BOOK OF ABSTRACTS

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WOOD TECHNOLOGY & PRODUCT DESIGN

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Ss. Cyril and Methodius University in Skopje
Faculty of Design and Technologies of Furniture and Interior – Skopje, Republic of North Macedonia

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WOOD TECHNOLOGY & PRODUCT DESIGN

4– 7 SEPTEMBER, 2019
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REPUBLIC OF NORTH MACEDONIA

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4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

CONTENTS

Nencho Deliiski, Goran Zlateski, Natalia Tumbarkova, Dimitar Angelski
MODEL PREDICTIVE CONTROL OF CONVECTIVE DRYING PROCESS OF LUMBER 1

Nencho Deliiski, Natalia Tumbarkova, Neno Trichkov, Zhivko Gochev, Dimitar Angelski
COMPUTATION OF THE THERMAL CONDUCTIVITY OF FLAT WOOD DETAILS IN A MODEL OF THEIR ONE SIDED HEATING BEFORE BENDING 2

Marija Djurkovic, Mira Miric Milosavljevic, Vladislava Mihailovic, Gradimir Danon
TOOL WEAR IMPACTS ON CUTTING POWER AND SURFACE QUALITY IN PERIPHERAL WOOD MILLING 3

Ladislav Dzurenda, Michal Dudiak
THE EFFECT OF THE TIME AND TEMPERATURE OF SATURATED WATER STEAM ON THE ACIDITY AND WOOD COLOUR IN THE PROCESS OF THERMAL MODIFICATION OF SILVER BIRCH WOOD COLOUR 4

Goran Zlateski, Branko Rabadjiski, Nencho Deliiski Zoran Tposki, Vladimir Koljozov
CONTINUAL VACUUM DRYING OF BEECH (FAGUS SYLVATICA L.) WOOD WITH DIFFERENT THICKNESS 5

Violeta Jakimovska Popovska, Borche Iliev, Julija Mihajlova
SCREW WITHDRAWAL RESISTANCE OF COMPOSITE WOOD-BASED PANELS (PART II) 6

Violeta Jakimovska Popovska, Borche Iliev, Julia Mihajlova
PHYSICAL PROPERTIES OF PLYWOOD DURING PROLONGED WATER EXPOSURE 7

Violeta Jakimovska Popovska, Borche Iliev
CHARACTERISTICS OF COMMERCIAL ORIENTED STRAND BOARDS (OSB) PRESENT ON THE MARKET 8

Konstantin Marinov
A THEORETICAL ANALYSIS OF THE FORESTRY AND WOOD PROCESSING MACHINES WITH SCREW DEVICES 9

Mira Mirić-Milosavljević, Vladislava Mihailović, Marija Đurković
IMPACT OF THE LOADING RATE ON MOR AND MOE OF THE PARTICLEBOARD USING A STANDARD BENDING TEST 10

Emil Kitchoukov, Nikolay Neykov, Tsvetelina Simeonova-Zarkin, Vladimir Mihailov, Borislav Yanakiev
ANALYSIS AND ESTIMATION OF THE PROFITABILITY OF FOREST CERTIFICATION OF WOOD PROCESSING FACILITIES IN EXPERIMENTAL FORESTRY ENTERPRISES - YUNDOLA AND BARZIA 11

Viktor Savov, Petar Antov, Nikolay Neykov
COMPARATIVE CHARACTERISTICS OF EXPLOITATION PROPERTIES OF MDF MANUFACTURED WITH PARTICIPATION OF NON-WOOD LIGNOCELLULOSIC RAW MATERIALS 12

Nikolay Neykov, Emil Kitchoukov, Tsvetelina Simeonova – Zarkin, Vladimir Mihailov, Borislav Yanakiev
INFLUENCE OF FSC CoC CERTIFICATION ON PLYWOOD PRODUCING ENTERPRISE PROFITABILITY 13

Samet Demirel, Gamze Kalayci
COMPARISON OF USING DIFFERENT GUSSET-PLATE MEMBER IN WOOD JOINTS 14

Dimitrios Tsalagkas, Zoltán Börcsök, Katalin Halász, Levente Csóka, Zoltán Pásztory
BIO-BASED ECONOMY CASE STUDIES AT UNIVERSITY OF SOPRON 15

Zoltán Börcsök, Dimitrios Tsalagkas, Zoltán Pásztory
EFFECT OF POST-HEAT TREATMENT ON THE THERMAL CONDUCTIVITY VALUES OF LOW-DENSITY BOARDS MADE FROM LIME BARK PARTICLES 16

Natalia Tumbarkova, Nencho Deliiski
EXPERIMENTAL RESEARCH OF SOME PARAMETERS OF THE LOGS' FREEZING PROCESS 17

Julia Mihajhlova, Borche Iliev, Violeta Jakimovska Popovska
RESEARCH ON THE PROPERTIES OF LIGHT BOARDS FROM LIGNO-CELLULOSE MATERIALS AND CEMENT 18

Marija Rashković
FOLK TREASURE IN SPACE AND ART 19

Mitko Nacevski, Borche Iliev, Violeta Jakimovska Popovska
VARIATIONS OF THE HARDNESS OF BALKAN BEECH WOOD (*FAGUS MOESIACA CZ.*) 20

Josip Ištvanić, Krešimir Greger, Ivana Perić, Marko Pečenec, Alan Antonović
LUMBER VOLUME YIELD FROM BLACK WALNUT (*JUGLANS NIGRA* L.) LOGS 21

Mitko Nacevski, Borche Iliev, Violeta Jakimovska Popovska
DETERMINATION OF THE FIBER SATURATION POINT OF AUTOCHTHONOUS AND ALLOCHTONOUS WOOD SPECIES 22

Branko Rabadjski, Goran Zlateski, Neno Trichkov
MAXIMUM QUANTITATIVE YIELD OF HARDWOOD LOGS IN THE TECHNOLOGY OF SAWMILL PROCESSING 23

Elena Nedelkoska, Frédéric Pichelin, Thomas Volkmer, Marion Noël, Benoît Canoine
PROPERTIES OF SELECTED WOOD COATINGS APPLIED ON THM - DENSIFIED NORWAY SPRUCE (PICEA ABIES K.) 24

Zhivko Gochev, Pavlin Vitchev, Georgi Vukov
DETERMINATION OF PERFORMANCE INDICATORS AND QUALITY OF TCT KNIVES WHEN SHARPENED WITH PCD GRINDING WHEELS 25

Georgi Vukov, Valentin Slavov, Pavlin Vitchev, Zhivko Gochev
INVESTIGATIONS OF THE FREE SPACE VIBRATIONS OF A WOODWORKING SHAPER, CONSIDERED AS A MECHANICAL SYSTEM WITH THREE MAIN BODIES 26

Georgi Vukov, Pavlin Vichev, Valentin Slavov, Zhivko Gochev
FREE DAMPED SPACE VIBRATIONS OF A WOODWORKING SHAPER, CONSIDERED AS A MECHANICAL SYSTEM WITH THREE MAIN BODIES 27

Panayot Panayotov, Kancho Kalmukov, Momchil Panayotov, Todor Petkov
QUALITY OF CEDRUS ATLANTICA MAN.WOOD 28

Jevtic Petronije, Mimica Stefanovic, Jovana Džoljić, Anastasija Temeljkova
THE MOST COMMON SECONDARY XYLOPHAGOUS INSECTS SPECIES IN LOG WAREHOUSE 29

Petronije Jevtić, Ljiljana Stošić Mihajlović
SUSTAINABLE FOREST MANAGEMENT AS THE QUALITY OF WOOD PRODUCTS AND COMPETITIVENESS OF SERBIA 30

Olga Popovic Larsen
INNOVATIVE ARCHITECTURAL TIMBER STRUCTURES BASED ON RECIPROCAL FRAME (RF) PRINCIPLES 31

Zoran Janjić
PAULOWNIA - RENEWABLE SOURCE OF ENERGY OF THE FUTURE 32

Atif Hodžić, Redžo Hasanagić, Salah Eldien Omer
THE PROBLEM OF THE CONSTRUCTION BY DESIGNING PRODUCTS 33

Konstantinos Ninikas, George Ntalos, Andromahi Mitani, Dimitrios Koutsianitis
ENERGY POTENTIALS FOR BUILDING MATERIALS FROM CELULAR BASED WASTE AND BY-PRODUCTS 34

Dea Beatović, Elena Nikoljski Panevski
RESTAURANT INTERIOR DESIGN 35

Vladimir Karanakov
ANALISIS OF POTENTIAL FOR DEVELOPMENT OF RURAL TOURISM THROUGH THE PRISM OF ARCHITECTURE AND DESIGN IN THE REGION OF MALESIA 36

Nikola Mihajlovski, Konstantin Bahchevandziev
CARE AND MAINTENANCE OF LEATHER UPHOLSTERED FURNITURE WITH TRADITIONAL LEATHER CONDITIONERS 37

Anastasija Temelkova, Petronije Jevtic
RESISTANCE OF WOODEN LACQUERED SURFACES TO UNSTITCHING 38

Dimitar Angelski
SHAPE STABILITY OF CURVED FURNITURE PANELS MADE OF INTERNAL PRISMATIC FIBERBOARD LATHS LAMINATED WITH MDF PANELS 39

Elena Nikoljski Panevski, Ivo Kanevce
QUALLITY OF THE WOODEN MATERIAL IN OUTDOOR FURNITURE 40

Elena Nikoljski Panevski, Emilija Tashkova
URBAN FURNITURE DESIGN 41

Mladen Furtula, Igor Džinčić, Srđan Svrzić
CNC WOOD MACHINES ACCURACY AND REPEATABILITY 42

Vladimir Koljozov, Zoran Trposki, Branko Rabadjiski, Goran Zlateski Vladimir Karanakov
RESEARCH ON THE EFFECTS OF THE CUTTING SPEED ON CUTTING FORCE AND THE CUTTING POWER IN THE PROCESS OD MILLING 43

Gjorgi Gruevski, Nacko Simakoski, Borislav Kjuchukov
EXAMINATION OF SOME STRENGTHS OF DISMOUNTABLE CORNER JOINTS IN THE CONSTRUCTION OF FURNITURE MADE OF PARTICLE BOARDS 44

Nadir Ayrilmis
THE SURFACE PROPERTIES OF OSB PAINTED USING ELECTROSTATIC POWDER COATING PROCESS 45

Nadir Ayrilmis
USE OF NATURAL FIBER REINFORCED BIO-PLASTIC FILAMENTS FOR 3D PRINTERS AS ALTERNATIVE TO PETROLEUM-BASED PLASTIC FILAMENTS 46

Nadir Ayrilmis
RECENT DEVELOPMENTS IN THE MANUFACTURE AND APPLICATION OF NATURAL FIBER REINFORCED THERMOPLASTIC COMPOSITES 47

Neila Fetić, Atif Hodžić
DESIGN OF INTERIOR FURNITURE 48

Maja Moro
TRENDS OF NUMBER OF WOOD TECHNOLOGY STUDENTS SINCE INTRODUCTION OF THE BOLOGNA PROCESS IN UNIVERSITY TEACHING IN CROATIA 49

Václav Sebera Jaka Gašper Pečnik, Boris Azinovič, Miha Kramar
NUMERICAL MODELING OF WOOD-ADHESIVE BOND-LINE IN MODE II FOR SPRUCE WOOD GLUED BY VARIOUS ADHESIVES 50

Goran Milić
DRYING OF HARDWOOD TIMBER - SCIENCE AND INDUSTRY..... 52

Milan Šernek, Jaša Saražin
BONDING OF WOOD AND OTHER MATERIALS..... 53

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

MODEL PREDICTIVE CONTROL OF CONVECTIVE DRYING PROCESS OF LUMBER

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ABSTRACT

A programmable control system for the convective drying process of lumber in chambers is developed, based on specially designed drying algorithm, which allows for computing the set-point values for the temperature and the relative humidity of the heating and drying air as a function of the wood species, lumber thickness and the initial and desired final wood moisture content.

The system allows for the carrying out of model predictive automatic control, at which after the introduction by the operator of data about the wood species and the thickness of the lumber, as well as the initial moisture content and the desired final value of the moisture content, the programmable controller in the system calculates the current values for the temperature and the relative humidity of the processing air medium, and also the duration of the separate stages of the drying process and carries out an automatic realizing of the computed parameters.

An application of the developed system for predictive automatic control of the convective drying process of pine lumber with thicknesses of 32 mm and 76 mm is given and visualized.

Keywords: convective drying process, lumber, automatic control, programmable controller.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

COMPUTATION OF THE THERMAL CONDUCTIVITY OF FLAT WOOD DETAILS IN A MODEL OF THEIR ONE SIDED HEATING BEFORE BENDING

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ABSTRACT

Mathematical descriptions of the thermal conductivity λ_w, specific heat capacity c_w, heat transfer coefficient α_w, and density ρ_w of the non-frozen wood in the hygroscopic range have been introduced in own 1D non-linear mathematical model of one sided conductive heating process of flat wood details. For the numerical solution of the model a software program has been prepared in the calculation environment of Visual FORTRAN Professional. With the help of the program, the 1D non-stationary temperature distribution along the thickness of subjected to one sided conductive heating flat wood details aimed at their plasticizing in the production of curved back parts of chairs has been calculated. The change of λ_w for beech details with an initial temperature of 20 ^oC, moisture content of 0.15 $kg.kg^{-1}$, and thicknesses of 12 mm, 16 mm, and 20 mm during their 30 min one sided heating at temperature of 100 ^oC of the heating metal body has been also computed, visualized and analyzed.

Keywords: flat wood details, one sided heating, thermal conductivity, plasticizing, bending.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

TOOL WEAR IMPACTS ON CUTTING POWER AND SURFACE QUALITY IN PERIPHERAL WOOD MILLING

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ABSTRACT

The aim of the research presented in this paper is to determine the impacts of tool wear on the cutting power and quality of the processed surface, as the selected workability criteria for different peripheral milling regimes. The test was carried out on test samples made from beechwood (*Fagus silvatica L*) planks of uniform density and moisture content and without visible wood structure flaws. The tool wear in this paper was defined using the values of flank wear width before and after peripheral milling of beech samples. The dependences of the examined criteria (cutting power and surface quality) on the level of tool wear in different processing regimes were formed. On the basis of the obtained test results, it can be concluded that tool wear undoubtedly significantly affects the cutting power and processed surface quality, which could be important for determining the cutting regime and the interval of tool replacement.

Keywords: solid wood milling, tool wear, cutting power, surface quality.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

THE EFFECT OF THE TIME AND TEMPERATURE OF SATURATED WATER STEAM ON THE ACIDITY AND WOOD COLOUR IN THE PROCESS OF THERMAL MODIFICATION OF SILVER BIRCH WOOD COLOUR

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ABSTRACT

The aim of the paper is to determine the correlation between the change in acidity and the colour of wood species *Betula pendula Rot.* in the CIE-L*a*b* colour space in the process of heat treatment of woodturning blanks with the dimensions of 40 x 90 x 800 mm with the saturated water steam in the range of temperatures from t = 105 to 135 °C and the time of heat treatment from τ = 3 up to 12 hours.
Wet silver birch wood changes pH in the range of pH = 5.3 ÷ 3.2 due to partial hydrolysis of hemicelluloses and extraction of water-soluble substances and loses whiteness (gets darker). By increasing the value of the coordinate of the red color a* and slight changes on the coordinate of yellow color b * acquires the color levels of varying intensity of brown color.
Colour coordinates of birch wood in the CIE L*a*b* colour space with dependence on temperature of saturated water steam *t* and the time of heat treatment *τ* are described using the equations:

$L^* = 83.6232+0.4815 \cdot t-1.9377 \cdot \tau -0.0041 \cdot t^2-0.0068 \cdot t \cdot \tau +0.1091 \cdot \tau^2$,
$a^* = 6.7847-0.0795 \cdot t+1.2265 \cdot \tau+0.0007 \cdot t^2-0.0026 \cdot t \cdot \tau-0.0511 \cdot \tau^2$,
$b^* = 19.8107-0.0014 \cdot t +0.7326 \cdot \tau-9.3472E-5 \cdot t^2-0.0027 \cdot t \cdot \tau-0.0255 \cdot \tau^2$.

Keywords: wood, silver birch, CIE-L*a*b* colour space, heat treatment, saturated water steam .

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

CONTINUAL VACUUM DRYING OF BEECH (FAGUS SYLVATICA L.) WOOD WITH DIFFERENT THICKNESS

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ABSTRACT

Drying in a vacuum has long time is considered as an attractive method for wood drying wood because drying rates are usually high and degrade is minimal. As compared with drying at the atmosphere pressure the principal advantage of vacuum drying of materials is that it provides certain intensification of this process and enables to carry it on lower temperature. The objective of this study is to evaluate the vacuum drying of beech wood with different thickness in terms of drying time, drying rate, moisture content variation and quality of drying. To evaluate the effect of the wood size on the drying rate, three different thicknesses 25, 38 and 50 mm were dried in a several runs in continues vacuum drying with the maximum temperature of 60 °C from different initial MC to 10 % final MC, at a pressure of about 600 mm Hg. Data analysis indicated high differences between various drying times and drying rates of different thickness of wood. Specimens 25 mm from MC of 60 % dried the fastest 47.6 h with average drying rate of 1,208 %/h . Specimens 32,0 mm dried slower 70.4 h, 0.837 %/h and those of 50 mm dried the slowest 90.5 h, 0,617 %/h. Additionally, the experiments also demonstrated that for all three specimens thickness below the fiber saturation point (FSP) the drying rate are significantly smaller about 50 % compared with rates above FSP. According to the International standard for evaluation of drying quality, it was observed that the drying quality was good, with no colour change not any visible drying defects. This experiment also indicates that that is possible to dry beech lumber in continues vacuum with reasonable drying rates in contrast to the conventional drying.

Keywords: beech wood, vacuum drying, drying time, drying rate, quality classes.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

SCREW WITHDRAWAL RESISTANCE OF COMPOSITE WOOD-BASED PANELS (PART II)

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ABSTRACT

The aim of the research presented in the paper is to determine the screw withdrawal resistance of composite wood-based panels intended for use in construction.

For this purpose, three experimental wood composite panels were made by combining particleboards and constructive peeled veneers of beech, black pine and poplar with thickness of 1,5 and 3,2 mm. The core layer of the composite panels was made of single-layer particleboard with thickness of 16 mm which was overlaid on both sides with two-ply cross-laminated veneers. Models of composite panels were made by combining a different veneer species for particleboard overlay (beech/black pine, poplar/black pine and poplar/beech).

Water-soluble phenol-formaldehyde resin was used for particle bonding and veneering.

The results from the research showed that the different combination of veneer species used for particleboard overlay significantly impact the screw withdrawal resistance of composite panels.

According to the obtained values of the screw withdrawal resistance, composite panels can be used in construction.

Keywords: composite wood-based panels, particleboard, veneer, beech, black pine, poplar, phenol formaldehyde resin, screw withdrawal resistance.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

PHYSICAL PROPERTIES OF PLYWOOD DURING PROLONGED WATER EXPOSURE

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ABSTRACT

The aim of this research is to study the physical properties of experimental plywood bonded with alcohol-soluble phenol-formaldehyde resin during prolonged water exposure. On the basis of the obtained data for the changes of the physical properties of plywood after exposure to prolonged water treatment of 192 days, water resistance of experimental plywood is evaluated. Tests for the thickness swelling, volume swelling and water absorption are made after immersion in water for prolonged period in controlled laboratory conditions. The measuring of thickness, length, width and mass of plywood test specimens for determination of these properties is made after immersion in water for the period of 1 day (24 hours) to 192 days (4608 hours).

Plywood model in this experiment was made from peeled beech veneers bonded with pure alcohol-soluble phenol-formaldehyde resin.

The results from the research showed that the plywood model is characterized by uniform density; it is dimensionally stable during and after prolonged water exposure, without any deformations of the shape of the test specimens. The changes of the values of thickness and volume swelling, as well as the values of water absorption in the analyzed period are proportional to change of the duration of the period of water exposure.

According to the obtained data from the tests of these properties the plywood model meets the requirements for load-bearing plywood for use in construction.

Keywords: plywood, alcohol-soluble phenol-formaldehyde resin, physical properties, water resistance, prolonged water treatment, thickness swelling, water absorption, dimensional stability.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

CHARACTERISTICS OF COMMERCIAL ORIENTED STRAND BOARDS (OSB) PRESENT ON THE MARKET

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ABSTRACT

The paper analyzes the properties of oriented strand boards (OSB) present on the market in our country. In past years there is an increased interest for construction of wooden buildings where the wood-based panels are one of the basic materials for structural and non-structural use. In such buildings different types of OSB can be used as load-bearing members or as general purpose board, as well as in dry or humid conditions depending on the place of incorporation in the building.

It is important to take an overview of the characteristics of these panels that are present in the market in our country, which will contribute in better understanding of the proper use of OSB according to their physical and mechanical properties.

Commercially produced OSB panels taken from one company from wood-based panel market were tested. Evaluation of the quality of the panels was made on the basis of the obtained results for the physical and mechanical properties of the panels. Properties of OSB panels were tested according to the national MKC standards and European norms.

Tested OSB panels taken from the market are not fully in accordance to the technical specification given by the manufacturer of these boards and the requirements of the standards for OSB panels for use as structural load-bearing panel. There are some deviations found in the quality of the panels in different panel's direction regarding to the obtained values of some of the tested properties.

Keywords: wood-based panels, oriented strand boards (OSB), physical properties, mechanical properties, construction.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

A THEORETICAL ANALYSIS OF THE FORESTRY AND WOOD PROCESSING MACHINES WITH SCREW DEVICES

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ABSTRACT

The forestry and wood processing machines with screw conveyors and screw presses for wood chips and forest seeds have wide application in the forestry and wood-processing industry. The utilization of the screw devices is due to some advantages they ensure at executing the technological processes, as for example unceasing of the process, high productivity, low levels of noise, dustless work, etc. The design of screws is in accordance with the determination of their main kinematic and dynamic parameters. Big part of the elaborated constructions is realized on the base of the practical experience. The relatively complicated transportation of products into the screw mechanisms makes difficult to express the process by mathematical means. This fact defines the problems with deducing of analytical relationships for determination of the main parameters of these mechanisms. In the present work some basic cinematics and structural parameters of the screw devices for processing and transportation forest seeds and wood chips are deduced and proposed.

Keywords: kinematics, wood chips, forest seeds, screw, pressure, speed, productivity.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

IMPACT OF THE LOADING RATE ON MOR AND MOE OF THE PARTICLEBOARD USING A STANDARD BENDING TEST

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ABSTRACT

According to the European Standard EN 310:1993 for the determination of the MOE and MOR of wood-based panels, it is necessary to select the loading rate on test samples, so that the maximum load is reached within 60 ± 30s (30-90s). During the test the sample often breaks after only a few seconds, therefore, far below the required lower time boundary. The results obtained for these samples should be discarded, otherwise the resulting values for the MOR and the MOE will be biased.

This paper is focused on the impact of the loading rate on the MOR and MOE of the particleboard in a standard bending test. The test was carried out in two ways: (i) using the maximum load that can be obtained on the test device, and (ii) by applying a much lower load, for which the sample failure occurs at the prescribed time interval. In either case, the given time for achieving the maximum load was the same, which resulted in significant differences in loading rates. The obtained results for the MOR and MOE were compared. Differences in the values obtained in the two applied loading rates indicate a potential error that can be made in determining the MOR and MOE if the requirement on the time prescribed to reach the maximum force is not fulfilled.

Keywords: particleboard, bending test, MOE, MOR, maximum load.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

ANALYSIS AND ESTIMATION OF THE PROFITABILITY OF FOREST CERTIFICATION OF WOOD PROCESSING FACILITIES IN EXPERIMENTAL FORESTRY ENTERPRISES - YUNDOLA AND BARZIA

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ABSTRACT

Forest certification plays an important role in helping and guaranteeing sustainable forest management. The interest in certification has increased in recent years. As of November 2017, the FSC-certified forestry holdings are 72, some of which are included in group certificates of the respective state-owned enterprises in whose territory they are located. The certified forest area in Bulgaria in November 2017 is 1 315 594 ha. Issues related to forest certification and sustainable woodworking management in the country are becoming increasingly important.

The main objective of the study is to analyze and evaluate the profitability of woodworking capacities in introducing the FSC Certificate for Sustainable Management of wood processing facilities in Experimental forestry enterprises - Yundola and Barzia These two enterprises are considered as model forestry enterprises, located in forest areas with high-grade coniferous and broad-leaved forests. The profitability of the wood processing plants of these enterprises over the last 5 years has been investigated and the impact of their forthcoming certification on their effectiveness has been studied.

The results obtained can be used as a guide in deciding on FSC FM / CoC certification for logging and tracking the production of woodworking enterprises in the country.

Keywords: sustainable management, forest industry, forest certification, economic analysis JEL: Q01, Q23.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

COMPARATIVE CHARACTERISTICS OF EXPLOITATION PROPERTIES OF MDF MANUFACTURED WITH PARTICIPATION OF NON-WOOD LIGNOCELLULOSIC RAW MATERIALS

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ABSTRACT

The shortage of wood raw material and the considerable amounts of agricultural waste and residues are one of the main environmental challenges today, which justify the relevance of studying the possibilities for utilization of non-wood lignocellulosic raw materials in the production of wood-based composites.

This article presents the study on the impact of including different non-wood lignocellulosic raw materials in the composition of MDF on their exploitation properties. Three types of non-wood lignocellulosic raw materials – maize stalks, industrial hemp stalks and thin bamboo stalks, were used for the purpose of the study. The materials were refined in laboratory conditions using defibrator disc mill. The panels were manufactured by using industrial wood-fibre mass and variation of non-wood raw materials from 10 to 40%. The main exploitation properties of MDF were determined and analysis on the possibilities of including the studied lignocellulosic raw materials in the composition of the panels was made.

Keywords: MDF, maize stalks, industrial hemp stalks, bamboo stalks, exploitation properties.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

INFLUENCE OF FSC CoC CERTIFICATION ON PLYWOOD PRODUCING ENTERPRISE PROFITABILITY

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ABSTRACT

The aim of the researches presented in the paper is to study the influence of the certification in FSC on the market expansion and profitableness of the plywood producer in Bulgaria. Penetration of the fast improving or well developed distribution markets can provide great marginal increment of return on equity.
For studying this influence, have been analyzed the main components of the economic efficiency before and after the certification. Problems appeard to the supply markets are considered in meaning of the supply chain costs in order to follow Chain of Custody requirements.

Alternatives for supplying the industrial roundwood of beech and poplar are assessed to outline the constraints in economic efficiency deriving after the FSC in the part of CoC certification.

Keywords: plywood, profitability, FSC, CoC.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

COMPARISON OF USING DIFFERENT GUSSET-PLATE MEMBER IN WOOD JOINTS

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ABSTRACT

In this study, lateral shear resistances of only glued joints constructed from three wood specie main member and two side members were investigated and compared. Scotch pine, alder and beech were used as main member (base member) while pine plywood and beech wood were used as side member (gusset-plate). Based on the results, in general, using beech wood gusset-plate in joints yielded significantly greater lateral shear resistances compared to the joint constructed from pine plywood gusset plate in each base member (Scotch pine, alder and beech). Changing wood base member from Scotch pine to Alder and Beech did not make any significant change in the joint with pine plywood gusset-plate. However, changing wood base member Scotch pine to Alder and Beech significantly increased the mean ultimate lateral shear resistances of the joints constructed from beech wood gusset-plate.

Keywords: lateral shear, gusset-plate, glued joints, wood joints, Scotch pine, alder, beech.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

BIO-BASED ECONOMY CASE STUDIES AT UNIVERSITY OF SOPRON

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ABSTRACT

Forest based sector plays a significant and inseparable role, through the transition and implementation of 'bioeconomy', 'bio-based economy', 'circular economy' concepts and strategies. This paper aims to report few bio-based economy case studies conducted at the University of Sorpon, and is divided in three parts. The first part describes the investigation efforts on the utilization of bark residues as a raw material for the manufacturing of thermal insulations panels. The second part is focused on the delignification of agricultural residues through an alkaline-hydrodynamic cavitation and examines their exploitation in paper and bioenergy production. Finally, the third part presents studies related to the fabrication of nanocellulose films and composites for various purposes.

Keywords: resource efficiency, bio-based insulation, hydrodynamic cavitation, nanocellulose.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

EFFECT OF POST-HEAT TREATMENT ON THE THERMAL CONDUCTIVITY VALUES OF LOW-DENSITY BOARDS MADE FROM LIME BARK PARTICLES

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ABSTRACT

Buildings in total, are reported to consume 40% of the EU's total energy demand and produce about 35% of greenhouse emissions, through their heating and cooling systems. Therefore, effective thermal insulation materials are crucial on minimizing building energy consumption and internal greenhouse gases. Research on thermal insulation panels made of biomass resources, also referred as 'bio-insulation' panels has been increasing rapidly due to their availability as renewable, low cost and eco-friendly materials.

Each year, a significant amount in million tons of bark generated during wood processing is produced globally, remains as a residual woody biomass. In addition, heat treatment affects the chemical, physical and mechanical properties of wood and mainly influences its mass, water uptake and dimensional stability. In this study, the effect of heat-treated bark particleboards on the thermal conductivity values were investigated. Particleboard samples with a target density of 350 kg m^{-3} were heat post-treated at three levels of time (15 h, 25 h and 35 h) at a heating temperature of 180 °C.

Considering all heat-treating periods, generally by increasing heat treatment time the thermal conductivity and density of bark particleboards were reduced. The measured average density was decreased by 12.7%, 16.3% and 16.1%, while the average thermal conductivity by 8.4%, 10.9% and 14.0% after 15, 25, and 35 h, respectively.

Keywords: bio-based, insulation panels, thermal modification, *Tilia* L.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

EXPERIMENTAL RESEARCH OF SOME PARAMETERS OF THE LOGS' FREEZING PROCESS

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ABSTRACT

This paper describes the results from an experimental research according to original methodology of the following parameters of the freezing process of logs: change in the temperature and relative humidity of the air processing medium in the freezer used for the experiments; temperature distribution in the longitudinal section of logs subjected to freezing; distribution of the wood moisture content and of the basic density of the wood in the separate layers of the logs' cross-section. The methodology is used for research of the mentioned parameters during many hours freezing in a freezer at a temperature of approximately –30 ºC of pine logs with a diameter of 240 mm, length of 480 mm and moisture content above the hygroscopic range. The automatic measurement and record of the temperature and the relative humidity is carried out with the help of Data Logger type HygrologNT3 produced by the Swiss firm ROTRONIC.

Keywords: logs, freezing, temperature distribution, relative humidity, moisture content, density.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

RESEARCH ON THE PROPERTIES OF LIGHT BOARDS FROM LIGNO-CELLULOSE MATERIALS AND CEMENT

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ABSTRACT

The aim of this research is production in laboratory conditions of light weight boards from different types of lingo-cellulosic materials and Portland cement as inorganic binder. Wood particles from recycled coniferous wood (white pine) and recycled deciduous wood species are used as lingo-cellulosic materials, as well as particles from grape vine rods, flax and hemp. Gel made from aluminum sulphate and sodium silicate solution (water glass) is used for mineralization of the particles.
Boards with thickness of 50 mm and dimensions of 400×400 mm are made in laboratory conditions. Test specimens for determination of the most important physical and mechanical properties are made from the boards. Some test specimens are used for determination of the coefficients of sound absorption and thermal conductivity.
The results from the research shows that light-weight boards from lingo-cellulosic materials and cement with density bellow 0,630 g/cm^3 can be classified as structural-insulation materials. Insulation properties and strength properties of investigated boards shows that they meet the requirements for application in construction as a material for components of wall panels, permanent formwork, roof panels, partition walls etc.
The obtained light-weight boards made of ligno-cellulosic materials and cement are a good option for sustainable material management, with a view to protecting, preserving and improving the quality of the environment, protecting human health, ensuring prudent, efficient and rational utilisation of natural resources.

Keywords: light wood-cement boards, recycled wood, lingo-cellulosic residues, mineral binding agents, utilisation of natural resources.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

FOLK TREASURE IN SPACE AND ART

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ABSTRACT

Directly inspired by the rich Macedonian cultural and historical heritage, and above all the miscellaneous treasury of artefacts which continuously unite various eras, I have triggered a new and unexpected display of inventive opportunities with a specific creative sensitivity. It is closely related to the ethnic motifs of our folk treasure and the natural materials, such as wood, fabrics, ceramics, lace, pearls, mother-of-pearl, and copper, which brought warmth to each of our homes not such a long time ago.

This magnificent synthesis of the most unexpected elements as fragments that are met and found in a different parallel dimension does not arouse only curiosity and a sigh, but it also triggers a thought, an urge for insight, a return deep into the past and a stroll through the history of the seemingly little things.

Their multiple purposes indicate undoubtedly the susceptibility of their use in various spaces, such as the family houses' interiors, the ethnic restaurants, hotels' lobbies, airports, and congress halls to which instantaneously the value of recognition, warmth, peculiarity, authenticity, and an opportunity to ennoble even the most modern space is given.

Keywords: tradition, ethnic motifs, interior, design, furniture, natural materials, lace, wood, copper.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

VARIATIONS OF THE HARDNESS OF BALKAN BEECH WOOD (*FAGUS MOESIACA CZ.*)

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ABSTRACT

The aim of this research is to determine the significance of the impact of the origin of wood trees (generative or vegetative), height of the cross-section (1,3 and 5,3 m above ground) and relative age of annual rings (distance from pith in radial direction) in which the measurements are made, on the variation of wood hardness, at near same ecological factors.

For determination of wood hardness Brinell method is used, and for statistical processing of the data from the measurements, software package SPSS Statistics 21 is used. On the basis of the obtained values form the tests for normal distribution of the hardness and analysis of the homogeneity of the variance, as well as on the basis of multiple comparison for determination of statistical significant differences between average values of wood hardness from different tree trunks, cross-section and age, it is found that the trees from vegetative origin produce wood with significantly higher hardness compare to the trees form generative origin. Among the two cases, the wood hardness of section 1,3 m is significantly higher than the wood hardness of section 5,3 mm. The increment of the relative age of annual rings in trees from vegetative origin in certain interval is followed by increment in wood hardness, whereupon the wood hardness decreases, while in trees from generative origin, first in certain interval the hardness is decreased, whereupon it is increased.

The obtained results of these researches, supplemented with the comparative researches of processing of standard (from generative origin) and nonstandard (from vegetative origin) timber should be taken in consideration when choosing the technological process.

Keywords: wood hardness, variation factors, vegetative origin, generative origin, height of trunk section, relative age of annual rings.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

LUMBER VOLUME YIELD FROM BLACK WALNUT (*JUGLANS NIGRA* L.) LOGS

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ABSTRACT

This paper experimentally and theoretically researches the performance indicators of sawmill processing of black walnut (*Juglans nigra* L.) logs in sawn boards. The research covered the veneer and sawmilling logs of the black walnut classified according to the Croatian standards. For the requirements of the experiment, the logs at the sawmill were classified into four qualitative classes: 1st class veneer logs, 2nd class veneer logs, 1st class sawmilling logs and 2nd class sawmilling logs. Logs were sawn up in the 30 and 50 mm nominal thickness of sawn boards. A mechanized line based on vertical log band saw with hydraulic carriage was used for primary sawing up. The 1st class veneer logs proved to produce the best lumber volume yield results. The 2nd class sawmilling logs proved to produce the worst volume yield results.

Keywords: Black walnut (*Juglans nigra L.*), veneer log, sawmilling log, sawmilling, sawn board, lumber volume yield.

DETERMINATION OF THE FIBER SATURATION POINT OF AUTOCHTHONOUS AND ALLOCHTONOUS WOOD SPECIES

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ABSTRACT

The aim of this research is to determine the fiber saturation point of wood from *Fagus moesiaca, Quercus sessilis, Quercus conferta, Robinia pseudoacacia, Pinus nigra, Pinus silvestris, Abies alba, Picea excelsa, Pseudotsuga menziesii, Cupressus arizonica, Sequoiadendron giganteum, Pinus strobus* and *Larix decidua*, as a contribution to the utilization of wood.

The material used for investigation was collected from twenty-eight methodologically selected localities.

The obtained average values of fiber saturation point are based on wood density and volume shrinkage, in accordance with the standard for wood investigation.

The results from investigation of fiber saturation point of wood from autochthonous species are within the limits of the up to now empirical and scientific knowledge. The obtained values for the allochthonous species that are subject of our investigation, can significantly impact on further introduction.

Keywords: fiber saturation point of wood, autochthonous and allochthonous species, nominal density, volume shrinkage, durability.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

MAXIMUM QUANTITATIVE YIELD OF HARDWOOD LOGS IN THE TECHNOLOGY OF SAWMILL PROCESSING

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ABSTRACT

This paper deals with the analysis of the maximum quantitative yield of beech, poplar, oak, chestnut and walnut sawmill logs. Beech logs were I - st, II - nd and III -th class of quality, poplar logs I - st, II - nd class of quality and oak, walnut and chestnut logs I - st class of quality. Maximum quantitative yield of beech logs from experimental tests ranges between 44,18 % and 51,50 %, the average value being 45,50%.Maximum quantitative yield of poplar logs were higher and ranged between 56,87% and 58,30%, the average being 58,30%.The average values of maximum quantitative yield of oak, walnut and chestnut logs varies from 66,82% for oak, which is the highest value, 58,00 % for walnut and 68,20% for chestnut.

Keywords: quantitative yield, logs, beech, poplar, oak, walnut, chestnut.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

PROPERTIES OF SELECTED WOOD COATINGS APPLIED ON THM - DENSIFIED NORWAY SPRUCE (PICEA ABIES K.)

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ABSTRACT

The aim of this study was to investigate the performance of diverse wood coating systems on THM-densified spruce wood. For this purpose, Norway spruce [*Picea abies* K.] was thermo-hydro-mechanically densified in a closed system, under pressure and steam. Five different types of solvent- and water-based coating systems were applied. To assess the interaction of the coatings and the densified wood, following tests were carried out: exposure to UV light, water permeability and climatic variation. The color of densified wood is more stable to UV light than non-treated wood and the coating system has insignificant influence on the color change. When specimens are exposed to a short-term change of climatic variation, the total volume change is less than 5% on uncoated densified wood, neglectable if coated. In case of long-term variation, (specimens exposed until constant weight), the protection effect of the coatings is less significant. The total volume change is appr. 8%. Therefore, if coatings are partially preventing moisture and water uptake of densified wood at short term exposure, they confer limited protection at long term exposure. Moreover, there is not significant performance difference within the different kinds of coating systems.

Keywords: wood, coating, densification, UV radiation, water permeability, wood modification.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

DETERMINATION OF PERFORMANCE INDICATORS AND QUALITY OF TCT KNIVES WHEN SHARPENED WITH PCD GRINDING WHEELS

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ABSTRACT

This article presents experimental results in respect of planer knives sharpening made of TCT, type K40 and K20 according to ISO grade classifications with abrasive tools from Polycrystalline Diamond (PCD). The specific consumptions of PCD abrasive was defined. The grits of PCD abrasive were with common heightened durability, anti-stick properties and organic binder. Some qualitative indices when sharpen planer knives were studied.

Keywords: planer knives, cutter head, sharpening, abrasive tools, polycrystalline diamond, tungsten carbide tools.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

INVESTIGATIONS OF THE FREE SPACE VIBRATIONS OF A WOODWORKING SHAPER, CONSIDERED AS A MECHANICAL SYSTEM WITH THREE MAIN BODIES

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ABSTRACT

Investigation of the free undamped spatial vibrations of a woodworking shaper, considered as a mechanical system with three main bodies, is the object of the proposed study. First, an original mechanic-mathematical model of a woodworking shaper developed by the authors is presented. The model considers woodworking shapers with lower placement of the spindle. In this model the woodworking shaper, the spindle and the electric motor's rotor are regarded as rigid bodies, which are connected by elastic elements with each other and with the motionless floor. The model takes into account the needed mass, inertia and elastic properties of the elements of the considered system. It includes all necessary geometric parameters of this system. After that a system of matrix differential equations is compiled and analytical solutions are derived. Numerical calculations are carried out by using the developed model and modern computer programs. The calculations use the parameters of a machine used in the practice. As a result of the whole study, the natural frequencies and the mode shapes of the free spatial vibrations of the studied mechanical system are obtained and illustrated.

Keywords: woodworking shapers, free vibrations.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

FREE DAMPED SPACE VIBRATIONS OF A WOODWORKING SHAPER, CONSIDERED AS A MECHANICAL SYSTEM WITH THREE MAIN BODIES

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ABSTRACT

Proposed study investigates the free damped spatial vibrations of a woodworking shaper, which is considered as a mechanical system with three main bodies. It presents an original mechanic-mathematical model targeted to investigations of the free damped spatial vibrations of woodworking shapers, developed by the authors. The model considers woodworking shapers with lower placement of the spindle. In this model the woodworking shaper, the spindle and the electric motor's rotor are regarded as rigid bodies, which are connected by elastic and damping elements with each other and with the motionless floor. The model takes into account the needed mass, inertia, elastic and damping properties of the elements of the considered system. It includes all necessary geometric parameters of this system. After that a system of matrix differential equations is compiled and analytical solutions are derived. Numerical calculations are carried out by using the developed model and modern computer programs. The calculations use the parameters of a machine used in practice. As a result of the whole study, the free damped spatial vibrations of the studied mechanical system are obtained and illustrated.

Keywords: woodworking shapers, free damped vibrations.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

QUALITY OF CEDRUS ATLANTICA MAN.WOOD

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ABSTRACT

Atlas cedar (*Cedrus atlantica Man.*) is a typical tree species for the regions of North Africa. Trees reach a significant height of 35-65 m. The diameter of the of the trunk at the chest height ranging between 0.9-1.8 m that gives it a considerable economic interest. The heard core wood could be coloured from reddish brown to dark brown. The sapwood is with light brown to grey colour. The average density of wood is 550 kg/m^3, ranging from 500 to 600 kg/m^3. This tree species was introduced in Bulgaria at the beginning of the last century in parks and gardens. In the middle of the last century, forestlands were afforested in the regions of Haskovo and Kardzhali, so quality of the wood should be known in view of its use. There is information that it is very suitable for making furniture, windows , doors and musical instruments. he conducted studies show that, for our region, the mechanical indicators of cedar are with better properties than those of *Pinus sylvestris L.*

Keywords: Cedrus atlantica, wood quality.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

THE MOST COMMON SECONDARY XYLOPHAGOUS INSECTS SPECIES IN LOG WAREHOUSE

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ABSTRACT

Article deals with the most frequent xylophagous insects, technical pests at the warehouses of freshly cut broadleaves and coniferous logs and protection measures from them. The most common technical pests on logging sites are xylophages from the genera *Plagionotus* and *Monochamus* and the families *Scolytidae, Platypodidae* and *Siricidae*. In order to increase the qualitative and quantitative utilization of wood as a raw material, first of all the xylophages attack should be prevented with all necessary preventive protection measures. If, however, there has been an attack of xylophages, either on sawmills or in the forest, attack should be suppressed together with repressive measures of protection. Selection of one of these measures depends on many factors, about what will be discussed in the article.

Keywords: logs, xylophagous insects, Plagionotus spp., Scolytidae, Platypodidae, Siricidae, preventive and repressive protection measures of logs.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

SUSTAINABLE FOREST MANAGEMENT AS THE QUALITY OF WOOD PRODUCTS AND COMPETITIVENESS OF SERBIA

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The forests go in front of a man, and the desert behind him.
African proverb

ABSTRACT

Forests cover 32% of the total surface area of the land. The physical, spiritual and economic health of each of the seven billion people on Earth is linked to the health of forest ecosystems. As a result of logging, the area of 130,000 km2 of forest areas disappears every year. 1.6 billion people are directly or indirectly dependent on forests. Forests are home to 80% of world's biodiversity. Wood industry products account for about 270 billion dollars in world trade. • One kilogram of wood embedded in good furniture is more expensive than one kilogram of material embedded in the most expensive car. From these, and the basic existential conditions of man, it is necessary to sustainably managed forests, which is also a condition of the quality of the products of the wood processing industry and the condition of the competitiveness of the timber production.

Keywords: sustainable forest management, wood industry, product quality.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

INNOVATIVE ARCHITECTURAL TIMBER STRUCTURES BASED ON RECIPROCAL FRAME (RF) PRINCIPLES

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ABSTRACT

This paper presents the innovative application of timber structures in architecture, through "Reciprocal Frame" (RF) principles. RF is a structural system that consists of a closed curcuit of mutually supporting timber beams, where no more than two elements are connected in one joint. The advantage of this is that the connections are identical, yet by connecting the beams in different configurations a distinct aesthetic expression can be achieved. The system is a kit-of-parts where through simplicity of construction a complexity in form is achieved. Further more, the RF allowes for design for disassembly principles to be applied, with structures that have reversible connections, and can be re-used, in the same configuration or connected in a completely new way. The paper gives examples of RF timber buildings that have been built in Japan and in Denmark. In addition, it presents research into new forms of RFs, especially explorations with bending active configurations is presented. Research into aspects of geometry, structural behavior, detailing, buildability, aesthetic and functional potential of bending active reciprocal frames is discussed. The the full-scale prototypes of bending active RFs, the "ReciPlyDome" and "ReciPlySkin", both made out of thin sheets of plywood are presented. Finally, directions for future research are outlined.

Keywords: architecture, reciprocal frames, bending active.

PAULOWNIA - RENEWABLE SOURCE OF ENERGY OF THE FUTURE

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ABSTRACT

Heating on wood pellets has become very popular in the world and in our country in the last few years, primarily due to its ecological and financial advantages, but it is still not sufficiently represented.

The use of paulownia as a firewood for the production of briquettes and the production of pellets stems from its high calorific value. Energy value: in dry matter of paulownia (13% moisture) 1kg of briquettes gives 4500-400 kcal, which is the upper value that one wood species can give and approximately the caloric value of better coal, and gives up to 5% of ash. Production of pellets from paulownia has shown numerous advantages. It dries quickly, alone, naturally, without energy consumption for heating (drying), this is a great saving in the production process. Paulownia showed an advantage both in the crushed phase and at the final stage of pelleting. Pellets of paulownia are produced twice as fast as traditional types - beech and oak trees. Paulownia gives cheap biomass because it does not require re-planting because the stems of new stems are growing even faster because the root system has already been developed.

Pellets, in contrast to petroleum and coal-based fuels, do not contain substances that are toxic to humans and the environment. The cultivation and use of paulownia contributes to the maintenance of ecological balance and conservation of nature on our planet.

Keywords: paulownia, energy value, pellet.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

THE PROBLEM OF THE CONSTRUCTION BY DESIGNING PRODUCTS

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ABSTRACT

Product design represents an element of differentiation in relation to the products of the competition, so in this way it's becoming a significant source for the acquisition and maintenance of the company's competitive advantage in the market. The paper presents the problem of development of wooden products from the initial idea to the constructional solution.

Keywords: design, constructional solution, wooden products.

ENERGY POTENTIALS FOR BUILDING MATERIALS FROM CELULAR BASED WASTE AND BY-PRODUCTS

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ABSTRACT

Dissimilar resources have been mixed to identify the likelihood of constructing building elements from waste products. Cannabis excesses and pine bark were used to create insulation boards and detect their energy potentials with regard to the thermal conductivity (λ). Different methods of processing the final boards validated altered thermal properties based also on unlike material's density. The results have validated the possibility of using waste cellular based ingredients to produce eco-friendly building materials. All cast-offs were collected within a small range to the laboratory (< 100 km). A life cycle assessment has been undertaken pointing out the low energy requirements for making these boards. Principles of sustainable design were used to maximize the prospective to upcycle waste resources.

Keywords: Wood by-products, cellular based residues, waste to energy, thermal energy properties.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

RESTAURANT INTERIOR DESIGN

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ABSTRACT

Design, art and architecture are a collective expression of the current social, political and environmental developments in the society. Interior design of spaces for collective use such as restaurant interior evolves simultaneously with the change of dynamics of everyday life. This paper observes closely restaurant interior design through repurposing office space of a building designed by Le Corbusier in 1954, India. The main points of this paper are designing the interior while taking into consideration the previous history of the building, aesthetics and functionality of the space.

The focus is on preserving the identity of the building and the creative approach of the architect by keeping some aspects of the previous aesthetics and use of visual elements of his artistic work when designing the furniture. Designing the overall interior guided by the cultural and climate context of the geographical location. Analysis of contemporary lifestyle, everyday social habits of modern people and how it will affect the future of restaurant interior design.

The role of the designer to embrace the changes and incorporate them in the final design in order to create comfortable spatial experience oriented towards the needs of modern people.

Keywords: Interior, Design, Restaurant, Le Corbusier, India, Contemporary architecture, Twentieth-Century architecture.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

ANALISIS OF POTENTIAL FOR DEVELOPMENT OF RURAL TOURISM THROUGH THE PRISM OF ARCHITECTURE AND DESIGN IN THE REGION OF MALESIA

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ABSTRACT

The motive for such a study was the valorisation and categorization of architectural heritage in some rural areas in North Macedonia that are located close to larger urban areas and the possibility of sustainable spatial development as well as the promotion of rural areas through action in areas such as architecture, urbanism, spatial planning, environmental protection, development of the civil sector and development of rural tourism.

For this purpose, we analyzed several rural entities and villages in Malaysia region. We selected the locations because they are located close to larger town centres such as Struga and Ohrid, and the possibilities for development of rural tourism.

Keywords: rural tourism, rural architecture.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

CARE AND MAINTENANCE OF LEATHER UPHOLSTERED FURNITURE WITH TRADITIONAL LEATHER CONDITIONERS

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ABSTRACT

The upholstery leather in the furniture is exposed to intensive wear conditions and dust. Periodic cleaning and maintenance is necessary in order to maintain its properties. In the period of use the leather loses its natural fats, absorbs salts then becomes hard and cracks.

Care and maintenance of leather in the upholstered furniture is a system of activities such as prevention, cleaning and conditioning of the leather. All these activities are interconnected to maintain the quality of the leather. The main task of the care products and maintaining of leather is its adjustment to the conditions of use, removal of deformations that occurred during use and prepare for its further use.

The aim of this paper is to review the method of maintenance of the leather in the upholstered furniture as well as to compare the classical care products with the commercial ones through a review of literary and experiential data.

Commercial conditioners do not satisfy the needs for conditioning the leather properties over a long period of time. Traditional conditioners made from animal fat, oils and waxes such as tallow, lanolin, fish oil and beeswax enhance collagen fibrils, maintain elasticity, contribute to hydrophobicity and increase its organoleptic properties.

Keywords: upholstery leather, leather furniture maintenance system, traditional leather.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

RESISTANCE OF WOODEN LACQUERED SURFACES TO UNSTITCHING

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ABSTRACT

In this study the resistance of lacquered wood surfaces to unstitching was analyzed. The samples for varnishing were previously prepared by second level and third level of grinding. Further, the samples were surface treated with unadventurous 2K polyurethane coating and modified 2K alkyd urethane coating. The aim of this study is to determine which of the used coatings will give a better resistance to unstitching. The test results shows that surfaces treated with modified 2K alkyd urethane coating give greater resistance to unstitching compared to the surfaces treated with unadventurous 2K polyurethane coating.

Keywords: surface, resistance, unstitching, grinding, 2K polyurethane coating, 2K alkyd urethane coating.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

SHAPE STABILITY OF CURVED FURNITURE PANELS MADE OF INTERNAL PRISMATIC FIBERBOARD LATHS LAMINATED WITH MDF PANELS

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ABSTRACT

Curved furniture elements are increasingly used in cabinet furniture. For making this type of construction, it is preferable to use bent lamination of wood or fixed to form by gluing composite materials. A major problem of fixed to form curvilinear composite materials is their shape stability. Significant internal stresses in the curved furniture composite materials leads to a change in shape. In this regard, the aim of the study is to determine the shape stability of agglomerate curvilinear furniture composite made of inner layer of fiberboard laths and two face layers of thin MDF. Curved agglomerate furniture composite with an internal radius of curvature (225 mm) were made. It was used three different PVA glues - „Pastelo“, „Kleiberit“ and „Apel“. Two types of laths are used – made from laminated and unlamented chipboard. Shape stability of all curved furniture elements were determined by measuring radius of curvature. Additionally, the shape stability of the samples was determined after convective heating in a drying chamber at 55° C.

Keywords: curved furniture elements, shape stability, PVA glue.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

QUALLITY OF THE WOODEN MATERIAL IN OUTDOOR FURNITURE

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ABSTRACT

The aim of this paper is to analyze the quality of the wooden material in outdoor furniture. For the purpose of this work is designed exterior furniture and urban equipment or set for garden. By analyzing this type of furniture and it's needs from anthropometrical point of view there comes the need for design of several different pieces of furniture, including: chair, armchair, stool, two person bench, 3 person bench, rectangular table, square table, swing and matching flower pots.
On the other side by analyzing outdoor furniture and its needs from material aspect there are certain reasons why there is use of thermo wood, and what are the positive consequences of its use.

The ultimate goal is to get a quality seating and leaving outdoor in which the human factor is very important. Through better understanding of the parameters of ergonomics, the designer can improve health and safety in furniture. Actually obligation and task of the planner is to constantly monitor research in the field of ergonomics to implement, maintain and improve the design of furniture's.
Thereby are observed anthropometric standards for this type of furniture as well as the chosen material which satisfy the conditions of permanent use and desired look.

Keywords: ergonomics, anthropometry, human factor, design, construction, material, thermo wood, environment, interaction.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

URBAN FURNITURE DESIGN

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ABSTRACT

For the purpose of this work is designed exterior furniture and urban equipment or set of exterior furniture arranging urban area (park, square). By analyzing this type of furniture and it's needs there comes the need for design of several different pieces of furniture, including: chair (seating for one), two person bench, three person bench, flower pots, ambient lighting and bin.

By analyzing outdoor furniture and its needs from material aspect there are certain reasons why there is use of thermo wood, and what are the positive consequences of its use.

In the process of designing it's starting from the square as a geometric most stable shape and its further development and integration in the shape of the outdoor furniture. The anthropometric standards observed for this type of furniture and as well as the choice of material which should satisfy the requirements and needs of the desired look.

The ultimate goal is to get a quality seating and leaving outdoor in which the human factor is very important. Through better understanding of the parameters of ergonomics, the designer can improve health and safety in furniture. Actually obligation and task of the planner is to constantly monitor research in the field of ergonomics to implement, maintain and improve the design of furniture's.

Keywords: ergonomics, anthropometry, bench, urban lighting, litter bins, urban area, pot, design, construction, material, thermo wood, environment, interaction.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

CNC WOOD MACHINES ACCURACY AND REPEATABILITY

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ABSTRACT

Machine accuracy can be defined as a degree of coincidence between measured, calculated or specified, and supposed correct, already known or given physical size value. The repeatability presents machine capability to achieve predetermined physical size value in numerous repetitions in the same working conditions.

There are many influential factors upon wood machine accuracy and repeatability, which consequently affect final product quality. Determining these factors and finding out their values is difficult and expensive. The main goal of this paper is to establish a possibility for implementation of new, enough reliable, method for product dimension and shape control using the photography and suitable software (Digimizer for dimension and Meshroom for shape determination) in order to obtain satisfying results for wood processing. Namely, accuracy and repeatability must fit into given tolerances used for wood products, which are significantly less demanding than those in metal works.

Applying this particular measuring method, CNC wood machine users would be able to control working parameters on regular basis, improving the product quality.

Keywords: CNC, accuracy, repeatability.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

RESEARCH ON THE EFFECTS OF THE CUTTING SPEED ON CUTTING FORCE AND THE CUTTING POWER IN THE PROCESS OF MILLING

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ABSTRACT

The processing of wood on a milling machine is a complex process that includes several factors, which affect product quality, tools performance and process safety. It also affects the productivity of the machine and the economics of the overall production process.

These are the main reason why the optimal determining of woodcutting process today attains greater importance in the wood processing industry.

The research was focused on creating a mathematical model of the interaction mechanism between tool and wood as a workpiece. Analytical tool is designed for determining some important factors in the wood cutting process – cutting force, cutting power, etc.

All of these factors are calculated as a function of exactly defined input parameters, grouped in several categories.

The mathematical model is supported with appropriate software.

Keywords: milling, woodprocessing, woodcutting tools, cutting force, cutting power.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

EXAMINATION OF SOME STRENGTHS OF DISMOUNTABLE CORNER JOINTS IN THE CONSTRUCTION OF FURNITURE MADE OF PARTICLE BOARDS

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ABSTRACT

The results from the research on destructive bending moments of corner joints of structural elements made of particle boards, where these joints are used mainly in construction of storage furniture.

It was found that the type of joints has significant influence on the destructive bending moment. This is defined by the type and size of joint elements and the area of the contact surfaces of the joints. Also we investigated the influence of use of the product on the destructive moment of different type of joints.

It is recommended that the research results are taken into consideration in strength design of furniture.

Keywords: corner joint, dismountable joints, particle boards, strength.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

THE SURFACE PROPERTIES OF OSB PAINTED USING ELECTROSTATIC POWDER COATING PROCESS

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ABSTRACT

Use of electrostatic powder coating technology for wood-based panels has increased in last decade. In this study, oriented strandboards (OSB/2 and OSB/3 grades) were coated by powder coatings using electrostatic corona spray gun. Epoxy/polyester coatings which was suitable for indoor applications were applied to the surface of OSBs at three different curing temperatures, 120 °C for 15 min, 140 °C for 10 min, and 160 °C for 10 min using corona gun. Surface properties of the OSB specimens, roughness, wettability, scratch resistance and film thickness were determined. The abrasion resistance and scratch resistance of the coated OSB specimens improved with increasing curing temperature from 120 to 160 °C. The best surface quality was obtained from the OSB/3 specimens cured in the infrared oven having 160 for 10 min while the lowest surface quality was found in the OSB/2 specimens cured in the infrared oven having 120 °C for 15 min. The wettability of the coated OSB specimens decreased with increasing curing time.

Keywords: Electrostatic powder coating, oriented strandboard, surface quality,wood.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

USE OF NATURAL FIBER REINFORCED BIO-PLASTIC FILAMENTS FOR 3D PRINTERS AS ALTERNATIVE TO PETROLEUM-BASED PLASTIC FILAMENTS

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ABSTRACT

Use of natural fibers in thermoplastic filaments for 3D printers has recently increased due to its significant advantages such as environmentally friendly and cheaper as compared to the synthetic fibers and fossil sources. Natural fibers, in particular for wood fibers or flour, are the most abundant environmental friendly bio materials for thermoplastics due to their low cost, low density, high modulus, non-toxic, easy supply, recycling and abrasion properties. Cellulose is non-allergic, tolerating high temperatures, and is an excellent electric insulator material, which can be processed with many 3D-printing methods. As the natural fibers are incorporated into the thermoplastics, the price of filaments for 3D printers will decrease, which considerably increase the use of 3D printer by consumers in near future. The consumers prefer environmentally friendly filaments for their 3D materials. Petroleum plastics such as acrylonitrile butadiene styrene (ABS), polyethylene, and polypropylene are harmful to the ecosystem and environment, although their good processing properties and relatively cheap price than bioplastics. However, due to increasing shortage in fossil fuels, the price of petroleum plastics is getting increasing. For this reason, use of bio plastics such as polylactic acid (PLA), Poli-β-hidroksibutirat (PHB), and thermoplastic starch in the thermoplastic filament production for 3D printers have rapidly increased. In addition, use of natural fibres help lowering the usage of petroleum based plastics and negative environmental effects. In this study, properties of the natural fibers and bioplastics are studied. In addition, the quality properties of the 3D printed products produced from natural fibers and bioplastics using 3D printers were studied.

Keywords: natural fibers, bioplastics, 3D printer, wood, thermoplastics, biocomposite.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

RECENT DEVELOPMENTS IN THE MANUFACTURE AND APPLICATION OF NATURAL FIBER REINFORCED THERMOPLASTIC COMPOSITES

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ABSTRACT

The use of lignocellulose based fillers and reinforcements in thermoplastics has been gaining acceptance in commodity plastics applications in recent years. Natural fibers generally refer to lignocellulosic materials derived from wood or agricultural materials such as kenaf, jute, hemp, flax, or other natural resources. Over the past two decades, natural fibers have received considerable attention as a substitute for synthetic fiber reinforcements in plastics. As replacements for conventional synthetic fibers like aramid and glass fibers, natural fibers are increasingly used for reinforcement in thermoplastics due to their low density, good thermal insulation and mechanical properties, reduced tool wear, unlimited availability, low price, and problem-free disposal. As a result of these advantages, natural fiber reinforced thermoplastic composites are gaining popularity in automotive and non-structural construction applications. In this study, recent developments in the manufacture and application of natural fiber reinforced thermoplastic composites were reviewed.

Keywords: natural fibers, thermoplastic composites, wood, wood plastic composites.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

DESIGN OF INTERIOR FURNITURE

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ABSTRACT

When moving a new space and investing in buying furniture and furnishing an object, it would be well to define customer requirements and wishes with regard to the future layout of the equipment.

The task of designers and technologists in the design of the interior, including the manufacture of furniture made of wood that is in direct contact with customers first discover their wants and needs, then these desires and needs shape the concrete acceptable solutions that will bring satisfaction to customers.

This paper will be presented problems of modern interiors, practically from contact with customers through use, will explain the Principles of interior design and display example of conceptual design of a kitchen with the necessary technical documentation and software for making same.

Keywords: interior, design, customer, conceptual design, software, designing.

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

TRENDS OF NUMBER OF WOOD TECHNOLOGY STUDENTS SINCE INTRODUCTION OF THE BOLOGNA PROCESS IN UNIVERSITY TEACHING IN CROATIA

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ABSTRACT

Croatia joined the Bologna process in 2001 and has been an active participant ever since. All study programmes have been aligned with the Bologna structure in 2005, and all students graduating in Croatia from these programmes receive ECTS credits and are entitled to diploma supplements. This article presents an analysis of the number of enrolled students of various study programmes at the Faculty of Forestry in Zagreb since academic year 2005/06. The base for these analysis are data of the number of students gathered from Information System of Higher Education Institutions (ISVU) for students of various undergraduate study programmes and specially for two wood technology graduate programmes. Correspondence analysis was performed for students enrolled in undergraduate programmes. Time series data analysis was performed for three wood technology study programmes.

Keywords: wood technology, students, Bologna process, correspondence analysis, trend

WOOD TECHNOLOGY & PRODUCT DESIGN
4th INTERNATIONAL SCIENTIFIC CONFERENCE
4th-7th September 2019 • Ohrid • Macedonia

NUMERICAL MODELING OF WOOD-ADHESIVE BOND-LINE IN MODE II FOR SPRUCE WOOD GLUED BY VARIOUS ADHESIVES

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ABSTRACT

Bond-line creates an interface between two glued surfaces and, therefore, its brings additional complexity into the mechanical behavior of glued component, especially around the bond-line region because an adhesive has a very different response to a mechanical stress than wood. From this perspective, the bond-line influences the total mechanical response of glued components by both its cohesive and adhesive behavior at wood-adhesive boundary. For timber constructions, there are many various adhesives one can use and each of them has a different mechanical characteristics, advantages and disadvantages.

The goal of this work was to create a numerical finite element models applicable for analysis of fracture problems in mode II. The models were developed for the adhesive that are often applied in timber constructions and wooden materials. The FE models include 2D geometry of the bond line and cohesive law fitted on the outputs of the experimental measurement. The experimental data for the developing numerical models were obtained using 3point end-notched flexure (3ENF) tests with the compliance-based beam method (CBBM) coupled with the digital image correlation to be able to obtain displacement slip needed for the development of the FE models. Furthermore, within the FE analysis, wood was modeled as orthotropic material including both elastic and plastic regions of deformation. The FE models were developed in Ansys computational system. The specific objectives of the work were following: 1) to create the cohesive zone models based on experimental data; 2) to develop parametric 2D and 3D model of the bond-line reflecting experimental data; 3) to analyze the influence of friction coefficient on resulting force-displacement outputs; and 4) to analyze plastic imprint into the specimens for Norway spruce and an influence of the fiber angle inclination.

Implementation of the cohesive law models of wood-adhesive system into the FE analysis was successful. The FE analysis provided the force-deflection response that was validated by the experiment work. The FE model showed that influence of the friction on the simulated force may be up to 5% of the maximal force which is not negligible effect. The imprint of the load head into specimen is substantial if span-to-height ratio is below 17. The influence of the fiber angle with respect to a longitudinal axis is rather high, i.e. angle of 14° means 30% reduction of maximal force.

Keywords: mode II, spruce wood, finite element analysis, crack propagation, adhesive bond.

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DRYING OF HARDWOOD TIMBER – SCIENCE AND INDUSTRY

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ABSTRACT

Despite the worldwide production of softwood timber being considerably greater, the importance of hardwood timber remains undiminished, especially when it comes to high-value wood products. The demand for high-quality dried hardwood timber has been experiencing continuous growth over the past decades and it predominately relies on timber dried in conventional kilns. While numerous improvements in kiln equipment have been implemented over the last decades, conventional drying of hardwoods remains a very slow process, mainly based on empirical knowledge. This paper provides an overview of the current situation related to hardwood drying in Europe and offers a discussion on potential research directions and overall industry situation by bringing into focus drying schedules and energy aspects of hardwood timber drying process. Present growth of research and technology should be accompanied by education, that is to say that the emphasis should be put on sharing and transferring knowledge to practitioners.

Keywords: conventional drying, hardwoods, drying schedules, energy consumption.

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BONDING OF WOOD AND OTHER MATERIALS

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ABSTRACT

The objective of the research presented in the paper was to determine the suitability of epoxy and polyurethane adhesives for bonding of wood and steel together. The quality of the adhesive bond was evaluated by a shear strength test which followed after each of the pretreatment procedures: exposure to the standard climate - relative air humidity 65 % and temperature 20 °C (20/65); exposure to moist climate - air humidity 87 % and 20 °C (20/87); and 24-hour soaking in water. The results showed that the studied polyurethane adhesives can be suitable for non-structural bonding of steel and wood in dry conditions, whereas they are not suitable for more demanding application in humid conditions. Epoxy adhesive bonds between wood and steel exhibited higher shear strength than polyurethane adhesives for all pretreatment procedures.

Keywords: adhesive bonding, epoxy, polyurethane, steel, wood.