ABSTRACT

Efficacies of different rock indices (point load strength, block punch index, Schmidt rebound hardness, ultrasonic P-wave velocity, effective porosity and dry density) in predicting uniaxial compressive strength (UCS) of granite, schist and sandstone from three different locations of India were evaluated. The block punch test requiring smallest disc specimen size proved to be efficient enough in estimating UCS and Brazilian tensile strength (BTS) of the concerned rocks. It is concluded that while framing a correlation between UCS and an index, data obtained from different rock types with different geology should not be clubbed together for any statistical correlation.

Multiple regression (MR) and fuzzy inference system (FIS) exhibited better predictive performances for UCS than simple regression. Statistically, both MR and FIS models were found to be comparable. However, one should be cautious while employing MR in predicting UCS as there is always a chance of cumulating plausible errors that might have remained within individual index test results. On the other hand, FIS seems to be an efficient tool in this regard because of its efficiency in handling uncertainties in the test results with transparency.

Rock failure modes at laboratory scale in relation to UCS values were investigated. The nature of the principal failure mode changes from axial splitting to shearing along single plane to multiple fracturing in case of both granite and sandstone specimens as UCS increases. In case of schist, specimens failed at low UCS depict failure along foliations whereas specimens which do not fail along foliations portray high strength. The relation between failure modes of all three rocks under uniaxial compression and corresponding UCS values was broadly explained in terms of damage evolution of the rocks. Failure modes of the specimens under Brazilian and point load tests with reference to corresponding strengths were also analyzed.

Most of the microstructural parameters quantified in this study did not show any perceptible correlation with UCS and BTS. With due need, the notion of quantifying one or a few of such parameters and proposing some of them individually or together in a unified function as indices to estimate rock strength empirically was evaluated.

Keywords: *Rock material (granite, schist & sandstone); Rock strength (UCS & BTS); Index tests; Microstructural analysis; Regression analyses; Fuzzy inference system; Rock failure modes.*