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Evolution of shear strength induced by crack growth under compressive creep in brittle rocks

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Evolution of shear strength in brittle rocks has a great significance for evaluating the rock mechanical properties during long-term geological tectonic movement. Microcrack growth has an important role in rock mechanical properties under compressive loadings. However, the relationship between evolution of shear strength and microcrack growth under compressive creep in brittle rocks is rarely established.

In this study, a micro-macro mechanical model was proposed by using the wing crack growth model, subcritical crack growth law, Mohr-Coulomb strain-softening criterion, and micro-macro damage relation. The micro-macro damage relation is established by linking the damage equation defined by microcrack growth and macroscopic strain. The wing crack growth model can explain the whole relation between crack growth and applied stress including the strain-hardening and -softening phases under compressive loadings. Coupling the relation between crack growth and applied stress, and Mohr-Coulomb strain-softening criterion, the crack growth-dependent shear strength can be also illustrated. Effect of microcrack geometry on time-dependent shear strength under compressive loadings was also discussed.