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A finite-element-based unit cell approach for simulating vertically perforated clay block masonry

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Based on the modelling approach proposed by Kiefer et al. [1], the authors developed a sophisticated three-dimensional finite-element model for simulating the compressive strength of vertically perforated clay block masonry. Using a *unit cell approach* with *periodic boundary conditions*, the *eXtended Finite Element Method (XFEM)*, and a *stochastic strength distribution*, the model is able to not only reliably predict the compressive strength, but also to estimate its standard deviation obtained from a set of experiments [2]. Additionally, the impact of fibre-reinforced bed joints on the compressive strength was investigated. Using a conventional glass fibre mesh, an increase of the 5 %-quantile of compressive strength up to 33 % could be predicted numerically, which agrees well with first experimental observations.

Besides the studies on the compressive strength, the proposed unit cell approach allows for easily applying *arbitrary loading scenarios*, such as in-plane shear, out-of-plane bending, or different combinations of those. Hence, the model enables calculating failure surfaces for vertically perforated clay block masonry and comparing it with state-of-the-art concepts, like the well-known Rankine-Hill surface, proposed by Lourenço [3]. Since more and more structural engineers rely on finite-element software to design masonry structures, reliable failure surfaces for masonry play a crucial role in encouraging engineers to choose vertically perforated clay block masonry as building material.

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