Short introduction to rock mass composition, groundwater and stresses

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The classification systems we are dealing with here are developed to help the engineers in their work for constructions in rock. Such constructions may be underground openings (tunnels, caverns, shafts) or surface excavations (cuttings, quarries etc.)

Figure 1 shows a typical section in the upper part of the earth's crust where the rock constructions are located. The various rocks are intersected by different discontinuities, such as faults, shears, joints and fissures. Besides some weak or chemically unstable rocks the discontinuities (see Figure 2) are generally the features of main importance in rock mechanics and rock engineering.

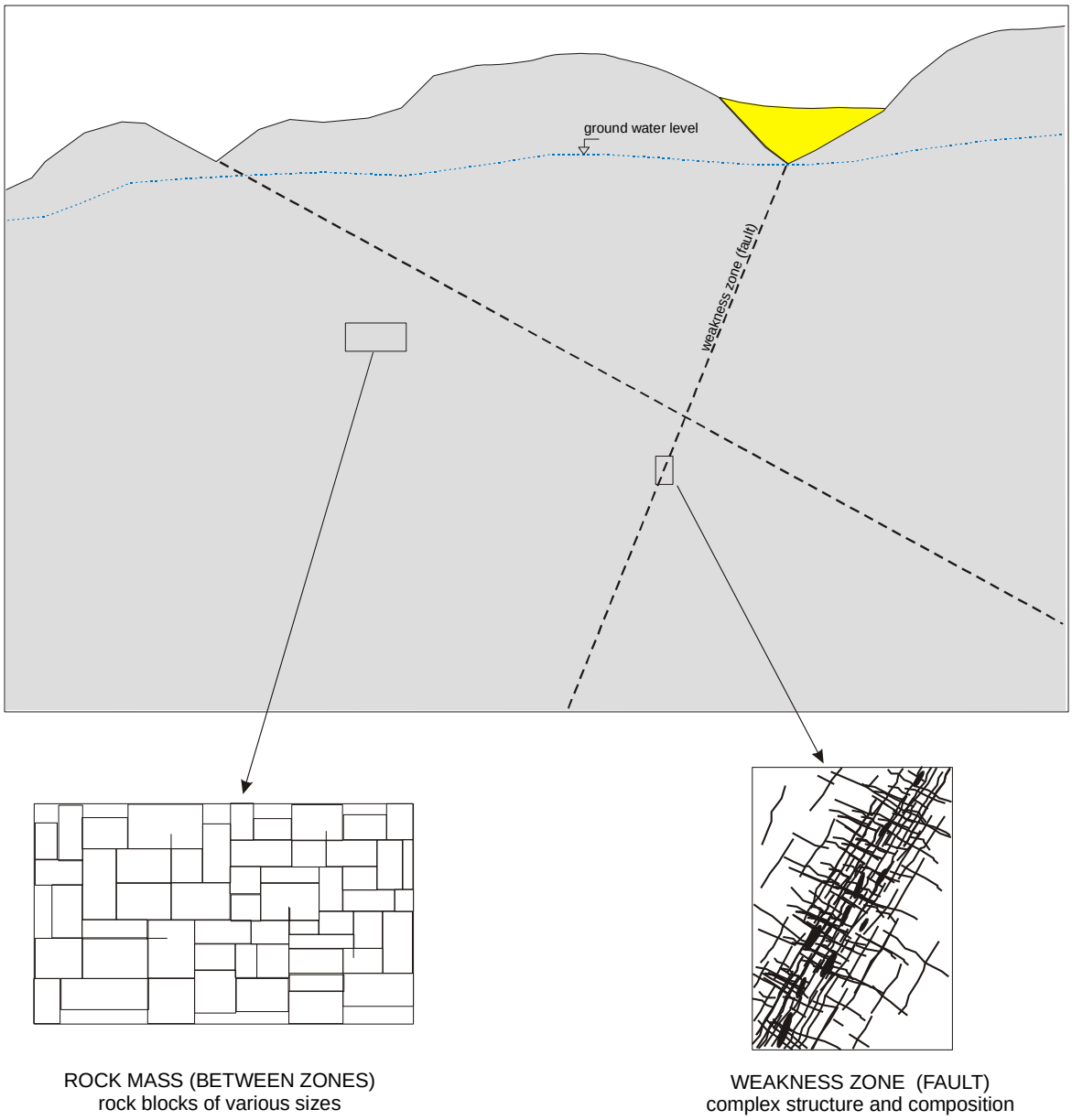

Figure 1 The two main groups of rock masses: weakness zones and rock masses between zones

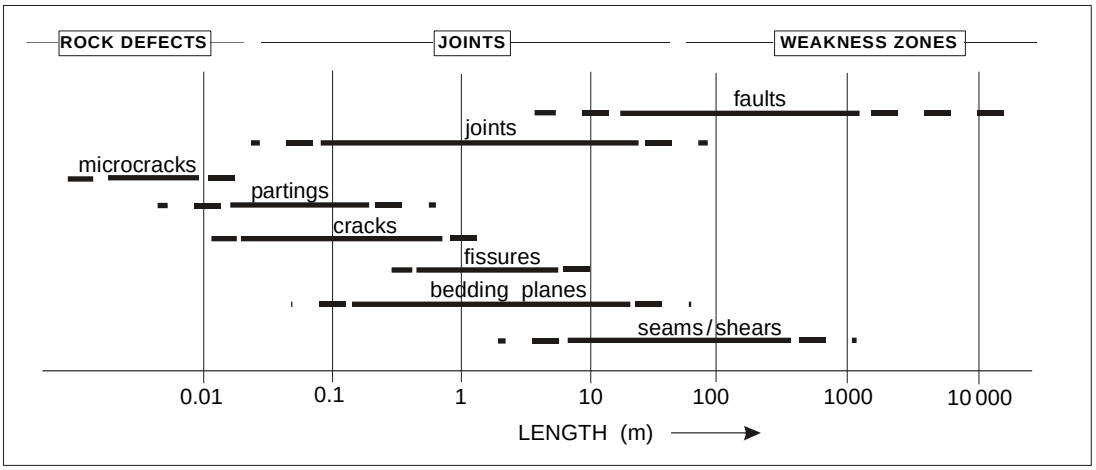

Figure 2 The sizes of main types of discontinuities defined in engineering geology

A rock mass between zones consists of rock blocks formed by joint, fissures and seams (filled joints). The distances between these types of discontinuities determine the size of the blocks. In addition to the block size their characteristics (roughness alteration, etc.) influence of the strength properties of and rock mass, as indicated on Figure 3.

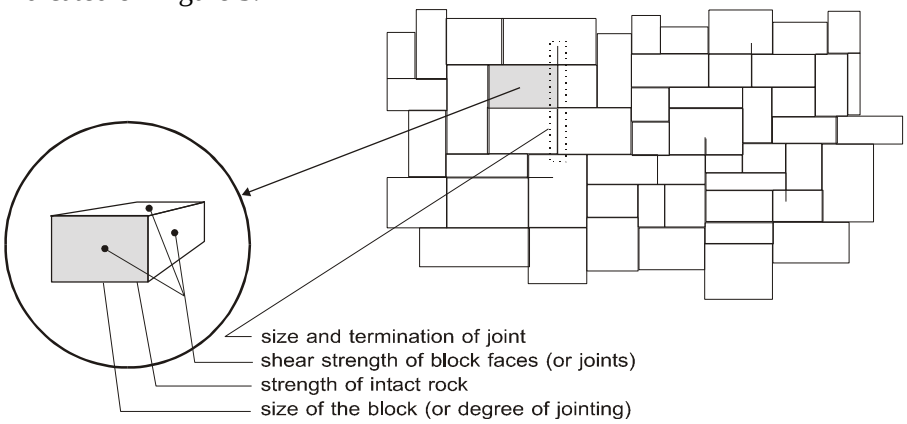

Figure 3 The main features influencing the strength properties of a rock mass between zones (from Palmström, 1995)

The blocks in a rock mass may vary within certain limits, and also the characteristics of the discontinuities may vary. For this reason the rock mass should be described by a range rather than by a certain number or value.

For composition and structure of the rock masses in a weakness zone is generally much more complicated. Therefore, the characterization or classification of these types of rock mass is often much more difficult and inaccurate.

Table 1 Main types of coating and filling materials and their properties

TYPE OF MINERAL FILLING	PROPERTIES
Chlorite, talc, graphite	Very low friction materials, in particular when wet.
Inactive clay materials	Weak, cohesion materials with low friction.
Swelling clay	Combination of very low friction and swelling with loss of strength
Calcite	May dissolve
Gypsum	May dissolve
Sandy or silty materials	Cohesionless, friction materials.
Epidote, quartz	Durable, high strength material
In addition the rock in the joint wall may be weathered	

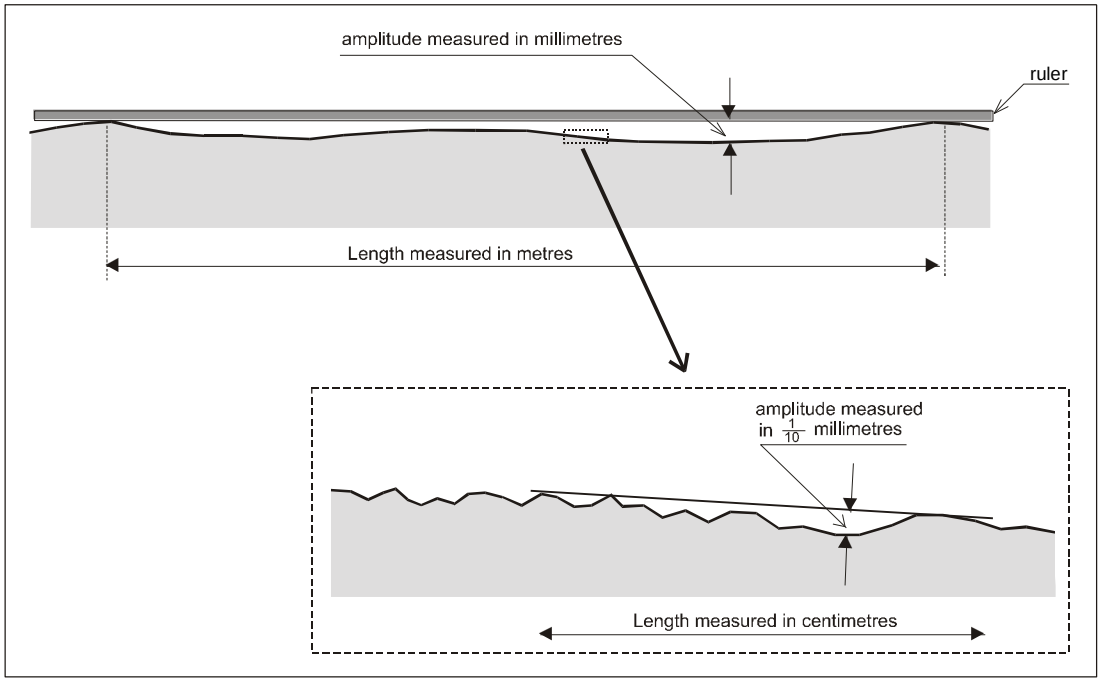

Figure 4 The roughness of joints composed of the small scale smoothness (lower figure) and large scale waviness

Rock mass is the term for the material in the crust. *Ground* is the term for a rock mass being exposed to certain external features, mainly water and stresses. This is shown in Figure 5

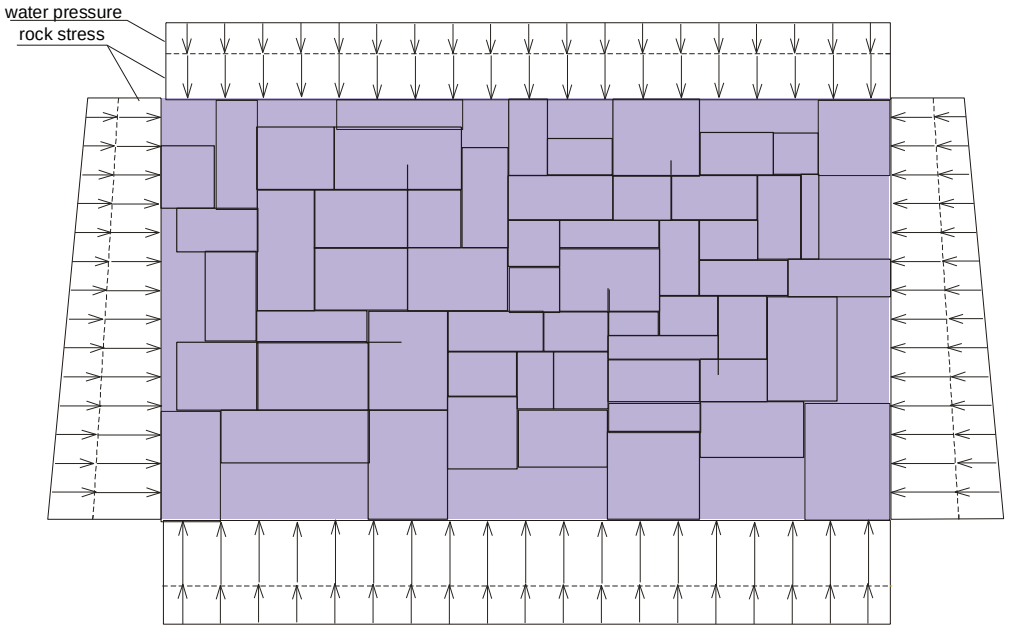

Figure 5 Ground is a rock mass exposed to water and rock stresses

The water pressure acting can often within reasonable accuracy be found, but the stresses acting may vary largely from location to location, especially the horizontal stresses. The reasons being the contribution from tectonic, residual or remanent stresses. In addition, the larger discontinuities may locally change the directions and magnitudes of the stresses.

With great variations in

- rock properties,
- block size,
- joint characteristics,
- water pressure, and in
- ground stresses,

it is obvious that the ground to be penetrated by a tunnel may show very great variations. Consequently, any attempt to form or develop a method to measure or classify the ground properties will turn out to be very difficult. Simplifications have to be made, which result in limitations. For the users of classification systems it is important to know and respect these. A lack with most classification systems today is that they do not clearly state their limitations. Another important issue is the uncertainties present in geology and sampling.