# Evaluation of 3d printing for sustainable construction



## Introduction

Today, in all fields of our lives, we can witness the ongoing search for fresh, contemporary techniques and techniques that fulfill sustainable development values. New approaches must, be more efficient in preserving our planet's exhaustible resources, have relatively low effect on the environment and, on the other and ensure a higher product quality. [2] Which is why, creating viable, cheap, stronger, recyclable, personalized and even environmentally reparable construction parts is a critical focus of current studies. [1]

Civil Engineering infrastructure includes buildings, bridges, highways, railways, tunnels, airports and other living, transportation and manufacturing infrastructure. Not only are construction infrastructures the vital manufacturing and life services for human beings, but they also represent the growth of culture and civilization. The requirements for safer, smarter, more affordable, more stunning and more lasting civil engineering infrastructure are increasing dramatically with the enhancement of people's living standards and the advancement of engineering technology. The current major construction infrastructures are facing severe problems of material decay and operational deficiency after decades of services. First, standard material failures are probable to lead to a danger of structural failure and deterioration of durability, such as concrete brittle failure and steel corrosion. Second, most conventional construction materials are nonrenewable and energy-intensive, putting too much pollutant release on the atmosphere and blocking the sustainable growth of construction buildings.

Thirdly, advanced buildings tend to be more convenient and more intelligent, https://assignbuster.com/evaluation-of-3d-printing-for-sustainableconstruction/ encouraging new construction products with not only outstanding mechanical characteristics but also versatile characteristics in multiple ways such as energy, sound, heat and light. In addition, the sustainable growth of infrastructure in civil engineering has become an immediate long-term problem.

New advanced composites such as high-performance concrete, multipurpose and intelligent cement composite materials, green and environmental composites for civil engineering are thus sought to satisfy the abovementioned needs in major construction development. [3]

One of the new promising technology is the technology of 3D Printing of individual structures and buildings. [2]

Literature Review

3D Printing in the construction industry.

Due to a shortage of labor, machinery and environmental problems, targeted demand (e. g. decreased building time, less pollution and waste) is becoming increasingly hard to satisfy in latest years. Three-dimensional printing (3DP) technology offers an innovative technique of building that can optimize building time, flexibility of design, reduction of errors, cost and preservation of the environment. 3DP technology is based on the design of the 3D model using the 3DP equipment to manufacture three-dimensional products layer by layer. 3DP is a type of rapid prototyping innovation that includes digital modeling technology, many state-of – the-art innovations, data technology and science / chemistry equipment. It is known as " the third industrial

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revolution's key technology." Compared with the traditional manufacturing technology, 3DP needs not solid mold, creates no waste materials and demands no complicated forging process during the manufacturing process. Therefore, 3DP can achieve the optimization on structure, saving material and energy in the production. 3DP technology is not only appropriate for the growth of fresh products, the rapid manufacture of single components and small batch components, the complicated design and manufacture of mold components, but also appropriate for the production, inspection, assembly inspection and design of quick reverse engineering. Thus, more and more attention has been paid to the 3DP sector. 3DP concrete is commonly used in civil engineering. Compton and Lewis (2014) used fiber-filled epoxy composites as printing composites and discovered that both wood and commercial 3D printed structures had almost the same complete rigidity. The application of 3DP technology has been reported worldwide. At present, three main concrete printing technologies, D-shape, contour crafting (CC) and concrete printing, are in public domain. D-shape's key concept is the method of powder deposition, which connects the powder using a chemical binder as an alternative. CC is based on concrete ink extruded against a trowel that gives the printed parts a smoother surface finish. Like CC, concrete printing also has a manufacturing process based on extrusion that manufactures complicated geometries of components by layers without hard job. Both D-shape and concrete printing are appropriate for gantry-based offsite printing when it comes to practical implementation, while CC is more appropriate for on-site, in-situ applications. (Advanced Composites for Civil

Engineering Infrastructures)

#### Engineering Management Problem

The standard construction industry appears to have concluded that 3D building printing will develop substantially in the coming years and conquer an important portion of the building market leading to more and more firms from the standard construction industry being engaged. With the entry into the 3D building printing sector of some of the giants and their vast resources from the standard construction industry, the evolving outcome is moving towards a bright future. Especially owing to the elevated labor costs in Europe, which 3D building printing can decrease, European building giants have become active participants in 3D building printing. (Construction Giants Embrace 3D Construction Printing)Dubai already possesses 3D printed houses and 3D printed trees which can charge your phone and also provide Wireless internet, while plans are also being made at Mohammed bin Rashid Al Maktoum Solar Park to develop a 3D printed laboratory for additive production and drone study. They are hopeful that their additive manufacturing equipment in the construction industry could have an enormous effect. Our machine capacities would allow a prospective decrease in labor costs of up to 90 percent while enabling building firms to build houses and buildings quickly. 3D Printing of buildings is said be quicker, more cost-effective and eco-friendlier. (Concrete 3D printing startup Cazza Construction to create 3D printed buildings in Dubai)Such technologies help in expediting construction with optimal use of resources. They help in bringing a paradigm shift in construction sector which is very much the need of the hour. 3D Printing can be used to print forms and constructions that could not be used using standard techniques. This can lead to the printing of

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partly hollow structures or shape structures that can lead to substantial material savings. This technology can also allow natural products or geopolymers to be developed that can make the building method very sustainable and green. 3D concrete printing provides the building a fresh dimension. With concrete, this technology can best fulfill the complicated requirements of modern architecture. Using a combination of binders and optimally proportioned and sized aggregates, together with appropriate chemical additives, the concrete blend is finely tuned to attain the rheological features that enable the material to be extruded and the postplacement shape retention. (India's first 3D Printing Construction Technology developed)

### Conclusion

Based on 3DP technology, an innovative building technique is created. 3DP composites can produce buildings automatically that optimize building time, preservation of the environment, flexibility of design, cost and reduction of errors.

The benefits of 3D Printing are:

-Ability to produce items of any form and complexity

-Building speed -Use of various components, including ecofriendly materials

-Wasteless Production -Process simplicity

-Reduction of human factor, hence enhancement of quality and precision of construction.

https://assignbuster.com/evaluation-of-3d-printing-for-sustainableconstruction/ The drawbacks of 3D Printing are:

-High price of equipment

-Lack of popular terminology

-Poor heat insulation and high-power usage

-Tooling components require further enhancement

Project Methodology

The three Engineering Management Tools which will be used to for data analysis are:

1. Cost Analysis: By using this tool, we can analyze whether the high initial investment for 3D Printing is beneficial when compared to standard construction methods. From previous reports, there is a significant decrease in the cost of constructing a building since with the induction of 3D Printing technology, one can save on labor and transportation costs since 3D Printing is almost completely automated and can either be made on site or parts can be made individually in a factory.

2. Scheduling: Normal construction projects take quite a long time to complete. With the introduction of 3D Printing technology, it is said that this can be reduced significantly. We will use scheduling to learn how much time can be saved when comparing the two methods of construction. 3. SWOT Analysis: With the help of this tool, we will look deeper into how Raw Materials are more ecofriendly and saved while using 3D Printing technology when benchmarked against the standard construction methods.

Project Plan

The research includes 3 main stages.

 Literature review: In order to obtain general knowledge in 3D Printing in the construction industry, the first stage of this project is to find journal papers. It will provide some ideas by studying past model cases to improve 3D Printing Technology with a Management perspective.

2. Collection of data: The data for this project would primarily be collected from different internet publications and articles. Before this study, research will stimulate data based on case studies. It will provide a general knowledge of how effective cost analysis can be conducted.

3. Data Analysis: This stage discusses the techniques used by 3D Printing in the construction industry for cost planning. Implementing this program will result in theoretical and practical decisions that will make 3D Printing more productive for businesses.

## References

[1] A REVIEW ON 3D PRINTING OF CONCRETE – THE FUTURE OF SUSTAINABLE CONSTRUCTIO

[2] 3D-PRIITIIG ÏF BUILD ÏBJECTS

[3] Advanced Composites for Civil Engineering Infrastructures