Wood crushing modelling for timber joint engineer problems

I. Tavakoli[†], J-F. Bocquet[‡*]

[†] tavakoli@caddev.fr
[‡]ENSTIB/LERMaB, University of Lorraine, Épinal, France, jean-francois.bocquet@univ-lorraine.fr

Numerical modelling of wood failure in very localized areas which happens very often in timber structure joints, remains complex. Locally, the properties of wood can vary very highly due to natural growth, which make the mechanical problem deviate from continuous mechanical assumptions. Another problem appears when the stress reaches the material limits, leading to microcracking as well as densification in these areas. The definition of the densification paths are then difficult to predict because of the densification and the difficulty to model due to numerous numbers of parameters to be identify.

In order to produce a simple and reliable predictive modelling approach for engineers, it is chosen to idealize wood as a structure [1] that is composed of an isotropic foam base, reinforced by beams in order to bring the orthotropic nature of the material [2] [3]. In this approach, the plastic flow of the structure is modelled by the collapse of the foam-beam structure. This approach makes it possible to maintain elementary behaviours in the two components which are the beams and the foam. The identification of the most parts of the parameters could be obtained with confined compression tests.

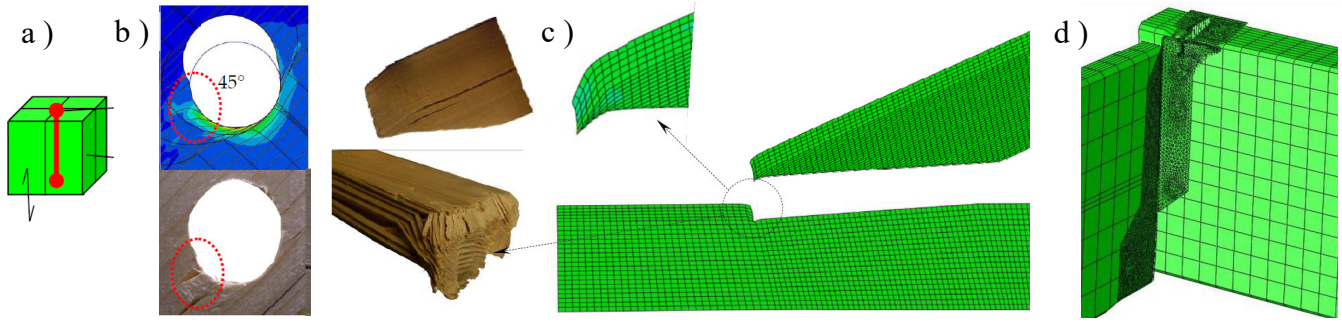

Figure 1: (a) Elementary cubic foam beam elements (b) Embedment test (c) Timber-to-timber joint (d) Folded metal anchors modelling.

After the realization of mesh adapted according to the type of problem, it is possible to approach several problems in a very promising way [4] such as the embedment of circular dowel according to the grain directions, the behaviour of joints with timber-to-timber contact (carpentry joints), the metal folded anchor type assembly behaviour fixed with nails or screws.

In order to perfect the modelling, it is then important to continue the research to master the predominant shear and transverse compression interaction on many aspects in the phenomenology encountered.

References

[1] P. Racher, J-F. Bocquet: « Non-linear analysis of dowelled timber connections: a new approach for embedding modelling ». Electronic Journal of Structural Engineering, 5, 2005.
[2] P.Toussaint, I. Tavakoli-Gheynani, J-F. Bocquet, P.Triboulot: « Application and modelling pre-stressed timber joints » IV European Conference on Computational Mechanics ECCM 2010 « Solids, Structures and Problems in Engineering Paris, France, Palais des Congrès, May 16-21 2010.
[3] I. Tavakoli-Gheynani, P.Toussaint, C. Barthram, J-F. Bocquet: « Embedment strength at any angle to the grain : experimental and numerical analysis IV European Conference on Computational Mechanics ECCM 2010 Solids, Structures and Problems in Engineering Paris, France, Palais des Congrès, May 16-21 2010.
[4] Tavakoli-Gheynani: « Modélisation tridimensionnelle d'assemblages de structure bois en tôle pliée mince par la méthode des élements finis », PhD thesis, Université Henry Poincaré, Nancy, 2011.

ISBN: 978-91-88898-64-7