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Empirical estimation of the uniaxial compressive strength from the point load test on anisotropic rocks (schists and shales)

Danny Burbano, Martín Jesús Rodríguez-Peces, and Juan Miguel Insua-Arévalo

Department of Geodynamics, Stratigraphy and Paleontology. Faculty of Geological Sciences. University Complutense of Madrid, Spain (martinjr@ucm.es)

The International Society of Rock Mechanics indicates that there is a direct linear relationship between the uniaxial compressive strength (UCS) and the point load index Is(50), which varies between 20 and 25. The results of these estimates are relatively acceptable in isotropic rocks or with very low degree of anisotropy. However, there are many works that have obtained a wider range of this RCS/Is(50) ratio, between 8 and 50, in tests with different types of rocks, mainly in rocks with moderate and high anisotropy. Therefore, the use of a single conversion factor for different types of rocks could provide wrong results. On the other hand, the potential of the point load test has not yet been fully assessed for anisotropic rocks.

In this paper, new empirical relationships are developed between uniaxial compressive strength and point load index Is(50) in anisotropic rocks, particularly in schists and shales. We have used data from 2015 point load tests and 229 uniaxial compressive strength tests performed in anisotropic rocks obtained during various stages of study of Paute-Cardenillo hydroelectric project, located in the eastern slopes of the northern Andes Cordillera (SE Ecuador). We have defined five anisotropic rocks types among the studied schists and shales: 1) Quartz-chlorite schist (Xqz-cl), 2) Micaceous-chlorite schist (Xm-cl), 3) Quartz-micaceous schist (Xqz-m), 4) Micaceous-graphitic shale (Pm-graf) and 5) Quartz-graphitic shale (Pqz-graf). For each one, the mean values of uniaxial compressive strength and point load index were obtained according to their orientation with respect to the planes of anisotropy, so that the majority of angles were covered between β = 0º to β = 90º.

It is found that there is no direct relationship between uniaxial compressive strength and Is(50), hence it is unreliable take traditional empirical linear regression models, which do not consider the effect of the planes of anisotropy in rock strength. In order to consider such a determining effect, three new empirical relationships that estimate the uniaxial compressive strength from Is(50) in anisotropic rocks are proposed.