

Study on Strict Homogenization Method and Model of Masonry under Different Bricklaying Methods Based on Regular Tessellation Theory

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ABSTRACT

The brick and tile of the existing masonry structures are precious, so it is not feasible that the components are used as the dismantling unit for maintenance and reinforcement. The homogenization method is an effective multi-scale calculation method, which can be used to establish the analysis model of masonry on the meso-level. By proposing the method of masonry structure regular tessellation and deconstruction, the internal regular tessellation rules of different bricklaying methods are explored and the theoretical system of masonry plane segmentation is established. Based on regular tessellation theory, three types of unit lattice were used to divide the various bricklaying methods periodically. On the premise of regular tessellation theory, three kinds of representative volume unit (RVE) were selected to regular tessellation the whole wall pieces under three different bricklaying methods by using rectangular partition lattice. By using the finite element software ABAQUS, reasonable material parameters were selected and the finite element model was established by using the separated modeling method. The equivalent parameters of RVE unit were obtained to realize the numerical analysis of masonry structure at the microscopic level. The compressive strength of three kinds of test specimens with different bricklaying methods was simulated, and the simulated and tested values of bearing capacity and deformation capacity were compared and analyzed. The results show that the strength of the selected RVE unit under running bonding bricklaying method was higher than that of the other two types, while the strength of one under flemish bonding bricklaying method was the second. On the whole, the RVE model established by treating masonry structure with strict homogenization method can better reflect the mechanical properties of specimens. The strict homogenization method based on regular tessellation theory takes brick by brick as the unit to be dismantled and replaced in the ancient architecture, which opens a new way for the fine analysis of masonry structure and maximizes the protection of the ancient masonry structure, which is of great significance for the protection of human cultural heritage.

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