2018 'Letter' to Research Gate: Response to authors who suggested RQD could 'rest in peace'

By Nick Ryland Barton

The respected developers of RMR (Dr. Dick Bieniawski) and RQD (Dr. Don Deere) passed away on either side of the 2017/2018 New Year. They will be remembered both with thanks and initial sadness. There is no doubt that rock mechanics and rock engineering users of their methods form only a very small portion of the 14 million users of Research Gate with its remarkable 100,000,000 research items. Nevertheless, perhaps most of our millions of colleagues will also have driven through a tunnel or drunk water from a reservoir where one of these rock mass classification methods were used in the drill-core related investigations for the subterraneous constructions, in infinitely diverse rock masses, in our numerous countries. So, the respected professors' passing, and their heritage is important to mark, also in 'the pages' of RG. RQD in particular has had enormous application in civil engineering.

As in all scientific and engineering fields there is competition and there are strong opinions. This is how each subject develops. Better arguments may be needed, or better methods eventually replace the old. Related exactly to these opinions it has recently been suggested by a small hand-full of co-authors that RQD, which was developed in 1964, should be replaced, or should rest in peace. This is an opinion that is hardly likely to be shared by many of the tens of thousands of engineering geologists who have used this method and will no doubt be using it in the future as well. Fifty years is a respectable track record in any field. But RQD must be used as intended, excluding incompetent unsound rock (record as RQD = 0, or the nominal minimum of 10 in the Q-value calculation). The value of RQD must also be acknowledged as an anisotropic measure of rock masses. The > 10cm centre-line-measured core stick records represent a surprisingly useful method, even though the 9cm and 11cm core sticks in shales can occasionally cause headaches. Likewise, the differentiation of drilling-induced and natural features in the core.

Permit me to add a small paragraph in support of RQD, which is a 50 years-old parameter that has been used for forty years in RMR and in the undersigned's Q-system, developed respectively in 1973 and 1974. Firstly, it was one of Don Deere's own Ph.D. students (Cecil, 1970) who came up with the important but simple idea of including the recording of the number of joint sets. His field work was focussed on tunnelling and cavern projects in Norway and Sweden. The development of the Q-system benefitted directly on Cecil's (and Deere's) work, and further parameters were appended, like joint roughness Jr, and a stress/strength term. Some partly similar parameters were appended to ratings for RQD by Bieniawski in his development of RMR.

Some few years ago when evaluating the work of 12 to 15 engineering geologists at a planned mine, the results of 340 *kilometers* of core logging were available, both as RQD, RMR and Q. So now comes the lesson in support of RQD. In comparison to the argument that RQD does a poor job to describe rock masses for dimension stone, where 1,000m3 or larger intact blocks of rock mass are desirable, we found that the 'from left-to-centre-to-right side' trending histograms of RQD, with tens of thousands of data points, formed a perfectly symmetric bell-shaped curve (centred on RQD = 50%) when we moved from low (0.01-0.1) to high (100-400) Q-value classes. Where was the bell-shaped curve? It was exactly as Deere had intended. It described our typical problem area for tunnelling and

foundations. The relevant Q-class was 1 to 4 (i.e. ‘poor’). So now to the question. Do we really want to stop using RQD? Let us at least thank Deere and Bieniawski for their contributions.