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 buildings as communities are increasingly dependent on infrastructure systems. Particular attention is paid to the preservation of historical heritage, as it is exposed to various damages. Many studies have considered the determination of building damage using these methods, although there are many problems in their practical application [1].

A typical example is the monitoring of the condition of the structures of buildings in the old housing stock, shown in Fig. 2.1 [1]. The house is located in Latvia, but such buildings are also existing in Ukraine and other Baltic countries. Cracks on the facade and inside buildings often occur due to changes in soil conditions, leaching, or construction work nearby, so constant monitoring can help detect changes and prevent further damage [1]. Assessment of the condition of the structures of an old building can provide options for extending its service life and preventing the development of destruction processes.

Nowadays, it is important to detect damage to monumental structures in seismically active regions. The use of Structural Health Monitoring (SHM) methods allows for an effective response to changes using data from sensors located on the building. For example, the Palazzo dei Consoli in Gubbio (central Italy) is equipped with a network of sensors for monitoring (Fig. 2) [3]. For monitoring, a Bayesian methodology was used, which combines dynamic and static monitoring data, finite element modeling, and visual inspections to monitor the building before and after a low-intensity seismic event. This allows to investigate all factors limiting decision-making, accurately evaluate options and prioritize interventions, avoiding the possible detection of false alarms [3].

Figure 1 - The old multistorey residential building [1].

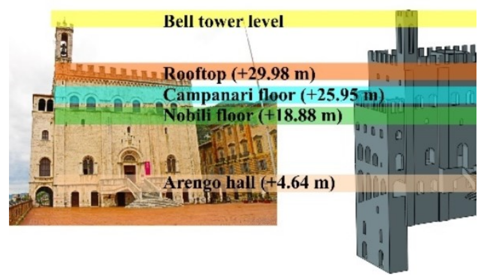

Figure 2 - Palazzo dei Consoli [3].

Thus, ensuring the safety of structures in construction is a necessary component of the design and operation of buildings and structures. Structural health monitoring allows to detect damage in time and extend their service life.

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