A theoretical derivation of the dilatancy equation for brittle rocks based on Maxwell model

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A b s t r a c t

In this paper, the micro-cracks in the brittle rocks are assumed to be penny shaped and evenly distributed; the damage and dilatancy of the brittle rocks is attributed to the growth and expansion of numerous micro-cracks under the local tensile stress. A single crack's behaviour under the local tensile stress is generalized to all cracks based on the distributed damage mechanics. The relationship between the local tensile stress and the external loading is derived based on the Maxwell model. The damage factor corresponding to the external loading is represented using the p–alpha (p–α) model. A dilatancy equation that can build up a link between the external loading and the rock dilatancy is established. A test of dilatancy of a brittle rock under triaxial compression is conducted; the comparison between experimental results and our theoretical results shows good consistency.

Key words: subcritical crack growth, dilatancy, distributed damage mechanics, Maxwell model, p–α model.

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