Evolution laws of strength parameters of soft rock at the post-peak considering stiffness degradation

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Key objective

To reveal the strength evolution law of weakly consolidated soft rock at the post-peak

Key methodology

The strain softening model of weakly cemented soft rock was firstly established based on the test results considering stiffness degradation at post-peak. Then, evolution equations of strength parameters were deduced assuming the subsequent yield surface satisfies the Mohr-Coulomb yield criterion. Finally, the theoretical model was numerically verified.

Major aspects investigated

1. To establish the strength evolution model of soft rock
2. To study the effect of stiffness degradation on the strength evolution of soft rock
3. To reveal the damage mechanism and plastic mechanism of soft rock

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Key conclusions (1)

- The damage threshold of soft mudstone under compression is at the yield point. However, the yield step before the peak point can be treated as an extension of the elastic range due to the relatively short feature and low damage level.
- Stiffness degradation behavior has a significant influence on the evolution laws of strength parameters. The evolution rule of the friction angle is dominated mainly by the instantaneous stress state and the damage mechanism. The attenuation law of cohesion is related to the plastic behavior in addition to the stress level and damage mechanism.

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Key conclusions (2)

- Strength parameters of mudstone show fast attenuation under low confining pressure, and the rate slows down with increasing confining pressure. The friction angle tends towards its initial value under high confining pressure. All the residual strength parameters are enhanced under high confining pressure.
- Our evolution model considering stiffness degradation in a mudstone sample can accurately demonstrate the attenuation law of strength parameters, thereby providing a theoretical basis for the further study of stability mechanisms of roadways excavated in soft rock strata.

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