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Review paper on 3D-Printed building and Home with its Advanced Compact Mobile Robot Tech.

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Abstract : ***The new technology of 3d printing of buildings for the sustainable houses of the future. 3d printing building technology is a new construction technique started with the invention of 3d printer. This project first aimed to determine an optimal mixture design for printable concrete by developing a concrete 3D-printer and experimenting with two different viscosity modifying admixtures. After complications arose, the project then aimed to investigate improvements to the interfacial bond between layers of concrete alongside developing a custom nozzle design that could perform inline mixing. Different paste extrusion techniques were investigated and an innovative nozzle design was created in order to perform inline-mixing. Further, testing of the design is needed in order to achieve results based on inline mixing.Contour Crafting as a promising technique that may be able to revolutionize construction industry in near future. It has many advantages of this technology, such as reduction of the costs and time, minimizing the pollution of environment and decrease of injuries and fatalities on construction sites could be listed. Even though many benefits of this new technology, of course we have some concerns are summarized in the conclusions as the technology still has many limitations. A brief description of examples of 3D printing in construction industry are presented (Stupino town, Moscow, Russia - Apis Cor first company to develop a mobile construction 3D printer).The 3D printing technologies, comparing to traditional techniques of constructing the buildings, could be considered as environmental friendly derivative giving almost unlimited possibilities for geometric complexity realizations.***

IndexTerms - 3D printing, Contour Crafting, concrete, high-efficient automatic construction.

1. INTRODUCTION

Contour Crafting is an additive fabrication technology using computer control. CC is a layered fabrication method which combines ancient Surface forming concept with modern robotics Technology. 3d Printing (3DP) Commonly Known as Contour Crafting(CC), Prototyping, Additive Manufacturing (AM) Is The New Method Of Creating Products From Materials Such As Plastic, Sand, Cement, Soil, Straw Chopped Rice, Steel, Geopolymer, And Other Powdered Materials. It is a layered material joining process that is based on 3D model data to manufacture various structures and complex geometric shapes without using any tooling, dies, or fixtures [2–4]. With its potential for automation, formwork elimination, construction waste reduction, and improvement of geometrical precision, 3DP shows a lot of promise for applications in the construction industry. 1930's Inventor William Urschel founded Urschel Labs and developed one of the first concrete motor Printing machines. The concept of 3D printing has evolved since the 1980s, but not many researches have focused on the concrete 3D printing technologies. concrete as a construction material are durability and it can withstand any natural disasters such as rain, snow and wind and provide shelter to live in. Dr. Behrokh Khoshnevis, a researcher from the University of Southern California, developed a system called Contour Crafting (CC) in mid-2000s that paved the way for the present day's 3D Concrete Printing (3DCP). This Contour crafting has been adopted widely by various research institutes to produce massive 3D printed structures. The use of CC in building industry can reduce the amount of physical labour used for projects and reduce construction wastes as well. The efficiency of 3D printing concrete is described later in this research.

2. Literature Review

2.1. Bauma Group Release 2019

Umdasch Group Ventures, the innovation hub of the Umdasch Group AG and future designer of construction, will present three potentially disruptive innovations for construction processes at bauma 2019: Contakt – digital construction site intelligence for an effective and sustainable increase in the productivity of construction processes. Neulandt 3P – a mobile field factory for worldwide industrial production of precast concrete elements to create living space. Contour Crafting – large-scale 3D construction printing with concrete on site The aim of Umdasch Group Ventures is to shape the future of construction. The focus is exclusively on important future challenges. They are dealing with megatrends having an impact on all areas of economy and society, for example digitization, sustainability, urbanization and demographic changeThe new developments are intended to offer customers in the construction industry completely new solutions in order to revolutionize construction processes. The products will either be distributed by the Umdasch Group Ventures or integrated into the portfolio of a sister company. Founded in November 2016, Umdasch Group Ventures is already presenting three innovations for the future of construction at bauma in 2019.

2.2. Hindawi Journal of Engineering (2020)

Rawan Allouzi et al. is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.(ree-dimensional (3D) printing is a procedure used to create 3D objects in which consecutive layers of a material are computer controlled produced. Such objects can be constructed in any shape using digital model data. First, this paper presents a state-of-the-art review of the advances in 3D printing processes of construction. (en, the architectural, economical, environmental, and structural features of 3D printing are introduced. Examples of 3D printed structures are presented, and the construction challenges facing Jordan, that encouraged this study, are stated. Finally, a precise description regarding the impact of 3D printing is provided by comparing conventional construction data of Ras Alain Multipurpose Hall in Jordan and the expected data if the same building has been built using 3D printing. (e suggested model is generated using Revit software. As a result of this study, an understanding of 3D printing procedure, mechanism of action, and its impact on the future of construction and architecture through economical, structural, and environmental parameters is achieved. (is leads to encourage engineers and contractors to take this subject into account for construction in Jordan.

2.3. Dr. Ahmed Saleh(June 2019)

The main aim of this research is to evaluate the feasibility of concrete for 3D printing, to emphasise the impact of this new technology for future construction and to encourage the use of concrete in 3D printing thereby reducing costs of construction and increasing the rate of productivity in construction industry. 3D printing is an additive manufacturing process of making three dimensional solid objects from a digital file. The materials used to produce the object are different types of hard plastic, metal, concrete, carbon fibre, food ingredients etc. The use of 3D printing has evolved in the recent years with the technological advancement in engineering sector. 3D printing architecture models have become an interesting alternative. Typically, architectural models are made of cardboard, wood or other moldable materials. Architects need models to study the aspects of their design. It is often changed to get a perfect concept of their idea in both architectural design and interior design.

2.4. Science direct (2017)

In this paper author state 3D printing structure, Material IntegrityAnd serious drawback in 3D-printed structures, when tested, usually turn out to be less strong and sturdy than more conventional buildings. This is because the materials used in 3D-printed buildings tend to break down and lose some of their structural integrity over time Engineers have long been working on new material methods that can withstand rigorous testing and comply with all pertinent building safety codes. There have already been many successes in this regard, including through refining existing concrete and polymer mixes and by incorporating biodegradable materials Itshould also be noted that, while 3D printers have come a long way, the equipment itself still has limitations. While one of the great promises of 3D printers is that they can do the work of many machines at once, the reality is that a lot of 3D printers are restricted in their functionality. This means that they can make large structures, but not necessarily complex or detailed ones. One of the primary goals in the 3D printing industry today is to innovate new construction methods that are efficient and low-cost, but that also enable a wider range of precision and functionality.

2.5. Tiago Pinto Ribeiro 2021

The Autor aim is to assess Overview of the Development of 3D-Printing Concrete3D-printing concrete technology has attracted more and more attention for smart con- struction due to its advantages of digitization, automation, and high degree of intelligence. This article introduces the basic principles and related processes of concrete 3D-printing technology, and reviews the development from the following four fields: the material properties, preparation technology, printing parameters, and evaluation criteria of 3D-printing concrete technology. Then the existing difficulties, development direction and key technologies of 3D-printing concrete are described. Finally, we look forward to the development prospects of 3D-printing concrete from the aspects of printing materials, software and hardware cooperation, printing technology, etc. All the researches will provide the useful references for the later development and research.

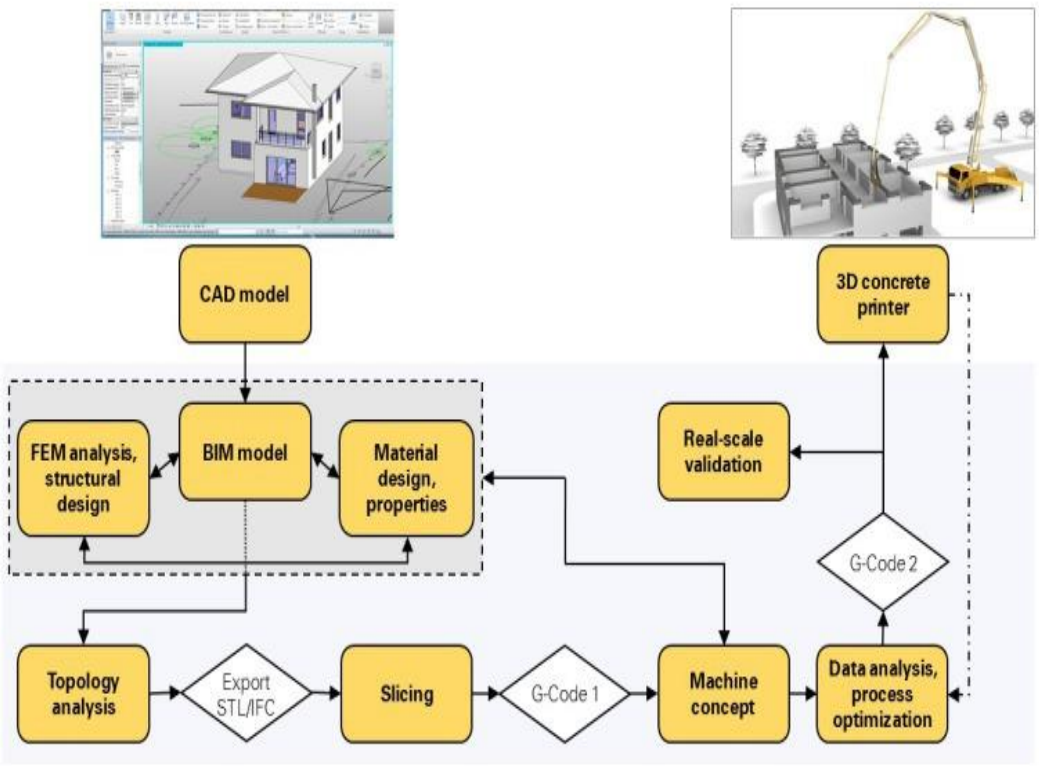
2.6. Yusuf Caner Kiroglu(July 2017)

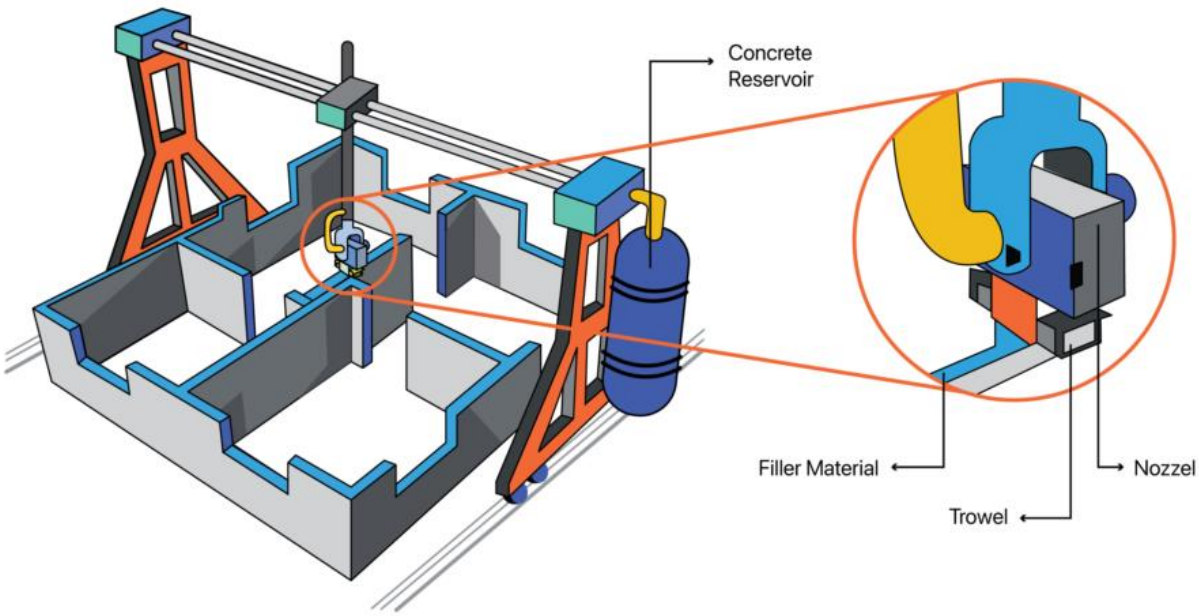
In this paper author has investigate, the starting point for any 3D printing process is a 3D digital model, which can be created using a variety of 3D software programs, for Makers and Consumers there are simpler, more accessible programs available or scanned with a 3D scanner. The model is then 'sliced' into layers, thereby converting the design into a file readable by the 3D printer. The material processed by the 3D printer is then layered according to design and process. As stated, there are a number of different types of 3D printing technologies, which process different materials in different ways to create the final object. Functional plastics, metals, ceramics and sand are, now, all routinely used for industrial prototyping and production applications. The different types of 3D printers each employ a different technology that processes different materials in different ways. Similar technique for 3D printing is selective laser sintering (SLS) that laser is used to melt particles of powder together to create an object. Materials used in the SLS technology usually have high strength and flexibility.

3. Methodology

3D printers of concrete are controlled by g-codes which is a machine language that controls the printer until the desired model is achieved. 3D concrete printers work in the same way as an FDM printer with a main difference being the materials printed: concrete in 3D printer and plastic in FDM printers.3D printers operate using x, y and z axis where x axis defines the length (moving the rails back and forth), y axis defines the distance between the rails and z axis defines the height. The area where the construction is to be made is first flattened and the printer along with the nozzle and the robotic arm setup is connected across the printers. A hose is used to connect the nozzle to a concrete truck. The nozzles are used to lay the concrete in layers and the robotic arm is used to fix thedoor and window frames. Khoshnevis's idea of 3D printing of concrete with counter crafting was an evolving point of this technology. First of all, spatial modeling software are used to create spatial and digital models of the structure. Slicing is made in horizontal layers using special softwares like Slic3r, Ultimaker, Simplify3D, etc. These are then sent to printers from which the structure is printed in layers. (How 3D printing is affecting construction industry) 3D printing of concrete can be done in three steps: preparation of data, preparation of concrete mix and printing of structure. In the first step, the

digital model of the object is made and is sliced using suitable softwares. A plan for laying the concrete in layers by the printer is made by the software. Then a proper concrete mix is prepared such that the concrete doesn't harden rapidly causing blockage in the nozzles and has a good workability. In the last step the concrete is made to flow through the nozzles according to the path programmed in the printer. (Additive manufacturing of concrete in construction: potentials and challenges of 3D printing).





4. Conclusion

The 3D printing technology has rapidly changed the views on using concrete as a 3D printable material alone. The requirements and challenges in adopting concrete to 3D printing have been discussed. 3D printing technique for cementitious material is a promising method that may revolutionize the traditional building and construction processes in terms of apparent benefits in low-cost, high-efficient automatic construction, architectural design freedom, and reduction of labor requirements and risks during construction. This paper has discussed the different types of 3D printing system that are available commercially in terms of their general benefits and drawbacks. The types of 3D printing concrete technologies, research and commercial projects that have practiced the technologies have been listed. The various possibilities of using concrete as a 3D printable material and future of this technology has been analyzed. Large-scale 3D printing processes of cementitious materials are reviewed. They have the potential to reshape the way we think about architectural buildings. However, 3D printing technology still faces certain

challenges associated with mechanical strength, reinforcement, curing, durability and correlation properties like flowability, extrudability and buildability. It is a great challenge to study printable cementitious materials compatible with 3D printers.

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