The Behaviour of Differently Orientated Fabric Sewn Systems under Biaxial Loading

Eugenija Strazdiene[1], Virginijus Urbelis[2]

[1] *Vilnius University of Applied Sciences, Didlaukio str. 82, Vilnius, Lithuania, e-mail:* e.strazdiene@mtf.viko.lt
[2] *Granberg LT, Kursiu str. 9B, Kaunas, Lithuania, e-mail:* vu@granberg.no

Abstract: During the development of simple methods to evaluate the performance and hand properties of textile materials, biaxial deformation methods are increasingly applied, i.e. not only membrane or punch loading, but also the method of extracting the specimen through the rounded hole. The later determines the real operating conditions of textile materials more accurately and realistically [1, 2].
The aim of this work is to investigate the effect of sewn systems pieces directions upon their spatial performance characteristics and anisotropy peculiarities of deformed shape.

Keywords: *sewn system, biaxial loading, anisotropy.*

Testing samples were prepared of two pieces of woven fabric joint together by an open superimposed seam. In the first group of testing samples, one piece was orientated in warp (WA) direction and was constant, while the second piece was orientated in different directions, i.e. α = 0º, 15º, 30º, 45º, 60º, 75º, 90º angles in respect to warp (WA) direction. In the second group of testing samples, one piece was orientated in constant diagonal (45º) direction, while the second piece was orientated in the same α directions. The warp direction is marked WA and corresponds to a 90º angle; the weft direction WE and corresponds to 0º angle (Fig. 1).

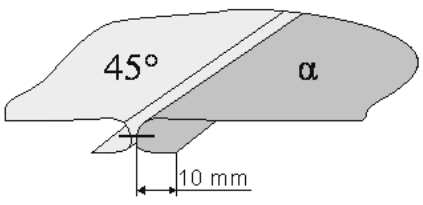

Figure 1 The schemes of the first and the second specimen groups

The effect of the cutting direction upon the behaviour of fabric sewn systems was investigated by two testing methods of biaxial loading [3]:
1st – by defining and comparing the parameters of sample extraction through the round hole;
2nd – by examining anisotropic behaviour of samples during their extraction through the rounded hole.
Testing results have revealed significant differences in extraction parameters for samples joined in different directions. The values of *P* (N), *A* (Ncm) and *tgα* of WA+α samples are 5-8% higher than the values of control WA+WA and 45°+α samples. Meanwhile, the extraction parameters of the 45°+α samples are 2-3% lower than the values of the control samples.
After examining anisotropic behaviour of the samples under biaxial loading it was found that the orientation of pieces in sewn system determines the shape of the sample during the extraction through a rounded hole. The samples cut in the diagonal (45º) direction acquire an ellipse shape, while pieces cut at a greater or lesser angle usually obtain a four-leaf shape.
The analysis of anisotropy variations has shown that biggest deformation differences appear between WA+WA and 45º+45º systems. The maximal shape deformation of WA+WA system is at 90°, and maximal shape deformation of samples of the group 45º+α appears when both sewn pieces are cut at 45° angles. No significant differences were observed between WA+WA and WA+WE.

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