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Three–dimensional formability of rolled, pressed, and plasticized veneers

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Abstract: *Three–dimensional forming (3D-forming) of thin wood materials – veneers is considerably limited.* To improve formability of veneers, the veneers were modified by rolling, pressing, or plasticising. It was shown that substantial improvement of 3D-formability was achieved only after modification by plasticising. Modification by rolling or pressing did not cause significant changes in formability of veneers.

Keywords: forming, veneer, 3D-formability, modification

INTRODUCTION

Wood is a material which can partly be formed. Forming is a process of changing of the shape and dimensions of a subject, caused by action of external mechanical forces, while the material is not removed (ZEMIAR et al. 2009).

The paper is oriented at problems of 3D-dimensional forming of thin wood flat materials – veneers. 3D-forming of native wood je considerably limited. Limitations result from the wood properties – from its small tensibility and various mechanical properties in different anatomical directions (WAGENFÜHR, BUCHELT, PFRIEM, 2006, LANG M., LANGOVÁ N., 1998).

Wood properties can be changed to some extent – they can be modified (WAGENFÜHR, RICHTER, BUCHELT, 2000) and so adapted to technological or user requirements. The aim of the research was to verify experimentally the influence of various modifications of veneers on their 3D-formability.

METHODS

Material

Experimental testing was done for birch veneer cut radially (Betula pendula). The reason for using the birch veneer was the (structural) anatomical structure of birch wood. The birch belongs to diffuse-porous wood species, it has homogenous structure what is a good precondition for its better formability in comparison with ring-porous or coniferous wood species.

The veneer used for the experiments had an average thickness of 0.55 mm. The specimens of circular shape with a diameter of 60 mm were made. Every test was done for a file of 30 specimens.

Modification of veneer properties

Rolling

Rolling was done with twin-roll device, developed for this purpose, when veneer strip passed once through the machine under specific pressure of 40 MPa (at a gauge pressure of 5 MPa). Moisture content of the veneers was of 8 % or the veneers were plasticised before rolling.

Testing of 3D-formability of rolled veneers was done after 7-day conditioning.

The initial average thickness of the veneer after rolling and conditioning (in the file of the veneers with 8 % moisture content) changed from 0.553 mm to 0.416 mm – which corresponds to the compression ratio of 24.8 %. In the file of veneers previously plasticised, the initial average thickness changed from 0.551 mm to 0.476 mm – the compression ratio was 13.6 %.

Pressing

Pressing was done in the printed press (type P30/ML, firm OMCN) at temperature of press plates 100 °C on the principle of one-time pressing of the veneer right to the thickness defined by a spacer bar, followed by its release. Thickness of the spacer bar corresponded to 30 % compression of the veneer. The average thickness of the veneers after pressing and 7-day conditioning was 0.443 mm (initial 0.550 mm) and that corresponded to the compression ratio of 19.5 %. Plasticised and pressed veneers reached the mentioned data 0.498 mm (0.548 mm) and 9.1 %.

Plasticisation

Plasticisation was done in plasticising device on the principle of indirect steaming. The specimens were stored under enclosure, horizontally on the grid above water surface for 15 minutes. The average veneer thickness was 0.550 mm before plasticisation and 0.567 mm after plasticisation.

Testing methodology

To assess 3D-formability of veneers we chose methods applied for the evaluation of sheet metal plasticity [VELES, 1989] with one difference; considering lower formability of the veneer in comparison with a sheet metal, the dimensions of shaping elements were changed. Tests were done by excavating, i.e. forming without changing the thickness, with specimens of circular shape, according to two principles shown schematically in Figure 1.

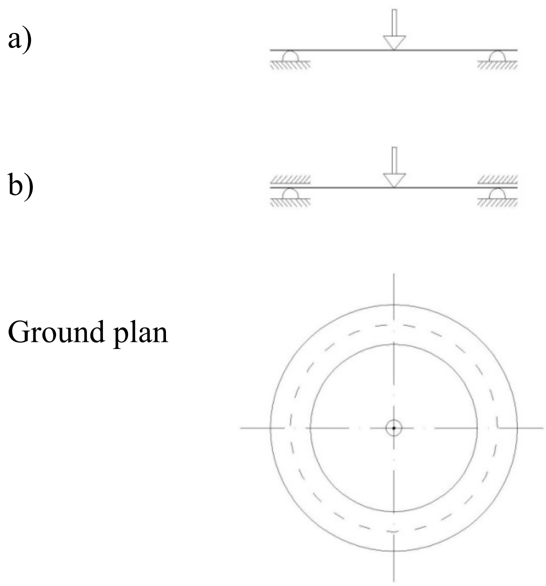

Fig. 1 Principles of the tests assessing 3D-formability of veneers: a) test with free placement of veneer, b) test with peripheral holder of veneer

The first principle represents the test with free placement of veneer; the second one represents the test with peripheral holder of specimen – veneer. In both cases the 3D-formability test is based on detecting the value of maximal depth at which the specimen was not breached under applied force. In general, damage can be manifested in two ways – formation of cracks or waves (waviness) in the plane of the veneer.

Schemes of mechanism of the test equipment for both types of testing are shown in Figure 2. Downforce on the veneer was applied by sphere hub fastened to the jaws of the test machine type Rauenstein ZD10/90. Deepening was recorded by indicator dials. Deepening for each type of examined veneers is a criterion for mutual assessment of their formability.

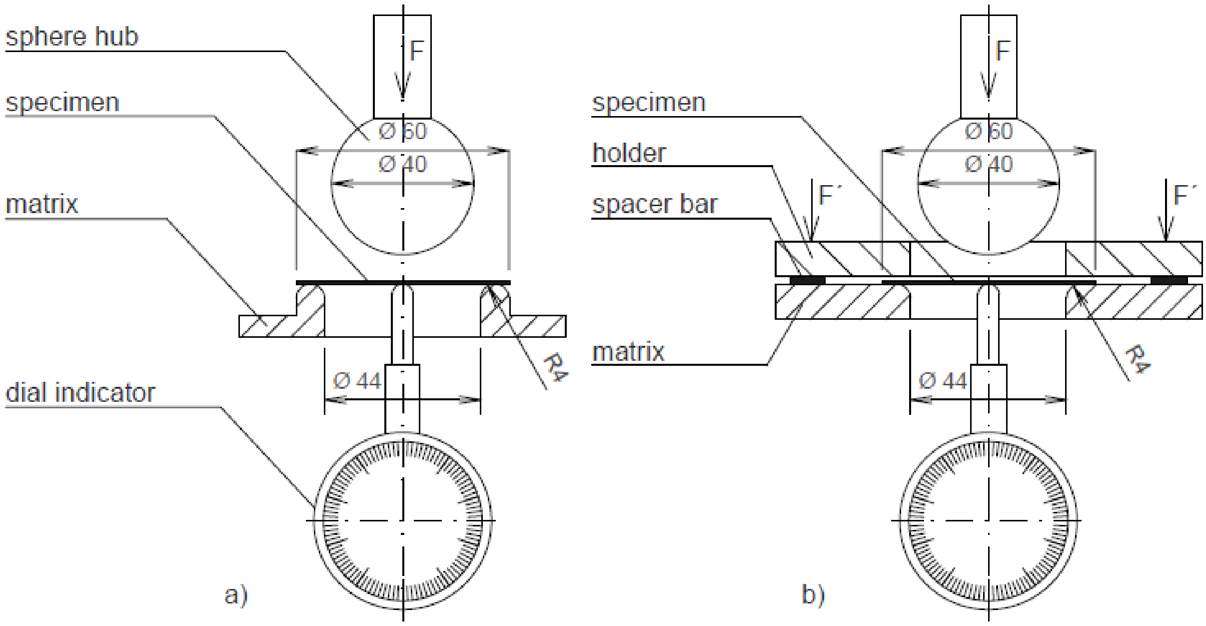

Fig. 2 Schemes of the tests equipment for assessing of 3D-formability of veneers: a) with free placement of veneer, b) with peripheral holder of veneer

RESULTS AND DISCUSSION

The numerical values, reflecting 3D-formability of veneers with free placement and peripheral holder, obtained by experimental tests by deepening are shown in Figure 3 and Figure 4. No-treated veneers, marked as the reference, represent the basic data for the assessment of 3D-formability (moisture content of 8 %). Modified veneers are: dry rolled (moisture content of 8 %), rolled previously plasticised, pressed dry (moisture content of 8 %), pressed previously plasticised, and plasticised veneers. The graphs show:

- at formability testing with free placement of a specimen, when compared with reference veneers, modifications of veneers by rolling and pressing at moisture content of 8 % (dry veneers) and modifications of veneers by pressing and previously plasticising were not significantly manifested. At specimens rolled and previously plasticised, lower values of deepening were measured when compared with reference veneers. On the contrary, the greatest deepening was reached at modification of specimens by plasticising.
- at testing of formability of veneers by deepening with peripheral holder, the tested veneer specimens modified by rolling at moisture content of 8 % (dry veneers) and by rolling of veneers previously plasticised showed a slight decrease in deepening when compared with the reference veneer. On the contrary, veneers modified by pressing at 8 % moisture content (dry veneers) and by pressing previously plasticised veneers showed a slight increase in deepening when compared with the reference veneer, while greater increase was recorded at pressed specimens previously plasticised. In researched methods of modification, the greatest deepening was measured for plasticised veneers.

When comparing both types of examinations and all ways of modifications showed in Figures 3 and 4, we can conclude that at testing of formability by deepening with peripheral holder, higher values of deepening were found, except rolled dry specimens where the deepening was about the same.

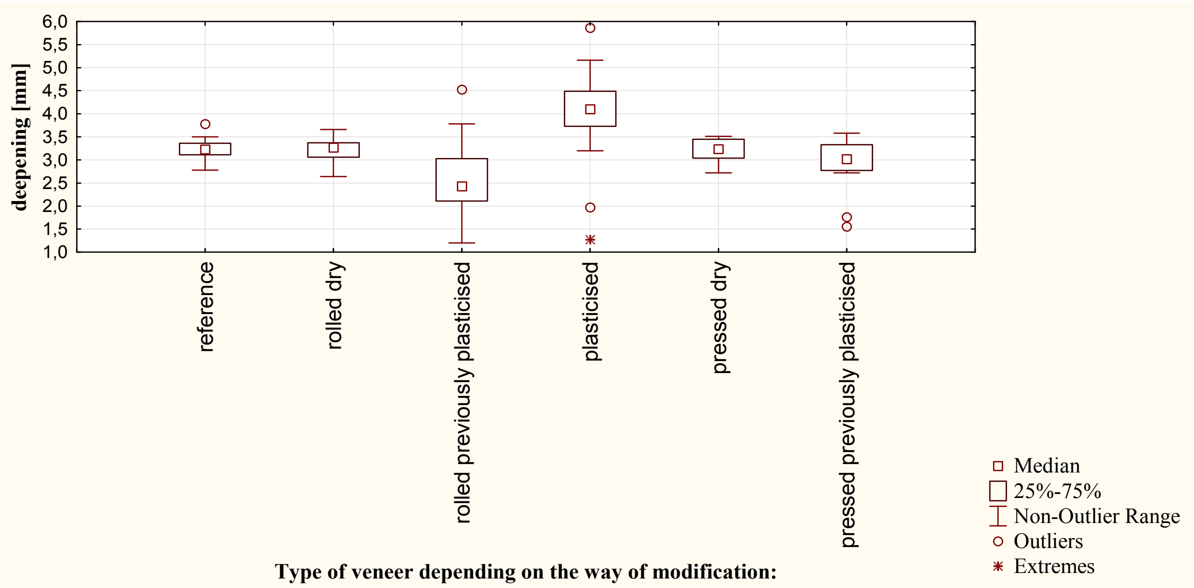

Fig. 3 Value of deepening at testing of formability of veneers with free placement of specimen depending on the way of modification of veneer

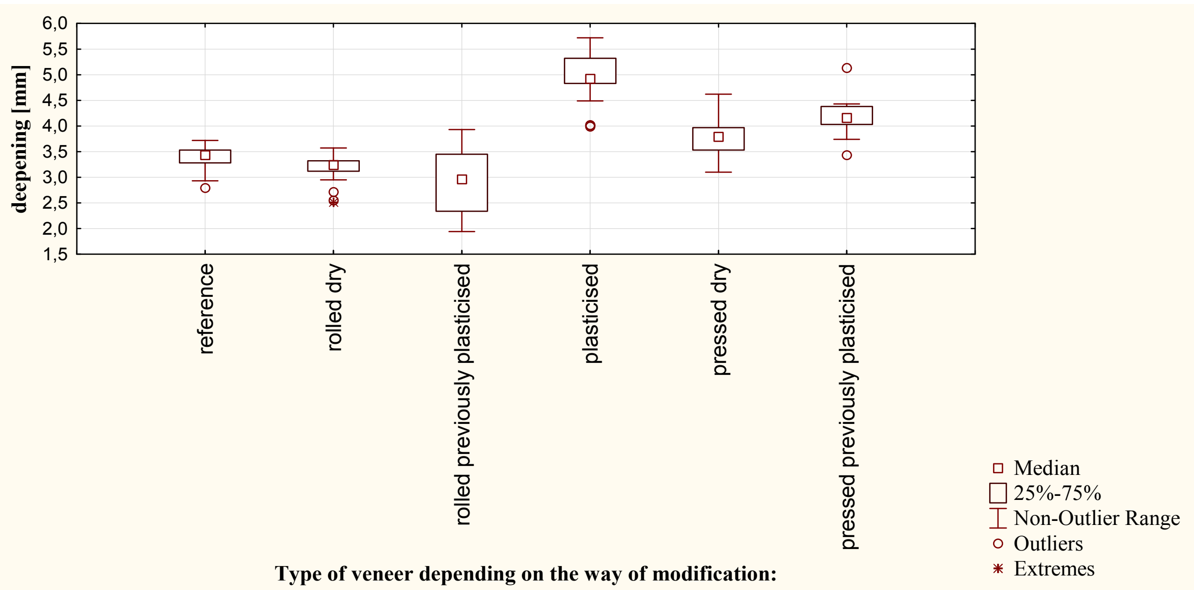

Fig. 4 Value of deepening at testing of formability of veneers with peripheral holder of specimen depending on the way of modification of veneer

CONCLUSION

The improvement of formability of veneers is a difficult and a complex task. In our research we focused on modification of veneer properties through compression (by rolling and pressing) and plasticisation. Our results showed that plasticisation can significantly affect

3D-formability of veneers. Compression did not result in substantial changes of 3D-formability of veneers.

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Streszczenie: *Formowanie 3D walcowanych, prasowanych i uplastycznionych fornirów*. W celu poprawienia formowalności fornirów, zostały one poddane procesom walcowania, prasowania i uplastyczniania. Modyfikacje związane z walcowaniem i prasowaniem nie spowodowały znaczących zmian w procesie formowania.

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