Development of a 3D Model of Open-Graded Friction Course to Evaluate the Inter-Connected Air Void with Aggregate Gradation

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Abstract

Open-Graded Friction Course (OGFC) is an asphalt material which has many advantages such as resistance to hydroplaning, low level of splash and spray, less headlight glare, improved visibility, a lesser number of accidents, reduced noise, and higher surface friction. OGFC is an advanced asphalt material which cannot thoroughly be understood by the results of traditional tests available. Though, OGFC consists of mastic, aggregate and air voids similar to hot mix asphalt, the porous structure of OGFC consists of a highly complicated interconnected void network. The number of voids and the void area of OGFC directly affects the durability and the permeability of the mixture. Therefore, it is necessary to increase the ratio of the area of interconnected voids to the area of total voids, in order to enhance the permeability of the OGFC mixture. A digital image analysis method has been introduced in this research in order to obtain different interconnected void structures for different gradations. This method consists of the identification of different properties such as number of void nodes, number of interconnected voids, areas of interconnected voids, reduction of interconnectivity with the depth, etc. An algorithm in "MATLAB" was developed to identify the properties of the cross-sectional images obtained by the captured surfaces of the cut specimens of OGFC. The obtained cross-sectional data of aggregates, voids and mastic was used to create the plotting data of the 3D model using the algorithm developed in excel. Finally, the python tool "plotly" was used on the "Anaconda" platform to create the 3D model based on the data model created in Excel. The data of three different gradations were analyzed by the use of this method and the results were obtained. According to the pre-evaluated test data of three gradations on durability and permeability, the validity of the 3D models was analyzed. The developed 3D model from this study can be used to determine the optimum gradations of OGFC considering the durability and permeability, based on the analysis of the internal structure arrangement.

Keywords: *3D model, Gradation, OGFC, Void arrangement*

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