About localization on plane strain test on bi-material specimen

H. A. Phung[1, b)], P. Balland[1,c)], N. A. Sène[1, 2, d)], L. Tabourot[1, a)]

[1]*Univ. Savoie Mont Blanc, SYMME, FR-74000 Annecy, France*
[2]*Université Cheikh Anta Diop de Dakar, Ecole Supérieure Polytechnique, BP 5085, Dakar-Fann, Sénégal*

[a)]*Corresponding author: laurent.tabourot@univ-smb.fr*
[c)] *Duc-Hai-Anh.Phung@univ-smb*
[c)]*pascale.balland@univ-smb.fr*
[d)] *ndsene@gmail.com*

Abstract. The main idea of this paper is to improve our knowledge on localization in a specific case of heterogeneous materials. Tensile and plane strain tensile tests are studied on different cases of bi-materials. This study is both experimental with digital image stereo-correlation for strain measurements and numerical with a simulation by finite element code.

In order to guarantee impeccable service life under more and more severe conditions, materials engineers are developing increasingly sophisticated materials. Many combinations are used to improve the materials. Thus, dual phase steels for example are nowadays particularly popular materials for the production of structural parts, particularly in the field of parts obtained with deep-drawing process.

These materials, which are composite structures, have therefore a particularly heterogeneous structure. The increase in yield strength is obtained by producing hard phase in a more ductile phase matrix. It is this mixture of antagonistic properties, ductility and hardness, that confers remarkable mechanical properties to this material The question raised here is to know to what extent this heterogeneous structure has an impact on the plastic behaviour of materials, particularly during forming, but also on the triggering of localization. The focus here is on the effect on localization, the impact on plastic behaviour [1] and in particular on the resulting large springback. In order to understand the effect of those heterogeneous structures on mechanical behaviour, specific bi-material structures have been created by combining strips of aluminium and steel, the various parameters of which are controlled (material proportions, mechanical properties of each material). In order to measure the effect of heterogeneity on localization, we are interested in strain plane tensile [2] localization, which appears to be relatively consistent with the possible situations encountered in shaping operations on industrial components. The work therefore consists in producing bi-material specimens by varying the respective proportions of each component. Strain plane tensile tests are then analysed in particular using stereo-correlation tools (Fig. 1) to access the topography that is developed during localization. A modelling and simulation work is carried

out as a corollary in order to validate the concepts inherent to the development of localization in heterogeneous structures.

Figure 1: Stereo-correlation on both side of our bi-material during testing

References

[1] L. Tabourot, N. A. Sène, P. Balland, N. Ksiksi, L. Charleux, M. Issack, Comparative study of modelling efficiency regarding localization development, AIP Conference Proceedings 1896, 160007, 2017, doi: 10.1063/1.5008182. ESAFORM 2018

[2] Paulo Flores, Víctor Tuninetti, Gaëtan Gilles, Pierre Gonry, Anne Marie Habraken, Journal of Materials Processing Technology, Volume 210, Issue 13, 1 October 2010, Pages 1772-1779

Acknowledges
This work has been realized in collaboration with MAHLE Composants Moteur France SA.