Estimation of Regional Stress for Heterogeneous Rock Mass with a Fault

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Abstract

It is necessary to determine regional stress from limited data of local stress for estimating stress distributions in a region under consideration for various engineering projects such as underground repository of high-level radioactive wastes. However, local stresses which we can measure are affected by heterogeneity of rock mass and discontinuities.

In this study, regional stress in a heterogeneous rock mass with a penetrating fault was defined as displacements at the boundaries as a function of the coordinates, which are different for the upper and lower rock bodies to allow relative displacements to the fault. The fault was modeled by joint elements with 16 nodes, and it was assumed that no sliding of the fault occurs.

When we estimate stresses in a field, these are a few problems. There are that it is difficult to measure all components of stress since we often measure only 4 stress components, that we cannot estimate mechanical properties of a fault accurately, and that it is also difficult to determine whether the fault is sliding or not. Therefore, by using a small-scale heterogeneous model composed of different rock bodies having a fault, the effects of such problems were investigated first, and finally, this method was applied to estimate regional stress in the Tono district, Japan, where the Tsukiyoshi fault exists.

The result showed that the stress distribution estimated from the regional stress was in good agreement with the tendency of measured data when the stiffnesses of the Tsukiyoshi fault were determined so that the error in the stresses at the measurement points might be minimized. However, the estimated stress distribution for the Mizunami shaft was not realistic since one component of the normal stresses was tensile. This was considered to occur due to the assumption that the fault is not sliding while the fault is sliding in reality. Thus, we need to establish a method for determing the regional stress when the fault is sliding.