The Impact of Technological Development on Improving the Properties of Timber and Utilization

Prof. Salah H. R. Ali
Professor of Engineering Metrology, Precision Engineering Division, National Institute of Standards (NIS), Giza (12211-136), Egypt
Professor (visitor), Department of Mechanical Engineering, Faculty of Engineering, Modern University for Technology and Information (MTI), Cairo, Egypt
SalahAli20@yahoo.com
Associ. Prof. Dr. Gehan A. Elsayed
Associate Professor of Architecture Engineering Department, Faculty of Engineering, Modern University for Technology and Information (MTI), Cairo, Egypt
GehanElsayed2@yahoo.com

Abstract:

Smart technology is now playing an essential role in engineering applications that aim to enhance people's quality of life. particularly in architecture and mechanical engineering. Despite the fact that wood has been considered a heritage since the ancient Egyptians used it in its most basic form, it will never be neglected as it is a traditional and natural material. Therefore, the hypothesis is that, the developments in nanotechnology and the application of smart technologies to wood will take variety of forms in order to optimize its architectural and environmental efficiency. Moreover, the improved characteristics of wood allow for a novel application of it that might affect the current path in a wide range of mechanical applications.

The research methodology is an analytical descriptive approach that shows the impact of smart technologies with nanotechnology in providing new wood characteristics to enable design engineers to maximize the usage of wood in an innovative way in engineering applications.

The objectives of the paper are to highlight the capability of using smart and Nano technologies to maximize the potential of natural and gained wood benefits in engineering applications. Furthermore, Experiments have shown that using definite kinds of wood in a various application, such as manufacturing 3D vehicle simulation models to analyze dynamic characteristics and improving the accuracy of mechanical measurement systems, as well as using wood in an urban context to improve technology and environmental efficiency.

Keywords:

wood properties, 3D models, architecture applications and mechanical engineering measurements

---

الملخص:

في الوقت الحاضر، تلعب التكنولوجيا الجديدة دوراً مهماً في التطبيقات الهندسية لتحسين جودة الحياة، لا سيما في الهندسة المعمارية والهندسة الميكانيكية. بينما يعتبر الاحتباس الحراري من القضايا الرئيسية التي تواجه المهندسين نحو ابتكار مواد ذات كفاءة بيئية وقادرة على التحمل في التطبيقات الهندسية الحديثة. على الرغم من اعتبار الخشب تراثاً، حيث استخدمه القدماء المصريين في أبسط أشكاله، لأنه مادة تقليدية وطبيعية، لذا فلن يتم إهماله أبداً. وبالتالي، من خلال تطوير التكنولوجيا

وصولاً إلى تقنية النانو، يأخذ استخدام الخشب نطاقات مختلفة لتعظيم استخدامه حيث تظهر كفاءته المعمارية والبيئية. علاوة على ذلك، من الواضح أن هناك تحدياً كبيراً لإثبات قوة ومتانة الخشب نتيجة اكتسابه كخصائص جديدة للوصول إلى استخدام مبتكر يمكن أن يؤثر على المسار الحالي في العديد من تطبيقات الهندسة الميكانيكية.

منهجية الورقة عبارة عن نهج وصفي تحليلي يستخدم للتأكيد على دور التقنيات الجديدة بتقنية النانو التي تمنح الخشب ميزات جديدة لتمكين مهندسي التصميم من تعظيم استخدامه بطرق مبتكرة في التطبيقات الهندسية.

تلخص هذه الورقة إمكانية استخدام التقنيات الذكية للوصول إلى أقصى استفادة من الخصائص الطبيعية لمادة الخشب والمكتسبة في التطبيقات الهندسية، نظراً لقيمتها في إضافة ميزات تصميم جديدة وخصائص فيزيائية لتحسين الكفاءة البيئية والاقتصادية والديناميكية. علاوة على ذلك، أظهرت التجارب أن استخدام أنواع معينة من الخشب في العديد من التطبيقات مثل تصنيع نماذج محاكاة المركبات ثلاثية الأبعاد لدراسة السلوكيات الديناميكية وكذلك في نظم القياسات الميكانيكية لتحسين دقتها. بالإضافة إلى ذلك، فإن استخدام الخشب كسياق حضري في مسار التكنولوجيا المحسنة والكفاءة البيئية قد حقق سلوكيات جيدة. في الختام، تم استعراض ومناقشة اتجاهات جديدة قيد التطوير في هذا المجال لعرض حلول للقضايا المهمة في المستقبل مثل النقل والقياس وأنظمة مراقبة الجودة التي تحتاج إلى معالجة علمية.

الكلمات المفتاحية:
صفات الاخشاب ; النمازج ثلاثيه الابعاد ; التطبيقات المعماريه وقياسات الهندسه الميكانيكيه

Introduction

Smart technology research is now one of the most important strategies globally as well as African countries to match work needs and create a comfortable lifestyle. However, the desire of using wood in a various application, such as the designing of caves to provide shelter from the environment and the manufacturing of wooden instruments, dates back to the creation of the world and the ancient Egyptians. (Creasman, P. P. 2013). With the appearance of ancient civilizations and religious civilizations, wood played an important part in the elegance and luxury of architectural decorations. Religious arts, such as Judaism, Christianity, and Islam, have changed over time.

Nearly 4% of the world's forests are plantations, which were planted to supply a range of ecosystem services, mainly timber and other wood products. As a result, many designers are keen in the success of producing specific timber based on three major criteria: genotype, environment, and genetics. (Air temp, humidity, storm probability, and fire frequency & pest and disease outbreak frequency and magnitude) and adjusting forest management behaviors (Elsayed, G., Hasan,R. 2016).

There has been a substantial revolution in mechanical design implementations to study aerodynamics and monitoring techniques. since the nineteenth century. Other changes in the American residential architectural arts were happened as well, especially those related to design methodology and building techniques. As a result, smart technologies have emerged as a significant tool to improve the usage of wood within many life aspects. (Pawson, S., et al. 2013). Timber is exactly a wood that has been treated into blocks, beams, and planks. Timber is commonly recognized in North America as lumber. Timber plays an important role in the construction of buildings. (Nocetti, M., et al. (2009) (Joseph, M. 2015) (Kolb, J., Schweiz, L.

& DGfH - German Society of Wood Research 2008), as well as it shares in various engineering design implementations. (Fig.1) describes the usage of wood in a variety of technological achievements, as well as the effects of wood with different materials in the form of Nano-cellulose.

Fig 1: The utilization of wood in a variety of technological installations (Earth Sciences Building (ESB) | UBC Campus & Community Planning 2021)

Until the twentieth century, timber was widely used to make bearing wall systems as well as slabs and roofs of the earliest buildings. (Michael F., et, al. 2008). However, it has achieved worldwide rankings due to its widespread use in building the features of cities in America, Australia, and Europe, as several modifications have been created to modify its features such as strength, durability, insulation, moisture absorption, and readability. Moreover, different kinds such as enhanced wood, wood composites, and engineered timber products have been evolved and developed. (Joseph, M. 2015). (David W. 2011Furthermore, with the emergence of these wood products, timber appears to be reasonable to bear both stress and tension pressures, as well as to be capable of covering large spans. as shown in Fig.2, which illustrate the usage of timber in several engineering applications, as well as the interaction of timber with other materials in the form of Nano-cellulose to enhance life resilience. So, the objective of this research is to show that the usage of timber in mechanical design and construction systems has grown globally, particularly when effective applications have been developed to reduce the mass of used wood, reuse and recycle it, to achieve all required properties at a competitive cost. While the aspects and methods used to enhance timber are considered fundamental to the eco efficiency that is embedded under the umbrella of ecological sustainability, there have been no simulations of using smart timber in modelling implementations such as 3D automotive simulation
models and measurement techniques.

A) The BUGA Wood Pavilion spans 30 m over a central event area on the 'summer island' in Heilbronn

b) the world's largest timber structure The Bank of Norrland In Sweden

c) La Seine Musicale, Paris (FR)

Fig 2: Examples of how to use timber in building construction). ("Redirect Notice", 2022)

The Methodology

While the applications, aspects, and methods for improving timber are completely responsive to the eco efficiency that is embedded under the umbrella of environmental sustainability, no simulations have been performed to assess the performance of using smart timber in modelling applications such as 3D vehicle simulation models and devices. So, this study assesses the dependent qualitative efficient factors that significantly improved the performance of timber products as follows:

- Review literature to document the innovative aspects that have resulted in the new timber qualities in a cost-effective manner.
- Simulation technique is used in modelling applications to assess the quality of smart wood's efficiency

The Hypothesis Is That:

The technological advances employed on timber nowadays can develop its physical qualities, allowing it to be more efficient in modelling applications. Also, this technology has the potential to increase the dependent qualitative efficient aspects of timber, thus improving its performance in architecture and construction.

1. The new factors had a considerable effect on the new timber potential.

This part of the research will investigate and document the technologically efficient properties of timber, as well as the role of smart and Nano technology on it. It will also illustrate how timber construction has evolved as an ecologically useful technology.

1.1 *The effect of smart technology on timber:*

Nowadays, smart applications on timber have developed in a variety of forms, but the majority seems to be embedded sensors or wood material substitutes. As follows:

a. Embedded sensors in timber; to evaluate the severe problems that have emerged as a result of the current humidity, since nano-sensors are flexible, resilient, and sensitive to moisture damage, they are used in a range of applications to assess humidity levels in a substance, including wood roofing. Another sensor is inserted in the main structural parts to provide bridge

owners and managers with better, more real - time information on how structures are performing and when maintenance is needed. as shown in Fig.3.

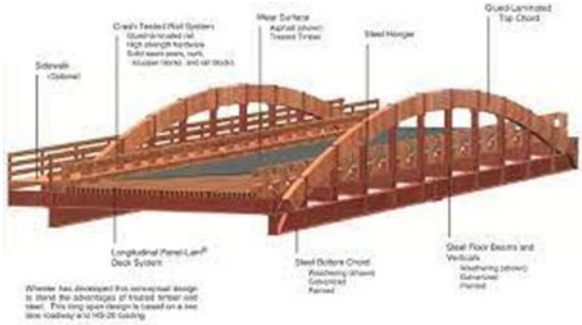


Fig 3: Shows Largest span timber arch bridge(chinadaily.com.cn)
the smart timber structure (Joseph, M. 2015)

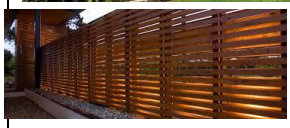
b. wood material substitution: Smart wood, also known as Fiber Cement wood replacement (USDA Forest Service 2021), is one of the Standard Classification of Goods (SCG) for Non-Asbestos. It is a durable high-quality material that has been treated by a steam and high-pressure system (Autoclave) as part of a technological package that includes Firm & Flex technology. Also, it has various properties as follows:

- High-quality materials that are long-lasting and almost durable, making them perfect for both indoor and outdoor usage. Bendable for materials less than 12 mm thick.
- Termite-resistant; easy to care for; no shrinking, folding, or bending using high-pressure, steaming firm & flex technology, Colors and designs that are as appealing as ready-made wood, natural texture and color that are identical to natural wood, and a wide range of applications.
- There are several useable thicknesses, such as desired cut, hammer, or easily apparent exactly like natural wood, non-Asbestos.

It has many applications as shown in Table 1: (USDA Forest Service -- Forest Products Laboratory 2021).

Table 1: Wood material substitution and its applications in architecture (Smart wood)
All figures in the table ("SMARTWOOD", 2019)

Case	SCG/ application	Properties /advantage	Image
For exterior and interior	Smart Wood Plank colonial series	The Colonial series is elegant, with carved and refined edges. It's a wood substitute that comes in a range of wood and grain kinds, has a deep wood finish and profile, and comes in a variety of attractive colors for both indoor and outdoor application. Because of the particular coating technology, the color of both the primer and the top coated substance keeps the same. Can be decorated immediately with acrylic paint.	

For exterior	SCG Smart WOOD Fascia Board	It is a wood substitute for a walled façade with no warping and no shrinking since every portion is subjected to a high steam treatment (auto clave) The pattern is accurate, delicate, and natural.	
	SCG Smart wood Shading Plank	It is a wood substitute for shade as a kind of privacy or sun protection, and it has various advantages.; - Acrylic paint may be applied directly to the primer. -Strong and long-lasting. -A smooth surface that suits new and existing designs. -Termite-resistant since it is mixed with cement -There is no shrinking since each item is subjected to a high-pressure steam treatment (autoclave).	 
	Smart wood Fence Plank	It may be built directly over an existing steel fence and can also be used as a stainless fence door to minimize weight and allow for faster opening and closing. Never destroy, it allows for efficient ventilation, is easily installed, and is lightweight, minimizing the cost of the frame.	 
	SCG Smart wood Floor Plank for construction and decoration	- It is resilient, strong, and long-lasting, and it may be placed on a steel frame or on top of a concrete floor. - It is termite-proof and weather-resistant on both the interior and exterior. -The grain of true wood is apparent on the surface, giving it the appearance of natural wood. -It includes a cream primer color that may be customized to the customer's preference.	
For exterior and interior		The Colonial series is elegant, with carved and delicate edges. It is a wood substitute that comes in a range of wood and grain variants, has a rich wood finish and a profile, and a range of attractive colors for both interior and exterior application. Because of the particular coating technology, the color of both the primer and the top coated substance remains consistent. Can be decorated immediately with acrylic paint	

1.2 The effect of Nanotechnologies on timber:

Nanotechnology has the ability to create a wide range of novel materials. It created wood tissue elements that are applied as composites, as well as unique resins and bio composites that evolved on the Nano scale. Furthermore, Nanotechnology has been used in the applications of laminates or coatings, as shown in Table

Table 2: Nano materials and its applications of laminates and coatings

Case	Nanomaterial	Properties/Advantage
Composites and laminates	Nano- cellulose fibers	Lignocellulose may be combined with a variety of polymers to generate composites that are biodegradable, cost-free, have good thermal properties, and are lightweight compared to their inorganic materials. Cellulose Nano fibres have the same durability and strength as Nano carbon tubes, which are used to reinforce construction elements instead of steel. So; These Nano fibres are used as natural reinforcing components that may be shaped into sheets and used to increase mechanical properties in reinforced composites such as polyvinyl alcohol film. (Siam fiber cement. com website. (2021).
Laminates and coatings	The transparent nano zinc oxide (Nano Z^{TM})	Protect wood from biological and ultra-violet deterioration. (Mann, S. 2006).
	The ORNL nanomaterial	It's a greyish silica coating used in the production of liquid-based thermal and electric insulators. (Mann, S. 2006).
	Nano seal wood	It repels water and can also resist UV absorption because the Nano particles form an incredibly tiny mesh that repels water and allows water vapor to escape from the wood, preventing decay, fungal, rotting, swelling, and shrinking. It is used in both indoor and outdoor wood products, is friction resistant, has no volatile organic compounds, oils, resins, or chemicals, and has a diverse variety of applications while being cost effective. (Mann, S. 2006).
	Silica, alumina and polymers.	They're a type of exceptionally waterproof coating influenced by the behavior of the lotus leaf. (Siam fiber cement. com website. (2021).
	Silver Nano particles	Because they are an excellent preservative against many bacteria, fungi, and viruses, as well as having minimal hazard to human cells, strong thermal resilience, high stability, and endurance, they are used as an antimicrobial paint to cover the surface of wood. It's a product that's ecologically friendly product. (Mann, S. 2006).

	Nano- copper and organic biocides	Nanoparticles have been documented to act as a biocide storage unit, and the technology used in this innovation may also be used to treat wood with fire resistant chemicals, water repellents, resins, and UV agents. Silver and copper have high thermal conductivity coefficients, which can assist speed up the heat treatment process by quickly transferring heat from the surface to the deeper layers. Nano-silver (NS) and Nano-copper (NC) have also been shown to reduce heat accumulation on the surface layer, hence delaying overheating and significantly reducing mechanical characteristics owing to /850 heat treatment.

2. The Unique Parameters Efficiently played a Significant Role in the New Timber Behavior in Mechanical Stress Conditions

As one of the smart technology techniques, AFM (Atomic Force Microscope) was used in certain publications to explore the characteristics of wood (Chen, C., et al. 2018). (Clement and Winston, 2014) These studies looked at the material characteristics of wood-derived cellulose nanocrystals (CNCs). AFM appears to capture the reality of surface topographical structure for Timber in diverse scenarios and surfaces with minimal sample preparation under particular conditions. as showing in Figs (4-6). As a result, under certain conditions, the AFM microscope is a powerful tool for analyzing in high resolution inspection of brittle woody fibers and surfaces with minimal test specimens..

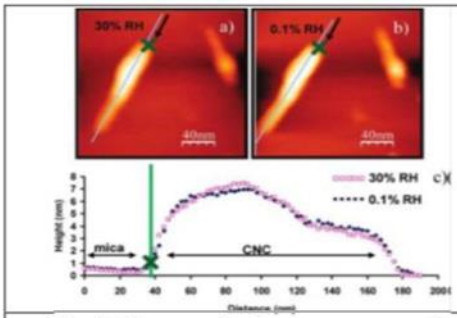


Fig 4: Topography images were made using GSI mode data at (a) 30% RH and (b) 0.1 percent RH. Part c depicts height profiles for 30% RH (pink) and 0.1 percent RH (blue) along the lines drawn in parts a and b, respectively.

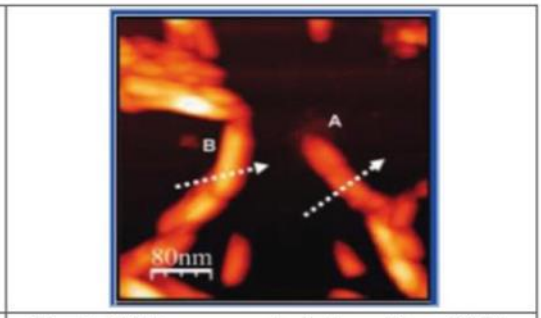


Fig 5: AFM nano-manipulation of two CNCs (labelled A and B) topographical pictures showing how the applied lateral force seems to bend the initially straight CNCs. Arrows indicate the direction of tip movement for

As a result of the significant advancements in smart technology application in the field of physical and chemical wood treatments, it was possible to transform wood into a "wood carbon sponge" that can sustain repetitive pressure and significant mechanical stress conditions. Scientists were able to remove lignin and hemicellulose from Balsa wood cell walls, which is a key step in changing the woody mesh-like structure into a laminate structure that looks like a spring. As a result, work on converting brittle wood carbon to compressible wood carbon

sponge has begun. Wood carbon sponge displayed a very sensitive electrical response as a stress sensor and a desired attribute for future potential applications, allowing it to be employed as a sensor for mechanical stress assessment, as shown in Fig.8. Fig.9 shows the physical differences between spongy wood, natural wood, and carbon wood based on the practical results. As shown in Fig.10, The practical findings also revealed that this new type of wood has significantly improved physical features and high bearing capacity for mechanical stresses under repetitive loads, allowing measuring systems to improve their accuracy and durability. According to the experts, the carbon sponge for this type of wood might be used in a range of vital applications in the future, such as water purification and energy storage panels for rechargeable electrical batteries. As a consequence, figure 10 demonstrates the repetitive compression results of the WCS material in measurements

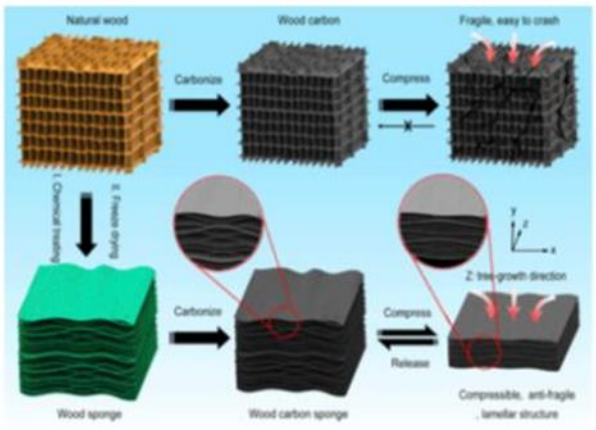


Fig 7: As a result of the particular arching layered structure, graphical analysis of the fragile WC, and very compressible WCS design and production technique, (Pawson, S., et al. 2013)

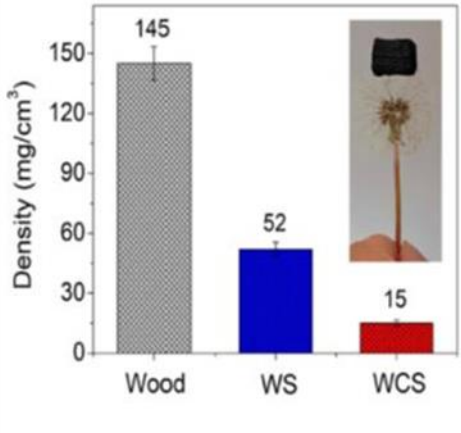


Fig 8: Density evolutions of natural wood, Wood Sponge (WS), and Wood Carbon Sponge (WCS).

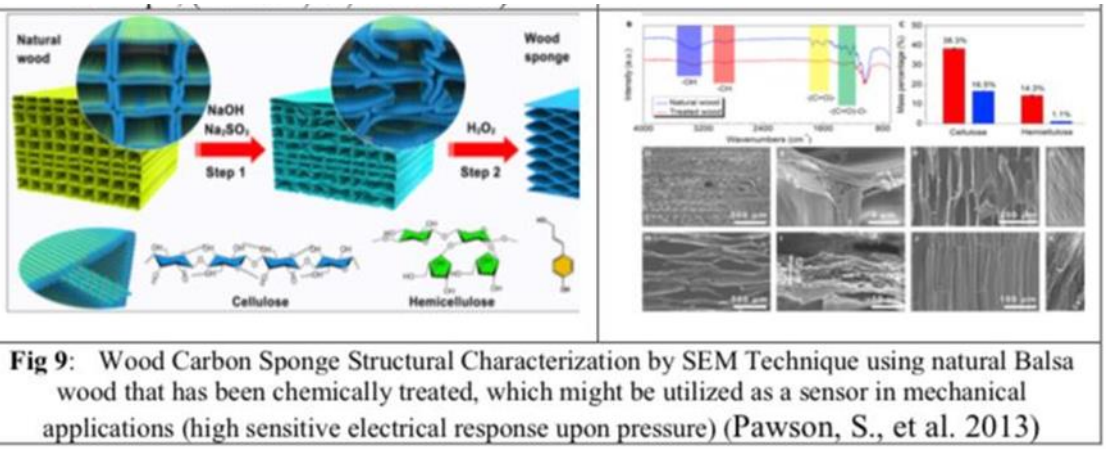


Fig 9: Wood Carbon Sponge Structural Characterization by SEM Technique using natural Balsa wood that has been chemically treated, which might be utilized as a sensor in mechanical applications (high sensitive electrical response upon pressure) (Pawson, S., et al. 2013)

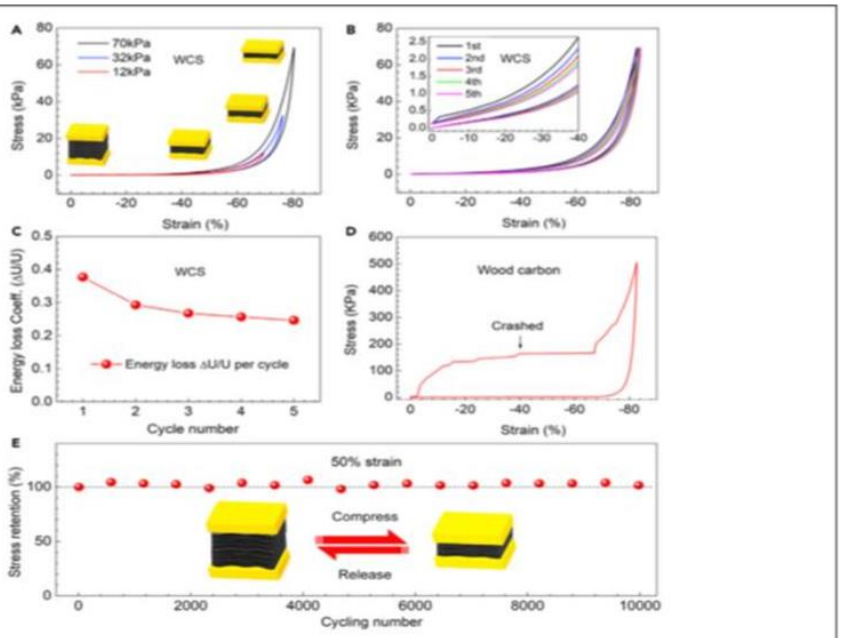


Fig 10: Mechanical properties of WCS and WC [20]
(A) WCS stress-strain curves with variable force loadings; insets show the WCS material at random times during compression.
(B) WCS stress-strain data produced after five repeated cycles.
(C) DU/U of WCS energy loss during each cycle.
(D) WC stress-strain curves
(E) Elastic strength retention after 10,000 cycles at 50% strain; the inset shows repeated compression of the WCS material.

Nowadays, it is feasible to state that the usage of tinny structural balsa wood to improve the accuracy and precision of a measuring system within one of the most important applications in mechanical engineering has been achieved in the laboratory and will be sustainable in the future.

3. Solid timber:

*Several types of solid wood structural or frame sections are used for walls, floors, rooftops, partitions, and building cores in solid wood construction (STC) (STC). The structural behavior of timber is optimized through solid wood design process, resulting in a more coherent structural characteristic. STC is now acceptable for a wide variety of purposes.

* STC is a manufactured off-site element. Off-site production refers to the fabrication and pre-assembly of building materials before they are installed on the construction site, and it may demonstrate the benefits of an innovative production system. Designing building system components with today's technical measurement tools **and production procedures has a lot of benefits:**

- Reduced industrial waste as a result of the unique production method.
- Pre-assembly techniques are intended to save time and energy on the construction site.

• Optimizing material performance, such as using current measurement tools for acoustic rating and machine testing, will estimate wood quality to create substantial value. (David W. 2011) (Nocetti, M., et al. 2009).

• Use of lower-quality timber for higher-quality applications makes a significant contribution.

• Cost savings of 4%, schedule savings of 20%, and an average of 3.7 change orders. STC provides two distinct approaches. as shown in the Table 3 (Michael F., et, al. 2008)

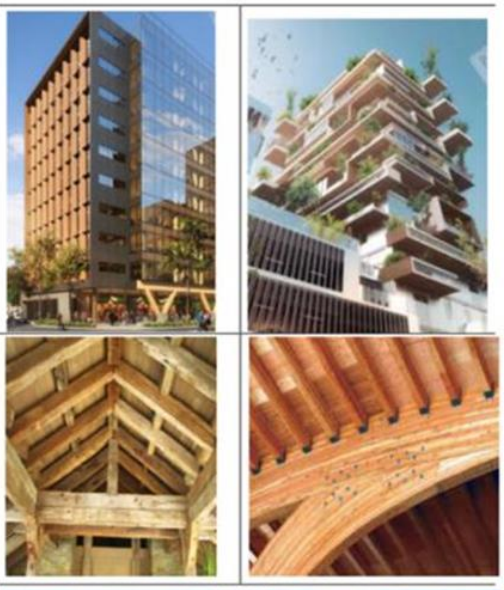
Table 3: Types of Solid Timber

All figures ("Types of Solid Timber - Google Search", 2022)

Technique style	Commercial name	Configuration figures	The benefits
Glued STC	Glue-laminated timber (GLT);		Traditional National Forest structural timber (wood) and other woody biomass, such as toxic forest fuels, beetle-killed trees, and rescue trees, can also be used with STC and other CLT methods. By using these plants, they have the potential to reduce costs related to the disposal of toxic gases and the removal of other woody waste from our forests.
	Structural composite lumber (SCL) together with Laminated veneer lumber (LVL), Parallel strand lumber (PSL)		
	Cross-laminated timber (CLT)		
Non-glued STC	Dowel-laminated timber (DLT)		
	Nail-laminated timber (NLT) and laminated cross-nail timber		
	Cross-laminated interlocking timber (ICLT)		

Nowadays, cross-laminated timber in the form of Bearing block panels or Frame wood is acceptable, and some of their examples are shown in Table 4.

Table 4: Examples of solid timber structure and mechanical implementations

Type	Example	Figure
Frame work timber *(FWT)*	When shifted perpendicular to the ground, the entire column has a thickness of 4 mm, and the columns and beams are stiffened with hardwood beech frames to withstand these forces. The enclosure and shape are merged in the wood grid shells, and the building makes remarkable use of natural construction materials. To complete the structure, prefabricated wood flooring, ceiling components, and each roof frame were erected as a single prefabricated piece, enhancing optimal indoor-outdoor interactions. (King Street in Brisbane, the world's tallest timber office building) (Nocetti, M., et al. 2009)	
Bearing block panels *(BBP)*	City academy, England, the three-piece CLT serves as the city academy's facade and is heavily covered with a brick rain screen. On the internal partition walls, which are coated in gypsum board, there is a combination of steel and CLT. CLT flooring cover the whole building and act as shear walls from inside. (Nocetti, M., et al. 2009).	 Soft-Story Buildings With Shear Walls
Bearing block panels as a Frame work timber	The Hive, England, Because the roof cones are extremely hard during construction, scaffolding was used to protect glue laminated wood ring beams at the top of the cones while the wood roof beams were lowered and fixed in position. If this structure had been completed, CLT roof cassettes would have been equipped with panels that collaborated to form a stressed skin. Three of the cones are separated by internal vertical walls that may be deflected. (Nocetti, M., et al. 2009)	 (B)

Because wood is organic, porous, and easily formed as it takes different positions in response to external environmental conditions, it has been used in interior design for many mechanical engineering applications, such as labs and mechanical workshops that have good equipment for technical processes to be easily available for usage of wood for advanced equipment such as wood making machinery in the preparation of wood blanks, as seen in [Fig. 11]. In addition to the usage of wood within various types of trains, such as passenger train cabins, including sleeping cabins, as long distances and across countries are required, as shown in [Fig.12.]

Balsa wood has lately been employed in the fabrication of various prototypes of vehicle and aeroplane designs, as well as large-scale wind turbine engine wings, all of which were built utilising three-dimensional flow for interactive aerodynamic design. as shown in the [Figs.13-14.]

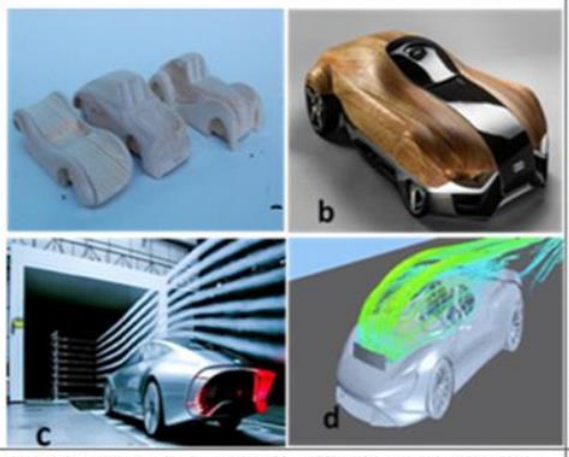


Fig 13: Wood was applied in the manufacture of vehicle models to better comprehend aerodynamics theory. (Jnido,G. et al,. 2019)

Fig 14: Wood is being used in the design of aviation models and to identify aerodynamic resistance.

As a result, the use of Balsa wood in 3D design and manufacturing of vehicle models enhances evaluation of the performance of mechanical dynamic systems (aerodynamic resistance), particularly for aeroplanes and vehicles.

4. Experimental Work and Conclusion

In the previous study, **two criteria** for the impact on timber were applied in order to produce an effective action in the future as an urban environment, and they are as follows:

1st: Unique factor affected timber as smart technology

2nd: Unique factor affected timber as Nano technology

4-1 *Qualification and Manufacturing*

Smart results in improvement allow a new development in the transfer from heavy wooden frames to light wooden frames or "balloon" style structure after evaluating the various aspects provided by timber vendors and other standard construction material. (according to integrated international standards) (Chen, C., et al. 2018). It is necessary to cut logs to standard lengths in order to make them more accessible and movable. Furthermore, technological advancements in timber facilities, such as the conversion from chainsaws to saw slats, demanded a huge level of uniformity, lowering the cost of wood transportation. As a result, It was possible to attain fast high economic growth. As a result of a number of factors, standardizations have developed as a technique of reducing shipping and manufacturing, hence increasing profitability and meeting customer demands. As a result, standardization is critical in the manufacture of timber in industrial operations. Because of modern technology and standards, structural systems and elements have been influenced. They respond to mobility and configuration flexibility within the eco efficiency, whether they are light weight or solid. as shown in the following Table 5.

Table 5: The relationship between the novel parameters of timber constructions and efficiency

<table>
<tr><th>The system</th><th>Struct-ure</th><th colspan="2">Mechanical engineering</th><th>Environmental efficiency</th><th>Economic efficiency</th></tr>
<tr><td rowspan="2">Frame like structure</td><td>Light weight</td><td rowspan="2">Light weight</td><td rowspan="2">- in the development of automotive models for the study of aerodynamic theories.
- the design of aircraft goals for the advancement of aerodynamic theory</td><td rowspan="2">As Nano Laminates and coatings are employed, it carries the infra-structure + durable+ bio capabilities.</td><td rowspan="5">Low cost of maneuverability + flexibility in building contributions and reductions to achieve building reuse + low usage of timber</td></tr>
<tr><td>Solid</td></tr>
<tr><td>bar-like construction</td><td>Light weight</td><td rowspan="3">Solid</td><td rowspan="3">- internal contributions and furniture design in trains -to develop the design of light systems and equipment</td><td rowspan="3">Shows the role of the passive solar energy design.</td></tr>
<tr><td>The laminated panels (CLT, GLT)</td><td>Light weight as tiles</td></tr>
<tr><td>Solid</td></tr>
</table>

5. Conclusion and Recommendations:

- After a decade of deterioration, timber can resume its place at the top of the agenda of urban design, and cities will serve as creative zones for invention, engagement, and discovery.
- As a result of the hugeness of timber construction knowledge, researchers are recommended to work alongside by presenting multidisciplinary research projects involving various fields of science in Egypt and around the world, with the goal of solving the human community's eco efficiency and measurement accuracy problems.
- Because the Egypt 2030 plan seeks to improve the transportation system, particularly trains, and the installation of the Cairo Monorail project to connect the New Administrative Capital to the 6th of October city has already begun, we believe it is urgent to use smart timber locally inside the benches, windows, and interiors of train cabins. [as mechanical application]
- We emphasize that smart technologies is to be used in the production of strong thin layers from timber in order to increase measurement accuracy and quality control system.
- With minimum quality control, the AFM method may be adapted to be a valuable tool for high determination assessment of fragile woody fibers.
- Finally, the authors recommend that new IS Standards must be explored for precision of measurements, geometrical characteristics, and surface form for machined wood in order to achieve developments in various technical applications, similar to those studied for metals. (Umetani, N., & Bickel,
B. 2018) (Clement, Winston. 2014).

Authors Contribution:

1-	Conception or design of the work	50%
2-	Data collection and tools	50%
3-	Data analysis and interpretation.	50%
4-	Funding acquisition.	50%
5-	Investigation	50%
6-	Methodology	50%
7-	Project administration.	50%
8-	Resources	50%
9-	Software	50%
10-	Supervision	50%
11-	Drafting the article	50%
12-	Critical revision of the article.	50%

References:

[1] Chen, C., et al. (2018).Scalable and Sustainable Approach toward Highly Compressible, Anisotropic, Lamellar Carbon Sponge, Chem 4, pp. 544–554, March 8, 2018.
Websiteat:https://www.cell.com/chem/pdfExtended/S2451-9294(17)30530-2
[2] Clement, Winston. (2014). Standardization in the Lumber Industry: Trade Journals, Builder's Guides and the American Home

[3] Creasman, P. P. (2013). Ship Timber and the Reuse of Wood in Ancient Egypt, Journal of Egyptian History, 6(2), 152-176. doi: https://doi.org/10.1163/18741665-12340007
[4] David W. (2011). "A History of Western Architecture" . Fifth Edition. Laurence King publishing Ltd. London, ISBN-10 : 1780675976
[5] Dute, R. R., & Elder, T. (2011). Atomic force microscopy of Torus-bearing Pit membranes. IAWA Journal, 32(4), 415–430. https://doi.org/10.1163/22941932-90000068
[6] Earth Sciences Building (ESB) | UBC Campus & Community Planning. (2021). Retrieved from https://planning.ubc.ca/earth-sciences-building-esb
[7] Elsayed, G., Hassan,R. (2016)" **Studying the capability of using timber in improving the configuration of the urban context**" paper presented at 2rd international Conference BUE ACE1Sustainable Vital Technologies, Cairo University , , BUE , Cairo, Egypt
[8] Europe: Plants as nanocellulose resource - Food News International. (2021). Retrieved from https://foodnewsinternational.com/2016/12/27/europe-plants-as-nanocellulose-resource/
[9] Http//www.antaria.com/pdfs/nano Z/nano Z_ brochure_ 02.pdf
[10] Http://www.nanotech ire.com/news.asp?rid=1584&pg=2
[11] Jnido,G. et al,. (2019). Deposition of tio2 thin films on wood substrate by an air atmospheric pressure plasma jet. Coatings, 9(7), 441. https://doi.org/10.3390/coatings9070441
[12] Joseph, M. (2015). Solid Wood, case studies in mass timber Architecture, Technology and design, Published by Routledge, Milton Park, Abingdon, Oxon,
[13] Kolb, J., Schweiz, L. & DGfH - German Society of Wood Research (2008). Systems in Timber Engineering: Loadbearing Structures and Component Layers. Berlin, Boston: Birkhäuser. https://doi.org/10.1007/978-3-7643-8690-0
[14] Leonardo Da Vinci Pilot Project. (2008). Design of timber structures according to EC 5. [place of publication not identified].
[15] Mann, S.(2006) Nanotechnology and Construction, Nano forum report, Institute of Nanotechnology
[16] Matsunaga, H., Kiguchi, M., & Evans, P. (2008). Microdistribution of copper-carbonate and iron oxide nanoparticles in treated wood. Journal Of Nanoparticle Research, 11(5), 1087-1098. doi: 10.1007/s11051-008-9512-y
[17] Miao, J., et al. (2017). Partial delignification of wood and membrane preparation using a quaternary ammonium ionic liquid. Scientific Reports, 7(1). https://doi.org/10.1038/srep42472
[18] Michael F., et, al. (2008). A world History of Architecture, Second edition. Laurence King publishing Ltd, London, ISBN-10 : 1780671113
[19] Nocetti, M., et al. (2009). Variability of wood properties in two wild cherry clonal trials. Wood Science And Technology, 44(4), 621-637. doi: 10.1007/s00226-009-0294-x
[20] Pawson, S., et al. (2013). Plantation forests, climate change and biodiversity. Biodiversity And Conservation, 22(5), 1203-1227. doi: 10.1007/s10531-013-0458-8
[21] Ryan, E. et al. (2015). Solid Timber Construction, Process, Practice, Erformance, Version 1.1, University of Utah, Integrated Technology in Architecture Center, College of Architecture and Planning, .
[22] Salah H.R. Ali and Omar M. Mohamd, (2015).Dimensional and Geometrical Form Accuracy of Circular Pockets Manufactured for Aluminum, Copper and Steel Materials on

CNC Milling Machine using CMM, International Journal of Engineering Research in Africa, Vol.17, pp.64-73, Switzerland.
[23] Salah H. R. Ali, (2014).Novel Prediction Analysis Method for Error Separation of Stylus system and CMM Machine, Advanced Materials Research, Vols.875-877, pp.671-679, , Switzerland.
[24] Umetani, N., & Bickel, B. (2018). Learning three-dimensional flow for interactive aerodynamic designTransactions on Graphics (TOG), 37(4), 1-10.
[25] USDA Forest Service - Forest Products Laboratory. (2021). Retrieved from https://www.fpl.fs.fed.us/index.php