

The effect of void shape on the mechanical properties of rock

David O. Potyondy
Itasca Consulting Group, Inc.

The bonded-particle model for rock (Potyondy and Cundall, 2004) represents rock by a dense packing of non-uniform-sized circular or spherical particles that are bonded together at their contact points and whose mechanical behavior is simulated by the distinct-element method using the two- and three-dimensional programs PFC2D and PFC3D. A bonded-particle model of lithophysal tuff has been used to study the effect of lithophysae (hollow, bubble-like voids) on the mechanical properties (Young's modulus and unconfined compressive strength) of this rock, and to quantify the variability of these properties. The model reproduces the failure mechanisms observed in the laboratory and exhibits a reduction of strength and modulus with increasing lithophysal volume fraction. The effect of void shape on mechanical properties is studied by inserting randomly distributed voids of simple shape (circle, triangle and star) and by inserting voids corresponding with lithophysal cavities identified in panel maps of the walls of a tunnel through this material (see Figure 1). These studies address tunnel-stability issues associated with mechanical degradation of planned emplacement drifts at Yucca Mountain, which is the designated site for the proposed US high-level nuclear waste repository (Bechtel SAIC Company, 2004).

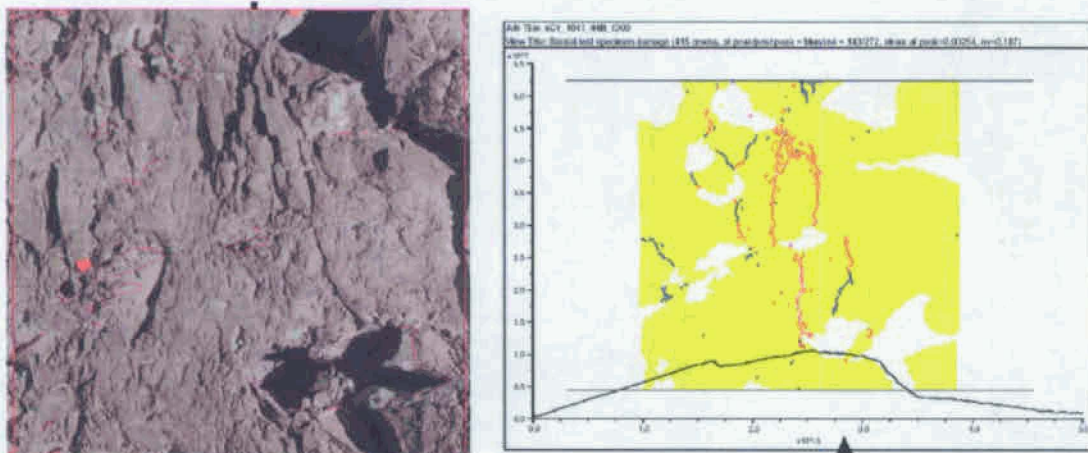


Figure 1 Left: Panel map of one-by-one meter area, and Right: stress-strain curve and damage at an axial strain of 0.5% in PFC2D specimen

REFERENCES

- Bechtel SAIC Company. "Drift degradation analysis," Bechtel SAIC Company, LLC, Las Vegas, NV, ANL-EBS-MD-000027 REV 03, September 2004.
- Potyondy, D.O., and P.A. Cundall. "A Bonded-Particle Model for Rock," *Int. J. Rock Mech. & Min. Sci.*, **41**(8), 1329–1364 (2004).