



Международно Бизнес Училище
International Business School



VUZF
Finance,
insurance, business,
entrepreneurship
and innovation

REFAN
PARFUMERIE & COSMÉTIQUE



furniture
videnov



XVII International WoodEMA 2024 Scientific Conference

GREEN DEAL INITIATIVES, SUSTAINABLE MANAGEMENT, MARKET DEMANDS, AND NEW PRODUCTION PERSPECTIVES IN THE FORESTRY-BASED SECTOR

Sofia, 15-17 May 2024

Title of the paper:

THE USE OF ENGINEERED WOOD PRODUCTS IN SUSTAINABLE BUILDING CONSTRUCTION IN MACEDONIA

Name of the authors: Marija Miloshevskaja Janakieska¹, Manja Kitek Kuzman², Dick Sandberg³

Affiliation:

1 Department of Architecture, Faculty of Engineering, International Balkan University, Skopje, Macedonia

2 Department of Wood Science and Technology, Biotechnical Faculty, University of Ljubljana, Ljubljana, Slovenia

3 Wood Science and Engineering, Luleå University of Technology, Skellefteå, Sweden



No material has filtered into our lives for as long and in as many ways as wood in its many shapes. **Engineered Wood Products (EWPs)** present the bridge between wood science, structural engineering, architecture and design. This book explores and illustrates the uses of various contemporary EWPs and introduces some new wood-based materials. Each page spread describes and presents information, about a specific EWP and the EWP is illustrated with inspiring images showing applications of the EWP in architecture, building construction and interiors.

The present work grew out of the interdisciplinary collaboration and different experiences of three wood scientists from Slovenia, Sweden and North Macedonia with different backgrounds - the wood engineers with experience and knowledge of technological needs, the architect with a deep knowledge of culture-based needs and wood scientists experienced in environmental science and forestry.

Ниту еден материјал не се инфилтрирал во нашите животи толку долго и на толку многу начини како дрвото во неговите многубројни форми. **Композитните производи од дрво (КПД)** претставуваат мост помеѓу науката за дрво, конструктивното инженерство, архитектурата и дизајнот. Оваа книга ја опишува и илустрира употребата на различни современи композитни дрвени производи и воведува некои нови материјали на база на дрво. Секоја нова страница е посветена на информации за специфичен композитен производ базиран на дрво и илустрирана со инспиративни слики од различните примени на овие производи во архитектурата, градежништвото и дизајнот на ентериер. Оваа работа произлезе од интердисциплинарната соработка и различното искуство на тројца научници: од Словенија, Шведска и Северна Македонија со различно образование - инженер за обработка на дрво со искуство и познавање на технолошките потреби и архитекти со длабоко познавање на потребите засновани на културата.

Detail from a bar at Gardemoen airport, Oslo, Norway, 2019

Engineered Wood Products
Композитни производи од дрво

Pioneering the Future of Architecture with Wood
Пионер во иднината на архитектурата со дрво во иднина

Marija Miloshevska Janakieska
Manja Kitek Kuzman
Dick Sandberg

Engineered Wood Products in Modern Architecture

Композитни производи од дрво во модерната архитектура

Pioneering the Future of Architecture with Wood

Пионер во иднината на архитектурата со дрво во иднина

Marija Miloshevska Janakieska
Manja Kitek Kuzman
Dick Sandberg





Robev Family House (1827). The famous Ohrid merchant family Robev lived in the house for 35 years when a criminal from Ohrid Ustref Beg burnt it to the ground 1861. Two years later, the house was rebuilt. Ohrid, North Macedonia, 2022

► Application in construction | Примена во градежништвото

The Forma Villa House (2011), Ravne na Koroškem, Slovenia, 2011



The Rant House (2013), Škofja Loka, Slovenia, 2013



The Terme Čatež Hotel (2012), Čatež, Slovenia, 2012



The Ekoprodukt in an industrial facility (2012), Komenda, Slovenia, 2012



Extension with a hall, Waldorf School (2009-2012), Ljubljana, Slovenia, 2011



The Punkl Youth Hostel (2011), Ravne na Koroškem, Slovenia, 2011



The Poljčane Kindergarten (2014), Poljčane, Slovenia, 2014



Interior detail in Sara Kulturhus (2021), Skellefteå, Sweden, 2022



CLT house, Kolarevič company (2022), Poljane, Slovenia, 2022



EWPs based on Veneer | Композитни дрвени производи произведени од фурнири

LVP Laminated veneer product Производи од ламелиран фурнир

→ STRUCTURAL | Конструктивни
Surface, profiled | Површински, Обликувани

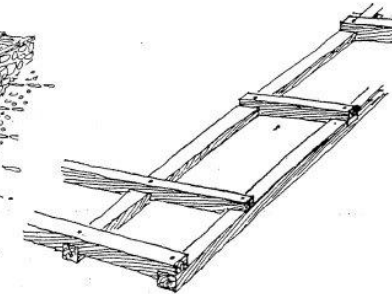
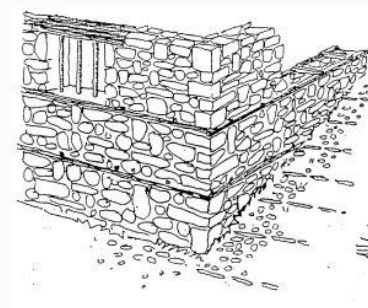
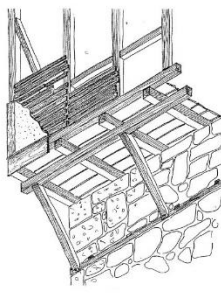
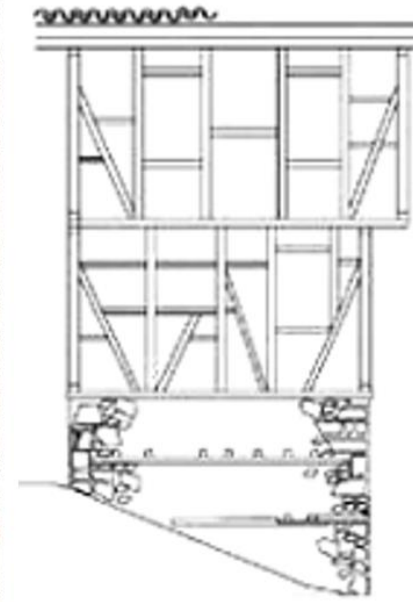


SPECIFICATIONS | Laminated veneer products (LVPs) consist of veneers bonded together with an adhesive under pressure into a predetermined shape in a mould and usually under an elevated temperature to shorten the curing time of the adhesive. The process used to manufacture such products is generally called laminated bending (bending is in a single direction, whereas moulded refers to the veneer bending in two directions, creating not just an undulating surface but a surface that is compound and three-dimensional) and it is commonly used for the manufacture of components for furniture and interiors for the production of complex shapes, as well as for exterior joineries such as windows. Shell-formed LVPs are typical moulded components that are used for chairs or interior details. Laminating offers the designer a great deal of creative freedom. One great advantage of LVPs is that it is possible to build up thick bends of small radius by lamination of thin veneers of any species of wood. Like the complex curves of an eggshell, moulded LVPs are in general much stronger than bent LVPs of the same thickness. All types of veneer can be used, but some are more easily shaped than others. The adhesive is extremely important for the function of the final LVP, and those most frequently used are urea-formaldehyde (UF), but melamine urea-formaldehyde (MUF), polymer isocyanate (EPI), polyurethane (PU), and epoxy adhesives are also used.

КАРАКТЕРИСТИКИ | Производите од ламелиран фурнир (LVP) се произведуваат со лепење на фурнири во калапи со однапред одредена форма под притисок и обично на покачени температури, со што се скратува времето на зацврстување на лепилото. Процесот што се користи за изработка на такви производи обично се нарекува свиткување (свиткувањето е во една насока, додека формирањето се однесува на свиткување на фурнирот во две насоки, создавајќи различни сложени тридимензионални форми). Обично се користи во производството на компоненти за мебел и ентериери со сложени форми, како и за столарија, на пример за прозорци. Производите од ламелиран фурнир во облик на школка се типични компоненти обликувани за столци и други елементи во ентериерот. Ламинацијата им нуди на дизајнерите широки можности од аспект на креативна слобода. Големата предност на производите од обликувани фурнири е тоа што овозможуваат да се добијат производи со кривини со мал радиус со ламинирање на тенки фурнири од секаков вид дрво. Еден таков пример е просторно сложената форма на лушпата од јајцето. Производите од ламиниран фурнир со облик (LVP) се генерално поцврсти од производите направени со свиткување фурнири со иста дебелина. Може да се користат сите видови фурнири, но некои полесно се обликуваат од другите. Лепилото е од исклучителна важност за финалната функција на ламиниранот фурнирски производ од дрвена граѓа. Најчесто се користат лепила уреа-формалдехид (UF), но за нивно производство се користат и меламин-уреа-формалдехид (MUF), полимер изоцијанат (EPI), полиуретан (PU) и епоксиден (EP).



In Macedonian architectural history, wood has held a high position, serving as a construction material, for both structural and non-structural elements.



The Ottoman Era Houses in Ohrid, Macedonia – the wooden structural system (bondruk system) of the traditional Macedonian house

After the earthquake in Skopje in 1963, several countries helped the city by building new structures, from different structural materials. In order to meet the housing needs of the people left without home in the earthquake, new system of timber prefabricated houses was introduced in Macedonia. These houses were built on several locations in Skopje and they were called Swedish and Finnish prefabs or Swedish timber houses. Prefabricated wood houses were ideal solution since wood is low in weight in relation to its load-bearing capacity and strength, the material ideally suited to industrial construction, making transport, erection and installation on site much easier.



Despite its significant historical usage, modern-day Macedonia predominantly employs wood in mountainous regions small houses, in the interior design or as a decorative element on the facades because of the beautiful aesthetic appeal. In recent decades, material choices in Macedonia have become increasingly limited, with designers, investors and companies sticking to conventional materials. The widespread use of steel and concrete, particularly following the 1963 earthquake in Skopje, has diminished the importance of wood.



House in Blatec, near Pehchevo, Macedonia - wooden elements in the structure and on the facade



House in Blatec, near Pehchevo, Macedonia - façade partially covered with wood

















Some basic types of prefab. timber houses in Macedonia [www.geo-ing.com]



House in Pehchevo, Macedonia - façade completely covered with wood

Nowadays, progressive construction practices across Europe, including Macedonia, are increasingly focused on environmentally friendly materials, particularly wood and various EWP. However, the debut of novel products within the Macedonian construction industry often encounters limited awareness and heightened uncertainty among consumers.

Nonetheless, the situation is changing in the last few years, due to the impact of European trends, and wood application is increasing. People's awareness is slowly evolving and they are beginning to see the positive features in living and using sustainable EWPs.

GLT Glulam-glued laminated timber 	CLT Cross-laminated timber 	PSL Parallel strand lumber 	LSL Laminated strand lumber 	LVL Laminated veneer lumber 
EGP Solid wood panel 	PB Plywood 	LDF/MDF/HDF Low/medium/high-density fiberboard 	VP Veneered particleboard 	PB Particleboard 
OSB Oriented strand board 	LS Light sandwich (honeycomb) panels 	WPC Wood plastic composites 	TM Thermally modified timber 	WFI Wood fibre insulation boards 



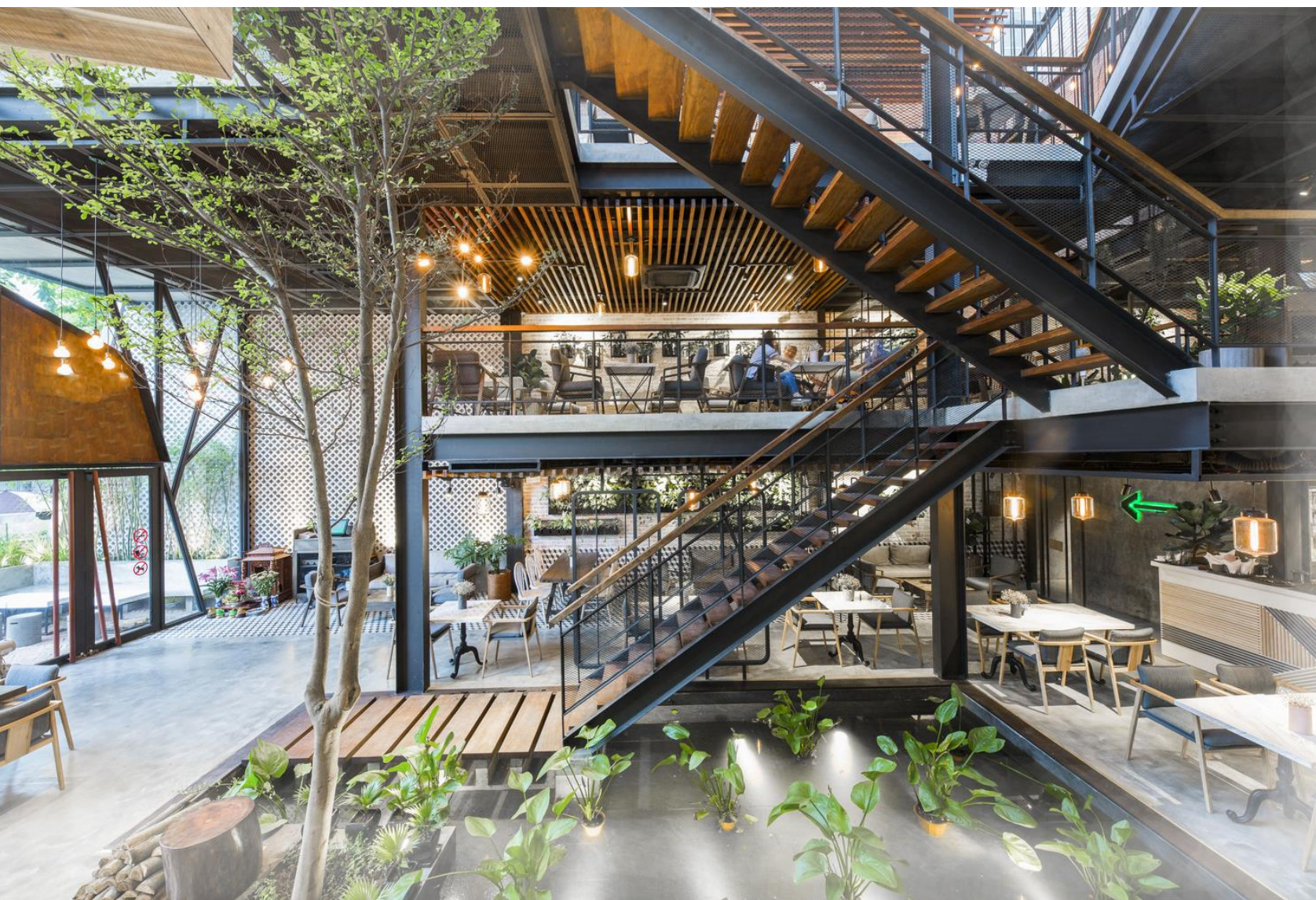
The application of EWPs in projects is especially interesting for architectural students and young architects who are inspired by European practices for sustainable and biophilic design



Project for Botanical Garden in Skopje, designed by Faton Kalisi



Международно Висше Бизнес Училище
International Business School



Department of Architecture
International Balkan University

Student: Abida Susevic
Project: Green Café in Skopje



Международно Висше Бизнес Училище
International Business School



Department of Architecture
International Balkan University



Student: Anel Cako
Project: Green Shopping Mall

In Macedonia, the wood sector has a very long tradition and has always been an important segment of country economy. To get a better picture of the importance of the forest sector, some additional information regarding relevant forestry statistics is presented in Table below.

Population*	2 093 599
Total area (km²)**	25 713
Surface area of forested land (km²)***	10 015
Forested area (%)***	39.71%
Number of naturally occurring tree species	319
Growing stock (m³)	75.94 · 10 ⁶
Annual growth of growing stock (m³ forest)	1.62 · 10 ⁶
Annual harvest (m³ forest)	1.34 · 10 ⁶
Hardwoods (m³)	-
Softwoods (m³) Sawn wood	-
Consumption Per Capita (m³/y)	0.1

* Worldometers. Available online: <https://www.worldometers.info/world-population> (Accessed on 24th of March 2024)

** Worldbank.org. 2020. Available online: <https://www.worldbank.org/en/home> (Accessed on 24th of March 2024)

*** World Data Atlas – North Macedonia – Forest Area – 2021. Available online: <https://knoema.com/atlas/North-Macedonia/topics/Land-Use/Area/Forest-area> (Accessed on 24th of March 2024)

Architects' Perception of EWPs in Macedonia

Methods

A survey questionnaire was constructed and developed by an international group of architects as a part of a larger survey. The study methods included a two-stage survey; in the first stage, personal interviews were conducted, and then, based on input from these in-person interviews, the second stage an exploratory web-based survey was designed. The survey questionnaire was in English.



Objectives of the study

- To evaluate the perception Engineered Wood Products (EWPs) by architects in the Macedonian construction market;
- To characterize information sources and their perceived value used by architects;
- to identify EWPs information needed by architects;
- to evaluate cooperation between architects, wood engineers and civil engineers.

The specific goals of the study were:

- (1) to identify the use of modified wood in a process of architectural planning,
- (2) to assess architect's knowledge of modified wood and their advantages.



The study provides an updated overview of the perception of modified wood products among architects.

- 98 completed answers in Macedonia.
- All have the tittle architects, some also engineers.
- 38% of respondents were men and 62% women.
- Respondents had an average of 5-15 years of experience.



Results













	GLT Glulam-glued laminated timber 	CLT Cross- laminated timber 	PSL Parallel strand lumber 	LSL Laminated strand lumber 	SWP Solid wood panel 	LVL Laminated veneer lumber 	PW Plywood 	LDF/MDF Low/medium/ high-density fiberboard 	VP Veneered particle board 	PB Particle board 	OSB Oriented strand board 	LS Light sandwich panel 
No	6	18	25	37	6	23	7	13	17	18	3	40
	6.6%	19.8%	27.5%	40.7%	6.6%	25.3%	7.7%	14.3%	18.7%	19.8%	3.3%	44.0%
Yes	85	73	66	54	85	68	84	78	74	73	88	51
	93.4%	80.2%	72.5%	59.3%	93.4%	74.7%	92.3%	85.7%	81.3%	80.2%	96.7%	56.0%

Table. Respondent familiarity with EWPs

Results













	Glued laminated timber				Solid wood panel	Laminated veneer lumber	Plywood				Oriented strand board	
	GLT	CLT	PSL	LSL	SWP	LVL	PW	LDF/MDF /HDF	VP	PB	OSB	LS
												
points	254	49,5	45,8	42,1	237,7	112,3	286,8	107,4	98,7	43,6	292,9	74,8
ranks	3	11	12	14	4	5	2	6	8	13	1	10

Table. Respondent familiarity with Top 5 Ranked EWPs



Results

Respondents were asked if they think there has been an increased use of new EWPs in the last 5 years. 35% think that the use has increased, while more than 50% think it remained the same.

Further on, respondents were asked to identify their clients' perceptions of EWPs. Their responses suggest that clients in Macedonia generally want to have more information about EWPs. Additionally, around 5% from Macedonia believe that their clients are not interested in EWPs.



The project "NOW", by a team led by Bekir Ademi, architect from Project Studio "BINA", is representing Macedonia at the "17. Biennale Architettura 2021"

Conclusions



Summer Scene City Park Skopje built 2022



Международно Висше Бизнес Училище
International Business School



Thank you for your attention!

