

Energy Efficiency Comparison of a Single-Storey House by 3D Printing Technology and Conventional Methods: A Case Study

Sahil Sharma¹, P. Mahakavi²

^{1,2}Amity School of Engineering and Technology, Amity University Madhya Pradesh, Gwalior
¹ pmahakavi@gwa.amity.edu

Abstract- Green buildings often contain energy-saving strategies. They may use high efficiency insulating material in the walls, ceilings, and floors to increase the building envelope's efficiency. Low-energy homes commonly employ passive solar building design, which is another strategy. Designers line windows and walls and arrange porches and trees to maximize solar gain in the winter while shading windows and roofs in the summer. This is a review of the strategies used to create energy-efficient green buildings.

Keywords- Green building, concrete, 3D modeling.

I. INTRODUCTION

In order to maximize resource efficiency and minimize the building's negative effects on human health and the environment over its lifetime, better siting, design, construction, operation, maintenance, and removal are prioritized in the creation of sustainable buildings, also known as green buildings. The following are some ways that green buildings work to lessen the negative effects of the built environment on the environment and human health:

- Making efficient use of energy, water, and other resources.
- Protecting occupant health and increasing employee productivity.
- Reduce waste, pollution, and environmental destruction. Natural building is a similar concept, but on a smaller scale and with a focus on the use of locally accessible natural resources. Other often

used terminology includes sustainable design and green architecture.

II. REVIEW OF LITERATURE

Green Building

The goal of green building techniques is to reduce a building's environmental impact. In addition to using a lot of water, energy, and land, buildings also have an impact on the atmosphere expenses are 300 percent overstated, according to a new World Business Council for Sustainable Development report. Important figures in the real estate and construction industries put the extra expense at 17% over traditional building, more than double the actual average cost difference of 5% and air. While the perceived costs of green buildings are overstated, the environmental impact of structures is often underestimated. Green [1-2].

Materials

Quick-growing plant materials like bamboo and straw, lumber from sustainably managed forests, ecological blocks, on-toxic, recyclable, sustainable, and/or recyclable substances are often considered "green" building materials. The Environmental Protection Agency (EPA) also suggests that building projects make use of recovered industrial resources, like foundry sand, coal

combustion goods, and demolition debris. Additionally, polyurethane significantly lowers carbon emissions. Businesses like American Insulock are replacing CMTs with polyurethane blocks. Polyurethane blocks are faster, more economical, and better for the environment. To reduce the amount of energy required for their transportation, produced and sourced nearby the construction site [3].

Reduced Waste

Another objective of green design is to minimize the waste of materials, water, and energy during the construction process. In California, for example, about 60% of the waste effect is attributed to business buildings. One of the goals of the construction phase should be to reduce the amount of material that ends up in landfills. Well-designed buildings also help reduce the amount of waste generated by the residents since they provide on-site alternatives like compost bins to reduce the amount of garbage that ends up in landfills. There are several strategies to mitigate the impact on wells or water treatment plants. Sometimes referred to as "greywater," wastewater from appliances like dishwashers and washing machines can be treated and used for non-potable applications like car washes and toilet flushing. Making fertilizer out of trash and wastewater is an alternative to this method that saves money and has additional advantages. Liquid fertilizer can be created by gathering human feces at the source and sending it to a semi-centralized biogas plant together with other biological waste. [4-5].

III. LIMITATIONS

- Although 3D printing could save construction costs, the high cost of printers is a significant drawback.

- Skilled labour is needed because 3D printing software and CAD skills are necessary.
- A study found that 3D printers use 100 times more electrical energy than traditional methods, which is much more energy than we could have imagined.

IV. DIFFERENT ATTRIBUTES OF ENERGY EFFICIENCY COMPARISONS

The time it takes to build a house in India depends on a number of factors, some of which are absent when we start building: organizing the materials, managing the labour force effectively, and looking for the necessary documentation. However, there are numerous other factors that affect how long it takes to build a house. If we take all of these into account when carrying out the construction operation, not only will the process of building our house appear straightforward, but it will also take much less time to complete.

- The location is the most important factor to take into account. We are adamant about our choice of location because of things like plot costs, how convenient it is for our daily drive, how close the hospitals are, and how safety must come first above everything else. The ease of construction is influenced by the site, which is highly important. The procedure can be sped up greatly by having the resources readily available, making it simple for employees to commute to their destination, and having affordable dining options close by.
- The budget is the second aspect that influences how long the construction process takes. Building a house is one of the most rewarding investments one can make, but it can come with a lot of costs. Throughout construction, the budget is crucial. The time it takes to build a house is entirely determined by the budget

because a larger amount requires more labourers to complete the job. The type of decorative element you want to use in your home will also determine how long the project will take to complete.

- Lastly, the quality of the building materials you use and the number of highly qualified engineers or contractors you hire for your work alone depend on how fluently you are spending the money. A straightforward floor layout has a better probability of accelerating project completion.

V. ADVANCED CONSTRUCTION TECHNIQUES

Any nation's development is based on its construction industry. Construction methods have undergone a revolution thanks to technological breakthroughs. Modern construction methods must be intelligent and sustainable in order to minimize negative environmental effects and boost productivity. Civil engineering final-year students can investigate these cutting-edge building methods that could influence the industry going forward. These methods make use of cutting-edge technologies including self-healing materials, green building practices, 3D printing, and building information modelling (BIM).

1. Prefabricated Construction Techniques

The technique of building components off-site and assembling them on-site is known as prefabrication. This method can greatly cut down on both the time and expense of building.

2. 3D Printing in Construction

A new technology that is making waves in the building sector is 3D printing. It entails building a structure layer by layer from a

digital model using a machine that is controlled by a computer. High precision is possible with this approach, and creating complex shapes is simple. 3D printing is a sustainable building method since it can cut down on labour expenses and material waste.

3. Green Building Techniques

Green building practices are designed to lessen a structure's negative environmental effects while fostering sustainability. It entails the use of energy-efficient designs, sustainable building materials, and renewable energy sources. Water use, carbon emissions, and energy use can all be decreased with the aid of green buildings. Final-year students can investigate the newest green building methods, like solar energy, rainwater harvesting, and green roofs, to encourage sustainability.

4. Building Information Modelling (BIM)

A computerized depiction of a building's structural and operational features is called Building Information Modelling, or BIM. It is a cooperative tool that can make building planning, design, construction, and maintenance more effective. The modelling of building information (BIM). In construction projects, BIM can assist minimize errors and omissions, which can save a lot of money and time. Final-year students can investigate the benefits and drawbacks of using BIM in the building industry.

5. Smart Building Techniques

Using cutting-edge technologies to monitor and manage building systems, such as sensors, the internet of things (IoT), and artificial intelligence (AI), is known as smart building techniques. These technologies can lower operating expenses, increase occupant

comfort, and improve energy efficiency. Students in their last year of study can investigate the newest smart building practices, which encourage sustainability and efficiency. These practices include automated HVAC and lighting systems.

6. Self-healing Materials

New building materials that have the ability to mend themselves when injured are called self-healing materials. Bridges, roads, and buildings can be built with these materials. They are able to identify and fix flaws like fissures and cracks before they worsen. This technology can lower maintenance costs, increase safety, and prolong the life of infrastructure.

7. Augmented Reality (AR) and Virtual Reality (VR) in Construction

In the construction sector, augmented reality (AR) and virtual reality (VR) are emerging as new technologies. By enabling stakeholders to view and engage with designs in a virtual setting, augmented reality and virtual reality (AR/VR) can improve the visualization of construction projects.

In construction, augmented reality (AR) and virtual reality (VR) By reducing mistakes and omissions during the design process, these technologies can save money and time. Students in their final year can investigate the newest AR and VR technologies and how they apply to the building industry.

8. Modular Construction Techniques

Building components are manufactured off-site and assembled on-site in modular construction. This method can greatly cut down on both the time and expense of building. It is perfect for constructing buildings like motels, hospitals, and schools.

Modular building can improve quality control, encourage sustainability, and minimize waste production.

9. Sustainable Infrastructure

In order to promote sustainability in the construction business, final-year students can investigate the most recent sustainable infrastructure solutions, such as employing recycled materials and renewable energy sources.

The future of the building sector is being shaped by advanced construction techniques. Civil engineering final-year students can investigate these methods more thoroughly to learn about their advantages, drawbacks, and possible uses. The world can be better off in the long run if advanced construction techniques result in a sustainable and productive construction sector. Final-year students have the potential to be at the forefront of this transition as the construction industry continues to evolve along with technology.

VI. EXPECTED OUTCOMES

In reducing water waste, green architecture may help protect biodiversity, conserve natural resources, enrich water reserves, and improve air and water quality. Green architecture also lessens your carbon footprint by releasing fewer harmful gases into the atmosphere and creating less waste. Buildings have the potential to mitigate climate change and preserve the environment in this way. To reach cities with cleaner air AND reduced environmental impact, optimizing energy use by ensuring acceptable comfort levels is crucial. Numerous infectious illnesses' geographic distribution is influenced by both natural disasters and climate change caused by environmental pollutants. The only means to address this problem are through

public awareness campaigns and a multidisciplinary approach from scientific experts; national and international organizations need to address the growing threat posed by this issue and provide sustainable solutions. Traditional building processes can result in lengthy completion times for projects, with major projects frequently taking 20% longer than projected and incurring cost overruns of up to 80% of the original budget. However, a project may now be completed in a few hours or days, depending on its size, and up to 70% less time is needed overall, all owing to 3D printing.

As a result, contractors can take on additional projects, which will expand their revenue stream. By precisely measuring the material needed to raise a building, 3D printing reduces waste production on the construction site by up to 60%. In the same way, assuming lower prices for the materials' acquisition and subsequent storage, there won't be any excess money spent on them. Businesses will reap an exponential growth in benefits from this technology as it reduces costs and time. It is particularly helpful in areas where labour is scarce and projects are needed. Businesses can save up to 80% on labour costs by using 3D printers to automate the construction process.

VII. CONCLUSION

The aforementioned data indicates that 3D printers are more efficient than the antiquated traditional building methods. Waste material is used in the construction of 3D printers. As a result, it is less expensive to labor and more environmentally beneficial. Globally, there is a growing need for 3D printing, which is the way of the future for the building sector. The amount of time that 3D printing technology consumes is minuscule as compared to the old, conventional way. Every organization will

need to use this technology in the coming years in order to survive in the business sector because of how effectively and efficiently the demand is growing. Based on my research report, the advantages, time, and cost explanation provided us with an overall trend.

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smart city and the smart company is sustainability of growth rather than just expansion.

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