The cracks opening monitoring in the museum building during the Poshtova Square reconstruction in Kyiv

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SUMMARY

In recent years a sharp raise of public and scientific attention to the environmental monitoring is observed. This is caused by the demand for the new and higher organizational and technical level of solving the problems related to its changes. According to the current regulatory documents, during the design, construction and operation of buildings and structures their scientific and technical support should be ensured. One of the main tasks of scientific and technical support is to monitor the technical condition and current information about the deformations and stresses that occur in building structures. In many cases, these deformations lead to the building structures damage, emergencies, and a significant decrease in the building reliability. The theoretical justification of the monitoring concept is based on the necessity of the complex system creation for collecting, accumulating, processing and using information, which should be accumulated in automatic mode by means of various sensors or control and measuring devices in the form of a database revealing the stress-deformed state of building structures. In recent years, in the State Enterprise "The State Research Institute of Building Structures" a lot of attention was paid to both regulatory and methodological support and practical implementation of monitoring systems.

Keywords: monitoring, ground failure, cracks, museum building, reconstruction, Kyiv
Introduction

Over the past 20–25 years, Ukraine has paid much attention to both regulatory and methodological support and practical implementation of monitoring systems in construction. Several regulatory documents, including the DBN B.1.2-5:2007, DBN B.1.2-12-2008 and DBN B.1.2-14-2009, which in more or less degree reflect the monitoring issues, were developed during this time. According to the current regulatory documents, the design, construction and operation of buildings and structures should be accompanied by their scientific and technical support. One of the main types of activities in the construction project scientific and technical support is its technical state monitoring. The monitoring necessity is prescribed in several national regulatory documents. For instance, the (DBN V.1.1-3-97, 1997) section 7 contains the requirement for the continuous monitoring of the landslide and landslide-hazardous territories state, including the instrumental observations of vertical and horizontal displacements of the slopes surfaces, as well as the regular inspections and periodic surveys of buildings, structures and engineering or transport communications located on the slopes and at a distance of up to 200 m from the slope edge; observations of the stress-strain state of buildings and structures components; observation of the horizontal displacements of the slip surfaces levels on sliding slopes; observation of the level and chemical composition of groundwater; observation of shear pressure values. In (Kaliukh, Ishchenko, 2020) a new scientific direction in the soil (slide) hazards study is formulated as the “integrated methodology for early warning systems of soil (slide) hazards”. It harmoniously combines the experimental studies of the landslide-prone areas monitoring with the use of modern sensors and devices that operate in an on-line mode with the comprehensive calculation of the stress-deformed state of the soil base within the dynamic scenario analysis of probable events. In Ukraine and abroad these questions are addressed by the well-known scientists (Slyusarenko, 2023), (Telyma, 2020), (Trofymchuk, 2018), (Vanichek, 2016) and others. The most complicated problem is related to the control and monitoring of the compacted soil physical and mechanical properties. In most cases, the control is indirect, as the density and moisture content are usually monitored only for dry material (Vanichek, 2016). The new continuous compaction control (monitoring) proposed by Brandl, Kopf and Adam is a certain step forward in this direction (Vanichek, 2016).

Monitoring of the cracks opening in the "Post Office Building" architectural monument during the Poshtova Square reconstruction in Kyiv

Almost in the middle of the Poshtova Square, behind the Church of the Nativity of Christ, a modest small one-storey T-shaped building with approximately 21.60x17.60 m dimensions is huddled. From a construction point of view, this is a frameless building with longitudinal and transverse load-bearing walls. The small building of the Kyiv postal stagecoach station was built back in 1865 (Fig. 1). Although the building has a very simple appearance, that is it which gave the name to the modern square. In the distant past, the station provided a reliable postal connection between Kyiv and many cities of the Europe and vast Russian Empire.

The cracks opening observation was performed using various measuring devices, which made it possible to obtain both qualitative and quantitative indicators of the cracks development. The observation station contained a defined number of pairs of observation marks made of non-ferrous metal and installed on the building structures (each of marks pair on both sides of the cracks), as well as a portable device (comparator) for reading the deformation size indications (Fig. 2). A SDM 50/500 strain gauge (comparator) was used to take readings. The device was equipped with a clock-type indicator with a division price of 0.01 mm. The limit for measuring the changes in the crack opening width was up to 10 mm. The set of rods on the device allowed to measure the cracks opening based on 50, 100, 200, 300, 400 and 500 mm. The replaceable leg attached to the base served to fix the selected length. Both legs had a spherical surface from below. They were in contact with conical recesses (sockets) on the observation marks installed on both sides of the crack.
Conclusions

1. The minor (from 2 to 4 mm) settlements of the building foundations were recorded for the building on Poshtova Square (Post Office Building architectural monument). According to the Table 4 (VSN 490-87, 1987), the maximum allowable deformations (settlements) of foundations bases are 10 mm.
The settlements up to 3 mm recorded during the observation period (957 days) did not exceed the maximum values permissible under the new construction effects. It should be noted that in 2015 the building structures and foundations were strengthened.

2. At the end of June 2015, during the repair works execution an observation station for determining the changes in the cracks opening width in the building structures was destroyed. As of June 26, 2015, minor (from -0.17 mm up to +0.07 mm) changes in the opening width were recorded. The observations of the width changes in the cracks, on which the T-18 marks pair was installed, lasted a little longer.

3. As of July 30, 2015, the gain of the crack opening width was -0.04 mm. The graph of the time dependent changes of the cracks opening width in the building structures was plotted in Fig. 3.

![Figure 3](image)

**Figure 3** The graph of changes over time in the cracks opening width in the building structures at 2, Poshtova Square: time axis; cracks width change, mm; marks pairs

**References**


