

Effectiveness of 3D Printing In Construction Industry over the Old Conventional Method Regarding Time and Cost: A Review

Abhishek Pandit¹, Aditi Kumari²

¹Maulana Abul Kalam Azad University of Technology, Dr. BC Roy Engineering college, Department of civil engineering, Durgapur, India

²Maulana Abul Kalam Azad University of Technology, Dr. BC Roy Engineering college, Department of Electronics and Communication Engineering, Durgapur, India

Abstract:- Technologies have a noticeable impact on our evolving business system, It has changed the way, we people do business. Now, here comes the word 3D printers, wherein the last 3 decades, we have noticed its remarkable growth in the additive manufacturing industry. 3D printing technologies allow us to design optimization and have serious advantages over convention manufacturing methods. All Industries must adapt themselves to this new system so that they could survive in the rapidly changing ruthless habitat. There is huge pressure, emerging in the Construction Industry to adapt to the new technological developments. Hence, 3D printing technology has gained a lot of attention in the Construction Industry as a new technological change that needs to be implemented in the industry, for its survival. The main objective of this paper is to review the factors affecting the 3D printers to evolve in the construction industry, Comparing cost between the traditional method and 3D-Printing technology of a single storey house, Time comparison between the traditional method and 3D Build printing technology of a single-storey house. This paper summarizes a comparison between old and new construction method with a focus on the adaptation of 3D printing technologies and giving a cost and time comparison and how effective the 3D could be if applied to the construction Industry. The paper proceeds in recognizing how much 3D printing is effective as compared to the conventional method and predicting the possible transformation areas in the construction industry.

Keywords:- 3D Build Printing Technology, Cost comparison, Time Comparison, Advantages and Disadvantages.

I. INTRODUCTION

3D printing is computer-controlled technology that is helping us to build a three-dimensional object by the process of additive manufacturing, which creates objects by adding layers to them. Additive manufacturing allows us to create complex designs and the best part is that it takes very little time to build and it builds houses with very few labourers, and the cost estimation for construction is very low. 3D

printing in the construction industry is revolutionary and enormously getting attention from every part of the construction industry of the world. In this research paper, we had worked on three major areas of 3d printers considering their work in the construction industry It was developed in the early 80s but at that time, it was of no use because it was very costly and expensive to use. In 2000, it became relatively friendly to use, as it allows to create the design on the computer and the cost comparison was very less as it uses plastics and waste materials to form the concrete of 3D houses. And suddenly it became affordable and became viable for a wide range of design, models, etc

II. FACTORS AFFECTING THE 3D PRINTERS TO EVOLVE IN THE CONSTRUCTION INDUSTRY

Global Impacts

The global construction industry is the cause for the highest carbon Impacts which results in :

- 40% of global energy consumption
- 38% of carbon emission
- 12% of water eutrophication

Therefore, Decarbonization is a great way in the Construction industry to lower down the emission of carbons. 3D printing or additive manufacturing has evolved as a potential solution to lowering down the energy needs, water wastage and carbon emissions.

3D printing in the construction context is a futuristic technology that creates 3D objects by the recurring process of the physical objects with continuous layers being formed up. Freshly, from polymer and steel, the industry has leapt forward utilizing concrete with potential implementation in construction engineering. Anecdotally, these technologies proved to lower the production time, shrink wastage and reduce labour costs remarkably. The provocation which circumscribed the 3D printing incorporate lack of standard building codes, great scale investment, effective execution and architectural designs.

Advantages and Limitations

○ ADVANTAGES

- **Environmentally friendly:** We can utilize raw soil and natural waste from the rice manufacturing chain for 3D printing. In theory, the substance for a 3D printed house can also be plastic and we've got an abundance of that
- **Affordable:** Big-scale industrial buildings can be constructed for a comparatively low price
- **Unusual shapes:** 3D printing can produce shapes that are impracticable or too costly to manufacture otherwise.

○ Limitations:

- Though the charge of construction may be reduced by 3D printing the cost of printers are expensive and a major disadvantage.
- Skilled labours are required as the knowledge of CAD and 3D Printing software are required.
- 3D printers consume way more energy than what we can think of as according to a research it consumes 100 times more electrical energy compared to conventional methods.

III. EFFECT ON TIME, COST AND ENVIRONMENT OF CONVENTIONAL CONSTRUCTION METHOD

The construction industry plays a key role in the socio-economic development of any country. Nowadays, the construction industry is quickly evolving because of the increase in the standard of living, demands of infrastructure projects well as the increase in population. This growth has donated notably to waste generation.

➤ Waste Materials from the Building Construction and Destruction:

The destruction and restoration of buildings follow a large amount of waste. Building waste many a time circumscribed concrete, bricks, metals, glass, plastics, wood, asphalt, and more. This waste is frequently disposed of in either landfills. It not only pollutes the land and air, but also the transportation required to remove such waste has a significant impact on the environment as well. As per the Environmental Protection Agency, there were as huge as over 170 million tons of debris generated in the construction and destruction of buildings alone in the U.S in the year 2003, of which 61 per cent were solely from the residential building.

IV. COST COMPARISON BETWEEN TRADITIONAL METHOD AND 3D-PRINTING TECHNOLOGY OF A SINGLE STOREY HOUSE

Quantity, Rate and Cost Estimation Of a 600 SQFT House In India

Planning and estimating the quantity of cost of a house that you are planning to construct is extremely noteworthy. If we start building a house without any pre-planning, we will find it very difficult to do it. Therefore, it's necessary to first estimate the rate, quantity and total cost of the building

materials, labours and some other resources that we are going to use in the construction of our house.

600 sqft is not a big area. That's why we must use this small area in a very progressive and efficient way. In this project, we have shown you the building materials and other resources that one should be in needs to build a 700 sqft house.

Details

Plot Area: **600 Square Feet**

Total Bedrooms: **1**

Type: **Modern**

Building Material in House Construction

The material used in construction for building houses in the building material. These are the main house building materials:

Concrete, Steel, Sand, Bricks, Ceramic Tiles, Granite. Kota Stone, wood, river sand, Door, Window, timber, Painting & granite, Plumbing, Electrification, composite material and Filling well as the increase in population. This growth has donated notably to waste generation.

To build a 600 sqft house, we need to use the following materials. The rate of each material, as well as their total costs, are mentioned below.

[1] **CEMENT:** One bag of cement costs approx 300 rupees. Construct a house of 600 sqft, we require 260 cement bags, which costs **78,000 Rs.**

[2] **STEEL:** Steel Is priced at 45 Rs/kg approx. We need approx 1.5 metric ton of steel, Total costs = **67,500 Rs.**

[3] **SAND:** The price of sand is 50 Rs/cubic ft and we need 1250 cuft. Total cost= **Rs 62500.**

[4] **AGGREGATE:** Priced at 22rs/cuft. We need 750 cuft. Total amount = **16,500 Rs.**

[5] **LABOUR RATE:** Average rate of single labour is 250 rs/sqft. We are working to construct a 600 sqft house. Hence, Total amount= **1,50,000 Rs.**

[6] **BHISHTY:** Priced at Rs 250/day. Required for 6 months. Total amount- **33,750 Rs.**

[7] **BRICKS:** We require 15,000 bricks Units. The rate of 1 brick is Rs 9. Total amount= **1,35,000 Rs.**

[8] **VATRIFIED TILES:** Priced at 37rs/sqft. vatrified tiles needed is 420sqft . Total amount= **15,540 Rs.**

[9] **GRANITE:** Priced at Rs160/sqft and the Quantity needed to construct is 190sqft. The total amount is **Rs. 30,400**

[10] **KOTA STONE:** Priced at 22/sqft. The quantity needed to be constructed is 270 sqft. Total amount required = **5,940 Rs**

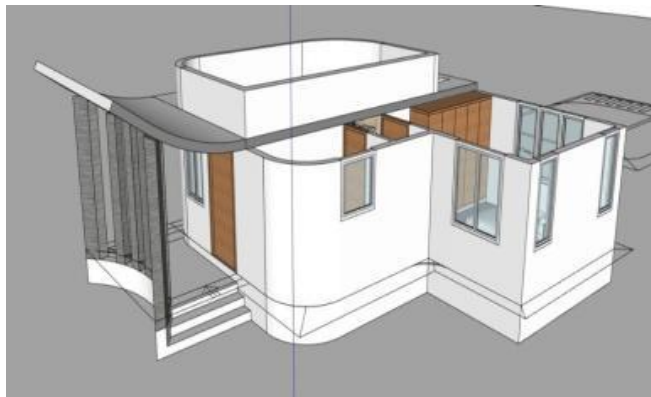
[11] **WINDOW GRILL:** priced at 1950/grill. The quantity needed for construction is 4 units. Total amount- **7,800 Rs**

[12] **DOOR:** Priced at Rs3650/unit. The quantity needed to be constructed is 6 units. Total amount= **21,900 Rs**

[13] **SLIDING WINDOW:** Priced at Rs3500/unit. The quantity needed to be constructed is 4 units. Total amount= **14,000 Rs**

[14] **WATER TANK:** Priced at Rs8/ltr. The quantity required for construction purpose is 1000L. Total amount= **8,000 Rs**

- [15] **PAINTING & WALLPUTTY:** Rate-19/sqft. Quantity needed to done altogether is 2850sqft. Total cost- **54,150 Rs**
 - [16] **ELECTRIFICATION:** Total amount= **45,000 Rs**
 - [17] **PLUMBING:** Total amount- **17,000 Rs**
 - [18] **CEREMIC TILES:** RATE- 22rs/sqft. Total sqft needed to be constructed is 250 sqft required. Thus, Total amount= **5,500 Rs**
 - [19] **EXCAVATION:** Rate- 7rs/cuft. Quantity needed to be excavated is 1950 Cuft. Total amount= **13,650 Rs**
 - [20] **DOOR FRAME:** Door framed is priced at 1950/unit. Quantity required for construction is 6 units. Total amount= **11,700 Rs**
 - [21] **OTHER ITEMS:** cost- **17,500 Rs**
- TOTAL COST OF BUILDING - Rupees. 8,11,330**
- PER SQUARE FT. COST= Total Cost of the Building/ Total sqft of the building**
- = (Rs 8,11,330/600)Rupees/sqft**
- = [1352 Rupees/sqft]**



As per Tvasta, the cost of constructing a 3D printed house is approximately **Rs 5.5 lakhs**

By considering numbers, we have calculated the difference in the Cost of 3Dprintbuilding to a Convention method constructing of a One-Storey building of a 600 sqft house in India

Difference:

- 1) Total cost of costruction of a One-Storey building using Conventional Method = **RS. 8,11,330 approx**
 - 2) Total cost of costruction of a One-Storey building using 3D Buildprinting = **RS. 5,50,000 approx**
- Subtracting [2] from [1] we get:
- [Rs 8,11,330 – Rs 5,50,000]**
- = Rs 1,00,500 approx**
- So, **Rs 2,61,330** approx is saved if we use to construct a One-Storey building using 3D printers compared to the conventional method of construction.

India’s First 3D Printed House



India's first 3D-printed house is built by alumni of IIT-Madras. India's first 3D-printed house is now ready. Taste's first structure is a single-storey house. The house was built in just 106 hours. Tavasta's official blog states, When it comes to waste materials, this technology creates the only 1/3rd of the waste generated using conventional building methods. The cost reduction is because it increases in labours demand. A structure takes almost a year but 3d printing technology takes few days to complete entirely. There is a saving in on amount and the waste material is also less and it takes a lot less in the number.

V. TIME COMPARISON BETWEEN TRADITIONAL METHOD AND 3DBUILDPRINTING TECHNOLOGY OF A SINGLE-STOREY HOUSE

Factors that determine the duration of building a house in India

As we begin the construction of our house, the important tasks of accompanying altogether the materials, workers management efficiently, searching for the paperwork are missing between. There are however many other facts that determine the duration of a house building and if we consider all these factors into account while executing the construction operation, then not only the process of building our house looks simple but also the time used to construct the house will be very less.

1. The most Primary thing that we must take into account is the location. Our selection of the location is adamant by factors like the prices of plot, Convenient of our day to day commute, access to hospitals, safety has to be the priority over any other things. The location plays a very significate role and influences the ease of the construction. Availability of the materials, easy commute to the location for workers and nearby cheap restaurants for the workers to eat can work wonders in fastening the process

2. The 2nd factor that affects the duration of the construction process is the budget. Constructing a house can involve great expenses but it is one of the most profitable investment one can make. The budget plays a significant role in construction. The budget solely determines the time taken to construct a house as more the amount means more the numbers of labours you have for the work, The quality of materials you use for construction as well as how many high professional engineers or contractors you hire for your work alone depends on how fluently you are spending the money...

3. Very closely related to the second point, Build contracts are also responsible to build a home faster. If a builder and workers do their work efficiently the work is supposed to be finished sooner. So it is always considered to be a smart play if choose the right contractor.

4. Even paperwork plays a significant role in expediting the process of construction of your house. Once, the plot gets finalized, budget, builder, the next task which is waiting is for applying for the relevant permissions from the state authority. The entire process may take 2 weeks to a month also.

5. Finally, the type of decorative element you want to use in the home will decide the total duration of the completion of the project. A simple floor plan has higher chances of expediting the process of completion of the project.

Pre-construction processes

Building a house can be a huge eye-opener. Not only are our expectations pitted against reality but also ends up becoming an enormous learning experience for us all. The overall assumption when determining the duration of the construction is that detail. The entire process can take up to three weeks.

Following which we can chart out a rough timeline for the on-site construction, which will vary depending on the size of your house.

The Average Duration of On-Site Construction

The initial steps of construction include acquiring temporary electricity connections and shed construction, which may last for two weeks. Once that is over, PPC Work in Footing continues for the next two days. Then comes the Column Marking, Boxing and Re-erection for the next one week. The next stage of construction involves Plinth Work which persists for 3 to 5 days, followed by refilling & PPC Works which typically goes on for another 5 days.

Once this stage is completed, the block or brickwork starts. It goes on for approximately 2 weeks, followed by another week of Lintel work.

Thereon, we move to the next stage which involves slab casting, electrical works and shuttering. This spans for another 3 weeks. Plastering is the next

Thereon, we move to the next stage which involves slab casting, electrical works and shuttering. This spans for another 3 weeks. Thereafter, we arrive at the electrical & plumbing Works which runs for the next couple of weeks.

Plastering is the next step in the construction process and may involve 3 to 4 weeks of work.

Finally, we move on to the more decorative aspects which include waterproofing, flooring, painting Works, fabrication, doors & windows Fittings and sanitary fitting & finishing works. All of this is likely to tantamount to 4 to 5 months. So, irrespective of the dimensions of the house, these basic stages of construction are mandatory so the first 4 to 5 months of construction are common to houses of all dimensions.

Time Required to Construct a House in 30 by 40 Plot Size (About 1000 Square Feet)

On average, a single-family with the size of 1000 square feet will usually be constructed within **7 to 12 months**. This can vary if custom designs are also included. Often fundamental, production homes as per the builders' templates are less time-consuming. A 1000 square feet plot with only one storey will take a lower spectrum of the time while a house with the same area but with multiple storeys, for example, ground floor plus two or three floors can go up to 12 months of construction.



India's first 3D printed two-storey building. Photo via COB

Back in 2020, Larsen and turbo conglomerate announced that it has achieved the first construction of 2 storey building that has been fully 3D printed. This is a great achievement in a construction company as it is the future of our construction. This achievement is a milestone. L&T claims that 3d printing is the first and it also has massive potential to significantly alter affordable housing. Yes, it is acceptable that many other companies are also adopting this technology but L&T groups printed 3d printing of real concrete made by their company itself and we can say that because of this the cost reduction is much higher in rate.

Impressively., L&T groups featured that it took them a total of 106 hours to complete the house and whereas other conventional methods can take 8-12 months.

VI. CONCLUSION

As we can conclude from the above data, 3D printers are effective as compared to the old conventional method of construction. 3D printers use waste material for construction. As a result, the cost of labours are reduced as well as it is environment friendly. The demand for 3D printing is increasing worldwide and is the future of the construction industry. As we compare the time comparison between the old traditional method and 3d printing, time consumed by 3d printing technology is very minimal. The demand is increasing so effectively and efficiently that in upcoming years, every company will have to adapt this technology for sustaining in the buisness world. Advantages, Time, and cost explanation based on my research paper gave us an overall trend.

As we can see that 3D printing technology is booming all over the world, especially in India.

The time difference between 3D printing technology and old conventional method is magical. It can change the revolution and it can set up the new era and the biggest change all over the world.

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