

A new development of relaxation testing system

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1. Introduction

The micro-structure of rock plays an important role to predict the long-term behavior for more than thousand years. The creep under constant load and the relaxation under constant displacement are typical time dependent phenomena, and through these we can guess the true stress-strain-behavior of rock or rock mass.

The relaxation test has scarcely been performed till now in contrast to the creep test^{1) 2)}. We developed a new relaxation testing equipment. Using this a series of relaxation tests have been tried in the constant-temperature room.

2. Experimental system

The loading unit of the testing equipment consists mainly of vessel, oil jockey, piston, loading platen and two stoppers(Fig. 1). A main problem in developing the loading unit is to keep up a constant axial deformation. For overcoming this difficulty, two screw-stoppers are used for fixing the loading platen. To make sure balance of the stoppers, we provide a load cell on which two parallel strain gauges are affixed.

The specimens used are coarse-grained granite. The granite specimens are made from blocks which are from Inada and Japan. The size of the specimens are $40 \times 20 \times 5$ mm(Fig. 2). All of the samples are prepared to ensure a tolerance of $4\mu\text{m}$ concerning parallelism and perpendicularity of the faces.

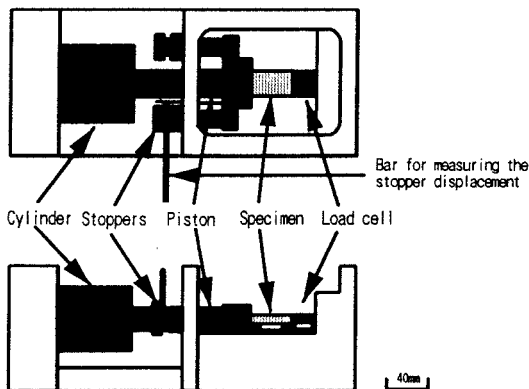


Fig. 1 Specimen and each part assembly of loading unit

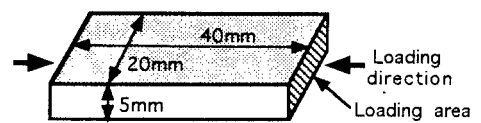


Fig. 2 Schematic diagram of specimen

3. Experimental procedure

The relaxation tests are performed in a constant-temperature room under control of $20 \pm 0.5^\circ\text{C}$. A granite specimen is placed on a concave-shaped steel block in a vessel and stress was applied to the specimen by a piston actuated through manually controlled loading pump. When the stress is arrived at

a certain level, the axial deformation is kept constantly by fastening the screw-stoppers. The specimens are kept in the room under different initial strain levels for several weeks or months. Axial stress and deformation were recorded in a personal computer.

4. Experimental results

The experimental system has been tested under relaxation state for several days, and complete stress-time curves exhibiting relaxation behavior were readily obtained at 80% and 85% stress level(Fig.3, 4). We also got a good result about the screw-stoppers. It kept up the axial deformation of specimen less than 0.005%(Fig.5).

5. Conclusions

According to the results of the relaxation test, the new developed system may allow the relaxation test for several years to predict the long-term behavior of rock mass. Through the analysis of more experimental data, this system will be updated for the triaxial compressive and relaxation tests.

6. References

- 1) M. Haupt: A constitutive law for rock salt based on creep and relaxation tests, Rock Mech. Rock Eng., Vol. 24, pp.179-206, 1991
- 2) S. Peng and E. R. Poduieks: Relaxation and the behavior of failed rock, Int. J. Rock Mech. Min. Sci., Vol. 9, pp.699-712, 1972

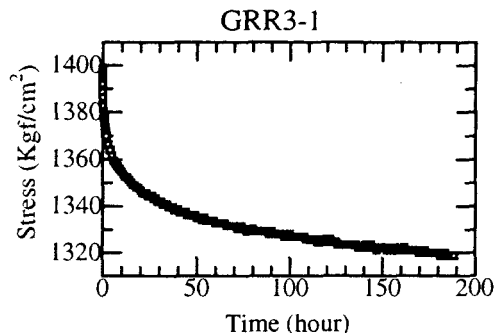


Fig.3 Relaxation test : stress vs. time at 80% stress level

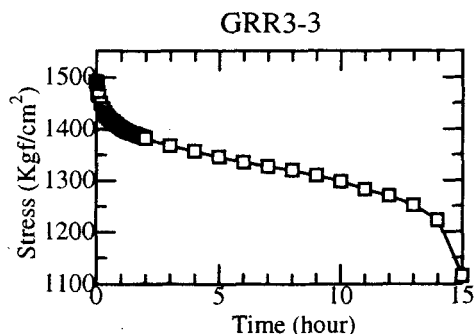


Fig.4 Relaxation test : stress vs. time at 85% stress level

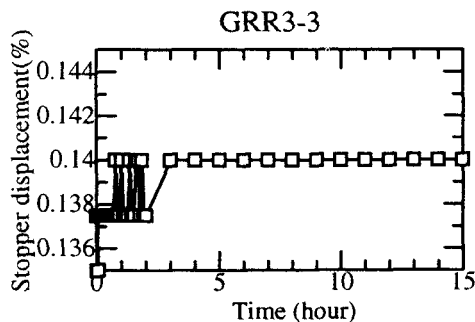


Fig.5 Displacement of stoppers