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Estimation of the REV size of fractured rock masses based on blockiness

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The representative elementary volume (REV) is the premise of the continuous-media method of analysis, and the investigation of the REVs of fractured rock masses is a fundamental area of rock mechanics research. The existence of an REV can be determined based on a variety of physical parameters. This paper presents an analysis of the REV in terms of the blockiness, which is defined as the percentage of the volume of isolated blocks formed by fractures in the total rock volume. Seventy-seven types of fractured rock mass models were developed based on 7 classes of fracture persistence and 11 classes of spacing that are suggested by the International Society for Rock Mechanics (ISRM) fracture classification. Rock blocks in each of the 77 types of fractured rock mass models were identified using GeneralBlock to determine the variation in blockiness with model domain sizes, which were changed from 2 to 20 times the fracture spacing. For each model domain size 9 random realizations were carried out to reduce the effects of randomness. The coefficient of variation (Cv) was then used to quantify the variability of the 9 random realizations. The fluctuation in blockiness with the variation in the scale of the model region was also investigated. In this way, the size of the REV in these models can be calculated using the average and the variance of the blockiness as indicators of the convergence. The blockiness of these fractured rock masses can be determined at the REV volume. The results indicate that of the 77 models, 76 REV sizes are between 2 and 20 times the fracture spacing. The fractured rock mass with a wide fracture spacing and very high persistence (WS2-VHP) has a REV size that exceeds 20 times the fracture spacing. Thus, the WS2-VHP model should be investigated further to validate this concept.