# GUEST EDITORIAL

### *Destructive criticism - constructive thoughts.*

The violent events that we have recently witnessed, as always, are due to different points of view of what is right and what is wrong. The 'right' to a certain point of view, and a destructive action, will nevertheless require a vigorous response. Let us draw some lighter-hearted parallels, closer to our profession.

Those who criticise a supposedly benign entity like RQD, can have a field day demonstrating what happens if joint spacing is a uniform 9cm in one stretch of core, and 11cm in the next. The same argument can be applied to RMR and Q. But we have a right to respond vigorously in defence of Deere's RQD, if we nevertheless believe that the 'core stick >10cm' technique, lies in a useful range for differentiating most of our rock engineering problems.

Readers of ISRM News Journal will recently have seen the opinion that joint spacing, number of joint sets and RQD do a poor job of quantifying block size. An alternative method (unlike RQD) is capable of quantifying block sizes of 1000, 10,000 or even 100,000$m^3$, as if this was the region where we needed solutions. We have a right to resist such anarchy, and defend the traditional point of view that joint spacing, and number of joint sets (already sufficient) and RQD, actually give a very good quantification of block size, especially in the area where our problems lie.

Your benign and colourful sub-continent is being violently pushed towards the north, throwing up constant challenges to hydropower developers in the lower Himalayas. The signs of a violent past are everywhere evident, but you resist these forces with admirable vigour, and accept the need for flexibility – like the bulldozer-drivers on constant stand-by, ready to use a new sector of the creeping hillside for today's road. Visitors fortunate enough to sample just a few of the problems, come away with hydrogeological lessons that last a lifetime.

A TBM that grinds to a halt in massive quartzite, that later gets buried in sand, gravel and water needing a dedicated drainage tunnel, that gets squeezed in phyllite, and finally succumbs to permanent burial in a deep, unplanned graveyard, bears witness to heroic struggles, which are sometimes only solved by admitting defeat. Comparing these realities with another of nature's wonders, the Sugar Loaf monolith in Rio de Janeiro, which has not been challenged by continental plate collisions, it is clear that we really need classification and characterization methods that stretch over many orders of magnitude. They also need to be fully coupled, to tackle the huge ranges of properties exhibited by present-day hydrogeologies – following millions of years of geometric turmoil, and too many millennia in the rain and sun.

There is a controversy in our profession today that is highly relevant to this discussion, as it directly challenges established beliefs that water and stress affect the properties that we measure. A recent suggestion that water and stress should be left out of rock mass characterization, and included later, after the 'properties' have been determined by the rock, joints and discontinuities, is a violation of common sense, for reasons that we should consider carefully.

The fluid pressures required, or the strains recorded, when we measure stress in porous rock, are two examples of coupled behaviour. Another is the back-calculation of deformation modulus, either under an instrumented plate loading test, or from radius-dependent strains caused by excavation. A third is the estimate or calculation of seismic velocities from travel times. The total stress minus the joint water pressure is fundamental to the stress, velocity and deformation modulus obtained from each of these measurements.

As mentioned elsewhere, we do not expect Moho velocities of 8 km/s to be 'corrected' for stress, fluid pressure, mineral density or percentage of melt, and presented as 4 km/s – so as to 'correlate' with a 'recommended' characterization of the unstressed, cool, dry, sub-crustal material. We have to include any important coupled properties in the characterization, and accept 8 km/s as the actual value – at 40 km depth. Even in the uppermost 100m of the solid crust, we can experience up to several km/s increase in Vp in an equally jointed rock mass, due to effective stress increases. Since total rock stress *and* water pressure *and* the state of clay-fillings may each be involved, why should we avoid considering them in the preliminary characterization?

To be successful, characterization methods must, by one means or another, correlate with these effective stress effects, which are fundamental in seismic velocity and in deformation modulus, and in deciding on the correct description (and rating) for a clay-filled discontinuity. Careful plate load tests, conducted relatively near the surface and at moderate stress levels, cannot give good estimates of deformation modulus for use in modelling of significantly greater depths. Furthermore, they will usually not have sampled sufficient of the important joint sets that may affect the underground excavations or dam abutments.

Distinct element models help to supplement the relatively limited scale of plate load tests with joint response, to give an approximation of the 'REV' response of the rock mass. Together with higher moduli at depth, and greater joint stiffness, these jointed models may be capable of coming closer to reality. If excavation is simulated, this reality may include a self-generated excavation disturbed zone, in which a *numerically modelled* load test would register lower modulus, as in practice. A numerical sampling of travel time for seismic velocity would also register a zone of lower velocity in the EDZ, and perhaps also a higher value in the highly stressed outer region. All these effects have been measured in practice. We should therefore insist that they are considered, when modelling is planned.

Returning to the hydrogeologic diversity that is our workplace, we should always remember that there are some fundamental differences in the format of RSR, RMR, Q and RMi, to list just four rock mass classification systems – at least two of which are used to characterize, and estimate conditions away from excavations. When calling for 'the removal of stress and water' in characterization, there will be different consequences for each system, and perhaps a break-down of the intended method. If the 'truncationists' would respect this fact, then the 'inclusionists' could continue to work in peace. A recent discovery that Q can be expressed in MPa, being the product of two fundamental components of rock mass strength, can be used to emphasise the need for defending a functioning point of view.

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