life of many objects, such as bridges, towers, architectural monuments and civilian buildings, it is important to develop methods for monitoring and recording damage to extend their service life [2].

Structural health monitoring includes periodic measurements to detect damage and its impact on building elements and structures. This provides up-to-date data on the ability of structures to perform their functions in the future, taking into account their aging and damage caused by the exploitation environment [1]. It implies for the assessment of their technical condition using prototype design models or instrumental building monitoring systems. These systems continuously monitor the characteristics of structures and can be used for early warning of signs of damage and risks of collapse [1].

SHM is used to monitor any building structure over its lifetime under direct or indirect loads. It not only analyzes the condition of structures, but also improves the understanding of their behavior by detecting changes through a system of sensors that collect data. This information helps to plan maintenance and repairs, as well as determine the remaining service life of the structure [1].

Structural damage leads to changes in modal parameters, such as frequencies, mode shapes, and damping coefficients. Vibration methods based on the analysis of these parameters are used to monitor the condition of building structures [1]. Particular attention is paid to natural frequencies, which are determined by modal analysis. Changes in the structural properties of structures cause changes in their frequencies, which becomes an incentive for the use of modal methods in damage detection.

The development of structural health monitoring is linked to advances in digital technology. Initially, monitoring was applied mainly to critical infrastructure, but now it is being extended to