Mechanical Strength Simulation of Concrete Samples Using COMSOL Multiphysics® with 3D Mesh Generated by Industrial Tomography System

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Introduction: Analysis of concrete structures is usually carried out by destructive methods. The internal volume flaws directly influence concrete properties. Such inclusions are empty or even resulting from the manufacturing process or degradation by percolation leaching dissolution and chemical reactions between its constituents. Industrial tomography systems (ITS), have proved to be a powerful tool for analysing and determining internal objects. In this context, this work aims at showing that it is possible to generate representative triangular meshes from real samples of concrete from data obtained with 3D ITS and use them to simulate mechanical properties. The results of these simulations can be used to compare them with the results of mechanical strength obtained in laboratory.

Experimental Methodology: Data preprocessing was carried out using STL in MeshLab Open Software (Figure 2). Preprocessing was required to reduce the set of data that make possible the simulation, but without losing the morphological properties of the concrete sample. The studies were applied to COMSOL Multiphysics® using the same parameters as in laboratory compression tests.

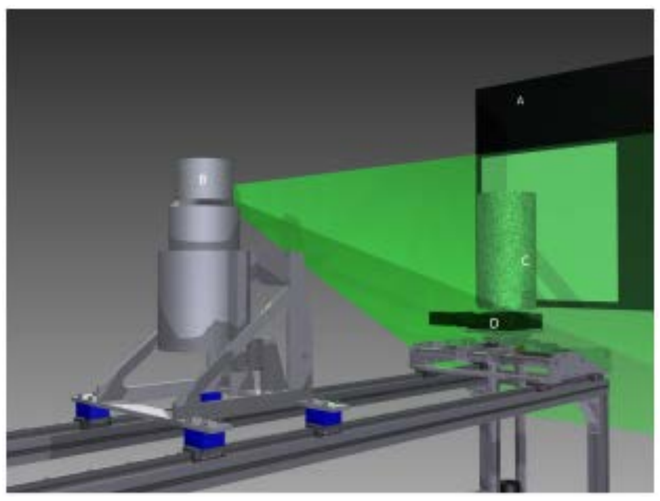

Figure 1. Illustration of a industrial tomography acquisition system.

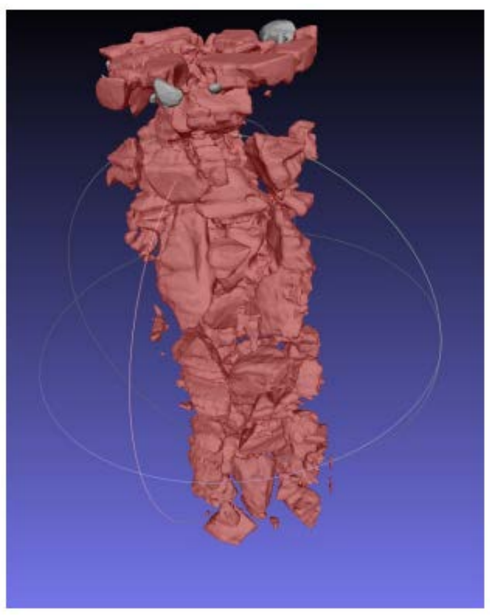

Figure 2. 3D Visualization of the concrete sample.

Results: Results obtained in the simulations allowed for the identification of higher concentrations of stress in interface regions (Figure 3). Due to limitations in face parameterization, it was necessary to reduce the number of granites. In this work only cement and four granite bodies were simulated.

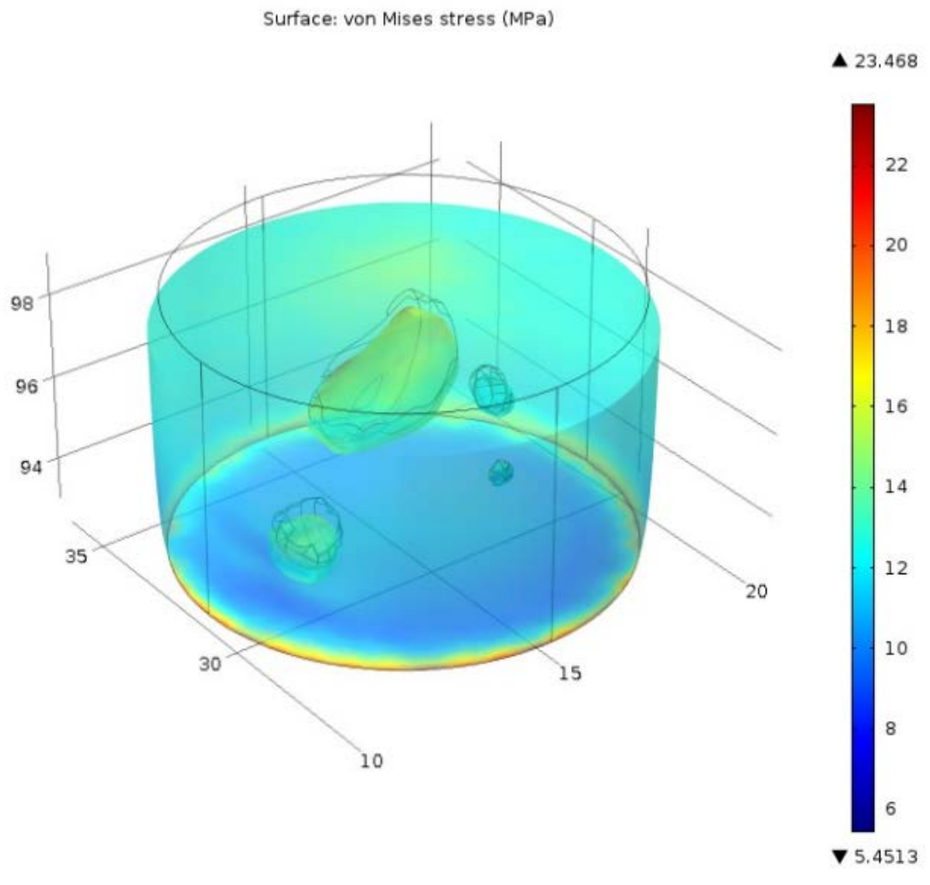

Figure 3. Mechanical simulation using COMSOL.

Conclusions: The results obtained in this study showed that the interfaces between different materials are the regions that are subject to higher stress. However, limitations of the platform prevented tests using the whole dataset. Future works include simulation using 3D tomography of a whole study which can then be compared with mechanical tests in laboratory.

Acknowledgements

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