

The bending properties of laminated wood combined with plastic

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Abstract: *The bending properties of laminated wood combined with plastic.* In the article we present the bending properties of laminated wood produced by the combination of beech veneer and plastic. The combination of wood and plastic enables us to create materials with different properties compared to solid wood. A small decrease in bending strength was demonstrated greater bendability laminated timber.

Keywords : laminated wood, veneer, foil, plastic, bend, bendability

INTRODUCTION

Wood is a natural material, the properties of which are determined genetically by tree species, by conditions for their growth, and cultivation interventions (ZEMIAR, GÁBORÍK 1993). Wood properties, not always satisfactory for certain areas of application, are motivation for improvement of them – and for orientation of research activities. New properties of wood materials can be obtained by layering of wood (ZEMIAR et al.1993, VILHANOVÁ, DUDAS 2013).

In our case, we focused on development of a new type of composite layered material formed on the base of wood and plastic bonded with a suitable adhesive.

MATERIALS AND METHODS

Processes of layering of wood and combining it with other materials, gluing of individual layers with various adhesives, and combining of various thicknesses of individual lamellas and their orienting, enable to obtain materials with different properties.

In the laminated wood, veneers are placed in longitudinal direction in all layers, i.e. wood grain direction is oriented in the longitudinal direction of laminated wood (Fig. 1). (ZEMIAR et al.1993)

For our research, we chose:

- 2 types of material (beech veneer, PVC – foils),
- 1 type of adhesive (polyurethane - PUR).

We researched properties of the layered material entirely consisting of beech veneer (Fig. 1a) and properties of the layered material consisting of wood and plastic, glued according to a construction given in Figure 1b. The construction was chosen in such a way that under bending load, both these materials were present in the zone of great pressure and tensile stresses, i.e. near the surface of layered material.

To compare the properties, we also researched the properties of solid beech wood with mean wood moisture content $w = 9 \%$.

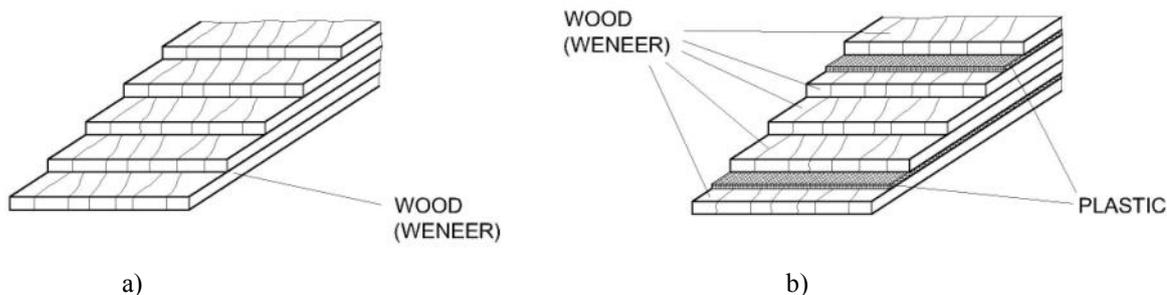


Fig. 1 Laminated wood

a) composed from beech veneers – type A; b) composed from beech veneers and plastic foils – type B

The properties of the researched materials were assessed on the base of deflection, bending strength, and modulus of elasticity in specimens with dimensions of 10×50×300 mm. Statistical set consists of 10 specimens for each test.

RESULTS AND DISCUSSION

The base for evaluation of properties of designed construction of laminated wood were the bending tests; on the base of which it is possible to quantify the properties of the construction. Test results are given in Table 1 and shown graphically in a coordinate system “deflection (y) – tension (σ)” for each tested set (Figure 2). In all the cases the graphs have a typical course.

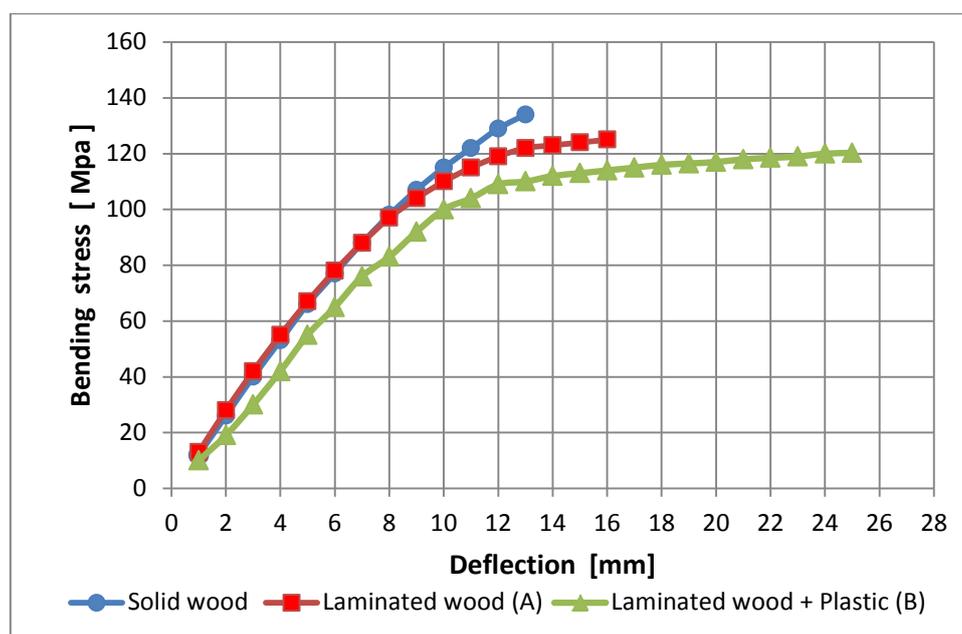


Fig. 2 Relation deflection - stress at strain into bend

Solid wood = beech wood;

Laminated wood (type A) = beech veneers;

Laminated wood + Plastic (type B) = beech veneers and PVC plastic foils

Bending strength is a property researched in terms of dimensioning of cross-sections of materials applied in construction of products. It has been demonstrated that materials layered according our compositions do not reach the strength of solid wood. Lowering of strength was about 4 ÷ 6 % when compared with solid wood.

For evaluating the deflection, we can clearly state that chosen plastic material (PVC foil) influences deflection significantly. As the aim was to contribute to increased toughness of the material (designed material when compared with solid wood), increasing deflection is not a negative phenomenon, but positive. The deflection was increased by 56 % when compared with solid wood.

Table 1 Bending properties of solid and laminated wood

Properties	Solid wood	Laminated wood	
		Type - A	Type - B
Bending strength - σ [Mpa]	134	125	120
Modulus of elasticity - E_o [Mpa]	14034	12116	10365
Deflection - y_{max} [mm]	13	16	25
Minimum bending radius - R_{min} [mm]	391	319	206

Modulus of elasticity expresses the internal resistance of the material against elastic deformation. The greater is modulus of elasticity, the greater tension is needed to induce deformations (Požgaj et. al 1993). The data show that the lowest values of modulus were achieved in materials with PVC foils; it is indicating that in these materials, in the area of elastic deformations, there are the same deformations in a lower tension, respectively in smaller load (if constant cross-section of the bent material).

Improved bendability of laminated wood with plastics (PVC) is confirmed also by **minimum bending radius** (R_{min}); the radius that can be achieved in bending. In this characteristic we reached an improvement by 35 %.

CONCLUSIONS

Combination of wood and plastics enables to create materials with properties different from the properties of solid wood. At given composition, when compared with solid wood, the laminated wood showed an increased bendability (at only a small decrease of strength) and increased toughness.

Final properties are influenced also by the type of adhesive. With other types of adhesives can be achieved properties different from the properties reached in our experiment.

Practical application of designed materials is particularly in the field of dynamic loading, for instance as parts of vibrating mechanical mechanisms or in construction of bed and sitting furniture, sports equipment, etc.

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Streszczenie: *Podatność na gięcie drewna warstwowego modyfikowanego tworzywami sztucznymi.* Praca opisuje podatność na gięcie drewna warstwowego powstałego przez spajanie fornirow bukowych oraz plastiku. Taki kompozyt ma własności mechaniczne różne od własności jego poszczególnych składników, testy wykazały większą podatność na gięcie przy nieco zmniejszonej wytrzymałości kompozytu, w porównaniu do drewna litego.

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