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APPLICATION OF DISCONTINUOUS DEFORMATION ANALYSIS AND PHYSICAL TRAP-DOOR MODEL IN PREDICTION OF SURFACE SUBSIDENCE AND STRESS DISTRIBUTION INDUCED BY UNDERGROUND EXCAVATIONS AND LANDSLIDE HAZARD

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Abstract:

A discrete numerical analysis method, Discontinuous Deformation Analysis (DDA) is employed to investigate the surface subsidence and stress distribution induced by mountainous underground excavations in a jointed rock mass. Different angles of the geological strata are tested. The ground subsidence of a jointed rock mass in a physical trap-door model is determined by a laser displacement sensor and the vertical stress is measured by small load cells. DDA simulates the openings excavation with the same geological conditions. The surface subsidence profiles and the stress distributions achieved from the DDA are verified by those gained from the physical trap-door model.

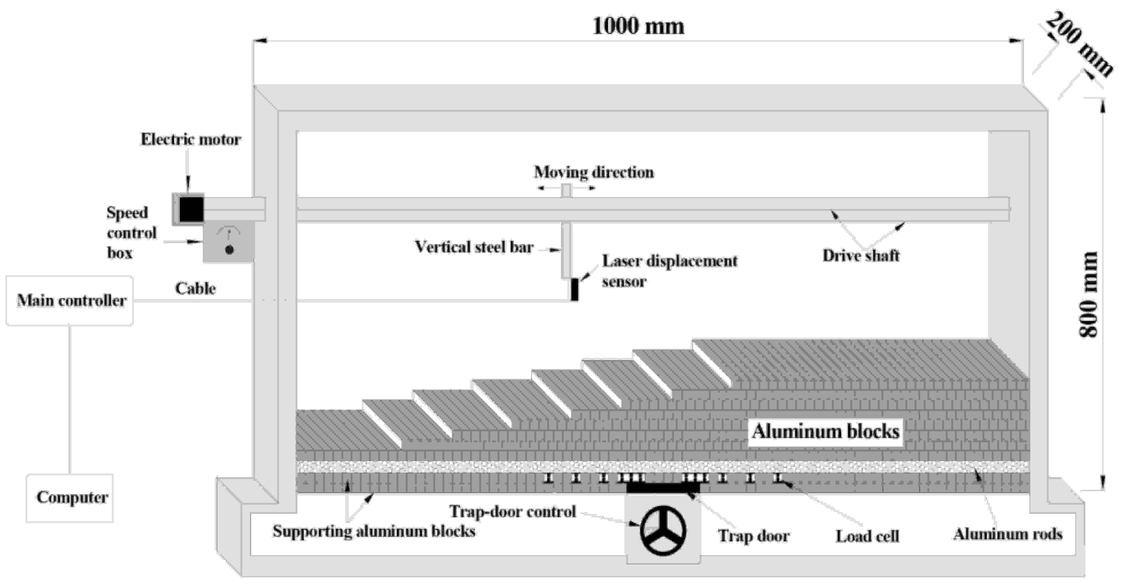

Figure 1: Trap-door model

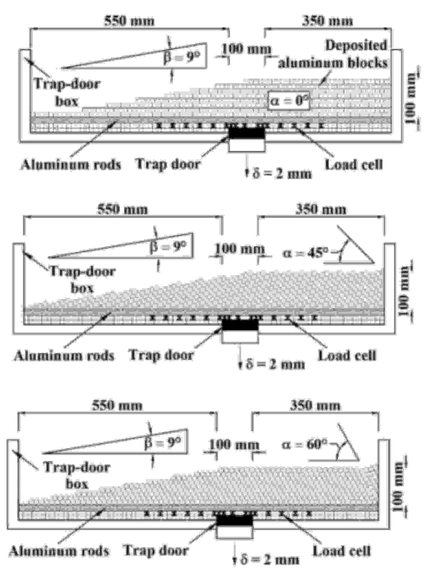

Figure 2: Single tunnel

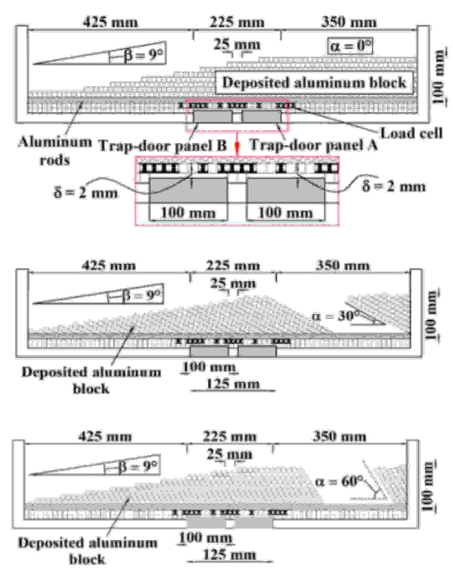

Figure 3: Twin tunnels

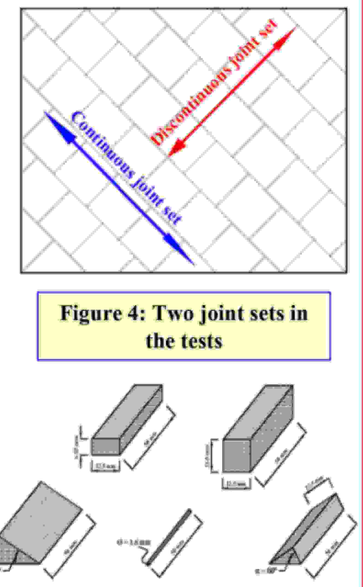

Figure 4: Two joint sets in the tests

Figure 5: Aluminum blocks

Test procedures:

- **A physical trap-door model is employed to perform the excavation process of mining structures. The aluminum blocks and aluminum rods arranged inside of the trap-door model simulate a jointed rock mass.**
- **DDA generates the simplified geometry models of the trap-door model with the same geological conditions and simulates the mining excavations.**
- **The surface subsidence profiles and the stress distributions achieved from the trap-door model and DDA are compared to prove the applicability of DDA.**
- **Real case studies with DDA simulation are analyzed.**

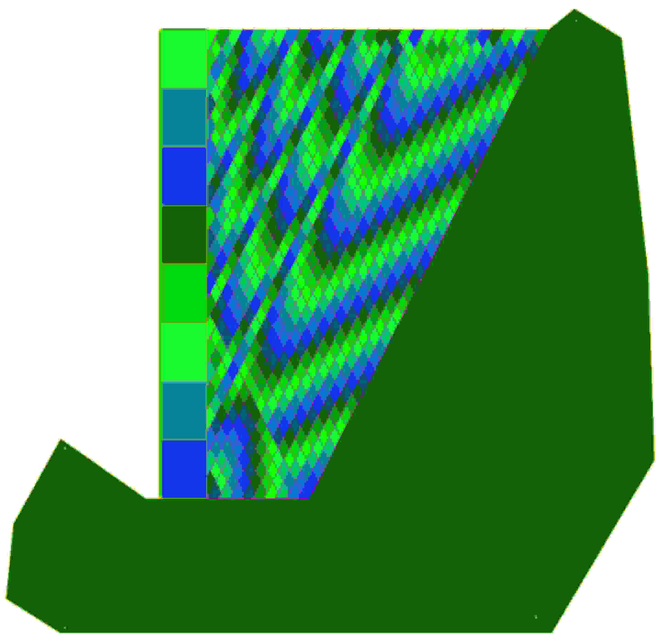

Figure 6: Rocky retaining wall with DDA

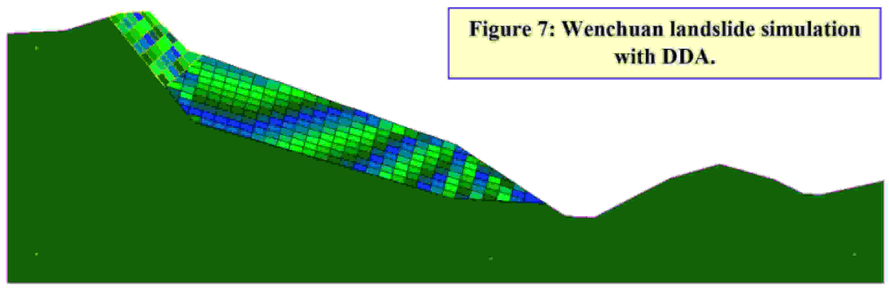

Figure 7: Wenchuan landslide simulation with DDA.

Figure 8: Mining-induced landslide at Nattai North of Australia.