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Three-dimensional forming of veneers

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Abstract: *Three-dimensional forming of veneers.* Forming of wood simultaneously in three dimensions is complicated process with various limitations considering natural properties of wood. Our research was focused on influence of distance between patrix and matrix – on 3D-forming of veneers made of birch and beech wood. Studied distances improved formability of veneers only to a small extend.

Keywords: veneer, forming, 3D-forming, sphere hub, matrix, distance

INTRODUCTION

Wood has been one of the most versatile materials which have been used for its natural properties. Wood has the unique aesthetic qualities which can be further improved by forming. Forming enables to reach individualisation of wood based products, the individualisation according to the consumer requirements. If we talk about furniture based on solid wood, the individual parts of the furniture can be formed in a plane or in a space – three-dimensionally. Due to heterogeneity and anisotropic properties of wood, three-dimensional forming of wood is a difficult process. Three-dimensional forming of wood is very limited especially due to its small tensibility. 3D-forming of materials based on veneer is influenced by many factors such as: wood species, thickness, wood fibre direction, and others. In our research we focused on the limit – the spacing between patrix and the matrix at spatial forming of veneers.

METHODS

For the experiments, we used veneers made from birch and beech wood – due to anatomic composition of the wood. Veneers were cut radially and tangentially, the thickness was of 0.55 mm and moisture content of 8 %. To evaluate 3D-formability of veneers, we used the methods for assessment of sheet metal (Smrž 2011), but with some modifications in shape and size with regard to the tested material – veneer.

The testing was performed with the test machine LabTest 4.050 using the test fixture that we designed (Fig. 1). The test fixture consisted of a spherical hub (diameter of 20 mm or 40 mm) and a matrix with a circular hole (diameter of 24 mm or 44 mm). In contrast to testing of sheet metals, in our experiments the spacing between the sphere hub and the matrix was bigger than the thickness of the veneer. The value of the mentioned difference – distance was chosen 2 and 24 mm. Spherical hub pushed the veneer into the circular hole until the veneer was broken.

Reached maximal deflection – deepening (y) became an assessment criterion for formability of veneer for a given distance – spacing resulting from the different diameter of the hub and the matrix.

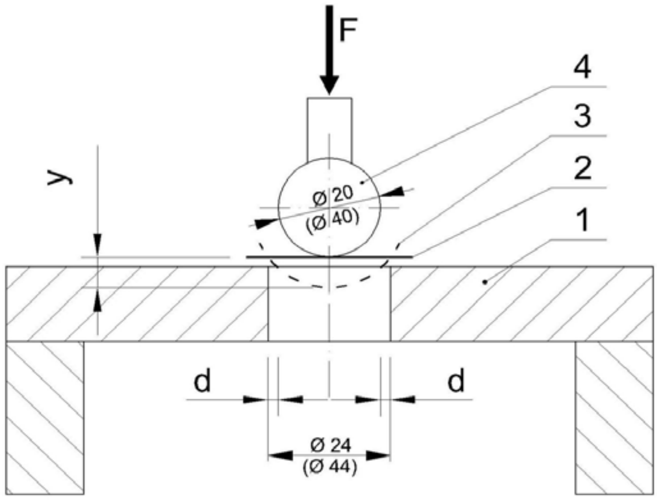

Fig. 1 Test fixture for 3D-forming of veneer
1 – matrix with a hole ø 24 mm or ø 44mm; 2 – veneer before forming; 3 – veneer after forming; 4 – hub /sphere ø 20 mm or 40 mm;
y – maximal deflection - deepening; d – distance

RESULTS

From the obtained results, we can conclude that test conditions have affected formability of veneers as exemplified by the data in Table 1. The diameter of the sphere hub as well as the distance – space between the hub and the matrix influence significantly the values of deflection – deepening at three-dimensional forming of veneer. Doubling the diameter of the sphere hub resulted in reduction of difficulty of forming which led to increased deflection, but only 1.6 times for birch and 1.24 times for beech.

Tab 1 Deflection of veneers at deepening – bending with hubes at various distances in the matrix

Wood species	**Type of veneer**	**Deflection – Deepening [mm]**		
		Sphere hub		
		ø 20 mm		**ø 40 mm**
		Distance		**Distance**
		2 mm	**12 mm**	**2 mm**
Birch	T	1,76	2,99	2,87
	R	2,03	3,31	3,34
	Average	**1,90**	**3,15**	**3,11**
Beech	T	1,83	2,15	2,35
	R	1,98	2,22	2,36
	Average	**1,91**	**2,19**	**2,36**
Total average		*1,90*	*2,67*	*2,74*

Enlargement of the distance was manifested similarly. Six-fold increase of the distance caused enlargement of the deflection only 1.7 times for birch and 1.15 times for beech. The results show improved 3D-formability for birch in comparison with formability of beech.

Similar trend for 3D-formability of birch and beech was found by Priehradník (Priehradník 2013).

CONCLUSIONS

Three-dimensional forming of native wood is limited to a large extend. Considering the anatomical structure of wood, diffuse-porous wood species are more appropriate for 3D-forming. 3D-formability of birch wood and beech wood are similar, but better results were reached for birch wood. At 3D-forming of veneers, enlargement of distance between patrix and matrix improved formability only by a little. To improve formability, it will probably be necessary to focus on the modification of the veneer before 3D-forming.

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Streszczenie: *Formowanie oklein 3D.* Formowanie drewna w trzech wymiarach jest procesem skomplikowanym I z licznymi ograniczeniami spowodowanymi własnościami drewna. Praca skupia się na wpływie dystansu między matrycą a patrycą na proces formowania fornirów bukowych I brzozowych. Badania wykazały że manipulacja dystansem poprawia proces jedynie w małym stopniu.

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