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Improvement of the Q-System Using the Rock Engineering System: A Case Study of Water Conveyor Tunnel of Azad Dam

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Abstract : Because the status and mechanical parameters of discontinuities in the rock mass are included in the calculations, various methods of rock engineering classification are often used as a starting point for the design of different types of structures. The Q-system is one of the most frequently used methods for stability analysis and determination of support systems of underground structures in rock, including tunnel. In this method, six main parameters of the rock mass, namely, the rock quality designation (RQD), joint set number (Jn), joint roughness number (Jr), joint alteration number (Ja), joint water parameter (Jw) and stress reduction factor (SRF) are required. In this regard, in order to achieve a reasonable and optimal design, identifying the effective parameters for the stability of the mentioned structures is one of the most important goals and the most necessary actions in rock engineering. Therefore, it is necessary to study the relationships between the parameters of a system and how they interact with each other and, ultimately, the whole system. In this research, it has attempted to determine the most effective parameters (key parameters) from the six parameters of rock mass in the Q-system using the rock engineering system (RES) method to improve the relationships between the parameters in the calculation of the Q value. The RES system is, in fact, a method by which one can determine the degree of cause and effect of a system's parameters by making an interaction matrix. In this research, the geomechanical data collected from the water conveyor tunnel of Azad Dam were used to make the interaction matrix of the Q-system. For this purpose, instead of using the conventional methods that are always accompanied by defects such as uncertainty, the Q-system interaction matrix is coded using a technique that is actually a statistical analysis of the data and determining the correlation coefficient between them. So, the effect of each parameter on the system is evaluated with greater certainty. The results of this study show that the formed interaction matrix provides a reasonable estimate of the effective parameters in the Q-system. Among the six parameters of the Q-system, the SRF and Jr parameters have the maximum and minimum impact on the system, respectively, and also the RQD and Jw parameters have the maximum and minimum impact on the system, respectively. Therefore, by developing this method, we can obtain a more accurate relation to the rock mass classification by weighting the required parameters in the Q-system.

Keywords : Q-system, rock engineering system, statistical analysis, rock mass, tunnel
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