

Effect of Nonlinearity on Measurement Accuracy of Stress Measurement Method Based on Theory of Linear Elasticity

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There are several well-established methods for high-precision stress measurement in hard rock. However, there is no stress measurement method for soft rocks, and it is currently under development. The stress measurement method under development for soft rocks, Conical wall hole technique, is assumed to be laboratory experiments in the development stage, and this study is a numerical experiment for the laboratory experiments. Known stresses were loaded on a linear elastic model and a nonlinear elastic model, and the stresses calculated from the strains generated at the measuring points were compared with the loaded stresses. Due to the nonlinear behavior of soft rocks, when the linear elasticity theory was applied to soft rocks without considering the nonlinearity, the stresses calculated from the strains generated at the measuring points were calculated correctly in the orientation, but there were different errors for different conditions in the magnitudes. Therefore, considering the nonlinearity, the stress field under each condition was inferred from the relationship between strain and stress, the elastic modulus was calculated under the stress field, and the stress was calculated again from the strain. As a result, these errors between the measured stress value and the loaded stress value was small in all conditions. Therefore, stress measurement is now possible even under the influence of nonlinearity.