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Finite Element Simulation of Sandwich Panels of Laminated Plaster and Rockwool under Mixed Mode Fracture

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Sandwich panels of laminated gypsum and rock wool have shown large pathology of cracking due to excessive slabs deflection. Currently the most widespread use of this material is as vertical elements of division or partition, with no structural function, what justifies that there are no studies on the mechanism of fracture and mechanical properties related to it. Therefore, and in order to reduce the cracking problem, it is necessary to progress in the simulation and prediction of the behaviour under tensile and shear load of such panels, although in typical applications have no structural responsability. To carry out this research, the behaviour of this material can be considered quasi-brittle and, based on this idea, in this work has been studied using a cohesive crack model that has been applied to other quasi-brittle materials, such as concrete, and has provided very satisfactory results.

This communication presents the work carried out to study the mechanical and resistant behaviour under normal and shear load taking into account the size effect of the specimen of plaster and rock wool. The authors designed an experimental campaign under mixed mode composed by testing specimens of different sizes. Assymetrical three-point bending tests have been performed on notched specimens, geometrically similar and of different size, to obtain load-displacement and load-crack mouth opening displacement curves. Previously a series of experimental tests were carried out to characterize a sandwich panel of laminated gypsum and rock wool, and each of its components: plasterboard, rock wool and paper. We designed the experimental campaign to obtain the strength properties of the studied materials, and its specific fracture energy, GF, as well as the complete curves of applied load versus displacement. From the experimental results it can be observed that the fracture energy is strongly influenced by the thickness of the wool, rather than the plate.

To numerically simulate the mixed-mode fracture behaviour of the panels we have used a finite element model with embedded crack, based on the cohesive crack model, using as input the experimental parameters obtained in the experimental campaign, obtaining a good adjustment. Based on these results we analyze the mixed-mode fracture behaviour of the material and the size effect of the panels. Finally, the authors have used this model to study the limitation of the maximum deflection of slabs in order to avoid its cracking.

References

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