

The accurate evaluation of rock stress measurement by means of Downward Compact Conical-ended Borehole Overcoring technique based on reevaluation of strain coefficient.

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Abstract

The accurate determination of rock stress at great depth is one of the most important problems to be solved in fields such as the deep geological disposal of nuclear fuel waste and the underground sequestration of carbon dioxide. Downward Compact Conical-ended Borehole Overcoring (DCCBO) technique is a method to apply to a downward vertical borehole bottom with depth of up to 1000 m.

In a shallow in-situ tests were carried out 11 times at bottom of a vertical borehole at depth of 4.9 m to 21.6 m from the gallery floor (Yoshida; 2003). However, the magnitude of vertical stress σ_z was estimated to be tensile in most of measurement points, which was thought to be unusual. It was thought that the sensitivity of the strain cell was reduced due to the adhesive that used in situ test. Thus, while the adhesive may have been strong enough to glue the strain cell together, it may not have been hard enough to provide sufficient measurement sensitivity.

In this study, strain coefficient which considered the mechanical properties of the adhesive based on the results of laboratory experiment to evaluate the time-dependent behavior of the adhesive were reevaluated. Then the results of in-situ test were reevaluated by proposed method. The results are summarized as follow;

- 1) Numerical simulation to determine mechanical properties of the adhesive to minimize the deviation of evaluated stress and applied stress was carried out with four regions FEM model which consists of rock region, adhesive region, epoxy resin region, and brass region. Mechanical properties of the adhesive and other parts were determined as follow; Young's modulus of adhesive; $E_a = 1.45$ MPa, Poisson's ratio of adhesive; $\nu_a = 0.00$, Young's module of epoxy resin; $E_e = 103.5$ MPa, Poisson's ratio of epoxy resin; $\nu_e = 0.30$, Young's module of brass; $E_b = 103.5$ GPa, Poisson's ratio of brass; $\nu_b = 0.35$.
- 2) The magnitudes of the reevaluated stress by using the conditions of described above were improved to some extent. Furthermore, with regard to direction of principal stress, reasonable results were obtained. Thus, we confirmed the practicality of DCCBO technique. However, in comparison the overburden pressure (about 12.5 MPa), the magnitudes of vertical stress were still underestimated. Based on the observation of recovered cores, the rock at the measurement points was heterogeneous and tended to form fine cracks when the stresses were relieved. It is possible that this affected the measured strain.