ABSTRACT

The effect of scale on shear strength is studied by performing direct shear tests on different sized samples of large joints. A rubber moulding system is used to obtain impressions of the roughness from a variety of natural joint surfaces. A brittle model material is developed and used to cast several sets of identical interlocking specimens, which are in turn subdivided into sets of equidimensional joint block samples, each of the sets representing a different average block size or joint length. All sample sizes are tested in the same relative direction of shearing and under precisely the same level of normal stress. A total of eleven joints displaying a large variety of surface roughness is included in the experimental programme.

The results from those tests show that peak shear strength is a strongly scale-dependent variable. Scale effects are most pronounced in cases of rough undulating joints, whereas they are virtually absent for relatively planar joints. The key factor behind the changing behaviour and strength with increasing scale is the involvement of different sizes of asperities in controlling the peak behaviour of different lengths of joints. An important consequence is a decrease in the value of roughness coefficient (JRC) and wall strength (JCS) operating at larger scale. Use of those indices may enable realistic allowance to be made for the scale effect in peak shear strength.

The normal deformability of rock joints is investigated by conducting loading/unloading and repeated load cycling tests on a wide ranging variety of fresh and weathered joints in five different rocks. The shear deformability is studied by performing direct shear tests at different levels of normal stress in a portable shear box. Several mismatched joints are also tested under compression.

In the present work the analytical representation of the stress-deformation curves is considered in detail.

Quantitative relationships between maximum closure, aperture, wall strength and roughness are defined.