Damage Evolution Characteristics of Shear Band-Bedrock Interface Under Wetting-Drying Cycles (Postprint)

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Abstract

Taking the "Banbiyan" dangerous rock in the Three Gorges Reservoir area as the research background, the damage evolution characteristics of this type of shear zone-bedrock interface under wet-dry cycles were investigated through wet-dry cycle tests, shear tests, and numerical simulation methods. The research results are as follows: the peak shear strength of the shear zone-bedrock interface is positively correlated with normal stress and negatively correlated with the number of wet-dry cycles; with the increase in the number of wet-dry cycles, the total deterioration degree of interface cohesion gradually increases and tends to stabilize, while the average deterioration degree at each stage gradually decreases, and the total deterioration degree of the internal friction angle increases but the average deterioration degree at each stage does not differ significantly; based on the mineral composition characteristics of the Jialingjiang Formation limestone, a mesoscopic parameter deterioration model for the interface under wet-dry cycles was established and its reliability was verified, and using this model for numerical simulation expansion, the variation laws of peak shear strength, crack number evolution, and total internal energy change of interfaces with different height-to-length ratios under wet-dry cycles were obtained; an empirical formula for interface shear strength parameters considering different height-to-length ratios under wet-dry cycles was proposed, and the obtained formula indicates that the height-to-length ratio of the interface has a more significant effect on the deterioration of interface strength than the number of wet-dry cycles. The research results provide reference value for studies on the overall mechanical properties of shear zones under reservoir water action and the stability of dangerous rocks containing shear zones.

Full Text

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Abstract

This study investigates the damage evolution characteristics of shear zone-bedrock interfaces under wet-dry cycling. The research reveals that the peak shear strength of the shear zone-bedrock interface is positively correlated with normal stress and negatively correlated with the number of wet-dry cycles. As wet-dry cycling progresses, the total deterioration degree of interface cohesion gradually increases and stabilizes, while the average deterioration degree per stage gradually decreases. The total deterioration degree of the internal friction angle increases, though the average deterioration degree at each stage remains relatively consistent. Based on the mineral composition characteristics of Jialingjiang Formation limestone, a mesoscopic parameter deterioration model for the interface under wet-dry cycling conditions was established and its reliability verified. Through numerical simulation extensions using this model, the variation patterns of peak shear strength, crack number evolution, and total internal energy changes were obtained for interfaces with different height-to-length ratios under wet-dry cycling. An empirical formula for interface shear strength parameters was proposed that accounts for different height-to-length ratios under wet-dry cycling. The derived formula demonstrates that the interface' s height-to-length ratio exerts a more significant influence on strength deterioration than the number of wet-dry cycles. These findings provide valuable insights for research on the overall mechanical properties of shear zones under reservoir water action and the stability of hazardous rock masses containing shear zones.

Keywords: Three Gorges Reservoir Area; water-rock interaction; shear zone-bedrock interface; wet-dry cycling; deterioration law

Note: Figure translations are in progress. See original paper for figures.