

# 3-D Printed Buildings

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**Abstract**—3-D printing is a form of additive manufacturing technology where a three dimensional object is created by laying down successive layers of material. It is also known as rapid prototyping. It is a mechanized method whereby 3-D objects are quickly made on a reasonably sized machine connected to a computer containing blueprints for the object.

It is amazing how quickly the technologies around 3-D printing have been developing over the last couple of years. 3-D printing is going mainstream. It's already become an incredibly useful tool for rapid prototyping in the manufacturing world and now it's moving into the world of buildings with the development of 3-D PRINTED BUILDINGS.

Printed buildings could lower the cost of materials ,speed up construction, make customized homes easier and cheaper to build and generate much less waste in the construction process.

The 3-D printed buildings are able to save 60 percent of the materials typically needed to construct a home and can be printed in a time span which equates to just 30 percent of that of traditional construction. In total 80 percent less labor is needed meaning more affordable construction and less risk injury to contractors.

This technology can be useful particularly for EXTRATERRESTRIAL PRINTED STRUCTURES for off Earth habitats such as Moon or Mars .And colonizing our neighboring planets might be closer.

In the future we might print not only buildings but entire urban sections.

## 1. INTRODUCTION

At the dawn of the 21st century, the condition of nearly 1 billion people in Indian subcontinent is, unfortunately, pathetic. There are people living in slums which is the breeding ground for diseases, crime, illiteracy and over population. Naturally, governments are after solutions. They are after finding ways to change the situation. However, the conventional method of construction is the main cause of concern as it promotes numerous ordeals being slow, labor intensive and inefficient, naming a few. If we look around, almost everything is synthesized or manufactured using automated and sophisticated machinery like shoes, appliances, cars. The only thing that is built by hand is the buildings. Construction is considered one of the most hazardous job. Construction today is very wasteful and generates lots of waste. So, a solution is urgently warranted.

So, here we have the solution in terms of a new technology generally known as 3-D Printed Buildings. Building printing refers to various technologies that use 3-D printing as a way to

construct buildings. The advantages of this would be quicker construction, lower labor costs, and less waste produced. It is also a potential way of building extraterrestrial structures on the Moon or other planets where environmental conditions are less conducive to human labor-intensive building practices.

And we can bring choice and architectural delight to the poor lot of the society.

## 2. THE IDEA BEHIND

The Idea is to use same method as a rapid prototyping. For example, if you want to develop a cup, first a 3-D model is developed virtually and then printed in reality by a machine, layer by layer.

## 3. PRINCIPLE

3-D printing is a form of additive manufacturing technology where a three dimensional object is created by laying down successive layers of material. It is also known as Rapid Prototyping. It is a mechanized method whereby 3-D objects are quickly printed on a reasonably sized machine connected to a computer containing blueprints for the object.

3-D Printers and common printers work on the almost same principle and only differ in printing materials. It's pretty much as used in your everyday inkjet printers while 3-D printers have ceramic, cement etc. as its printing materials.

A 3-D printer can break down any three dimensional model designed by the computer based CAD software into several layers of flat slices and by using laser beams or hot melt nozzles deposit and bind these materials layer by layer and ultimately building a whole object.

## 4. HOUSE BUILDING PROCESS

Various approaches for printing buildings are being used. Two of the cardinal techniques are CONTOUR CRAFTING AND D-SHAPE.

### 4.1 Contour Crafting

Contour crafting (CC) is a layered fabrication technology developed by Dr..Behrokh Khoshnevis of the University of Southern California.

In manufacturing, there is a process called CAD/CAM (Computer Aided Design/Computer Aided Manufacturing). A lot of things which we see in our daily life are designed on computers and are made without any human interference through machines. So, by scaling up those processes, we can bring them to the realm of construction. So, Contour Crafting is scaling up 3-D printing to the scale of buildings. The cementitious material, initially concrete, is deposited through a nozzle and buildings are built layer by layer. In the process, a lot of things can be done including automatic reinforcement, automatic plumbing, electric installation etc. Once this process is finished, other process can be commenced such as wooden finishing, tiling or even painting etc.

#### 4.2 D-Shape

Italian robotics engineer Enrico Dini, the inventor of an extremely large-format 3-D printer that uses sand and a chemical binding agent to create a stone-like material. Dini's machine, called D-Shape, is the largest 3-D printer in the world. Located in a warehouse near Pisa, it looks like a stage-lighting rig and works like a laser-sintering machine, but with sand instead of nylon powder, and chemicals instead of a laser.

A moving horizontal gantry first deposits a 5mm substrate layer of sand mixed with magnesium oxide, then, via a row of nozzles, squirts chlorine onto the areas of sand that are to become solid. This resulting chemical reaction creates synthetic sandstone.

The gantry is then raised, another layer of sand is added and the process is repeated. When the D-Shape has completed its printing, the surplus sand is carefully removed to reveal the solid object underneath.

### 5. ENVIRONMENTAL IMPACT AND ADVANTAGES

The Environmental Impact of Contour Crafting technique are significantly lower than traditional concrete masonry construction methods. Printed buildings could lower the cost of materials, speed up construction, make customized homes easier and cheaper to build and generate much less waste in the construction process.

It saves up to 60% on materials as it uses recycled construction and mining waste.

It saves up to 70% on time by improving the efficiency and decreasing the construction time.

It requires an infinitesimal 20% of the labor required in the conventional methods. It can provide a good working environment for the construction workers as they are less likely to be exposed to hazardous materials and noise.

### 6. THE FUTURE: EXTRATERRESTRIAL BUILDINGS

The right time to colonize our neighboring planets might be closer than we'd thought.

The printing of buildings has been proposed as a particularly useful technology for constructing Off-Earth habitats such as habitats on the Moon or Mars.

Building a base on the moon could theoretically be made much simpler by using a 3-D printer to construct it from the local materials. Printed lunar soil will provide both radiation and temperature insulation for the lunar occupants. The building technology mixes lunar material with magnesium oxide which will turn the lunar material into a pulp that can be sprayed to form block when a binding salt is applied that converts material into a stone like solid.

3-D printing offers a potential means of facilitating lunar settlement with reduced logistics from earth.

This method solves a space travel's largest issues: space, weight and fuel as taking one kilogram of material like brick to the moon costs between \$100,000 to \$200,000.

### 7. CONCLUSION

According to me, 3-D printing is a revolution in the construction industry and one can imagine what we can make with this technology. If we could build a home then we, definitely, could make buildings and who knows one day we will build skyscrapers, bridges etc. I think this technology will definitely change the way buildings are built. This could be a game changer particularly in countries like India and China who are facing rapid urbanization. We can use this technology to rebuild buildings destroyed in natural disasters and we can even give physical outlook to an entirely devastated site.

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