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Geophysics for urban preservation

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The paper describes the results of geophysical studies conducted under modern urban conditions. This outlines new exploration opportunities offered by geophysics in geotechnical and archaeological areas, as shown in the historic centre of Kazan, the capital of the Republic of Tatarstan. The resulting data disprove the established concept that geophysical techniques cannot be effectively used in urban areas. The author has developed a new and highly effective geophysical monitoring technique that is not affected by the noise generated by buildings. The results of high precision areal and profile gravity measurements, including the indoor ones, are reviewed. The method allows the recording of non-tidal gravity changes caused by groundwater movements, the location of building areas affected by them and the timely elimination of such effects. Transient electromagnetic sounding in monitoring mode can be used to study groundwater movements in isolated areas over a long period. This monitoring technique has been effectively used to study architectural monuments of the Kazan Kremlin. The local accumulation and intensive migration of groundwater and the karst-suffosion and landsliding processes have been shown to cause the inclination of the Suyumbeki Tower, a unique architectural monument of the 18^{th} century, and the destruction of some structures and fortress walls. Preserved remains of ancient structures in the anthropogenic layer of the Kazan Kremlin and in the Bogoroditsky Nunnery have been located and described. Other issues covered include the successful location and tracing of fault zones, weak dam zones and the bottom of the anthropogenic layer and the detection of the negative impact of recent tectonic movements on structures.

In the author's view, these results can serve as an adequate basis for setting up special

geophysical services to solve the above problems in urban areas.