11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

A MULTISCALE METHODOLOGY FOR HOLLOW CLAY-BRICK MASONRY

A. Sridi[1,2*], J-F. Regrettier[2] , J. Gautron[2], V. Foussard[2] and H. Ben-Dhia[1]

[1] Laboratoire MSSmat, Ecole Centrale Paris, 92290 Châtenay-Malabry, France
ahmed.sridi@ecp.fr / hachmi.ben-dhia@ecp.fr
[2]Bouyer Leroux, 49280 La Séguinière, France
jfregrettier@bouyer-leroux.fr / jgautron@bouyer-leroux.fr / vfoussard@bouyer-leroux.fr

Key Words: *Hollow Clay Brick Masonry, Multiscale Modelling, Arlequin Method.*

Masonry is an old building solution that has been used for more than 10,000 years, but still occupies an important part of the construction market today. Therefore, understanding the behaviour of masonry is essential to define reliable approaches that could help one to design new products and to assess the safety level of existing masonry-based buildings, especially when these structures are submitted to both mechanical and possibly severe thermal loadings.

The achievement of this goal is burdensome with regard to the complexity of these structures. Indeed, masonry walls are quite heterogeneous. They rely on hollow clay bricks with peculiar architecture (see Fig 1(a)) and mortars, the identification of their mechanical properties is required, in the one hand. On the other hand, the resulting (thermo)-mechanical problem is clearly multiscale (see the homogenization technique applied by A. Anthoine on periodic masonry [1]).

In this study, a multi-scale model for the thermo-mechanical behaviour of masonry walls, characterized by periodic arrangement of hollow clay bricks and mortars, is developed. The model is based on the Arlequin framework [2][3].

More precisely, simple beam (for the 2D case) or plate (for the 3D case) models are used there where the solution is sufficiently regular, namely far from area of concentrations or singular stresses where local full 2D (in the 2D case) and 3D (in the 3D case) models are intermixed in the Arlequin framework to compute a solution of a reduced model that decreases drastically the numerical costs. The resulting model is represented in Figure 1(b).

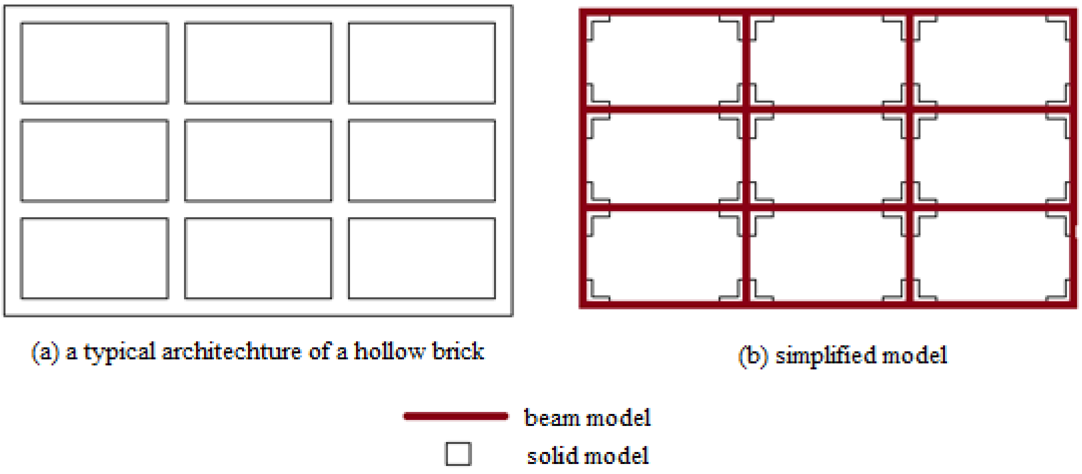

Fig1.Simplification of the brick architecture in the Arlequin framework

Theses cost reduced surrogate models allows us to develop optimisation strategies and reduced models methods to find out sets of parameters that lead to designed walls satisfying the legal norms, in a reasonable computational cost.

REFERENCES

[1] A. Anthoine, Derivation of the in-plane elastic characteristics of masonry through homogenization theroy, *International Journal of Solids and Structures*, Vol.32, Issue 2, pages 137-163, 1995.

[2] H. Ben Dhia, Multiscale mechanical problems : the Arlequin method. *Comptes Rendus de l'Academie des Sciences Series IIB Mechanics Physics Astronomy*, Volume 326, Number 12, pp. 899-904, 1998.

[3] H. Ben Dhia, G. Rateau, The Arlequin method as a flexible engineering design tool, *International Journal for Numerical Methods in Engineering*, Vol. 62, Issue 11, pages 1442-1462, 2005.