BOOK OF ABSTRACTS

5th International Scientific Conference
WOOD TECHNOLOGY & PRODUCT DESIGN

14th– 17th September, 2021
University Congress Centre,
OHRID, NORTH MACEDONIA

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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5th INTERNATIONAL SCIENTIFIC CONFERENCE

WOOD TECHNOLOGY & PRODUCT DESIGN

14– 17 SEPTEMBER, 2021
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JANKA HARDNESS OF PLYWOOD REINFORCED WITH PRE-IMPREGNATED COTTON FABRICS

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ABSTRACT

Higher properties of plywood can be achieved trough applying different non-wood materials in their structure.

The aim of this research is to study the Janka hardness of experimental plywood reinforced with cotton fabrics pre-impregnated with alcohol-soluble phenol-formaldehyde resin.

Plywood models were made of eleven layers of peeled beech veneers with thickness of 1,5 mm and 1,85 mm. Alcohol-soluble phenol-formaldehyde resin was used as plywood binder. The pre-impregnated fabrics were incorporated as layers in the structure of the plywood panel. Different models of reinforced plywood were made through a change of the position of the reinforcing layers in the structure of the panel. One additional model was made without reinforcements as comparing plywood model.

Tests for plywood hardness according to Janka were done on each plywood model. The research results showed that the values of Janka hardness are affected by the use of pre-impregnated fabrics as reinforcements in plywood structure.

Keywords: plywood, reinforcement, pre-impregnated cotton fabric, alcohol-soluble phenol-formaldehyde resin, Janka hardness

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DIMENSIONAL STABILITY OF MULTIPLEX PLYWOOD WITH MAINLY UNIDIRECTIONAL GRAIN ORIENTATION

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ABSTRACT

Multilayer plywood made from wood veneers with mainly unidirectional grain orientation known as multiplex panels represent a significant group of modern wood-based panels. Application of these panels in modern construction and in other application areas determines achieving higher physical and mechanical characteristics of these materials, their consistency during prolonged water impact, humidity, heat, as well as their dimensional stability.

The aim of the research presented in this paper is to study the dimensional stability of experimental multiplex plywood reinforced with cotton based prepreg. The cotton prepreg was made form cotton fabric pre-impregnated with alcohol-soluble phenol-formaldehyde resin.

The experimental multiplex plywood was made of eleven layers of peeled beech veneers with thickness of 1,85 mm. Alcohol-soluble phenol-formaldehyde resin was used as plywood binder. The orientation of the veneers in the plywood structure is parallel to the longitudinal axis of the panel, with the exception of the subsurface layers which orientation is transverse to the longitudinal axis of the panel. The cotton prepreg reinforcements were inserted in each adhesive layer of plywood.

To define the dimensional stability of the panels, laboratory tests were performed on the most important physical properties, as well as on bonding quality trough the shear strength test. Tests of water absorption and thickness swelling were performed during prolonged water treatment.

Keywords: plywood, multiplex, reinforcement, prepreg, pre-impregnated cotton fabric, alcohol-soluble phenol-formaldehyde resin, dimensional stability, physical properties, shear strength.

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WATER ABSORPTION AND THICKNESS SWELLING OF REINFORCED PLYWOOD DURING PROLONGED WATER EXPOSURE

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ABSTRACT

The aim of this research is to study the physical properties during prolonged water exposure of experimental plywood reinforced with cotton fabrics pre-impregnated with alcohol-soluble phenol-formaldehyde resin.

Plywood composition was consisted of eleven layers of peeled beech veneers with thickness of 1,5 mm and 1,85 mm. The veneers were bonded with alcohol-soluble phenol-formaldehyde resin. The pre-impregnated fabrics were incorporated in each adhesive layer of the plywood panel.

On the basis of the obtained data for the changes of the physical properties of reinforced plywood after exposure to prolonged water treatment, water resistance of experimental plywood was evaluated. Tests for the thickness swelling, volume swelling and water absorption were made after immersion in water for prolonged period of 192 days in controlled laboratory conditions.

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.

Keywords: plywood, reinforcement, pre-impregnated cotton fabric, alcohol-soluble phenol-formaldehyde resin, water absorption, thickness swelling, prolonged water treatment.

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IMPACT OF RESIN CONTENT ON WATER ABSORPTION AND THICKNESS SWELLING OF COMPOSITE WOOD-BASED PANELS

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ABSTRACT

The aim of the research presented in this paper is to study the impact of resin content on water absorption and thickness swelling of composite wood-based panels.

For this purpose three experimental models of composite wood-based panels were made that represent a combination of particleboards and constructive veneers. The core layer of composite panels was made of single-layer particleboard with thickness of 16 mm. Particleboards were overlaid on both sides with beech peeled veneer with thickness of 3,2 mm.

Water-soluble phenol-formaldehyde resin with 10 %, 13 % and 16 % dry matters content on dry wood basis was used respectively for production of single-layer particleboard cores of the three composite models. The resin used in all three models was modified with epoxy resin.

The veneers were bonded on the particleboard core with the same resin that was used for particle bonding, but without modifier.

Tests for the water absorption and thickness swelling after immersion in water for 2 hours and 24 hours, as well as after immersion in boiling water for 2 hours were carried out in controlled laboratory conditions.

The results from the research showed that the resin content in particleboard core has significant impact on the values of the tested properties of composite wood-based panels.

Keywords: resin content, composite wood-based panels, particleboard, veneers, water-soluble phenol-formaldehyde resin, modifier, water absorption, thickness swelling.

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ANALYSIS OF THE DIMENSIONS OF SCHOOL CHAIRS IN THE PRIMARY SCHOOLS IN THE MUNICIPALITY OF AERODROM – SKOPJE

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ABSTRACT

Educational institutions are facilities where each person spends many years of their life. Chairs used in these institutions are designed with specific features of shape, material and size. Long-term use of chairs in educational institutions may be the cause of damage to the health of consumers if they are not carefully designed and dimensioned.

Compliance with the prescribed rules and dimensions in the design of school chairs is of great importance for the proper development of the users that are in the phase of growth and development when using this type of chars.

In this paper, the functional dimensions of real samples of chairs taken from primary schools in the Municipality of Aerodrom – Skopje will be measured. The testing samples of chairs will be designated to the group that they belong to according to the EN 1729-1:2006 standard, and all requested dimensions according to the standard will be measured.

The purpose of this work is to show the real condition of school chairs in elementary schools and whether the chairs are with the requested dimensions of the EN 1729-1:2006 standard.

Keywords: elementary school, school furniture, school chair, school desk, anthropometry of children, physical development.

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QUALITY ASSESSMENT OF SURFACES PROCESSED WITH CNC WOODPRKING MACHINING CENTER

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ABSTRACT

The current work presents the results of experimental studies, performed to assess the surface quality of solid wood parts, processed with CNC machining centre, type Rover A3.30 (Biesse, Italy). The influence of some parameters of the cutting mode, in particular, the cutting speed (V_c) and the thickness of the removed layer (h) on the change of the roughness parameter R_z was assessed. The roughness of the processed surface was measured with a roughness tester, type „Surftest SJ-210“ (Mitutoyo, Japan). Based on the obtained experimental data, graphical dependences, presenting the influence of the individual factors on the quality of the processed surface were derived. In order to ensure higher quality of the milled surfaces, recommendations for the optimal values of the studied factors are made, taking into account the characteristics of the processed materials.

Keywords: CNC, surface quality, wood milling, cutting mode.

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CREATION OF 3D CAD MODELS FOR 5-AXIS CNC MACHINING CENTER THROUGH CONTACT DIGITALIZATION

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ABSTRACT

The article presents results of a study, in production conditions, of the MicroScribe G2 system as an alternative to traditional coordinate measuring machines (CMMs). With the help of an articulated arm, the system provides appropriate accuracy data capture for building CAD models for 3D software applications. The AlphaCam software complex was used to develop a control program for a 5-axis CNC machine, model Pade Clipper L, to make a schoolboy chair seat.

Keywords: CAD models, 3D digitizer, Alpha CAM, MicroScribe G, 5-axis CNC machining.

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ANALYSES AND VALIDATION OF CUTTING FORCES PREDICTION MODELS IN WOOD MACHINING

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ABSTRACT

A lot of research has been done related to the influence of different machining factors on the wood machining process. Methodologically, the factors are divided into three main groups that affect cutting mechanics: factors associated with material properties, factors that are dependent on the cutting tools, and factors attributed to the cutting process itself. A better understanding of machining factors could be the foundation for predicting the behavior of the material in the machining process. Also, it may consequently contribute to a more efficient and economical machining outcome and above all, the better quality of the machined surface. One of the basic parameters of cutting mechanics is cutting forces. There are various models in the literature for determining the dependence of values of cutting forces on the selected impact factors. Different cutting force models are analyzed and compared in this paper. The results performed in the peripheral milling parallel with wood grains of oak wood (*Quercus robur*) were used for the testing of models. The analysis of these models indicated that there is no match between the calculated and experimental results, but there is a similarity in the form of a curve. Changes in the measured values are accompanied by corresponding changes in the calculated values, which indicates that these models can find application in real cutting conditions.

Keywords: machining factors, peripheral milling, cutting force, cutting power, oak wood.

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DISTRIBUTION, MORFOLOGICAL- STRUCTURAL PROPERTIES AND THE USE OF BLACK LOCUST (ROBINIA PSEUDOACACIA L.) IN SLOVENIA

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ABSTRACT

Black locust (*Robinia pseudoacacia*) is a tree species that originates from North America. The species was introduced to Europe in early 17th century. The first data about its appearance in Slovenia comes from 19th century. In Slovenia, it's the most common foreign introduced tree species. It can commonly be found in the sub Mediterranean and Pannonian part of the country, it also rarely appears in the dinaric part of the country. While it's the most common foreign introduced species, it overall only represents 0,6% of the timber stock in the country. It is a deciduous species with a distinctive canopy. Tree bark starts smooth and gray, but later on cracks and turns brown. Its wood is one of the hardest out there. The faster it grows, the denser it gets. It also bends well in wet or dry state. If it's dried too quickly, it can break, so caution is needed when being dried. It can be used for parquet, because of its coloring, stability and hardness (Anderson, 1990). It also works well for decorative veneer. Its durability allows it to be used for buildings exposed to water and to be used in mines. The same feature also allows it to be used for outdoor furniture, fences, tool handles, sports props and in every case where though wood is needed. It's also used in many vineyards as support pillars, which seems to be its most common use in some parts of Slovenia. The last feature worth mentioning is, that its's useful as firewood thanks to its high density.

Keywords: Black locust, Slovenia, wood structure, distribution, wood use, Robinia pseudoacacia.

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COMPUTER SIMULATION MODEL FOR MEASURING THE WIDTH OF UNEDGED SAWN BOARDS USING CAD AND SPREADSHEET PROGRAMS

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ABSTRACT

The article presents the simulation model for simulated measurement of unedged sawn boards with the help of CAD and spreadsheet program. The simulation model is based on graphical simulation of sawing in CAD program on cross sectional area of simulated logs. The cross section of log in simulation can be circular or elliptical and diameter of simulated log can be in the range from 20 cm to 100 cm. From the cross section of each unedged sawn board that is obtained by simulated sawing, the width can be easily measured in different ways that are common in sawmilling practice and are prescribed by national norms in Croatia. Because different measurement methods can yield different volumes of boards, it is of interest to determine if there is any unfair advantage in using different methods for width measurement of the same unedged sawn board. After the widths have been measured on the simulated boards, they are further processed in a spreadsheet program and the results of simulated measurements with different measurement methods can be easily compared and used for comparison with data obtained from measurements on real boards in regular sawmilling practice. The presented simulation model is practical because it represents quick, simple and cheap way for comparing influence of different width measurements methods on board volume calculation. The disadvantage is that drawn models are idealized i.e. not accurately depict the actual form of logs, and finally the actual widths of boards.

Keywords: computer simulation model, unedged sawn boards, width measurement, sawmilling.

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PETITE TIMBER STRUCTURES IN/AND ARCHITECTURAL DESIGN EDUCATION

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ABSTRACT

The aim of this paper is to present a recent educational experience developed through the ongoing pedagogical process at the Faculty of Architecture in Skopje, exploring the advantages of informal tools of education with particular focus on the learning-by-building method of learning architectural design.

The main goal of the teaching experience explored in the paper was to introduce the architecture students with the great potentials of timber as architectural building material. The paper specifically focuses on presenting four case studies, documenting the development of different timber structures of high architectural quality, designed and build by architectural students. Each architectural structure was realized within the educational, pedagogical, social, cultural and representational framework of the International Summer School of Architecture, an architectural workshop that for 30 consecutive years has been organized by the Faculty of Architecture at Ss. Cyril and Methodius University in Skopje.

The International Summer School of Architecture was established in 1992, and has since then been a place for teaching and learning architecture for more than 500 domestic and international students and more than 100 architects and teachers from all around the world. In the 30 years of its existence the International Summer School of Architecture has shown the ability to transform and adapt its format to numerous pedagogical viewpoints and concepts, from highly theoretical to applicative. As much as four International Summer School sessions have been realized exploring the learning-by-building methodology, as result of which several timber structures were designed and built on various locations by the students and their tutors. The collection of timber structures presented in the paper represent not only a valuable portfolio of the International Summer School of Architecture of the Faculty of Architecture in Skopje, but a significant source of knowledge for studying architecture design methodologies, processes and strategies, as well as engineering and construction techniques and their place in the architectural design education on university level.

Keywords: architectural design education, learning tools, learning-by-building method, timber.

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INFLUENCE OF TRANSPARENCY OF WRAPPING STRETCH FOIL ON COLOUR OF SMALL SLAVONIAN OAK WOOD (*Quercus robur* L.) SAMPLES DURING SHORT TERM WRAPPING AND EXPOSURE TO ULTRAVIOLET RADIATION

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ABSTRACT

During some research wood often must be transported or temporarily stored and protected, while at the same time it is necessary to prevent the influence of solar radiation and water loss. For this purpose, most common protection used is transparent wrapping stretch foil. However, black wrapping stretch foil can also be found and bought on market in recent years. This black wrapping foil is opaque and at first glance it seems that it probably could be better for wrapping wood samples in it for protection. In this research oak wood (*Quercus robur* L.) small samples were wrapped in transparent and opaque wrapping stretch foil and exposed to various influences in the form of artificial UV radiation and Solar radiation. Thereafter, it has been determined whether there has been a change in colour.

Keywords: Slavonian oak (*Quercus robur* L.), wrapping starch foil (transparent, black/opaque), colour change, CIE *L*a*b**, UV radiation, Sunlight.

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HOT AND COLD WATER SOLUBILITY OF MILLED SLAVONIAN OAK WOOD (*Quercus robur* L.)

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ABSTRACT

During hydrothermal processing, oak wood is often exposed to heat, humidity and/or water, especially during drying, steaming, boiling or rewetting by water, *etc*. So, through this research hot and cold water extraction according to ASTM standard D 1110 – 84 (Reapproved 2001) *Standard test methods for water solubility of wood* was conducted whereby water soluble extractives (WSE), respectively, extractives yield of Slavonian oak wood (*Quercus robur* L.) was determined from obtained extracts.

Keywords: Oak wood (*Quercus robur* L.), Slavonian oak, hot water extraction, cold water extraction, water soluble extractives (WSE).

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POSSIBILITY OF DRYING OAK LAMELLAS IN DEHUMIDIFICATION KILNS

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ABSTRACT

This study aimed to investigate the possibility of drying oak lamella – a solid wood top layer of engineered wood flooring – in dehumidification kilns. One of the problems with conventional drying of lamellas is potentially too high relative humidity of air at the beginning of the process caused by very fast evaporation of water from the wood surface. Drying in a dehumidification kiln (with adequate dehumidifier size) is an interesting alternative to reach high drying quality in a reasonable time. Drying tests were done in an industrial dehumidification kiln and programmable climate chamber. The influence of different drying conditions on drying time and quality (final moisture content (MC_f), deformations, checks, discolourations) were examined. It was demonstrated that thin oak lamellas (approx. 5 mm thick) can be successfully dried in a dehumidification kiln. With applied drying schedule (initial temperature 36 °C, final 46 °C), the drying cycle will last 2 to 5 days, depending on the amount of wood and initial MC.

Keywords: oak lamella, wood flooring, drying, dehumidification kiln.

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DECORATIVE PROPERTIES OF WOOD SURFACE FINISHING WITH OILS AND HYDRO OILS

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ABSTRACT

Due to governing trends, emphasizing the natural beauty and the texture of the substrate in wood surface finishing attracts a lot of attention. Different coatings are used for this purpose. In addition to traditional penetrating materials such as oils, waterborne-oil coatings giving the effect of untreated wood have been developed (hydro oils). In this research, we investigated the decorative properties of the samples of beech (*Fagus sylvatica* L.) and walnut wood (*Juglans regia* L.) coated with oils and waterborne-oil coatings. The higher color change (ΔE) was obtained when the samples were coated with oils, compared to the samples coated with hydro oils for both wood species. After oil application samples of both wood species had a noticeably higher degree of gloss, while samples coated with hydro oil showed lower gloss values than untreated wood (for both wood species). The change in gloss of samples after coating was related to increase/reduction of surface roughness of the samples.

Keywords: wood, oil, hydro-oil, surface finishing, color, gloss.

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STRUCTURAL CHARACTERISTICS OF NARROW LEAVED ASH WOOD

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ABSTRACT

The properties of wood, its behavior during processing, as well as the application and use of wood elements and products, are altogether the consequences of the anatomical structure and chemical composition of wood. The formation of basic anatomical elements of wood (wood cells) proceeds slowly through the metabolic processes. Besides the genetic factors, such processes are influenced by the environmental conditions, which cause the dimensional variations of wood structural elements at different positions in the stem. Therefore, the aim of this study was to evaluate anatomical characteristics and dimensional variations of the most common anatomical elements - wood fibres in the stem of narrow leaved ash (*Fraxinus angustifolia* Vahl. ssp. *Pannonica* Soo & Simon), represented by the cells that provide the mechanical support and the cells that serves as the transport elements (vessels). Three characteristic cross-sections (transversal, radial and tangential) of narrow leaved ash wood were observed and analyzed with application of scanning electron microscopy (SEM). The integrated system, which includes *Leica DMLS* light microscope and *Leica DC 300* camera, coupled with the *Leica IM 1000* software, was used to measure the length, cell-wall thickness and lumen width of mechanical fibres and vessels.

The results of this study suggest that both the lumen width of vessels and the cell wall thickness of mechanical fibres increase in radial direction, from the core towards the bark, while the lumen width of fibres decreases in the same direction. In addition, the length of mechanical fibres increases towards the bark, reaching the maximal values at the middle section of radius. The height position in tree trunk also show the influence on dimensions of structural elements. Both the length and the cell wall thickness of mechanical fibres decrease towards the top of the trunk, while the lumen width of fibres increases.

Keywords: anatomical characteristics, vessels width, fibre length, fibre cell wall thickness.

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INFLUENCE OF SOLID WOOD FUELS ON THE ENVIROMENT

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ABSTRACT

Currently, the scientists are very much divided over whether wood is an ideal renewable fuel or not. The reasons for different opinions are: the usage of fossil fuels in the cultivation, production and transport of biomass, the cycle of regeneration of forests and forest ecosystems, as well as the amount of absorbed CO_2 from the production and combustion of wood fuels. Also, it is very questionable to use wood fuels outside the countries and continents of origin to satisfy the form of using renewable energy sources. All of the above mentioned requires the establishment of new world and national policies on the use of wood as fuel, which includes the sustainability of forests, and production of real green energy from wood biomass. Also, wood as a raw material and product should be part of the circular economy. An example of good practice could be the wood industry where wood products could be "neutral", and wood as an energy source is primarily consumed at the place where wood residues are generated.

Based on the example of the use of wood fuels in Serbia, the data collected and analyzed could contribute to the understanding of this problem. The paper analyzes energy consumption and GHG emissions through equivalent CO_2 for the production of solid wood fuels (firewood, wood chips and pellets), their use in small (domestic) and large (industrial) boilers through the ratio of obtained and consumed energy and consumption of wood raw materials per energy produced. As a third parameter, the data on the emission of PM 2.5 particles during the combustion of these three wood fuels as one of the major participants in air pollution were analyzed. Finally, an analysis of pellet production and the possibility of reducing the use of fossil fuels in this process are given as well.

Keywords: solid wood fuels, energy, GHG, equivalent CO_2 emission, air pollution.

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DESIGNING SOLID SURFACE MATERIAL HI-MACS FURNITURE IN 3D FORM

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ABSTRACT

A three-dimensional form and materials are in close interdependence because the material largely depends on the form. Each material has its own characteristics and possibilities that must be respected if one wants to realize a certain form. Thus, wood allows one thing, marble another, concrete third, clay, bronze, iron, plastic, each of them allows something different to be expressed.

Inspired by the egg as a shape and form, I design seating and relaxing furniture presented in individual elements or in sets that are used in households and in all public buildings' halls. This project includes: a two-seater settee, a glass-top coffee table, two armchairs and a swing to relax. The solid surface is a modern symbiosis of design and quality. By using this material, its appearance, sense of touch, durability and choice of colors and designed shapes allow us to transform almost any idea and any application into reality.

Keywords: solid surface, material, shape, form, relaxing, furniture, design, quality.

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FINITE ELEMENT ANALYSIS OF LOGS GEOMETRY INFLUENCE TO 1st NATURAL FREQUENCY WITH RESPECT OF FREQUENCE-RESONANCE METHOD USE

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ABSTRACT

This paper aims to present the influence of geometry simplification on the investigation of logs mechanical properties (dynamic elastic modulus) as the non-destructive testing of wood structures and materials is a common method for assessment of timber quality. The modal analyses of logs with a variation on three levels of geometry (from simplified primitive volumes to precise scanned 3D objects) were carried out in ANSYS Workbench and Mechanical APDL (Ansys® Academic Research Mechanical, Release 2020 R2, ANSYS, Inc.). Fundamental frequencies in bending and longitudinal mode were validated by comparison with the results of in-situ measurement. The logs were measured by stress wave propagation (SWP) and frequency-resonance method (FRM) and dynamic elastic moduli from these data were calculated. Validation was followed by series of modal analyses (computed by finite element method) where geometry precision to 1st frequency and dynamic elastic modulus was evaluated. Results were discussed with respect to provide foundations for enhancement of methods for non-destructive wood measurement.

Keywords: modal analysis, dynamic elastic modulus, vibrations, non-destructive testing.

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DENSIFIED POPLAR FOR ELECTRIC GUITAR NECK: EXPERIMENTAL AND NUMERICAL ANALYSIS

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ABSTRACT

Electric guitar necks (EGNs) and parts are usually made of hardwoods (i.e., maple, ash, etc.), including protected exotic species coming from overseas (mahogany, etc.), due to their aesthetics, high stiffness and density. Additionally, EGNs typically include a truss rod – a metal bar stiffening the neck against bending caused by string tension. In order to reduce the environmental impact of guitar production, we believe that EGNs can be made from local and fast grown plantation wood modified using a thermo-hydro-mechanical (THM) process. In this paper, we analyze the potential of using THM densified poplar wood as a substitute material for EGN. We believe our approach for EGN production may be (i) more convenient due to higher mechanical properties of densified wood while preserving similar vibrational performance; (ii) more economical due to local and cheap resources use and absence of a truss rod; (iii) more environmentally friendly due to reduced logistics and energy costs. To analyze the hypothesis resulting from (i), we performed both experimental tests and numerical analyses. Experiments consisted of poplar wood densification (dens. ratio 2) to obtain the elastic orthotropic material model of densified poplar suitable for finite element analyses (FEA). We carried out compression tests accompanied with digital image correlation which provided a set of elastic material coefficients – 3x normal elastic moduli (E_L, E_R, E_T), 3x Poisson's ratios (μ_{LR}, μ_{RT}, μ_{LT}); 3x shear elastic moduli (G_{LR}, G_{RT}, G_{LT}) were calculated from measured values. Developed material models were employed in FEA of (i) guitar neck deflection induced by string tension and (ii) modal analysis of a neck including sensitivity study for the role of density and elastic moduli on eigenfrequencies. FEA showed the highest 1st principal stress (PS1) is located on the bottom of the neck. Further, PS1 changes with change of E_L – deflection decreased 40 % and PS1 increased ~ 11 % as E_L increased from 12.4 GPa to 22 GPa. Eigenfrequencies decrease with density but increase as E_L increases (1st freq 17.4 %, 2nd freq. 21.4 % and 3rd about 27 %).

Keywords: poplar, densification, mechanical properties, finite element analysis, acoustics, electric guitar neck.

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SENSITIVITY ANALYSES OF STEM, ROOT-PLATE AND BRANCHES MECHANICAL RESPONSE

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ABSTRACT

Numerical investigation of tree structures is an increasingly used method for understanding its mechanical response to loading. The aim of this study is, with the use of the numerical methods, to find the significant parameters that influence the response of stem, root-plate and branches. The parametrical finite element (FE) models of stem, root-plate and branches have been developed in ANSYS Mechanical APDL (Ansys® Academic Research Mechanical, Release 2018, ANSYS, Inc.). Both of these models were validated and used for series of sensitivity analyses. The significant role of anchorage strength for both stem and branches was found, which implies the importance of consideration of not full-fixed anchorage in mechanical analyses. In the upper part of the stem and on the top of the branches the significance of tapering was observed. The importance of the position for observation of the relation between input and output parameters was confirmed also by the significance of elliptical cross-section to mechanical response in the middle part of branch. The higher significance of geometrical properties than material properties confirmed that the internal changes of material can be observed when the shape of the stem or branch is described precisely.

Keywords: finite element method, sensitivity analysis, tree, tree biomechanics.

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ANALYSIS OF THE INFLUENCE OF THE LENGTH OF BEECH SAWLOGS (*FAGUS SYLVATICA L.)* ON THE MAXIMUM QUANTITY EXPLOITATION

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ABSTRACT

More than two decades have passed since scientific research was done on the influence of the length of beech sawlogs on the maximum quantity exploitation, so therefore there is no new data on this topic.

For this particular aim, an analysis was done regarding beech sawlogs, a wood species that dominate this region in sawmill technology and processing.

The analyzed logs were graded according to the European grading standard. The logs were inherent to the I^{gt} and II^{nd} quality class. The sawlogs were with the length of 2,0; 3,0 and 4,0 m.

The sawlogs with a length of 2,0 m were with a measured diameter at a range from 31,0 to 52,0 cm, at the narrower end of the log, and on the wider end from 32,0 to 53,0 cm. There were 15 analyzed logs with a wood mass of 4,2 m^3.

The logs with the length of 3,0 m were with a measured diameter at a range from 33,0 to 50,0 cm, at the narrower end of the log, and on the wider end from 35,0 to 54,0 cm. The analysis covered 15 logs with a wood mass of 6,5 m^3.

The logs with the length of 4,0 m were with a measured diameter at a range from 35,0 to 52,0 cm, at the narrower end of the log, and on the wider end from 39,0 to 56,0 cm. The number of analyzed logs was 15. The wood mass of the logs was 8,9 m^3.

The total count of analyzed logs was 45 and the amount of processed wood mass was approximately 22,0 m^3.

The log diameter taper (S) of analyzed logs was as follows:

– for the length of l = 2,0 m → 0,5 ÷ 1,0 cm/m, S_{sr} = 0,54 cm/m, logs with a great mass;

– for the length of l = 3,0 m → 0,66 ÷ 1,33 cm/m, S_{sr} = 1,01 cm/m, logs with a full mass;

– for the length of l = 4,0 m → 0,75 ÷ 1,5 cm/m, S_{sr} = 1,23 cm/m, logs with a poor mass.

Maximum quantity exploitation (P) of the different lengths of the logs was as follows:

– for the length of l = 2,0 m → P = 66,60 ÷ 68,32 %, Psr = 67,26 %;
– for the length of l = 3,0 m → P = 64,20 ÷ 66,99 %, Psr = 65,16 %;
– for the length of l = 4,0 m → P = 61,07 ÷ 62,53 %, Psr = 61,10 %.

Keywords: logs, beech, sawmill, measurements, quality class, sawn lumber, quantity exploitation.

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INFLUENCE OF JOINT TYPE AND TYPE OF FIT ON JOINT STRENGTH IN CHAIRS

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ABSTRACT

The strength of the angular joint of the side rail with the back leg in chairs is analyzed in this paper. The analyzed joint represents one of the most critical points in the construction of chairs. The connection of the side rail and the back leg can be produced in several ways, but the paper analyzes the two most commonly used: the connection with an oval mortise and tenon and the connection with a double dowel and hole. In addition to the joint type, within the work the type of fit was also varied as one of the seven factors that affect the strength and durability of chairs. The test was performed on four groups of samples with a total of 200 samples. Statistical analysis showed that there is a significant influence of these parameters on the strength of the joint. The test results showed that the bending strength changes with the variation of the mentioned factors. The joints with an oval mortise and tenon with a higher fit showed the greatest strength. Joints with higher fit showed higher strength values.

Keywords: chair, oval mortise and tenon, dowel, strength.

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APPLICATION OF CNC TECHNOLOGY FOR MAKING TRADITIONAL DECORATIVE WOOD ELEMENTS FOR FURNITURE AND INTERIOR

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ABSTRACT

Machines with computer numerical control (CNC machines) are flexible technological systems, which enable the production in very small series, as well as individual products (one-piece series), in a very short production time, with exceptional precision and excellent quality of processed products.

The technical characteristics of modern numerically controlled machines enable the production of complex three-dimensional shapes, with the use of three, four or five regulated machining axes. This way of processing is an opportunity for application of complex three-dimensional shapes and patterns of furniture and interior elements in the style of traditional Macedonian woodcarving.

Keywords: Numerical control, Computer numerical control, CNC technology, Three-dimensional shapes, Traditional decorative wooden elements.

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INFLUENCE OF DIFFERENT POLYHIDRC ALCOHOLS ON POLYMER PROPERTIES OF LIQUEFIED BLACK POPLAR WOOD (*Populus nigra* L.)

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ABSTRACT

The aim of the study was the influence of different polyhydric alcohols as liquefaction solvents and their mutual volume ratios on the polymeric properties of liquefied black poplar wood (*Populus nigra* L.). Polyhydric alcohols polyethylene glycol 400, diethylene glycol, dipropylene glycol, ethylene glycol and glycerol were used as solvents in the study, and for liquefied wood were analyzed the solid residue, the degree of liquefaction and the hydroxyl OH number as its polymeric properties. Liquefaction of wood was performed separately with each polyhydric alcohol as well as their mixtures in different volume ratios by the method of acid catalysts under precisely defined conditions. Based on the obtained results, the most favorable liquefaction conditions were determined in terms of obtaining the most favorable polymeric properties as a first step in different applications of the same for different bioproducts.

Keywords: liquefied wood, polyhydric alcohols, polymer properties, black poplar wood (*Populus nigra* L.)

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INFLUENCE OF MOISTURE CONTENT AND TEMPERATURE ON THE BENDING STRENGTH OF BEECHWOOD

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ABSTRACT

The influence of moisture content (MC) and temperature on the bending strength (modulus of rupture -MOR) of beechwood was investigated. The wood was exposed to the temperatures 20-100 °C, usually used for hydrothermal treatments of beechwood in the industry, and the moisture content of wood was varied: oven-dry (0%), moisture content for indoor use (8-10%), air-dry (16-18%), fiber saturation area (22-25%) and the fresh wood (60-105%). The effect of MC variation on mechanical properties was limited to the hygroscopic area and with the increase of MC the MOR of beech wood decrease significantly. The temperatures slightly affect the MOR in the full range of wood moisture. With the increase of MC the effect of temperature is more significant. MOR was investigated in the radial and tangential directions, but no significant differences were observed in this regard.

Keywords: beech, modulus of rupture, moisture content, temperature.

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INFLUENCE OF FURNITURE EXPLOITATION ON THE BENDING STRENGTH OF FINAL CORNER JOINS MADE OF ORIENTED STRAND BOARDS

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ABSTRACT

The purpose of this research, presented in the paper is to show how the exploitation of furniture affect the strength of its connectors, more precisely the bending strength of the final corner dismountable joints for designed furniture – office desk.

For solving this problem 2 office desks were made (from chosen material OSB panels), joined by dismountable connectors, and also from the same material and the same type of connectors, reference test fixtures were made and their bending strength was the value of comparison.

Office desks were tested according to European Standard for determining the stability of the structure and that was simulated exploration of furniture. After that, the final corner compositions were cut off, and its bending strength was compared with the reference test fixtures strength.

The obtained results showed that the exploiting of dismountable furniture has not a significant impact on their compositions strength.

Keywords: bending strength, dismountable joints, OSB, European Standard, final corner joints.

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DETERMINATION OF THE FIRMNESS OF CORNER JOINTS FOR CONSTRUCTED CORPS FURNITURE MADE OF REEFINED PANELS OF PARTICLE BOARDS

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ABSTRACT

This paper presents data about the firmness of bending of outside corner joints, mountable- demountable and fix, of refined panels of particle board with a width of 25 mm. The research was conducted on two kinds of samples and two different kinds of connective elements.

The two kinds of sample objects are divided in two groups according to the way of composition as follows:

- group 1: the first are obtained by extraction i.e. cutting up an already constructed element – bedside table which was subjected to a test method for determining firmness, durability and stability- furniture for indoor use EN 1730: 2000;
- group 2: the second sample objects were not subjected to any tests and were composed of two parts of particle board with given dimensions in accordance with the normative and are connected with the chosen connective objects.

In this research the following constructive connections were used: an excentre clutch – minifix with a clamp and an element for tying from the firm Hafele and a plastic corner brace.

Keywords: excentre clutch, plastic corner brace, particle board, firmness, strength of bending.

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A SIX-YEAR XYLOGENESIS ANALYSIS OF MATURE NORWAY SPRUCE TREES AT BRNO SURROUNDINGS (SOUTH MORAVIA REGION)

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ABSTRACT

Wood formation or else called xylogenesis is a cyclic, dynamic, complex process, strongly correlated with forest productivity and is highly influenced from the regional ecological and environmental/climatic conditions. Thus, the knowledge of intra-annual wood formation dynamics and its response to the existing climate change impact, is crucial for the forthcoming forest management strategies. However, understanding the wood formation processes is timely and still remains poorly understood.

Norway spruce trees are one of the most important economic timber species in wood industry. The purpose of this study was the monitoring of cambial activity and tree-ring formation of Norway spruce trees growing at Rajec-Němčice area during 2015-2020 period.

Climatic data registered from a meteorological statin within the research plot, indicated similar annual average temperatures, but variations in the annual precipitation amounts among the six years period. The year 2015 which was one of the driest years, indicated the shorted xylogenesis duration (85.17 ±17.38 days) and tree ring growth (0.48 ±0.15 mm). In contrast, 2019 and 2020 two years with higher annual precipitation than the average precipitation amount in this area, presented wide tree-rings (1.09 ± 508.5 mm and 1.27 ±0.5 mm respectively). 2016 and 2018 years following a dry (2015) and wet year (2017) exhibited intriguing results, yet deeper analysis is needed.

Keywords: cambial activity, wood formation, cell differentiation, *Picea abies.*

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ANALYSIS OF THE PROCESSING MODE ON THE CUTTING FORCE WHEN CUTTING BEECH WOOD

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ABSTRACT

The aim of the researches presented in the paper is to study the influence of the processing mode on the cutting force when cutting beech wood.
After determining the physical properties of the boards that will be cut in order to examine the influence of the processing regime on the quality of the cut, the measurement of cutting power and acoustic emission at certain processing regimes was performed. Immediately after cutting, the accuracy of processing was measured at each processing mode.

Immediately before cutting, the tool bluntness was measured. The tool that will be used for cutting is a circular saw with 24 blades, 300 mm in diameter. Wear was measured on four blades spaced equidistantly along the circumference of the circular saw.

After that, the cutting forces, acoustic emission, sawdust width and machining accuracy were measured.

The results of the research are given in tables and are presented graphically.

Keywords: beech, cutting power, processing modes, cutting quality.

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USE OF CURVED SHAPES IN CHAIR DESIGN

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ABSTRACT

Curved shapes of furniture parts are often used in furniture design and interior decoration. Technological production of curved shapes involves bending wood, but mainly it takes place from bent veneer moldings and beech. For other types of wood, curved elements are made by sawing and arc joining.

Slavonian oak furniture belongs to high price class furniture. The aim of research is to explore the need for Slavonian oak bending furniture elements. The frequency of curved shapes of chair elements, their dimensions, degree of curvature and constructional technological performance on existing products on the market will be investigated. The possibility of rationalizing the described elements from technological, design and economic points of view will be examined.

Keywords: curved furniture elements, Slavonian oak (Quercus robur L.), high price range furniture.

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COLOUR OF BIRCH WOOD IN THE PROCESS OF THERMAL TREATMENT WITH SATURATED STEAM AND THE DEPENDENCE OF THE TOTAL COLOUR DIFFERENCE ON THE ACIDITY OF WOOD

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ABSTRACT

The paper presents changes in the colour of birch wood (*Betula pendula Rot*.) in the thermal process of wood colour modification with saturated water steam in the temperature range t = 105 - 135 °C during τ = 3 to 12 hours. The light white-brown colour of birch wood acquires colour shades from pale brown to brown in the thermal treatment process. Changes in the colour of birch wood are expressed in terms of the total colour difference in the colour space CIE L*a*b*.

In the thermal process of heat on wet wood, conditions are created for the course of chemical reactions, such as: extraction of water-soluble substances, hydrolysis of wood hemicelluloses,depolymerization of polysaccharides and chemical changes in lignin manifested by modification ofwood chromophore system manifested by wood colour change. Due to the hydrolysis of hemicelluloses under given technological conditions, the acidity of birch wood changes with a decrease in the pH value.The presented dependence of the total colour difference ΔE* on the change in the pH of birch woodis a suitable technological tool for the evaluation of the achieved change in the colour of birch wood in the technological process.

Keywords: wood, white birch, thermal treatment, saturated water steam, colour, acidity.

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SUSTAINABLE CONCEPTS OF MACEDONIAN TRADITIONAL ARCHITECTURE FROM THE 19TH AND 20TH CENTURY

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ABSTRACT

At a time when urban environments are growing rapidly at the expense of basic environmental and socio-cultural values, the topic of sustainable design is becoming increasingly relevant. Sustainable development over the past few decades has emerged as an integral part of most engineering disciplines. On the other hand, the knowledge acquired from the traditional architecture comprises complex and rich range of environmental values.

The aim of this research is to detect principal aspects of environmental design in Macedonian traditional residential architecture from the 19th and 20th century, as well as to perceive the potential for implementation of its values and qualities in terms of space, identity, culture and environment in the contemporary context, rather in a technical than in a vernacular sense.

The research was conveyed through separate analysis of the environmental, socio-cultural and socio-economic principles typical of that architecture, in a way to detect architectural concepts compatible with the modern approach of the architectural practice. Also it is necessary to find a way to stimulate new forms of vitalizing the neglected areas by developing modern sustainable concepts wherever applicable, in accordance with the current physical, socio-cultural and economic standards.

Keywords: Sustainable design, Architecture, Traditional architecture, Socio-cultural context.

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ENERGY EFFICIENCY MEASURES IN THE SAWMILLS

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ABSTRACT

Energy make up about 10% of sawmill operating costs and are a place for possible savings and reduction of effects on the environment. While the price of energy is usually set by others, the energy use is to a certain extent possible to influence by the company itself.

The paper analyses the types of energy, places of consumption and quantities consumed per unit of product at a hypothetical sawmill that delivers dried timber. The analysis of the literature showed that most of the energy in such sawmills is used for drying fresh material, namely thermal energy (more than 80% of the total consumed energy), but also electricity for driving fans and other equipment in wood drying kilns (3.3% of the total consumed energy), as well as fuel for charging / emptying the drying kilns. The remaining energy is used for debarking, cutting logs, material handling…

Energy Management System (EnMS) recommendations were used for Energy Efficiency Measures proposals. The EnMS for sawmills is developed using the international standard ISO 50001 as a basis. By implementing EnMS, it would be possible to make significant energy savings and reduce greenhouse gas emissions from sawmill processing. Some of these measures are closely connected to the implementation of energy management systems (EnMS) as they primarily rely on the behavioural change in the companies; others would also require certain investments. It is especially important to note that the systematic approach in raising energy efficiency also very often leads to improvements of the efficiency of the production processes.

Keywords: sawmills, energy efficiency, milling, drying, energy management system.

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RESISTANCE OF WOODEN LACQUERED SURFACE TO ABRASION

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ABSTRACT

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

Keywords: surface, resistance, abrasion, grinding, 2K polyurethane coating, 2K alkid-urethane coating.

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DETERMINATION OF THE STRENGTH OF BENDING, FOR COMPOSITIONS IN THE CONSTRUCTION OF BEDS MADE OF MASSIVE WOOD

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ABSTRACT

In this thesis are shown the analysis of the bending strength of corner joints made of beech wood, that are used in wooden bed constructions.

Four types of corner joints made from solid wood are included in this research, which can be used in the construction of beds. They include: Joints with half groove and glued corner block: Joints with staples and glued corner block: Joints with barrel shaped nut and screws and Joints with angle brackets.

These specimen's are tested by loading them with bending strength. Standard national Bulgarian and European methods are implemented in this research, that are used for determining the strength criteria for the corner joints. Using these methods, the bending strength of the joints is established in two ways: With opening of the elements of the corner joints and With closing of the elements of the corner joints.

The middle moment of breaking whilst bending of all four specimens is the basic criteria for determining the bending strength.

The analysis of these experiments give clear picture about the strength index of these joints, that can be used in the construction of beds.

Keywords: bending moment, strength criterion, bending strength, corner joints, frame constructions (construction of solid wood), beech wood, solid wood beds.

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WOOD CREEP MEASUREMENT

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ABSTRACT

Wood is an anisotropic viscoelastic material, and its time-dependent behaviour depends on both elastic and viscous properties. There are some rheological models, which allow the computational prediction of wood creep, but the reliable input data for common European wood species are not available. For modeling of creep, it is necessary to have tensile and compressive compliance curves for longitudinal, radial, and tangential directions of wood, measured under uniform conditions (loading level, relative humidity, temperature).

This study aims to introduce a device for the long-term measurement of uniaxial creep strain curves of wood under constant loading level, relative humidity, and temperature. The simple non-powered hydraulic device, which multiplies the load from the suspended weights, was designed and built. This allows keepingof constant force on the wooden specimen. The specimen is loaded by tension and for the compressive tests, the reverse jaws are used. The ratio of piston areas of used hydraulic cylinders is 1: 3,5. The maximal allowed weight of suspended weights is 200 kg (reaching up max tensile force 7500 N). The loading device is supplemented by a conditioning chamber for assurance of constant climatic conditions. The uniaxial creep deformation (elongation/shortening) of the specimen is observed by a camera (1 frame per minute). The analysis of the creep strain is realized by the 2-D digital image correlation method. Device was tested by the series of the specimens made from Norway Spruce (*Picea abies*) wood. Each specimen was loaded for 10 days, uniaxially by 50 % of the yield strength. During the test, the specimens were conditioned by 65 % relative humidity and 20 °C (12 % of wood moisture content). Experimental data will be used for the creation of a complex computational rheological material model.

Keywords: viscoelasticity, creep measurement, time-dependent wood behavior.

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INTRODUCING NEW ACTIVITIES INTO THE STUDY PROCESS

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ABSTRACT

The purpose of this paper is to present a way to introduce new activities into the study process to increase the creativity of students and at the same time offer them the opportunity to make new products from wood. We encourage students' creativity by introducing new approaches to the study process. We introduced "Project Week" in our educational work in order for students to get to know the specific steps and at the same time be involved in the entire process of introducing a new product from product idea, design and planning to product promotion. We have included several subjects in the entire implementation of the project work, in which students plan and prepare individual phases of product implementation.

Keywords: creativity, designing, students, study, project, wood, project week, promotion.

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COMPARISON OF THE RESULTS OF MEASURING THE ANNUAL RING WIDTH OF DOUGLAS FIR WOOD (PSEUDOTSUGA MENZIESII) BY DESTRUCTIVE AND NON - DESTRUCTIVE METHODS

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ABSTRACT

The aim of this research is to compare the results of measuring the annual ring width of Douglas fir wood by the visual (non-destructive) method and using the Resi 500 resistograph, ie the destructive method. Two visual methods were used in this research, the first of which is based on measuring the annual ring width with a magnifying glass magnification 10 times, and the second method is based on image processing in the CDendro program.

After a detailed statistical analysis of the obtained measurement results of the annual ring width , the differences in the measurement results were tested for the purpose of comparing the destructive and non-destructive methods.

Key words: annual ring width, Douglas fir wood, measurments methods.

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URBAN FURNITURE FROM SUSTAINABLE MATERIALS

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ABSTRACT

The subject of this paper thesis is the design of exterior furniture and urban equipment that will play a key role in achieving healthy furniture and will meet the needs of the citizens in terms of functionality, anthropometric and ergonometric needs.

The rapid growth of urbanization has created overcrowded traffic and pollution of city areas. Thus the design of urban green spaces and furniture design is in line with the emotional needs of citizens and can make a significant difference to the comfort of use and give the city identity.

In urban areas, greenery is less common than in rural areas, so people are in urgent need of a visually and functionally beautiful environment. Therefore we can use the abandoned forgotten places in the city to create green areas equipped with aesthetically designed urban furniture, to prevent visual confusion in the city. Green spaces and beautiful urban furniture can give the city a distinct identity. Beautifying the city's visual surroundings should be our obligation, together with our improvements in ecology oriented design.

Keywords: steel, used wood, eco wood coatings, composition, triangle, pyramid, urban equipment.

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THE ROLE OF ERGONOMIC DESIGN IN KITCHEN FURNITURE

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ABSTRACT

The subject of this paper thesis is project analysis of the five kitchen types situated in different living spaces. The aim of the paper is anthropometric, ergonomic project analysis of different kitchens for different spaces. Project for the functional kitchen should play a key role in achieving healthy furniture and meet the needs of the consumers in terms of functionality, anthropometric and ergonometric demands.

Ergonomics analyses the relationship between the human body and the objects we use and the spaces we live and work in, in order to optimize movements and avoid unnatural postures that could be harmful to our health. In the home, the kitchen is one of the areas that most benefits from ergonomics. It ensures ease of use and allows you to move comfortably in the space based on your physical requirements and habits.

The ideal length of the imaginary line that unites the sink, refrigerator and hob should be no longer than 6m. The length of the individual sides of the triangle, however, can vary based on the size and shape of the room. Ideally, the distance between each zone should be at least 90cm. Excessive distances waste energy, requiring continuous movement from one end of the kitchen to the other. If the three points are too close together however, working becomes uncomfortable and cramped.

The process of ergonomic design begins with dividing the space dedicated to kitchen into sections. Starting with the zone dedicated to storing food, which should include the refrigerator and ideally some storage cabinets, as well as a surface for preparing food. After this comes the cooking area, which should include a surface for resting hot pots and pans on next to the oven and hob. The sink area should also include a space where plates and cutlery can be placed after washing. The most important workspace in a kitchen is the one between the sink and the hob; this is where most activities are carried out. Identify the main food preparation area between these two points. This should be the most continuous and longest work surface in the kitchen and should be strong and durable enough to serve a meal on.

Keywords: anthropometry, ergonomy, project, materials, kitchen cabinets, furniture fittings, sustainable materials.

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PRODUCT DESIGN AND REUSABLE MATERIALS

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ABSTRACT

In this paper there is analysis and elaboration of materials and design used in production of urban furniture. The furniture is intended for the exterior of an urban area (park, square…) – furniture for public use. By analyzing the criteria and parameters, furniture was designed to meet the public urban space.

In the process of composition analysis and creating a geometric shape, the hexagon is taken, in order to create the design of the furniture. Four elements are included, bench, bicycle parking lot, a waste bin, ambient lighting.

When designing the functionality, anthropometric and ergonomic standards are taken into account, as well as the choice of materials that meets the furniture requirements for external conditions and climate change.

Keywords: concrete panels, used wood, eco wood coatings, hexagon, triangle, urban equipment.

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OVERVIEW OF STRUCTURAL JOINTS IN TRADITIONAL CROATIAN HOUSES IN THE AREA OF KUMROVEC AND DONJA KUPČINA

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ABSTRACT

The aim of the paper was to determine the construction features of traditional buildings in Croatia. It is not possible to unilaterally determine the traditional construction and architecture in Croatian heritage, since Croatia is rich in a diverse typology of traditional buildings depending of the locations. This paper is focused on the analyzed buildings in the area of Kumrovec and Donja Kupčina (north and mid part of the Continental Croatia). The basic methods used in this paper were collecting photo documentation in situ and interviewing experts. Special attention was paid to structural joints of the traditional buildings and specific design and construction details of the facades. The most commonly used angular joint is so-called sjek (cut), which appears in two types: "Croatian" and "German", depending of the type of the buildings. The construction of roof, foundations, and stairs was also analyzed. The observations from this research will be applied to the design of a modern prefabricated public building.

Keywords: Croatian heritage, traditional wooden houses, structural design, wooden joints.

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CELL WALL AREA VARIATIONS OF WHITE POPLAR (*POPULUS ALBA* L.) JUVENILE WOOD

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ABSTRACT

White poplar (*Populus alba* L.) is becoming interesting species for breeding because of its tolerance to drought and variations in levels of ground water. However, its wood anatomical properties have not been sufficiently investigated, whereas data on cell wall area can certainly be interpreted in relation to wood density. Fiber lumen area, vessel lumen area and ray area of white poplar juvenile wood from two sites in Croatia was measured. Cell wall area (%) was calculated as a percentage remain after detracting fiber lumen area, vessel lumen area and ray. Variations in cell wall area in radial direction (from pith to bark) and between trees within two white poplar populations were investigated. Preliminary results indicate that cell wall area varied significantly from pith to bark and between trees within one site. In juvenile wood from the other site, both variations were non-significant. In conclusion, variation significance demonstrates different cell wall area radial trends from both sites, suggesting that only one site confirms variable properties within juvenile wood. As well, different tree effect on cell wall area within two populations was detected.

Keywords: cell wall area, juvenile wood, *Populus alba* L., wood anatomical properties variation.

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ORGANIC DESIGN AND MODELING OF BENDING PLYWOOD FURNITURE THROUGH THE WORK OF ALVAR AALTO

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ABSTRACT

Organic approach to molding dates back to the classical period and further on evolves through the period of renaissance, it was the period when the famous Michelangelo claimed understanding of architecture arises from the human body. Since the all-individual parts of the human body are in a harmonious relationship, followers of this approach thought that architecture and design should be in such a harmonies relationship as other species in nature. The very beginning of this approach in architecture and design dates from the late 19th century. Founders of this approach are architects and designers Frank Llyod Wright (USA), Charles Rennie Mackintosh (UK), Alvar Alto (Finland) and the couple Charles and Ray Eams (USA). Functional and minimalistic, but at the same time warm and lively modern Scandinavian design contains quality in its appearance. Life and work of Alvara Aalta is perhaps the best example of Scandinavian architecture and design of 20th century and the summit of style. He was the first who retreated from pure formalism and geometrical shapes, that was common in the early period from modernism. His personal expression, the fluidity of movement, the emphasized value of informality finally came out to the surface. The name of Alvara Aalta is a synonym for modern and innovative architecture, and not only that, he's been given a credit for making a great contribution to modern furniture design. Alvara Aalta has been working on chair design, as many other designers did. He worked on perforated plywood backrest and free shaping as well. One of his many design solutions is a unique tripod which has a cult status and as such it dates back over 80 years. Worth mentioning is the chair Paimio (1932) better known as chair 41. This particular chair was part of the hospital equipment and served to lung patients as an apparatus for easier breathing while in an upright position. This paper analyzes the use of an organic approach to design through Scandinavian design, the sculptural appereance of the furniture and production methods of Finnish industry based on bent laminated elements made from birch and fir.

Key words: scandinavian design, Alvar Alto, furniture, organic approach, plywood.

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DESIGN AND MODELING OF BENDED FURNITURE THROUGH THE WORK OF MICHAEL THONET

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ABSTRACT

Design and modeling of solid wood in various forms is a technique that has numerous advantages, starting from reducing wood waste which is a simpler and faster way to create various shapes through increasing the strength and rigidity of modeled details, to the possibility of better processing and lower investment costs. Improving the elastic properties of wood and their ability to retain a modeled shape under the influence of moisture and heat has been known for hundreds of years. Michael Thonet's research work and inventiveness, at the time of manufacturing, paved the way for the establishment of industrial, mass-produced bent furniture. Thonet managed to develop a technological process for the production of bent furniture, which included elements of industrial production with its own infrastructure, economical and modular concept of furniture production, marketing and opening of retail chains. Michael Thonet is a pioneer of the industrial concept of making bent furniture, Thonet furniture made in organic forms is still extremely popular today.
This paper analyzes the role and importance of industrial design and modeling in the process of making bent furniture through the work and innovations of Michael Thonet and the development of the Gebrüder Thonet factory. Special attention is given to the great success of the iconic N14 chair on the market, but also to the design philosophy of Michael Thonet focused on simplifying the compositional elements of mass production, which combines strength, beauty and flexibility.

Key words: wood bending, design, modeling, construction, moisture, heat, furniture.