

1. Luka PANIĆ, 2. Atif HODŽIĆ, 3. Ekrem NEZIREVIĆ

## MODERN AND SOPHISTICATED PROCESSES OF 3D VENEER PLYWOOD BENDING

1. PANA CONSULTING s.p., BOSNIA & HERZEGOVINA

2-3. University of Bihać, Faculty of Technical Engineering, BOSNIA & HERZEGOVINA

**Abstract:** Under modern processes of 3D veneer plywood bending we consider creation and using of new technologies. This work emphasizing the importance of technological change of processes and products made from plywood panels, in order to ensure competitiveness in the domestic and foreign market. 3D plywood was created as a response to the increased demand for products that can be moulded into complex 3D forms, like metal or plastic. However, in this case appears well-known problem of anisotropy of wood. This problem is solved by patented mechanical modification of wood. 3D plywood panels opening up new possibilities in the design of chairs, curved fronts for furniture in three dimensions, as well as veneer interior for luxury cars or yachts.

**Keywords:** modern processes, 3D plywood panels, bending

### INTRODUCTION

Survival, growth and development are the main goals the of which inevitably narrows the company producing furniture from plywood, in the dynamics of business processes. Development strategy and business policy, as instruments for the realization of these objectives, using known and acceptable modern production processes to stable operations, and thus the growth and development of companies in the domestic and foreign markets. [1]

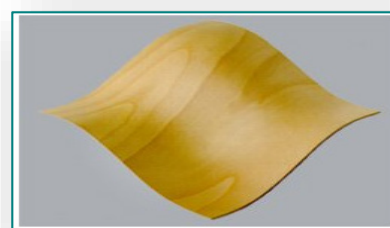
We live in a time of three dimensions. In all spheres of life there is use of 3D technology: 3D movies, 3D movies, 3D animation, 3D ultrasound. Therefore felt need to produce 3D plywood, which would suppress plastic and metal from the production of furniture, that are dominant in the last decade compared to wood.

However, there is a question of the anisotropy of wood or dissimilar physical and mechanical properties of wood in different anatomical directions. Although the thickness of the veneer is small (typically 0.5 mm to 1.0 mm) they also behave differently when bending in the different anatomic directions. [2] For shallow forms such as filling in of frame construction veneers are relatively easy to bend. However, if we want to build a more complex three-dimensional form, veneers are the most frequently forced to break down. Same thing, but to a much greater extent, occurs with plywood.

This work examines and describes some conventional techniques of bending plywood that are common to the manufacturer in the region, but have their limitations. [3] Special attention was given to the mechanical bending modified veneers that have very similar behavior in all anatomic directions and can be bent into complex 3D shapes.



a)



b)

**Figure 1.** Three-dimensional (3D) veneer plywood produced by bending, from: a) peeled veneer b) mechanically modified veneer [5]

## GOAL AND SUBJECT OF WORK

Radical changes in technology have accelerated the emergence of the so-called modern production technologies (processes), and caused the technological competitiveness become key determinants of business performance. Long-term profitability of the company assumes a successful strategic management of technology, the basis of which is exactly the technological changes, modern production processes.

The subject of this work is to improve production in bending plywood, adopting modern industrial and bending process 3D plywood.

The aim of this work is to analyze the modern production process of bending plywood, which contribute unlimited possibilities of designing and producing furniture from 3D veneer sheets.

## BENDING OF PLYWOOD

Today, more and more there is a need for bending plywood. Methods plywood bending may be different, but they all have a common goal and that is to bend the plate with the desired radius and that they maintain the shape and not become damaged. On the market there are special plywood designed for bending.

## CONVENTIONAL TECHNIQUES OF PLYWOOD BENDING

One of the most simple methods of plywood bending is steaming of panel in a closed vessel. The workpiece is placed in a chamber for holding the mating fixed time, which depends on the thickness of the plate and typically is calculated so that for each centimeter of thickness of plate takes 25-30 minutes. After steaming, the panel is folded over the template, attaches stage or in some other way, and so holds until dry. This method of bending largely depends on the quality of glue and gluing method, and there is always a risk of layering sheets of veneer.

Another method bent plywood is a method of plate threading. On the inner side that will be facing the molds, a series of parallel cuts of a certain depth by means of circular saw or a series of circular saw while cutting depth does not exceed two-thirds of the plate thickness. Adhesive is applied to the threaded side in an amount sufficient to fill the cuts to make stable structure. The plate is placed in a mold with the second threaded plate, so that their threaded sides facing one another, and remain in the mold until the adhesive does not harden. [3]

## MODERN TECHNOLOGIES OF 3D PLYWOOD BENDING

3D plywood panels were created in response to increased demand for products from wood which can be shaped in a mold in three dimensions, like metal or plastic. And in this case, appears well-known problem of the anisotropy of wood. This

problem is solved by patented mechanical modifications veneer. This product opens up new possibilities in the design of chairs, curved fronts for furniture in three dimensions, as well as veneer interior luxury cars or yachts.

3D plywood panels can be found in unexpected places, such as in the interior of a luxury car, as the center console with the BMW X5, also used in the veneering of expensive medical equipment such as MRI Siemens and Loewe Opta TV whose body is veneered with exotic veneers.

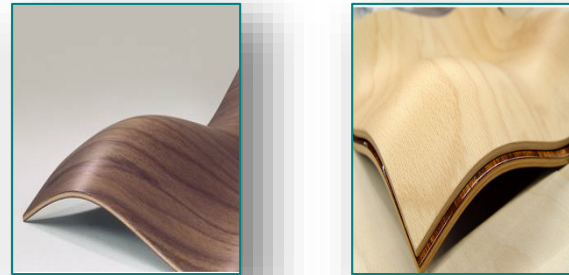


Figure 2. Trodimenzionalne (3D) furnirske ploče [7]

3D plywood panels are made with surface layers of peeled veneer beech, or sliced veneer beech, all kinds of walnut, oak or cherry, which were previously mechanically modified, so their texture remains unchanged. The inner layers are made of peeled beech veneer. The thickness of three-dimensional plywood ranges from 1.5 to 20mm. Veneers are glued to plywood (molding) in a mold (template) with male and female or in diaphragm presses by applying the UF glue for hot or cold bonding. [7]

By applying 3D plywood, designers open a wide field for the realization of ergonomic design. The chair made of three-dimensional plywood weighs only 2 kilograms (Figure 4), indicating more efficient use of wood.



Figure 3. The process of making 3D plywood with male and female template [8]

Three-dimensional plywood can be combined with conventional, two-dimensional veneer sheets, so that only certain parts of products are made from plywood 3D (Figure 5).





Figure 4. Chair „Three skin“ [7]



Figure 5. One-piece plywood seat and back [5]

By using three-dimensional plywood we stepped into a new world and open the possibility of producing so far hardly imaginable product. Thus once again we return to the wood its rightful place as a warm, generous, environmentally clean and renewable material.

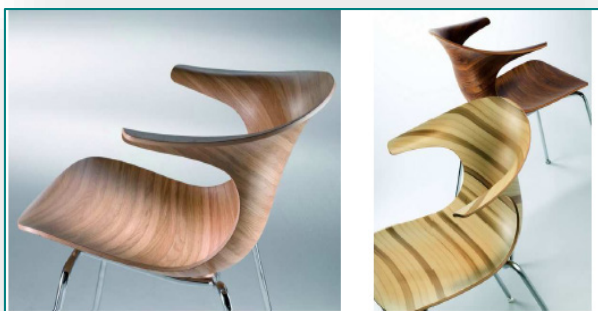


Figure 6. Stilica „Loop“ [6]

#### RESEARCH OF FUTURE USE 3D PLYWOOD

The research future applications of 3D plywood is in progress, and one of the main objectives is to increase the degree of possible deformation in order to obtain moldings with strong relief contours. On that way veneer would continuously follow the contours of the edges and corners of the boards.

By development and application of CAD/CAM software, it is possible, prior to construction, a software simulation of usage and analyze the behavior of the product that will be happening in the operation. Thus we are able to advance to make certain corrections - if it turns out that the original version does not meet the predicted requirements. Therefore the development of the product is significantly cheaper and the process of development is shortened because the prototype selects only product that meets the functional and aesthetic criteria.

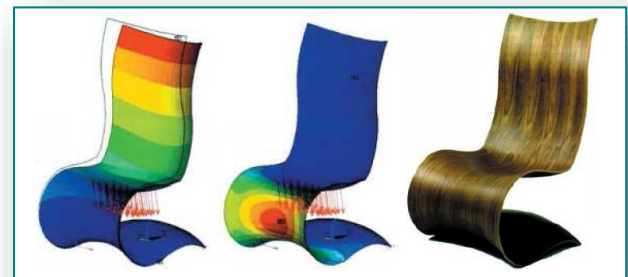


Figure 7. The software analyzes the load of the seat and backrest with chairs "XUS" (Designer: Peter Karpf, a Dane, Producer: iform, plugs) [7]

#### CONCLUSION

In modern conditions of competition, great risk is taken by the enterprises that do not adopt modern processes production and develop new products. Such companies will find that their products are victims of changing needs and tastes of consumers, shortened product life cycle and the increasing domestic and foreign competition. At the same time, new product development can be very risky, especially because of the high cost of the development process.

We live three time dimensions and all spheres of life resulting 3D technology. Therefore felt need to produce 3D plywood in response to increasing demand for products that can be formed in molds in 3D.

The modern process of 3D bending plywood is based on the application of veneers that are mechanically modified so that their texture is retained. 3D plywood panels are made with an external layer of peeled or sliced veneer beech, walnut, oak or cherry, while the inner layers are made from peeled beech veneer. Veneers are bonded (3D plywood) in a mold with a male and

female plate, with the use of special UV glue for hot or cold bonding.

Application of modern production processes in the furniture industry opens unlimited possibilities in the design of unusual furniture forms, by which we beautify the living space and once again we return to the wood its rightful place as a warm, generous, environmentally clean and renewable material.

#### Note

This paper is based on the paper presented at The 12th International Conference on Accomplishments in Electrical and Mechanical Engineering and Information Technology – DEMI 2015, organized by the University of Banja Luka, Faculty of Mechanical Engineering and Faculty of Electrical Engineering, in Banja Luka, BOSNIA & HERZEGOVINA (29th – 30th of May, 2015), referred here as [9].

#### REFERENCES

- [1.] Skakić D., Krdžović A. (2002): Finalna prerada drveta, Šumarski fakultet, Beograd
- [2.] Nikolić M. (2004): Furniri I slojevite ploče, Građevinska knjiga, Beograd
- [3.] Ćurčić S. (2006): Nekonvencionalni procesi obrade, Fakultet tehničkih nauka, Novi Sad
- [4.] Robotić V. (1984): Dizajn i razvoj proizvoda od drveta, Osijek
- [5.] <http://www.danzer.com>;
- [6.] <http://www.tapo.hr>;
- [7.] <http://www.reholz.de>
- [8.] <http://lego.fordeq.com>.
- [9.] Luka Panić, Atif Hodžić, Ekrem Nezirević, Modern and sophisticated processes of 3d veneer plywood bending, The 12th International Conference on Accomplishments in Electrical and Mechanical Engineering and Information Technology – DEMI 2015



**ACTA Technica CORVINIENSIS**  
BULLETIN OF ENGINEERING

**ISSN:2067-3809**

copyright ©

University POLITEHNICA Timisoara,  
Faculty of Engineering Hunedoara,  
5, Revolutiei, 331128, Hunedoara, ROMANIA  
<http://acta.fih.upt.ro>