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Using wood as a new generation building material in the context of sustainable development

ABSTRACT

Wood is a natural resource that is renewable, easily recoverable and stores carbon dioxide, making wood constructions a feasible alternative to attaining significant sustainability targets. In the '90s, technological attendees invented the laminated wood beams, and it begins to apply the ingenious truss solved principle to the building structures of laminated and plywood. A new generation hybrid construction method dubbed the Urban Timber (UT) System was designed to support the timber buildings based on the diagnostic vulnerabilities of wooden structures. The system was defined and demonstrated while taking into account structural behavior, architectural value. Everything else is left to the designer's discretion, his sensitivity, and, above all, his ability to leverage technology from the many advantages and many-sided. The research seeks to inform future generations about the predicted sustainable features of wooden structures, which are touchstones of the global construction industry, under the usual circumstances of a new industry. To that end, it has proven why industrialized timber building systems are a fundamental problem in the context of the present environmental, social, and psychological discussion and the utilization of distinct construction approaches using sustainable materials. Timber is seen as the future building material, according to the findings.

Keywords: *Wood; Construction Material; Sustainability; Human Psychology*

1. INTRODUCTION

The combined deforestation, forest management, and afforestation may cause an equivalent decline, by 2030, of around 25 percent of present CO2 emissions due to fossil fuels [1]. The forestry industry can impact carbon emissions by replacing fossil fuels with bioenergy or indirectly utilizing wood goods rather than greenhouse-gas intensive items [2]. When the forests are held accountable, the trees are dismantled and transformed into wood products, and thus the storage of carbon is enhanced over lengthy periods. A significant concern in this approach is a responsible purchase of wood products, and a certification system has been established for forestry and control of the chain to ensure the provision of wood products from sustainable sources used in development or product lines [3].

Nevertheless, wood was one of the construction materials most frequently used since ancient times. Since the early twentieth century, other aspects such as ecosystem balance and experienced ecological comfort in timber buildings have been explored and appreciated because of increased attention. While wood is utilized in traditional buildings based on the size of the tree, it may now be manufactured in industrially required sizes. It shows high tensile and pressure resistance in the direction of the fiber. It expands depending on humidity; it is light compared to other building materials and is a special material that provides heat insulation due to its low heat conduction.

As a consequence, the usage of wood grows in favor of buildings. Current designs push environmental concerns, increasing health and

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living space requirements and interesting new wood items. When we consider energy usage in the building sector and the material cycle, we can see that wood offers several benefits. Wood binds carbon dioxide during its development and prevents reintroduction in the environment years after the material has been made into the wood. Due to today's environmental issues, the building industry's trend toward sustainable or recyclable materials has expanded, as have studies on ecological structural designs. Wood is also popular since it is natural, simple to work with, and long-lasting. It can also be utilized with many types of materials. Attastes on today's comfort have changed, new technology is emerging, the number of construction floors has expanded, and wood construction materials have shown incapable of satisfying these demands. This difficulty, however, has been substantially overcome owing to the hybrid usage of wood material.

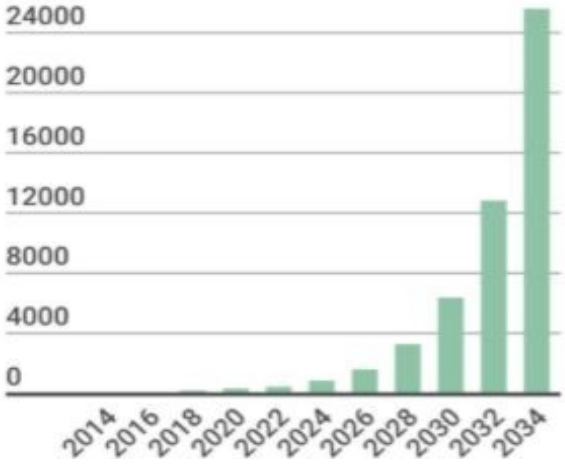
Figure 1. Community Centre, Ludesch – Austria

Slika 1. Društveni centar, Ludeš – Austrija

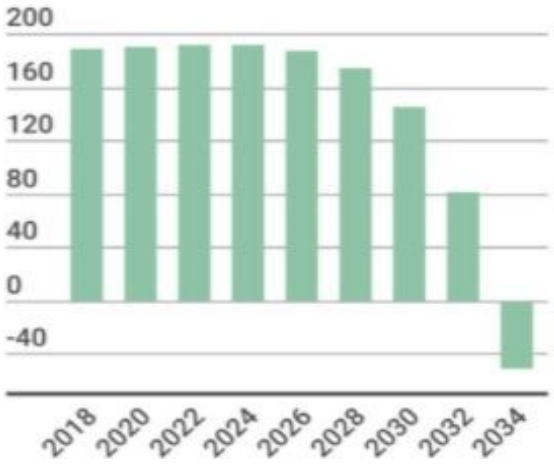
Since the amendment, it is used as wood construction material in housing projects. Recent projects show that sustainable construction with optimum energy use using ecological materials can produce architecturally attentive and economically efficient results. The community center in Ludesch, Austria (see Figure 1), designed by architect Hermann Kaufmann and finished in 2006, is an example of a creative and cost-effective ecological building project. In addition to creating a passive building, it has been optimized the specific primary energy consumption in the main building and simultaneously reducing environmental production expenditure [4]. The long-term detrimental influence of construction processes and materials on material resource consumption and physical environmental quality, according to Tzonis [5], is an essential consideration in design today. An example of the stunning artwork and a spectacular display of the structural ability of the glue-laminated timber coatings is the dynamic, solid roof structure for the Hanover EXPO 2000 design by Thomas Herzog and Julius Natterer (see Figure 2).

Figure 2. Thomas Herzog and Julius Natterer design

Slika 2. Dizajn Thomas Herzog i Julius Natterer



Mass Timber Buildings Constructed Per Year
Masovne drvene zgrade izgrađene godišnje



Carbon Impact in Millions of Tones Per Year
Uticaj ugljenika u milionima tona godišnje

Figure 3. Timber Buildings and Carbon Impact Data for North America (North American Mass Timber Report, 2020)
Slika 3. Podaci o drvenim zgradama i uticaju ugljenika za Severnu Ameriku (North American Mass Timber Report, 2020).

With the removal of height limitations in residential timber structures, the industry collaborated with architects to create new manufacturing processes. It also demonstrates that timber enables a sustainable, energy-efficient design tailored to society to create healthier structures and a more sustainable construction regime for our cities [4]. Traditionally, in structures where wood is a carrier, the dimensions would be limited to the size of the wood material, which can usually be found. Timber today can be prepared in industry-standard sizes. In addition, solutions such as strengthening chemicals or using other elements to increase durability have been developed. With the help of new technologies processed or maintained, the construction sector has been re-used widely in many world countries. Every two years, the number of recent mass timber structures doubles globally. As depicted in Figure 3, by 2034, the US construction industry, therefore, expected to save more carbon than it ever released [6].

Due to the continuing trade and legal restrictions, potential emission reduction in the marketing of wood products in the construction sector has still been achieved [7]. Several challenges impede the adoption of new technologies, including the sustainability of the existing technologies and social systems, lack of application knowledge, lack of finance, inadequate incentives for replacing old technologies with new, excessive costs, and a lack of demand in the markets [8]. In Europe, wood is still the most important renewable energy source. According to Peter Wilson, the 21st century is called the Wood Century, Managing Director of Timber Design Initiatives (see Figure 4). Given the wonderful characteristics of wood, he believes this will be the material he may choose for all buildings [9]. The favored construction material was wood for a thousand years, based on its availability, amount and strength, and weight, according to Laguarda Mallo and Espinoza [10]. The use of wood as a building material, despite its several advantages, has certain disadvantages. Wood quality is influenced by the species, cellular architecture, moisture content, location of the tree, and sections within the same tree [11].

Wood has been a popular construction material for one thousand years, according to Laguarda Mallo and Espinoza [10], due to its availability, quantities, weight, or strength ratio. The use of wood as a building material, despite its several advantages, has certain disadvantages. The wood quality is determined by species, cells, humidity, and the tree's location and parts of the same tree [11]. The properties of Wood change additionally according to the direction due to its anisotropic nature. Finished wood products were created to overcome internal wood variability and efficiently utilize the material [11].

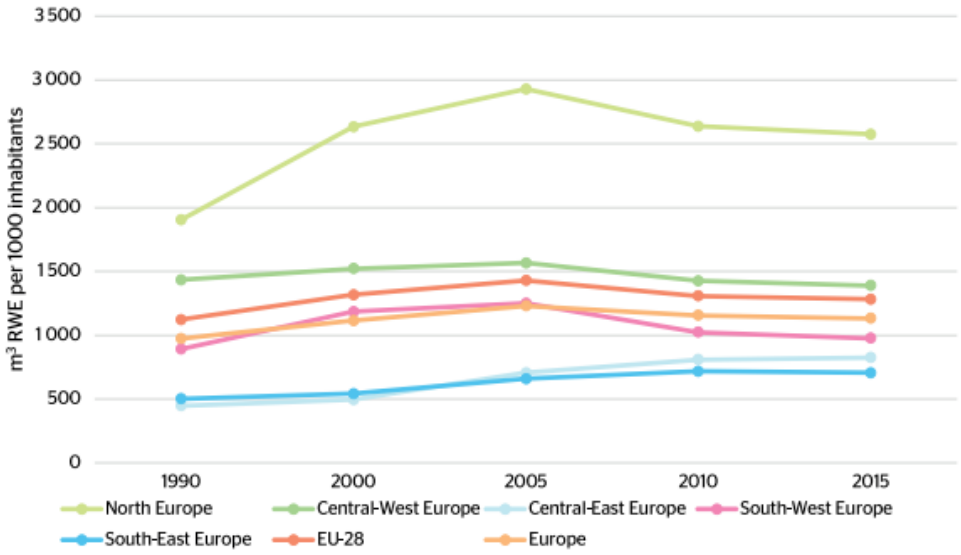


Figure 4. Trends in wood consumption, by region, 1990-2015 [12]

Slika 4. Trendovi potrošnje drveta, po regionima, 1990-2015 [12]

CLT (Cross laminated wood) is one of the industrial wood products which gains in popularity within Europe since its debut two decades ago. It has been extremely successful [13]. CLT has demonstrated success in Europe and is entering the Canadian and Australian markets [10].

However, it is still not widely adopted in the construction industry of all nations. Today, it is observed that the restricted use of wood in construction systems in some countries. However, today, the importance of energy-efficient building design has increased due to the increasing environmental pollution and the depletion of energy resources. In this context, CLT has the potential to be a cutting-edge product that can boost the wood products industry's competitiveness in both the Turkish and North Macedonian construction markets. Therefore, the emphasis of this study focused on the innovative wooden construction systems and the up-to-date position of the developed regions like Europe, Canada, and the USA, which new ecological structures have been built for many years. Even though CLT is already in preliminary stages throughout most countries, the early phases of the research effort to embrace new goods must also be focused on awareness and attention. Furthermore, the purpose of this study was to evaluate the market potential of wood building material and learn about the environmental, structural, and economic views of wood materials used by the consumers, which should be evaluated by entrepreneurs, manufacturers, and suppliers of industry interested in gaining access to the future construction timber market.

2. UTILIZING WOOD AS A SUSTAINABLE CONSTRUCTION MATERIAL

The wooden frame construction style influences the traditional house building style as the most preferred option for millions of worldwide residences, especially in North America [14]. Although it has an important place in most of the country's construction history and culture, concrete and steel structures have gained popularity since the last century. Nowadays, the world's developed countries are turning to wood in every aspect of their lives due to its being healthy, natural, sustainable, and safe day by day. Among civil engineers, architects using Timber as a contemporary building material are gaining popularity in sustainable development. Timber is a durable construction material that is also implemented as a structural frame element with the help of modern technology. The materials used instead of wood in buildings are not stable and carry risks to human health. Wooden frame structures have the characteristics of being the world's most economical and comfortable residences [15]. Since people could quickly obtain housing materials using wood resources, the wood frame construction style has become an advanced, versatile economic technology with a wide variety of research and applications. It has reached the capacity to meet and overcome the challenges in building science.

Emphasizing that many ancient timber houses exist today, the wood is the closest material to human nature with its living and breathing structure. Timber's weight and bearing capacity ratio is higher than that of reinforced concrete and steel, and that spans up to 70 meters with Timber can be passed without columns as in Hamar Olympic Stadium (The Viking Ship), Norway [16]. The Timber is at the forefront in terms of resistance to weather conditions and chemicals. The service life of timber poles used in telecommunication lines and timber road bridges is 50 years [17]. The life of concrete, steel, and PVC can reach half the life of the Timber. Timber gets the highest grade in terms of reliability in earthquakes.

Contrary to the general opinion, the fire resistance of Timber is superior to that of concrete and steel and stated that in recent years in the USA, places with large crowds have begun to be built as timber carcasses against fire hazards, and even steel constructions in Germany are covered with Timber. The researches on fires reveal that Timber is one of the safest materials against fire. In addition to its heat-proof feature, Timber becomes charred and keeps the structures standing long during a fire. While timber structures withstand fire for 90 minutes, steel construction structures collapse within 15 minutes [18, 19].

Like any other building system, the timber frame construction method requires reasonable care in its design and construction to provide permanent shelter, comfort, and safety. When well designed and built, the timber frame construction is quick and easy to construct and renovate. It is durable, long-lasting, its primary raw material is fed from a renewable and sustainable source. Since wood is a natural insulator, it minimizes heating and cooling costs and is easy to insulate. Thanks to the basic equipment and fasteners used, it is strong, light, and flexible. It easily meets the prevailing wind and snow loads types and levels. It is designed to withstand extreme wind and earthquake loads, and it is earthquake resistant. It can meet and exceed fire safety and sound control levels set by Building Codes [20, 21].

It is adaptable to all climates, from hot and humid regions to icy areas [22]. However, mold caused by humidity in buildings can cause irreparable health problems, so such facilities are called Sick Buildings [23]. With the help of contemporary technologies in the construction materials sector, composite timber structures offer the healthiest environment to live in with superior heat and enhance moisture insulation properties

[19, 24]. By using insulation and coating materials on foundations, roofs, and walls, wooden structures are protected from external influences, and adequate moisture insulation can be made together with the structural strength of the wood [25].

As long as they are protected from the permanent moisture that occurs due to wetting in wooden structures, there is no deterioration period as a material. Like all materials, wood has advantages and disadvantages and needs some precautions to ensure long service life. Wood does not rot when kept dry, if it gets wet, it dries up, and it should be allowed to dry. Protection in wooden buildings is ensured through good design and implementation, proper storage and handling of materials, and the use of materials suitable for application conditions and location.

Concrete structures are toxic due to emitting radon gas [26, 27]. Experts emphasize that Timber is the building material that requires the least energy for its production and processing. Contrary to popular belief, using Timber reduces forests but ensures that forests are kept alive more consciously.

3. CHARACTERISTICS OF WOOD USING IN THE CONSTRUCTION

There has been a recent increase in interest in using wood for distinctive buildings in architecture and civil engineering. We must distinguish between wood, wood, and wood in building techniques [28]. The following ideas used in related literature are described by Dehne and Krueger [29]:

Wood is a hard lignified, fibrous material found under the bark of the trees. Most of it comprises cellulose and lignin. Wood is a naturally uneven natural material.

Timber: cut and processed tree wood for construction material such as beams and posts.

Lumber: Timber cut into regular or specified lengths, creating plaques, planks, or other building parts.

Wood as a construction material is used in various forms and sizes depending on the production process. Historically, common types of wooden constructions, building productions, and structural timber products that have been used in industry are listed in Table 1 [11,30,31]. According to Ramage et al. [32], many manufactured panel materials, including plywood, the OSB, medium fiber (MDF), and Fiberboard, have been combined with dimensioned wood frame systems to deliver bracing and shear strength. Even though wood products manufactured have higher structural characteristics than dimensional wood, adhesives must be used.

Table 1. Common types of wooden construction materials

Tabela 1. Uobičajene vrste drvenih građevinskih materijala

Building Production System and Construction Material	Details	Applications
Traditional Light-Frame Buildings	*Balloon framing*, popular at the turn of the century, comprised two-story buildings with full-height wall framing parts.	Most residences, commercial structures, bridges, and utility poles were built using abundant wood resources. The essential building elements include foundations, floors, outside walls, ceiling and roof, and wood decks. The core construction may consist of wooden posts carrying a built-in girder on a proper footing, with treated wooden basement walls. The outside walls of light-frames often bear the weight, support the upper floors and the roof. Joists and trusses are often utilized for ceiling and roof systems and are frequently called trusses.
	Platform framing establishes the framework of each layer from the bottom to the top. Platform frame construction uses innovative and unique materials, panel goods for floor and roof coverings, and frame structure or on-site building rather than prefabricated components and modules.	
Post-Frame and Pole Buildings	The primary vertical framing components of post-frames and poles function as round poles or rectangular posts. This form of architecture was once known as "pole structures," but it is now more often recognized as "post-frame" construction due to the heavy use of posts.	Light wall and roof structures are placed on poles or posts regularly spaced for relatively small constructions. The structural basis of this type of architecture was initially used for agricultural buildings utilizing round poles, but it has subsequently been used in commercial and residential constructions.

Log Buildings	*Modern log houses* come in various styles, ranging from modest, simple vacation homes to big, permanent residences. Natural or manufactured logs, rather than dimension timber, are used to construct log home wall systems.	Logs or conventional construction can be used to construct roof and floor systems. The two ways used by log home firms to classify log kinds are round and shaped. The logs in the round log system are all about the same diameter and have a smooth, utterly rounded surface. The logs are machined in a forming process to specific forms, which are typically not complete. The exterior surfaces of the logs are spherical; however, they may be flat or round within. An interlocking joint is formed by machining the junction between logs.
Heavy Timber Buildings	*Timber Frame*	Large sawn timbers are joined by hand-fabricated connections like mortise and tenon in a traditional timber frame. The building of such a structure necessitates a high level of craftsmanship.
	Mill Type	In the eastern United States, mill-type structures have often been used for storage and construction complexes. It consists of massive transverse woods, with the columns organized in a grid based on the length of the beam and the girder.
	Glulam Beam	Supporting columns are inserted at the corners of pre-established grids in a panelized roof system with the glulam roof structure. The primary glulam beams support purlins which can be cut timbers, glulam, parallel chord trusses, or prefabricated I-joists wood.
	Arch Structure	Arch structures are ideal for applications that require wide, unobstructed surfaces, such as churches, recreational structures, and aircraft hangars.
	Dome	Radial rib cells consist of curving members, which stretch between the base ring (tension ring) and the compression ring at the top of the cup, and additional ring members between the stress and compression ring at varying heights.
	Timber Bridges and Log Stringer	Other choices emerged with steel and reinforced concrete development, which have since become critical bridge-building materials.
	Sawn Lumber	Sawn lumber can be used to construct a variety of bridges.
	Glulam	When structural glued-laminated or glulam boards are utilized, the space capacity of bridges is significantly improved.
	Structural Composite Lumber	Laminated veneer and oriented strand are the two forms of structural composite lumber (SCL) used to build wood bridges. SCL may be used to build many of the same bridges that solid-sawn or glulam wood can.
Engineered Timber Products	Parallel Strand Lumber (PSL)	Beams, Columns
	Laminated Veneer Lumber (LVL)	Beams, Columns, Cord
	I-Joists	Joist Beams
	Glulam, GLT (Glue Laminated Timber)	Beams (Long span) High Loading
	Structural Insulating Panels (SIPs)	Roof, Wall, Floor
	Cross-Laminated Timber (CLT)	Roof, Wall, Floor
	Brettstapel / DLT (Dowel-Laminated Timber), NLT (Nail Laminated Timber) (Dowellam).	Roof, Wall, Floor

Table 2. highlights the findings of research studies on the features of Timber Construction Products as a building material undertaken during the last decade. The system deals with environmental, structural, design, fire, seismic and thermal performance. Some study projects have examined the most critical results on every element of the quality of wood goods [10].

Table 2. Timber Construction Products characteristics as a building material.

Tabela 2. Karakteristike proizvoda od drveta kao građevinskog materijala.

Issue	Research Summary	Scholar
Environmental performance and sustainability	Life Cycle Analysis (LCA) of wood materials with steel and concrete. Wood-based alternatives spent 15% less energy than concrete during the building lifecycle.	[33]
	The amount of energy needed to work (defined as the amount of energy required). To satisfy the requirements of HVAC systems, including heating, ventilation, airconditioning, lighting, and house appliances, CLT delivers 10% less energy consumption than concrete houses.	[34]
	CLT outstrips concrete buildings in all environmental performance areas, including ozone depletion, global warming potentials, and eutrophication.	[35]
	Concrete and steel structures had almost the same amount of CO_2 (1984 tons), whereas CLT buildings contained less than half of that amount (727 tons).	[36]
Installation simplicity and cost competitiveness	CLT decreases building time to up to 30%, which substantially cuts the expenses related to on-site work.	[37]
	When compared to typical concrete building processes, it takes less than half the time.	[38, 39]
Structural performance	The hardness of CLT panels is assessed using product standards, including EN 13353 (DIN, 2003), EN 13986 (DIN, 2005a), and EN 789 (DIN, 2005b). The US Standard for Laminated Timber provides the certified and quality assurance of CLT panels in North America standards and testing techniques.	[40]
	The 42-story CLT-concrete-hybrid structure named the Timber Tower Research Project was proposed in a Skidmore, Owing, and Merrill architectural and engineering company study.	[41]
	CLT has been employed for several large projects, including the Stadthaus, London's eight-story housing, Forte Skyscraper, Melbourne, Australia's 10-story residential skyscraper.	[10]
Design flexibility	The structural features of CLT provide considerable architectural freedom throughout the design procedure, allowing a variety of opening structure configurations in terms of number, dimensions, and position and flexibility to arrange regions without jeopardizing the structural integrity.	[42]
Fire performance	CLT panels can provide fire resistance similar to standard non-combustible external wall components.	[43]
	Three CLT walls conducted the ASTM E119 experimental fire resistance test at an independent fire test laboratory in Buffalo, NY.	[44]
Seismic performance	Even if it is subjected to a severe earthquake simulation (7.2 magnitudes on the Richter scale), the structure is dragged between 1.5-inch top layers after the test and lateral deformations (permanently measured; 82 feet highest point of the building).	[45]
Thermal performance	Wood's heat conductivity is substantially lower than metals and is around two or four times lower than mineral wool, a typical thermal insulation material.	[46]
	Timber panels provide thermal mass in the building shell and internal floors and walls, storing and releasing heat day and night.	[47]
	Because air infiltration may substantially alter the inside environment, the thermal conductivity of a building's "airtightness" is essential for its thermal performance.	[48]
Human Health	The latest research on the physiological impacts of wood on people was provided in this review. Reports regarding the physiological effects of wood on people have steadily grown.	[49]

4. THE IMPACTS OF WOOD ON THE HUMAN PSYCHOLOGY

The use of wood by humans dates back to ancient times. The dazzling modernization of cities has increased structural materials such as metal, plastic, and concrete worldwide; In recent years, the demand for wood has started to rise again [50]. The most important reason for this is the relaxing effect of wood on human psychology. Natural wood furniture and decor products and wall coverings used in the spaces have a warm, cozy, and self-confidence-increasing impact on people, and reinforcing people's belonging to nature and wood encourages positive and positive thoughts. In addition, wood, which regulates the heart rhythm, reduces the adverse effects caused by stress and creates a popular point with its soothing effect on the longing for nature. Scientific studies show that wood also causes effects on people, increasing attention power and focus ability and increasing concentration [51].

The positive psychological effects of wood have also been tested on students in schools. A change in the pulse rate of the students was observed in the classrooms with interior spaces created with natural wood materials, and the stress in the morning decreased immediately after coming to school and did not rise again. The stress level of the students in the control group in the classrooms formed with standard building materials continued throughout the day. Stress experiences, such as feelings of fatigue and inefficiency, were less common in wooden classrooms than in normal ones [52,53,54].

The use of wood in interiors affects human behavior and social communication [55]. In offices where wooden products are used, the visitors' first impressions about the staff are much more favorable than those in places where wood is not used. In offices where wood is used, the personnel is more efficient, successful, confident, responsible, and peaceful than monotonously decorated offices.

It is understood that the positive effects of imitation, that is, unnatural wood, are meager compared to natural wood. Physiological measurements showed that people's sleep quality increased and their stress level decreased in rooms with raw wood material. Imitation wood materials could not create the same effect. Using wooden materials such as wooden trays and furniture can be recommended in the nursing home [56]. Thus, with the impact of the psychological relief of wood, the personnel in charge could be more sensitive and affectionate towards the nursing home residents. The physiological effect from wood-based stimulation was investigated by Ikei et al. [49]. These investigations have found that wooden-based stimulation of olfactory, touching, and hearing with materials leads to physiological relaxation, such as lower brain activity, improving nerve parasympathy, blocking nerve activity, and reducing blood pressure, rates of the heart, and stress hormones.

5. DISCUSSION OF RESULTS AND CONCLUSIONS

Tall buildings should not be the main focus of Wooden Construction Materials in the urban environment. These systems must seek out more cost-effective options that can support structures and more complex architectural solutions. The hunt for new generation building production methods should continue to maximize the multifunctional properties of construction materials, resulting in new ways of thinking, creating, and constructing with wood. Research into low-carbon solutions should be expanded to solve the problems we confront in the building industry. As a result, multidisciplinary research and development capabilities in architecture and urban planning and sustainable knowledge are essential for resilient urban systems and construction processes. Low-carbon modular construction solutions based on, among other things, load-carrying, cross-laminated wood panels, and design concepts will give substantial possibilities for reducing carbon and waste. Many architects and engineers have recently developed building components that build low carbon life cycles for urban housing, implementing principles of design and modular prefabrication, which lead to significant emissions reduction, aimed at avoiding construction waste in low-carbon and zero-waste building systems. Low-carbon materials and techniques feature green supply chains, a reduced environmental effect throughout the lifetime, lightweight to decrease energy consumption, fully reusable, and allow non-plant prefabrications to be prototyped.

We need to understand how the components that make up the wood structure contribute to its various properties at all scales, from the macro to the micro. Material characteristics which are not in place in timber may need engineering megastructure with wood. Specific architectural and technical solutions can optimize this connection and illustrate that wood constructions have structure and space layouts that differ fundamentally from steel or concrete structures. A range of structural solutions and wood materials are available in challenging structures. As a result, the pace of dissemination is influenced by how potential adopters perceive the product's qualities. The research evaluates the market potential of

wooden building materials by examining the degree of knowledge, attitudes, and readiness to accept the items.

Finally, understand the information, attitudes, and characteristics that affect a potential adopter's choice to accept a product. To assess the materials' potential for effective adoption in the country, data on how people describe wooden materials and their readiness to embrace them in the future is necessary. The structural system features and static requirements of the panel system made with timber elements are not different from large-size prefabricated concrete panels. The growing interest in building with wood materials stems from the fact that building with reinforced concrete and steel materials consumes much energy and emits tons of carbon dioxide into the atmosphere during production. Timber, a renewable resource, is favored for various reasons, including having a lower carbon footprint, needing less energy in production, and generating less water contamination. The use of this material in engineers and architects working in the construction sector, such as the strength of awareness and dissemination of the service, should be targeted. Projects requiring the use of timber material should be increased and supported. Society should also be aware of the comfort and advantages of industrial Timber.

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IZVOD

KORIŠĆENJE DRVETA KAO GRAĐEVINSKOG MATERIJALA NOVE GENERACIJE U KONTEKSTU ODRŽIVOG RAZVOJA

Drvo je prirodni resurs koji je obnovljiv, lako povrativ i skladišti ugljen-dioksid, čineći drvene konstrukcije izvodljivom alternativom za postizanje značajnih ciljeva održivosti. Devedesetih godina prošlog veka, tehnološki polaznici su izmislili lamelirane drvene grede i počelo je da se primenjuje princip rešenih rešetki na građevinske strukture od laminata i šperploče. Metoda hibridne gradnje nove generacije nazvana Urban Timber (UT) sistem je dizajniranja da podrži drvene zgrade na osnovu dijagnostičke ranjivosti drvenih konstrukcija. Sistem je definisan i demonstriran uzimajući u obzir ponašanje konstrukcije, arhitektonsku vrednost. Sve ostalo je prepušteno dizajnerskom nahođenju, njegovoj osetljivosti i, pre svega, njegovoj sposobnosti da iskoristi tehnologiju iz mnogih prednosti i mnogostranosti. Istraživanje nastoji da informiše buduće generacije o predviđenim održivim karakteristikama drvenih konstrukcija, koje su kamen temeljac globalne građevinske industrije, u uobičajenim okolnostima nove industrije. U tom cilju, dokazano je zašto su industrijalizovani sistemi drvenih građevinskih objekata fundamentalni problem u kontekstu sadašnje ekološke, društvene i psihološke diskusije i korišćenja različitih pristupa građenju koristeći održive materijale. Drvo se, prema nalazima, vidi kao budući građevinski materijal.

Ključne reči: drvo; građevinski materijal; održivost; humana psihologija

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