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# 3D Finite Element Modelling for the investigation of the cavity effect in extensometric rock-deformation measurements

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Monitoring of long period near-surface deformations of the Earth-crust is mostly performed by extensometry using equipments with different principles (eg. clinometers, interferometers, metal or quartz extensometers), capable for measuring of variations even in 10-11 order.

Using the observations wide spectra of natural physical processes of the Earth (e.g. tidal phenomena, self-oscillation of the Earth, pole-motion, variations of Earth's rotation, mass rearrangements, tectonics, geodynamics, climatic changes) can be analysed. Beyond these objectives application possibilities include the analysis of consequences caused by such kind of anthropogenic activities as mining, industrial activity, water-, oil- or gas exploitation as well.

As the instruments are usually established in natural or artificial caves, tunnels, wells under the surface in order to minimize environmental influences (changes in temperature, air pressure, humidity...), one has to take into account the distorting effect of the cavity system itself on the real rock deformations. The so-called cavity effect covers the phenomena that a rock matrix with a unique cavity system deforms differently than it would be filled with rock materials. This causes an inhomogeneity problem in the observation system. The cavity effect is one of the most important factors influencing the absolute accuracy of geodynamic deformation measurements. Data sets compiled from different observatories could be improved by the estimation of this effect. The calculation of the real cavity effect influencing the accuracy of the deformation measurements cannot be done analytically. In actual practice generally various installation rules are considered in the designing phase to decrease the effect (Mentes, 1997: Continuous measurement methods for observing geodynamic, environmental and industrial deformations, Academic Doctoral Thesis, Sopron, In Hungarian).

In this paper finite element modelling has been performed to analyse the phenomenon in general. Authors calculated the deformations of a simple-geometry 3D cavity, which is caused by variable gravity loads. Dependence of the cavity effect on changing of distinct elastic properties in categorized models has been investigated.
Authors introduced qualifying parameter fields calculated using the results of the FE modelling (nodal displacements as a model answer for the gravity load), in order to characterize the effect.
Modelling results can be used as an estimation not only for the absolute cavity effect rate of the intended arrangement, furthermore the sensitivity of the given system against a particular geometric property. As an application example finite element modelling were carried out in order to estimate the influence of the complicated cavity system surrounding the "Budapest-Matyashegy" Gravity and Geodynamical Observatory of the Eotvos Lorand Geophysical Institute of Hungary.