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Jacking Test

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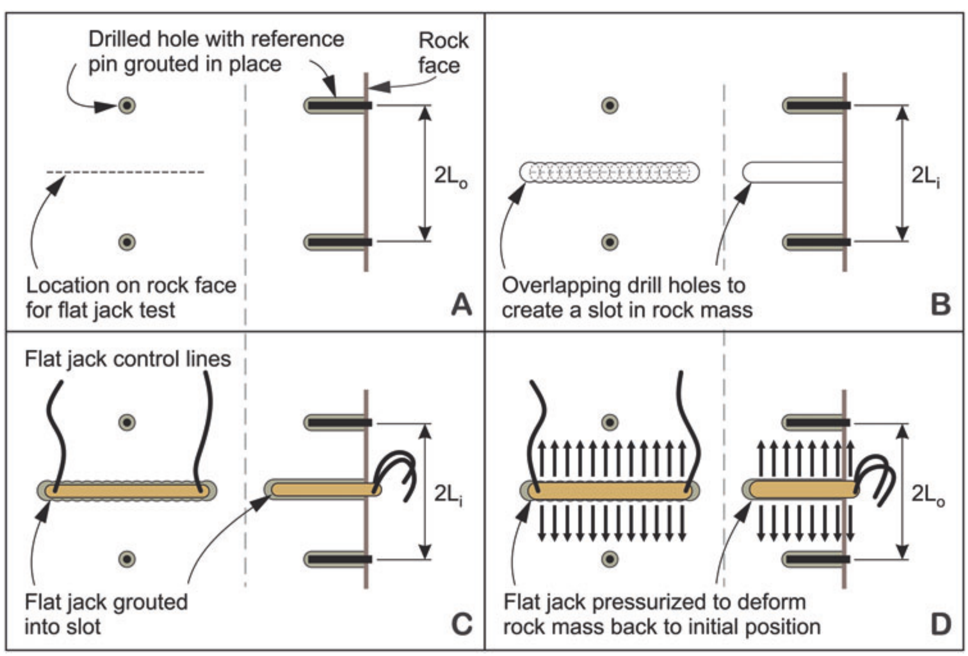
Definition

A jacking test in rock mechanics is used to apply a stress and measure the resulting rock-mass deformation.

Jacking test results are used for estimating rock mass performance and its influence on engineered works, such as concrete dams and pressure tunnels, and for estimating *in situ* stress conditions for design and construction management. If the stress-strain behavior complies with Hooke's Law, then the slope of the stress-strain relationship is the *modulus of elasticity*; however, if it does not comply, then the slope is the modulus of deformation (Goodman 1980). Four types of jacking tests are performed for rock mechanics applications: plate jacking, borehole jacking, radial jacking, and flat jacking (ASTM 2016).

Plate jacking tests use circular, steel plates, hydraulic rams, and suitable reactions, with stable frames for attaching deformation monitors, typically linear-variable-differential transformers (LVDTs). Measured values are the radius of the plate (*pr*), the *stress* applied by the plate (*ps*) (load divided by plate area), and the mean displacement of the plate (*pd*) corrected for any rotation (Kavur et al. 2015). The modulus of elasticity (*E*) may be calculated by assuming that the rock is a homogeneous infinite half-space of elastic isotropic material, and specifying a value for *Poisson's ratio* (*v*) using



Jacking Test, Fig. 1 Four steps of flat jack test. (**a**) Installing reference pins and measuring distances. (**b**) Drilling overlapping hole to create a slot and measuring the corresponding pin distances. (**c**) Installing the flat jack and fixing it in place with neat cement grout. (**d**) Pressurizing and depressurizing the flat jack while measuring corresponding pin distances

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$$pd = \frac{C\,ps(1 - v^2)pr}{E};\,E = \frac{C\,ps(1 - v2)pr}{pd} \qquad (1)$$

where C is a boundary-condition constant ($C = \pi/2 = 1.57$ for a perfectly rigid plate; $C = 1.70$ for a flexible plate).

A **borehole** jacking test uses a tool with diametrically opposed curved platens that fit into a ~ 76 mm diameter borehole. A two-ram jack presses the platens into the borehole wall, LVDT sensors record platen movement, and a gauge records pressure. A radial jacking test is similar to the borehole jacking test except it is performed inside a suitably sized tunnel, drift, or adit. Measurements are made in diametrically opposed pairs around the circumference of the excavation.

A flat jack consists of two sheets of steel welded around the perimeter, filled with oil that can be pressurized. The test consists of four steps (Fig. 1): (1) installation and measurement of one or more pairs of pins that will be on opposite sides of a slot for the flat jack; (2) drilling overlapping holes to create a slot for the flat jack; (3) installing, seating, and cementing the flat jack; and (4) monitoring the distance between measurement-pin pairs while the flat jack is pressurized and depressurized. Flat jack tests are performed in slots at different orientations to allow in situ stresses to be estimated by recording the orientations of the slots and measurement-pin pairs, and the pressure required to deform the rock to its preslot position.

Cross-References

- ▶ Deformation
- ▶ Hooke's Law
- ▶ Modulus of Deformation
- ▶ Modulus of Elasticity
- ▶ Rock Mechanics
- ▶ Strain
- ▶ Stress

References

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