



# INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

## A STUDY APPROACH TO SUSTAINABLE CONSTRUCTION MATERIALS

<sup>1</sup>Ar Ritika Goel, <sup>2</sup>Ar Mukesh Gupta,

<sup>1</sup>Assistant Professor, <sup>2</sup>Architect,

<sup>1</sup>Department of Architecture,

<sup>1</sup>Sigma College of Architecture, Kanyakumari, India, <sup>2</sup>CP & DS Associates, Ghaziabad, India

**Abstract:** The goal of this study is to better comprehend approach for sustainable building construction materials. Since modern life involves sophisticated technologies, as we all know, we also need to learn about sustainable building materials because of environment safety. A detailed examination of sustainable building materials is provided in this abstract, with an emphasis on current advancements of construction materials, concentrate on recent developments, and their effects on the built environment. The main characteristics and advantages of these cutting-edge materials—such as improved strength, durability, thermal performance, and lower carbon footprint—are highlighted in the abstract. It talks about how advanced manufacturing methods like 3D printing and nanotechnology are transforming manufacturing and allowing for previously unheard-of levels of design freedom. With all factors considered, this abstract offers insightful information about the most recent developments in building materials, as well as a road map for navigating the changing field of resilient and sustainable construction methods for developers, architects, engineers, legislators, and other stakeholders.

**Index Terms** – Sustainable building, Construction materials, 3D Printing, Nano Technology, Strength, Durability.

### I. INTRODUCTION

When compared to conventional building materials, advanced materials offer more strength, durability, and sustainability, which is propelling innovation in the construction sector. These materials are revolutionizing the design, construction, and operation of buildings and infrastructure. They are frequently the result of material science and modern manufacturing techniques. The following are some major innovations in advanced building materials:

### II. SEVERAL INNOVATIVE METHODS FOR SUSTAINABLE BUILDING MATERIALS

This study examines the new construction materials have had a profound impact on building design, height, features, and energy efficiency. Modern substitutes for or improvements upon standard materials like steel, concrete, and polymers have made it possible to create unique and complex designs while maintaining energy efficiency, sustainability, and security. Businesses are constantly coming up with creative answers to satisfy consumer needs, providing a variety of modern materials and methods meant to solve current construction-related issues.

#### 2.1 LIGHT GENERATING CONCRETE

It is a building material based on light emitting property. It is due to of uniform distribution in optical fibres throughout its body. It is also known as translucent concrete. Its work based on Nano – optics and optical fibres that fibres are generally placed on top of each other and its act like a silt that's why its carry light through it.



Figure 1: Image of light generating concrete

### Example - Van Gogh-Roosegaarde Bicycle Path, Netherlands

This is a bicycle path in Nuenen, Netherland, it incorporates the light generating concrete material it helps to create a glow in night in the bicycle track whole day with daylight it will get charged. It create a very beautiful route for the evening walk or cycle ride. It can save lot of electricity energy and it can provide better illumination and artistic beauty.



Figure 2: View of Van Gogh – Bicycle path

### 2.2 THERMASTEEL PANEL SYSTEM

It is an innovative construction technology that unites structural strength, easy in installation and have energy saving ability. This panels consist core of Expanded Polystyrene (EPS) foam it gives excellent thermal insulation properties. It have strength and durability because EPS foam is sandwiched between galvanised steel. This panels have interlocking system that's why it can fit tightly and its increase thermal performance of this material.



Figure 3: Image of thermasteel panel system

### Example – Greenway Elementary School, USA

It is aimed to create a comfortable learning environment to the students. Construction is based on the thermasteel panel system it has light weight, energy saving and quick construction property. This panels are prefabricated off – site and the assembled into the site it helps to reduce time and wastage. This panels have excellent insulating properties and energy consumption for heating and cooling.

### 2.3 LIQUID GRANITE

It is a very adaptable material that can be used like concrete. It is made from an inorganic powder and 30% to 70% of industrial recycled waste and waste of aggregates. It promotes sustainability towards the construction practice. It is a fire resistant material. It is helping to enhance the building activities through environmental impact.



Figure 4: Image of Liquid Granite

### Example – Port of Houston

This is an international port in the world for that this is a flooring solution for the 1350 square foot area in their construction and office area because it experiencing a tremendous growth for that need a perfect solution for the flooring. It is a very good option to replace the cement. Definitely this material can replace cement concrete guarantee given by inventors.



Figure 5: View of the Office area (Port of Houston)

### 2.4 CROSS LAMINATED TIMBER

It is an engineering wood product that comes in popularity because of its originality, strength and sustainability. It is made by the layering of several pieces of lumber boards. These layers are arranged in a perpendicular to each other which helps the panel's structural morality. It helps to reduce time and cost of construction because it is a prefabricated technique and it can be assembled quickly on site.



Figure 6: Image of Cross Laminated Timber

### Example – Sara Kulturhus Center, Skelleftea, Sweden

This is designed by White Arkitekter, it is built by locally available material cross laminated timber and glulam. It is the nod to that area in history of timber construction. In this we have prefabricated CLT modules used in between two elevator cores and it will held by the strong wooden beam and pillars. This hotel consist of 20 floor and CLT is used for making walls and floors. Infact in the short parts of the building also made from wood frames and beams. This building life span at least 100 years claim by the White Arkitekter.



Figure 7: View of the Sara Kulturhus Center, Sweden [Source: gbdmagazine]

## 2.5 TRANSLUCENT WOOD

It is an integrated material that unites the natural structure of wood the property of light transmission. It is spawned by chemically removing cellulose from the wood, which is responsible for wood color, opacity we get from natural wood. This procedure leaves behind a permeable cellulose structure that is then expectant with a transparent polymer, like as epoxy or acrylic resin. It allows light to diffuse through it like soft and natural illumination in comparison with regular wood.

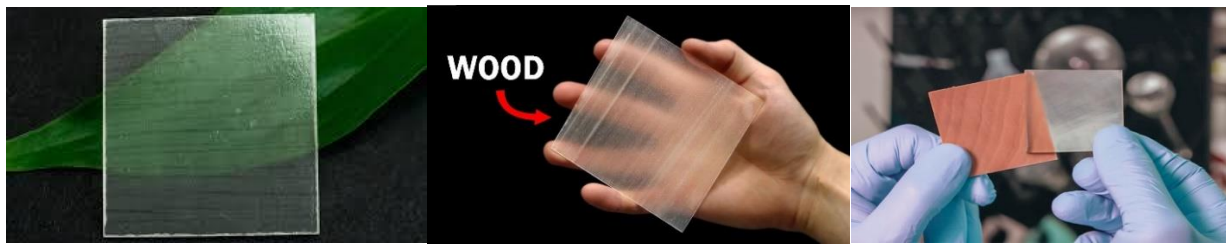


Figure 8: Image of Translucent wood

### Example – Nova Ruda Kindergarten in the Czech Republic

This is designed by Petr Stolin Architekt, it has double skinned translucent façade of fiberglass. Inner part of the building is to be covered by the fibre glass with wooden frame, and the whole structure is wrapped by the material of steel and fiberglass shell. The steel structure surrounded the whole building, it has featured with two walkways around with the main sections, and it is concealed from the street view by adding one layer of the trapezoidal fiberglass. This layering of the fiber glass is giving glow behind the outer skin in the night time. With the steel shell the centre part of the building surrounded by the long courtyard, with the walkways and staircases that allow inside movement between to the private garden space with exposed perimeter walkway.



Figure 9: Image of Nova Ruda Kindergarten [Source: Dezeen.com]

## III. ADVANTAGES, DISADVANTAGES AND APPLICATIONS

Table 3.1: Table describes the advantages, disadvantages & application of above stated materials

Material	Advantages	Disadvantages	Applications
<b>Light Generating Concrete</b>	<p>Safety chances will increase as it helps to guide &amp; navigate the area.</p> <p>It has energy saving properties that's why it comes as a sustainable material.</p> <p>Design flexibility also good in this material.</p> <p>Aesthetic appearance &amp; its reduced environmental benefits also.</p>	<p>Initial cost is high for this material.</p> <p>Light intensity is dependent on how much light is consumed throughout the day.</p> <p>Special knowledge is required while using that material.</p> <p>With time degradation the material will have less intensity of light because it will be affected by UV rays.</p> <p>Limited color options.</p>	<p>In the context of architectural and construction it's used for windows, facades, interior walls and for natural light.</p> <p>In bridge tunnels, transportation facilities help to provide guidance in night time.</p> <p>It is a wayfinding element in outdoor and indoor places.</p>

<b>Thermasteel Panel System</b>	It provides superior thermal insulation property, which leads to energy savings and its reduced utility expenses. It has steel component that's why its provides excellent structural integrity. It's a lightweight panels easy to handle and carry. It can prevent from moisture, corrosion, and termites because of treated steel and EPS foam.	This material is available in less quantity that's why initial cost is high rather than standard materials. For sophisticated designs it can be a costly, in case of any repair or any alterations is much more difficult and expensive.	It is used in various applications like residential buildings, commercial structures, and industrial. It is good for healthcare facility because of its strength, insulation property and construction speed.
<b>Liquid Granite</b>	It is a fire resistant. Durable, aesthetic appearance gives flexibility in design. It can easily customized with any color, pattern & texture. It is the cost saving material comparing the granite.	It required professional installer. In the case of heavy wear and tear area it have shorter life span.	Kitchen countertops, bathroom vanities, flooring, wall cladding, furniture's and interior decors.
<b>Cross Laminated Timber</b>	It has strength, lightweight in nature and environment friendly. Easy to handle and move. It has prefabrication specifications also with help to do construction faster.	Many challenges we need to face for this material like moisture sensitivity, fire risk, limited production capacity, acoustical performance issues.	It is to be used in walls, floors and roofs in plenty of wide range of building types.
<b>Translucent wood</b>	It has light transmission property. It has the material strengthen property. Aesthetically appearance is good. It has sustainability also.	This material has expensive & complex	We can use this material in windows facades, and for access of natural light.

### Inferences

The study conducted on those materials demonstrates an encouraging move towards the more environmentally friendly, effective and creative building strategies. For adopting each material we need to follow some special considerations related to that particular materials. In this innovative materials have initial costs is high and may require skilled expertise in all materials. All materials have the potential to provide sustainability, environmental benefits, green building strategies and it will help to reduce overall carbon footprint of construction projects. Durability and long term performance of some materials need considerable approval, especially when dealing with different climatic conditions and applications in construction.

#### IV. CONCLUSION

Advanced construction materials significant developments in sustainable and outstanding performance in building technology. Each and every materials have some distinctive advantages and disadvantages, which make it useful for a different variety of applications depending on the project requirements and concerns about the environment. In brief, these advanced building materials became popular in building industry would most surely require continuous study and their applications will be based on the initial investment costs of that particular material and it will give long terms improvements in sustainability achievement and aesthetic appearance. According to the today's scenario we need to make sure about the buildings sustainability for that advanced building materials is good option in the modern buildings. If we use advanced building materials in modern buildings definitely its set good example for our construction industry. We can easily achieve sustainability in our modern buildings after using advanced construction materials.

#### REFERENCES

- [1] Lowe J. (1965), Method of Making Translucent Concrete
- [2] Kats G. The expense and monetary advantages of green structures: a report to California's maintainable structure team. Sacramento, CA: Sustainable Building Task Force; 2003.
- [3] Holland.com, global and tourism to get-inspired the current van-gogh-roosegaarde-cycle-path
- [4] Varghese.P.C. Building Materials, PHI Learning Pvt. Ltd., Google eBook.
- [5] Li, Guangfan; Huang, Yong; Chen, Chaohe, Advanced Building Material, Trans Tech Publications Ltd.
- [6] Westcoat.com project-profiles of liquid granite epoxy chip flooring solution for port houston

