COMPLEX FINITE ELEMENT SIMULATIONS OF LINEAR HARDWOOD CUTTING

F. Šebek[1], P. Kubík[1], J. Tippner[2], M. Brabec[2] and O. Dvořáček[3]

[1] Institute of Solid Mechanics, Mechatronics and Biomechanics, Faculty of Mechanical Engineering, Brno University of Technology, Technická 2896/2, 616 69 Brno, Czech Republic, e-mail: {sebek,kubik.p}@fme.vutbr.cz
[2] Department of Wood Science and Technology, Faculty of Forestry and Wood Technology, Mendel University in Brno, Zemědělská 810/3, 613 00 Brno, Czech Republic, e-mail: {jan.tippner,martin.brabec}@mendelu.cz
[3] Competence Centre for Wood Composites and Wood Chemistry, Wood K plus, Wood Materials Technologies, Konrad-Lorenz-Straße 24, 3430 Tulln, Austria, e-mail: o.dvoracek@wood-kplus.at

Keywords: *Chip, Damage, Disintegration, Triaxiality, Wood*

The hardwood is a composite constructional material that is increasingly used due to, among others, the climate change (increasing temperature). Therefore, it is necessary to study the wood behaviour under the conditions that are important for improving the industrial processes such as the cutting. The present work focuses on the European beech. Important parameters of linear high-speed woodcutting were studied using an in-house device [1]. The analysis covered the grain orientation, depth of cut and cutting speed. Numerical simulations were carried out within explicit finite element method considering the otrhotropy of elasticity, plasticity and fracture [2, 3]. The cracking was realized through the element deletion technique, which resulted in realistic prediction of chip formation. Also, the reaction forces from computations corresponded well to experiments. Those were twice greater for the cut perpendicular to the grain when compared to the cut parallel with grain growth. Finally, the developed model may serve for deeper analysis or optimization of the cutting process including the study of tool wear.

REFERENCES

[1] O. Dvořáček, D. Lechowicz, T. Krenke, B. Möseler, J. Tippner, F. Haas, G. Emsenhuber and S. Frybort, Development of a novel device for analysis of high-speed cutting processes considering the influence of dynamic factors. *Int. J. Adv. Manuf. Technol.*, Vol. **113**, pp. 1685–1697, 2021.

[2] F. Šebek, P. Kubík, M. Brabec and J. Tippner, Modelling of impact behaviour of European beech subjected to split Hopkinson pressure bar test. *Compos. Struct.*, Vol. **245**, 112330, 2020.

[3] F. Šebek, P. Kubík, M. Brabec and J. Tippner, Orthotropic elastic–plastic–damage model of beech wood based on split Hopkinson pressure and tensile bar experiments. *Int. J. Impact Eng.*, Vol. **157**, 103975, 2020.