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 (Gökcęoğlu, 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 (Lindquist, 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 et al., 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


