Rock Mass Classification and Support Design using the Q-System – A.K. Naithani, National Institute of Rock Mechanics, Bengaluru – 560 070 (*E: anaithania@gmail.com*)

The Q-system was developed at NGI between 1971 and 1974 on the basis of approximately 200 case histories of tunnels and caverns (Barton et al. 1974). They presented a useful correlation between the amount and type of permanent support and the Q with respect to tunnel stability. There has been a significant advance within support philosophy and technology in underground excavations since the introduction of the Q-system in 1974. After its introduction in 1974, two revisions of the support chart have been carried out. On the basis of 1050 examples mainly from Norwegian underground excavations an extensive updating was done in 1993 (Grimstad and Barton, 1993). Based on more than 900 new examples from underground excavations in Norway, Switzerland and India, an updating was made in 2002. This update also included analytical research with respect to the thickness, spacing and reinforcement of reinforced ribs of sprayed concrete (RRS) as a function of the load and the mass quality (Grimstad et al. 2002).

The Q-value gives a description of the rock mass stability of an underground opening in jointed rock masses. High Q-values indicates good stability and low values means poor stability. The numerical value of the index Q varies on a logarithmic scale from 0.001 to a maximum of 1,000 and is defined by six parameters (eq. 1). Q-value 0.001 is generally for exceptionally poor quality squeezing ground, while 1,000 is for exceptionally good quality rock which is practically unjointed (Barton et al. 1974).

$$Q = \frac{RQD}{J_n} \times \frac{J_r}{J_a} \times \frac{J_w}{SRF} \quad (1)$$

Where RQD is Rock Quality Designation (degree of jointing), J_n is Number of joint sets, J_r is Joint roughness number, J_a is Joint alteration number, J_w is Joint water reduction factor and SRF is Stress Reduction Factor

Q-value and the six appurtenant parameter values give a description of the rock mass. Tunnel Quality Index can be used for the recommendation of support design of tunnels and large underground caverns. To evaluate the efficacy of the proposed support system, the capacity of support system can also be determined. Author was associated for the construction of underground rock cavern complex for strategic storage of crude oil at Visakhapatnam (1.33 MMT capacity), Padur (2.50 MMT capacity) & Mangalore (1.5 MMT capacity), twin tunnels on the Hungund–Hospet Section of NH-13, Mahatma Gandhi Kalwakurthi lift irrigation scheme (MGKLIS) and Kaleshwaram-DBRAPCSS Link-II lift irrigation scheme (KLIS) where this system was used. Presently author is applying this system for the construction of Palamuru Ranga Reddy lift irrigation scheme (PRLIS) and Godavari lift irrigation scheme (PRLIS) are being constructed in the Telangana State.

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