Correlation between petrographic characteristics and physico-mechanical properties of granitic rocks from the Utla area, Gadoon (Swabi), NW Pakistan

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Granitic rocks are widely used as dimension stone and construction material. However, the suitability of rocks for use in construction depends on their mechanical properties. The latter are in turn generally controlled by the petrographic characteristics including grain size, shape of grains, fabric (arrangement of mineral grains and degree of interlocking), type of contacts, mineralogical composition and the degree of weathering. The intrinsic properties of rocks, including mineralogy and texture, can be used to assess the engineering properties of stones.

A vast body of extensively exposed and readily accessible granitoids occurs around the Utla area of Gadoon, northwestern Pakistan. Samples representing different textural varieties of granitic rocks were collected. These rocks are petrographically divided into a) massive coarse grained (CG), b) fine grained (FG) and c) foliated coarse grained granites (CGF). Following a detailed petrographic examination, physico-mechanical properties including unconfined compressive strength, unconfined tensile strength, water absorption, specific gravity and porosity of the collected samples were determined. The average uniaxial compressive strength of all the three types of samples (CG = 45.98MPa, FG = 42.44MPa and CGF = 32.11MPa) falls in the range of those rocks which are designated as moderately strong. The measured porosity and water absorption capacities of both the massive and foliated varieties of the coarse grained granite are also within the range of values permissible for use as construction material.

The petrographic features and physico-mechanical properties are statistically analyzed to see a possible relationship between them. Among the three, the massive coarse grained variety yields the highest strength values most probably because of (i) greater variation in its grain size, (ii) lower abundance and non-alignment of micaceous minerals, and (iii) lower values of water absorption and porosity. These results reveal that a multitude of petrographic features including grain size, grain shape, grain size distribution, modal mineralogy and preferred orientation of grains collectively govern the physico-mechanical behavior of the studied rocks.