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Application of modeling of electromagnetic field and GPR measurements in investigations of antique tenement

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The article presents the results of Ground Penetrating Radar (GPR) measurements carried out in a historic tenement in Krakow. The aim of this study was to check if there is an empty space under the apartment's floor.
Ground Penetrating Radar is a noninvasive geophysical method which is particularly important during the test of antique tenement. In the case of historic buildings it happens that architectural documentation is not sufficiently accurate or has been destroyed or lost. Moreover the GPR provides adequate accuracy and resolution of received data.
Because of required resolution and depth range antennas with frequencies 500 MHz and 800 MHz were used for measurements. Six measuring profiles were determined from P1 to P6. In this presentation profiles P3 and P4 are the most important.
Due to the ambiguity of the surveying results modeling attempt of electromagnetic field distribution in the medium was undertaken. Programme GPRMax2D v. 2.0 (author - Antonis Giannopoulos) was applied to create models.
In this programme the GPR numerical analysis uses the finite – difference - time – domain method (FDTD). The FDTD approach to the numerical solution of Maxwell's equations consist of discretization both the space and the time continua. Under certain assumptions the solution is accurate. Increase the complexity of the shapes modeled objects does not increase the computation time.
At the basis of echograms from profiles P3 and P4 geometry of the models was constructed. Few types of models for profiles P3 and P4 was prepared. The first of theme assumed a signal with 500 MHz frequency, second – 800 MHz frequency, third – 200 MHz frequency. Next models included partial buried the basement with moist sand. In order to obtain the best adjustment for measuring echograms parameters such as the size of objects, the dielectric constant and wave velocity was changed.
Radargrams obtained as a result of the modeling were compared with processed measurements radargrams. Very similar reflections from the top of the basement appeared. There was no significant reflection from the bottom of the basement.
Radargrams (from measurements and modeling) confirmed the presence of voids under the floor of flats.