Geophysical Research Abstracts
Vol. 12, EGU2010-5899, 2010
EGU General Assembly 2010

Determination of Uniaxial Compressive Strength of Ankara Agglomerate Considering Fractal Geometry of Blocks

Aycan Coskun (1), Harun Sonmez (2), K. Ercin Kasapoglu (3), S. Ozge Dinc (4), and M. Celal Tunusluoglu (5)

(1) Hacettepe University, Geological Engineering, Ankara, Turkey (aycancoskun@hacettepe.edu.tr), (2) Hacettepe University, Geological Engineering, Ankara, Turkey (haruns@hacettepe.edu.tr), (3) Hacettepe University, Geological Engineering, Ankara, Turkey (ercin@hacettepe.edu.tr), (4) Canakkale OnSekiz Mart University, Department of Geological Engineering, Applied Geology Division, Çanakkale, Turkey , (5) Canakkale OnSekiz Mart University, Department of Geological Engineering, Applied Geology Division, Çanakkale, Turkey (ctunus@comu.edu.tr)

The uniaxial compressive strength (UCS) of rock material is a crucial parameter to be used for design stages of slopes, tunnels and foundations to be constructed in/on geological medium. However, preparation of high quality cores from geological mixtures or fragmented rocks such as melanges, fault rocks, coarse pyroclastic rocks, breccias and sheared serpentinites is often extremely difficult. According to the studies performed in literature, this type of geological materials may be grouped as welded and unwelded birmocks. Success of preparation of core samples from welded bimrocks is slightly better than unwelded ones. Therefore, some studies performed on the welded bimrocks to understand the mechanical behavior of geological mixture materials composed of stronger and weaker components (Gokceoglu, 2002; Sonmez et al., 2004; Sonmez et al., 2006; Kahraman, et al., 2008). The overall strength of bimrocks are generally depends on strength contrast between blocks and matrix; types and strength of matrix; type, size, strength, shape and orientation of blocks and volumetric block proportion. In previously proposed prediction models, while UCS of unwelded bimrocks may be determined by decreasing the UCS of matrix considering the volumetric block proportion, the welded ones can be predicted by considering both UCS of matrix and blocks together (Lindquist, 1994; Lindquist and Goodman, 1994; Sonmez et al., 2006 and Sonmez et al., 2009). However, there is a few attempts were performed about the effect of blocks shape and orientation on the strength of bimrock (Linqduist, 1994 and Kahraman, et al., 2008). In this study, Ankara agglomerate, which is composed of andesite blocks and surrounded weak tuff matrix, was selected as study material. Image analyses were performed on bottom, top and side faces of cores to identify volumetric block portions. In addition to the image analyses, andesite blocks on bottom, top and side faces were digitized for determination of fractal dimensions. To determine fractal dimensions of more than hundred andesite blocks in cores, a computer program namely FRACRUN were developed. Fractal geometry has been used as practical and popular tool to define particularly irregular shaped bodies in literature since the theory of fractal was developed by Mandelbrot (1967) (Hyslip and Vallejo, 1997; Kruhl and Nega, 1996; Bagde etal., 2002; Gulbin and Evangulova, 2003; Pardini, 2003; Kolay and Kayabali, 2006; Hamdi, 2008; Zorlu, 2009 and Sezer, 2009). Although there are some methods to determine fractal dimensions, square grid-cell count method for 2D and segment count method for 1D were followed in the algorithm of FRACRUN. FRACRUN has capable of determine fractal dimensions of many closed polygons on a single surface. In the study, a database composed of uniaxial compressive strength, volumetric block proportion, fractal dimensions and number of blocks for each core was established. Finally, prediction models were developed by regression analyses and compared with the empirical equations proposed by Sonmez et al. (2006).

Acknowledgement

This study is a product of ongoing project supported by TUBITAK (The Scientific and Technological Research Council of Turkey - Project No: 108Y002).

References

Bagde, M.N., Raina, A.K., Chakraborty, A.K., Jethwa, J.L., 2002. Rock mass characterization by fractal dimension. Engineering Geology 63, 141–155.

Gokceoglu, C., 2002. A fuzzy triangular chart to predict the uniaxial compressive strength of the Ankara agglomerates from their petrographic composition. Engineering Geology, 66 (1-2), 39-51.

Gulbin, Y.L., Evangulova, E.B., 2003. Morphometry of quartz aggregates in granites: fractal images referring to nucleation and growth processes. Mathematical Geology 35 (7), 819–833

Hamdi, E., 2008. A fractal description of simulated 3D discontinuity networks. Rock Mechanics and Rock Engineering 41, 587–599.

Hyslip, J.P., Vallejo, L.E., 1997. Fractals analysis of the roughness and size distribution of granular materials. Engineering Geology 48, 231–244.

Kahraman, S., Alber, M., Fener, M. and Gunaydin, O. 2008. Evaluating the geomechanical properties of Misis fault breccia (Turkey). Int. J. Rock Mech. Min. Sci, 45, (8), 1469-1479.

Kolay, E., Kayabali, K., 2006. Investigation of the effect of aggregate shape and surface roughness on the slake durability index using the fractal dimension approach. Engineering Geology 86, 271–294.

Kruhl, J.H., Nega, M., 1996. The fractal shape of sutured quartz grain boundaries: application as a geothermometer. Geologische Rundschau 85, 38–43.

Lindquist E.S. 1994. The strength, deformation properties of melange. PhD thesis, University of California, Berkeley, 1994. 264p.

Lindquist E.S. and Goodman R.E. 1994. The strength and deformation properties of the physical model m!elange. In: Nelson PP, Laubach SE, editors. Proceedings of the First North American Rock Mechanics Conference (NARMS), Austin, Texas. Rotterdam: AA Balkema; 1994.

Pardini, G., 2003. Fractal scaling of surface roughness in artificially weathered smectite rich soil regoliths. Geoderma 117, 157–167.

Sezer E., 2009. A computer program for fractal dimension (FRACEK) with application on type of mass movement characterization. Computers and Geosciences (doi:10.1016/j.cageo.2009.04.006).

Sonmez H, Tuncay E, and Gokceoglu C., 2004. Models to predict the uniaxial compressive strength and the modulus of elasticity for Ankara Agglomerate. Int. J. Rock Mech. Min. Sci., 41 (5), 717-729.

Sonmez, H., Gokceoglu, C., Medley, E.W., Tuncay, E., and Nefeslioglu, H.A., 2006. Estimating the uniaxial compressive strength of a volcanic bimrock. Int. J. Rock Mech. Min. Sci., 43 (4), 554-561.

Zorlu K., 2008. Description of the weathering states of building stones by fractal geometry and fuzzy inference system in the Olba ancient city (Southern Turkey). Engineering Geology 101 (2008) 124–133.