

GEOPHYSICAL MONITORING OF THE INCLINED SUYUMBEKI TOWER, KAZAN, RUSSIA

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The Suyumbeki Tower, a unique architectural monument and a symbol of the town of Kazan and its Kremlin, is a seven-storey, 58 meter-high, spike-headed, red brick, passage watchtower. In the beginning of the 20th century, geodesic measurements indicated an eastward 1.14 meter-inclination (δ) of the tower's axis. Repeated measurements showed that the Tower kept falling, by now δ reaching 1.9 m. In order to find the cause of the Tower's inclination, the high-precision gravity monitoring is conducted here since 1995 with narrow-range gravimeters GNU-KV on a grid of 5×5 m (measurement error: 10^{-7} m/s²). The monitoring revealed non-tidal gravity variations due to seasonal changes in hydrogeological conditions associated with a natural reservoir of ground- and technogenic waters situated beneath the eastern part of the Tower's basement that must have been a major cause of the Tower's eastward inclination. Electromagnetic sounding permitted us to trace the reservoir's bottom (water-resisting layer). The presence of the said reservoir was confirmed by two bore-holes. Gravimetric monitoring inside the Tower, taken on two levels/storeys, permitted the determination of the first and second gravity potential derivatives (V_z and V_{zz}), and the location of the rock volume out of which rock particles can be most intensively washed. These gravimetric data have been confirmed by repeated electromagnetic sounding at the same points.