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Predicting uniaxial compressive strength and deformation modulus of volcanic bimrock considering engineering dimension

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1. Introduction

Reliable design parameters for geological masses are necessary for successful engineering designs such as tunnels, dams, highways and deep slopes. As is well known, uniaxial compressive strength (*UCS*) and elastic modulus (*E*) of rock material are two fundamental inputs commonly used as an upscale parameter for prediction of strength and deformation properties of the geological masses.

Geological mixtures composed of rock blocks surrounded by weak matrix material are defined as Block-In-Matrix-Rock (bimrock). Bimrocks are highly problematic geological masses for construction of engineering applications on/in bimrocks due to its complex engineering behavior similar with the jointed rock masses.[1–8] Therefore, bimrocks have been popular geological masses for the studies on characterization and predicting of the mechanical behaviors for the last 25 years.[9–14] In some recent studies, bimrocks are mainly classified under two subclasses by considering the bound strength between matrix and rock blocks as welded and unwelded bimrocks.[15,16]

Preparation of representative cores particularly from unwelded bimrocks is extraordinarily difficult task due to higher strength contrast between weak matrix and stronger blocks. Therefore empirical models have been studied for the last twenty-five years on bimrocks considering the volumetric block proportion (VBP) as crucial input parameters for almost every empirical model.[9,11,12,14] However, none of these empirical approaches includes block count (B_c) in engineering dimension.

The boundary strength between block and matrix can be considered the weakest component in terms of strength. When the number of blocks in engineering volume increase it can be stated that the areal amount (specific surface) of the weakest component in engineering volume also increases. The number of blocks in engineering dimension may be different depending on the block size even if volumetric block proportions are the same (Fig. 1). Of course volumetric block proportion (*VBP*) is a crucial parameter for predicting of strength and deformation properties of bimrocks. However, VBP has no capability of defining the amount of weakest component itself. Ankara agglomerate as a kind of volcanic welded bimrock was selected as the study rock material for understanding the effect of block count (B_c) in engineering volume on mechanical behavior of bimrocks. Agglomerate can be evaluated as a kind of bimrock, which is composed of andesite fragments surrounded by weak tuff matrix (Fig. 1).

As given in Fig. 2, while almost impossible to obtain undisturbed core samples from particularly unwelded bimrocks, it was slightly possible to obtain limited number of core samples from welded bimrocks due by spending extraordinarily efforts such as drilling operation at site. Overall uniaxial compressive strength of unwelded bimrocks generally decrease when volumetric block proportion (VBP) of bimrocks increases. On the other hand for welded bimrocks, overall uniaxial strength generally

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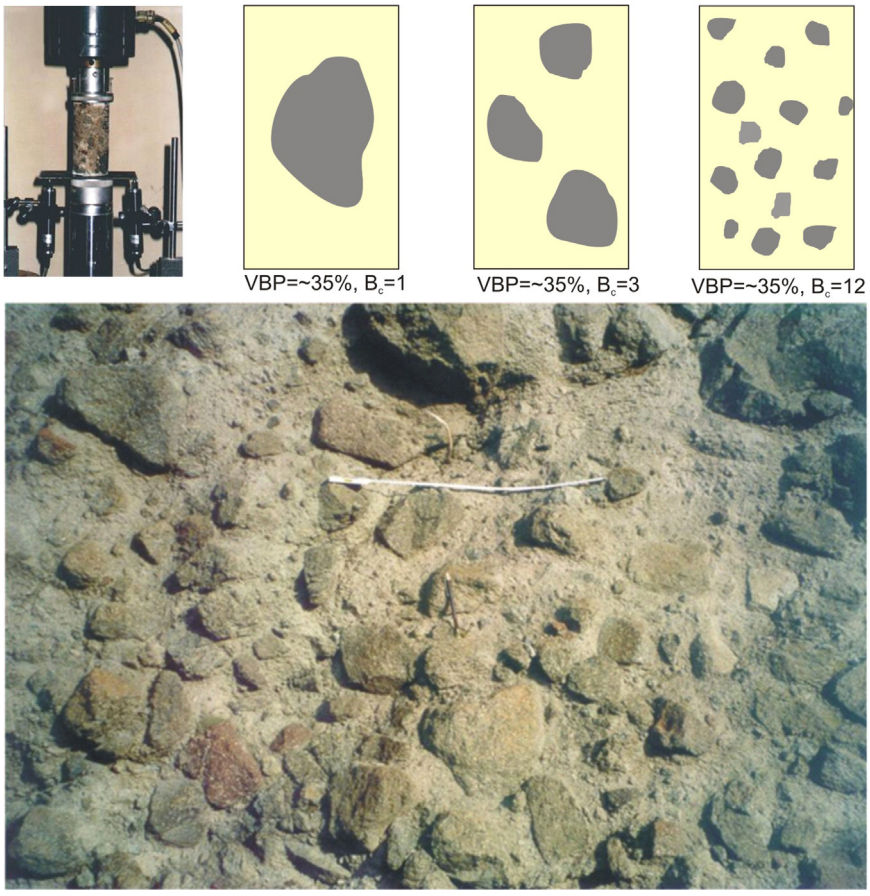

Fig. 1. Schematically illustration for the change in number of block counts (B_c) even if VBPs are the same, and a view of Ankara agglomerate outcrop and a core obtained from Ankara agglomerate [12].

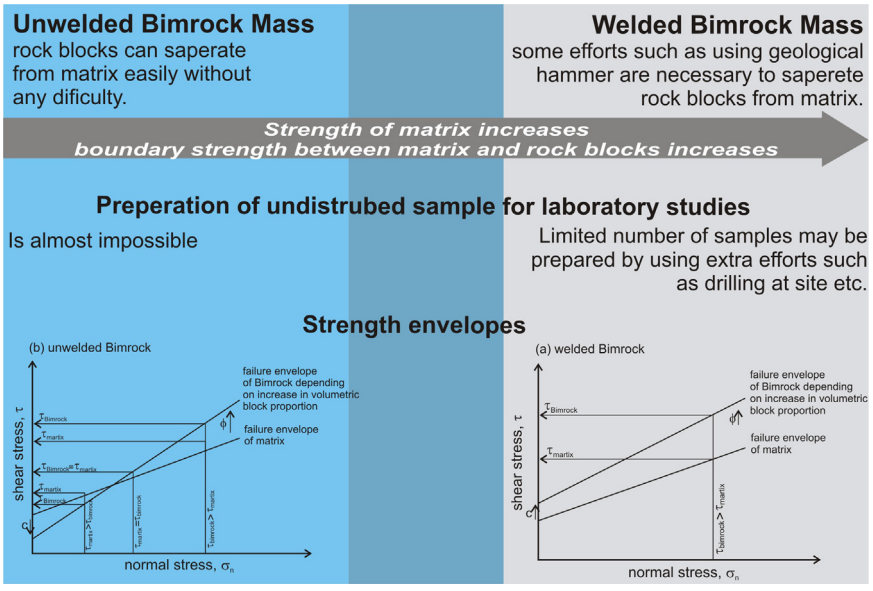

Fig. 2. Schematical explanations for the mechanical behaviors of welded and unwelded Bimrocks.

increases when VBP increases (Fig. 2). The established database obtained by laboratory studies employed on agglomerate cores taken by drilling studies at site during a research project was used for the study.

In this study, the importance of block count (B_c) on mechanical parameters of welded bimrock mass was investigated. In addition to statistical tools such as simple and multiple regression equations, Artificial Neural Network (ANN) which is commonly considered as one of soft computing techniques in rock mechanics, was also used as an alternative prediction tool to generate prediction models for *UCS* and *E* of Ankara agglomerate considering engineering dimension.