COMPUTATION OF EFFECTIVE ELASTIC PROPERTIES OF REINFORCED CEMENTITIOUS COMPOSITE USING MICRO-TOMOGRAPHY AND FINITE ELEMENTS

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Abstract: Effective elastic properties of reinforced cementitious composite are determined using a fully non-destructive approach that combines micro computed tomography (microCT) and computational homogenization concepts. Cementitious composite materials have a wide range of applications in several industries. In the oil industry, refractory concretes are commonly used to support equipment and pipes to carry oil in high temperatures. In order to increase the refractory concrete performance, austenitic stainless-steel fibers are normally included in the mixtures as reinforcements. Since the addition of reinforcement changes the material's behavior, it is necessary to determine the influence of those fibers in the material's effective elastic parameters. Computer simulation is an attractive strategy to investigate the mechanical behavior of materials, and an alternative mean to avoid laboratory tests that are destructive, costly and time-consuming. Computational techniques, such as numerical homogenization by finite elements, have been successfully used in the literature to determine effective elastic properties of composite materials. In these techniques, materials with complex phases' distributions and boundaries can be analyzed. However, the accurate evaluation of the composite properties depends on a reliable computational model. Hence, the microCT has an essential role in the process of generating the models. In the process of homogenization, samples of the material are digitalized in a microCT scanner generating a 3D image of the material's internal micro structure. The images are processed and segmented, generating the 3D virtual models. The homogenization is carried on a microscopic block called representative volume element (REV) that is the smallest volume of reinforced refractory concrete in which any measurement made represents the whole sample. Periodic boundary conditions were implemented in the finite element analysis allowing the process of determination of the RVE to convert faster. The proposed approach is validated using experimental data.

Keywords: Reinforced Cementitious Composite, Computational Homogenization, Micro Computed Tomography, Periodic Boundary Conditions, Finite Elements Method.