6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 – 15 June 2018, Glasgow, UK

AN INTERFACE MODEL TO SIMULATE THE MECHANICAL BEHAVIOUR OF ADHESIVE JOINTS

Francesco Ascione[1*], Marco Lamberti[2], Frédéric Lebon[3], Aurélien Maurel-Pantel[4] and Maria Letizia Raffa[5]

[1] Dept. Civil Engineering, Univ. of Salerno (Italy), 84084 Fisciano (SA), fascione@unisa.it
[2] Dept. Civil Engineering, Univ. of Salerno (Italy), 84084 Fisciano (SA), malamberti@unisa.it
[3] LMA, Univ. of Aix-Marseille (France), 13453 Marseille Cedex 13, lebon@lma.cnrs-mrs.fr
[4] LMA, Univ. of Aix-Marseille (France), 13453 Marseille Cedex 13, maurel@lma.cnrs-mrs.fr
[5] CNRS, Laboratoire Modélisation et Simulation Multi-Echelle, UMR CNRS 8208, France, maria-letizia.raffa@u-pec.fr

Key Words: *Fracture, Interface model, Adhesive connection.*

During the last decade the applications in the field of civil engineering of composite structures made of FRP (Fibre Reinforced Polymers or Plastics) involving adhesives are grew exponentially. One of the most promising applications is the realization of a beam-to-column connection by using structural adhesives that is becoming a valid alternative to the classical bolted connection. In bonded connection due to the absence of holes (present in bolted connection), the stresses are more uniformly distributed over the bonded surfaces, stress concentration and damage to the fibers caused by the holes are non-existent. Recently, an experimental investigation was performed by the authors [1] to assess their strength, stiffness and overall performance showing that their performance can equal and surpass the performance of similar bolted connections in FRP structures. The role of two parameters, the thickness of the adhesive layer and the friction at the adhesive interface, need to be studied in deep in view of a further improvement of the mechanical response of such a bonded connection. Furthermore, in order to propose formula for its design and verification it is necessary to evaluate the stress and strain distribution along the adhesive layer. With this aim, the present paper presents the numerical results obtained by using an upgrade of an interface model previously presented by the authors [2]. The model is derived by an asymptotic analysis, due to the thickness of the adhesive layer, of a composite structure made of two elastic solids bonded together by a third thin one, which has a nonlinear behavior. The adhesive is micro-cracked by adopting a Kachanov-type model [3], which was yet successfully applied to cracked composites materials. In order to prevent a possible interpenetration between the adherents, it is supposed that the elasticity coefficients depend totally on the adhesive thickness and crack length in tension, while in compression they depend only partially. As mentioned before, by adopting an asymptotic analysis, rescaling the governing equations of the problem it is possible finally to have a model of an imperfect soft interface with unilateral contact and damage evolution. This model has been successfully validated by authors in further studies on brick-mortar interfaces [4]. The proposed numerical results show a good accordance with experimental evidence furnishing useful information about the influence on the mechanical response of the connection by the adhesive thickness.

REFERENCES

[1] F. Ascione, M. Lamberti, G.A. Razaqpur, S. Spadea, Strength and Stiffness of Adhesively Bonded GFRP Beam-Column Moment Resisting Connections. *Comp Struct*, Vol. **160**, pp. 1248-1257, 2017.

[2] E. Bonetti, G. Bonfanti, F. Lebon, R. Rizzoni, A model of imperfect interface with damage, *Meccanica*, Vol. **2**, pp. 1911–1922, 2016.
[3] I. Sevostianov, M. Kachanov, On some controversial issues in effective field approaches to the problem of the overall elastic properties, *Mech Mater*, Vol. **105**, pp. 69-93, 2014.
[4] M.L. Raffa, F. Lebon, R. Rizzoni, "Derivation of a model of imperfect interface with finite strains and damage by asymptotic techniques. Application to masonry structures", Meccanica (2017), https://doi.org/10.1007/s11012-017-0765-3.