The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

MULTISCALE SIMULATION OF THE FRACTURE BEHAVIOR OF FIBER REINFORCED CONCRETE UNDER IMPACT LOADS

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Keywords: *Multiscale Methods, Fracture behavior, Dynamic effects*

For the numerical simulation of fiber reinforced concrete under impact loads, many aspects must be considered. Above all, fiber reinforced concrete possesses a complex material behavior. Its various components and their interaction lead to complicated fracture mechanisms, especially under dynamic loads. Consequently, it is important to not only consider the material from a macroscopic point of view, but to include the influence of the underlying microstructure into the analysis as well.

Here, this is achieved by using the Multiscale Projection Method (MPM), developed by Loehnert and Belytschko [1]. Its basic idea is that in all areas of interest, a closer look at the microstructure of the material is taken. This can encompass a more detailed material model, or the consideration of microcracks and heterogeneities, like fibers. By defining a fine scale domain in adequate areas, such as around the tip of a macrocrack, the effects of those previously mentioned aspects on the overall propagation behavior, are taken into account. Within the MPM, fine and coarse scale are coupled in a concurrent way, by enforcing displacement boundary conditions from coarse to fine scale and projecting back the stresses obtained from the fine scale computation to the coarse scale.

Another important aspect of this analysis is that when considering impact loads, the effects of inertia play an essential role. Consequently, inertia terms are included into the formulation and additional coupling terms are added, to extend the MPM to dynamics. This way, the influence of waves and their complex reflections on fracture propagation can be analyzed.

To capture the fracture behavior efficiently and accurately, a phasefield approach is employed within the fine scale domain. On the coarse scale, an enrichment of the displacement field, obtained from the fine scale compuation, enables the use of rather coarse meshes while still obtaining accurate results.

REFERENCES

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