

TOPICAL REPORT

DIGITAL DESIGN & FABRICATION

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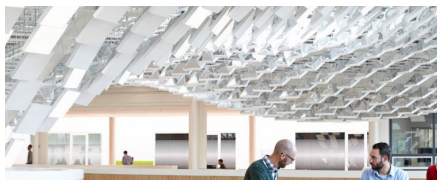
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PARAMETRIC ARCHITECTURE



Comfort, Interaction and Efficiency: Artificial Intelligence in Architectural Projects

"The incorporation of new technologies into architectural designs has been expanding design possibilities over the last few years. Automation in construction processes can be used both in large scale city strategies, and smaller-scale demands like in the construction of residences. One of the more recent ways that technology has been integrated into the design of workplaces is through the incorporation of artificial intelligence, which uses data that can "teach" the machines how to work in several levels of autonomy."

Source: Archdaily

How Will Generative Design Impact Architecture?

"Using geographic information, urban guidelines and regulations, street layouts, orientation, weather patterns and building heights as input data, the tool generates a series of possible scenarios for architects and planners to evaluate and refine their final product. With machine learning, the system has the ability to improve the task and generate improved projects as it accumulates experience."

Source: Archdaily

Timber Parametric Design in Istanbul Airport

"The design is directed by Turkish Airline's philosophy of 'flow' within the airport. The Flow Wall shifts depending on the functions of the various areas it traverses; at the cinema room, it shrinks to draw people in towards the screen and in the kitchen area it becomes a peak to signal passengers from afar. LED lighting highlights the flow lines to aid intuitive wayfinding."

Source: Archdaily

DIGITAL FABRICATION

DIGITAL FABRICATION



Digital Tessellation on Surface Active: Application, Visualization, and Fabrication

"This article explains how a computational design method can approach the fabrication process of design process and facilitate the designers to finish back and forth procedure in each stage of the design process. The research method used in this research was experimental method by highlighting the object modelling process with a parametric design approach which is supported by software's simulations."

Source: ICAPAS

Structural performance and digital fabrication of low-cost folded sandwich structures

"This thesis develops a new structural system suitable for low-cost transitional prefabricated housing. The system utilises rotational press-fit (RPF) integral joints, a lightweight hybrid fibre reinforced polymer (FRP) timber material, and a novel folded assembly method. Together, these techniques allow for extremely high system performance, including low cost and streamlined fabrication; high-speed and uncomplicated construction; and strong and predictable structural behaviour. The new system has been developed following systematic improvement to existing features of digitally-fabricated residential housing systems, specifically systems that employ press-fit connections for plywood building component assembly. The key findings of this thesis are in three areas, summarised as follows."

Source: Alqaryouti, Yousef

The Digital Fabrication Lab Contribution to the Sustainable Development Goals: Exploring Waste Materials and Fabrication Techniques

"an overview of the potential digital tools will be exposed, and with a later test carried out using some of these tools with a balanced process among digital design,



Augmented Bricklaying / Gramazio Kohler Research

"The Kitrys winery façade, built from 13596 individually rotated and tilted bricks are currently the largest architectural project entirely assembled on-site with an augmented reality fabri-cation interface. Researchers from Gramazio Kohler Research collaborated with incon.ai, a spinoff recently launched by the Robotic Systems Lab of ETH Zürich, to develop the custom made dynamic optical guidance system."

Source: Archdaily

An Overview of Digital Fabrication in Architecture

"A couple of years ago, digital fabrication was making headlines regularly, promising to drastically change the architecture practice. The revolution in architecture might not have arrived yet, but research projects, experiments and the dedication of several architects and universities already opened a new realm of possibilities for architectural expression. Therefore, it seems appropriate to give an overview of the impact the technology had so far within the architecture practice. This article covers the different types of processes within the field and the projects that experiment with them, with the scope of reframing the architectural potential of digital fabrication."

Source: Archdaily

VUILD completes first digitally fabricated house within mountainous village in japan

"as for the design process, VUILD has introduced shopbot again, using digital fabrication to generate local traditional architectural techniques called 'gassho zukuri' and 'wakunouchi' originally developed to withstand heavy snowfalls. in addition, great attention was given to the orientation of the house, with the gable surfaces placed north and south in order to imitate gassho zukuri, and mountains running parallel to the guesthouse forming a U-shaped gutter, similar to the path of the wind. a 'wind-catcher' was arranged to the east side facades in order to secure the daylight, ventilation, and warmth at the same time."

Source: Design boom

ROBOTIC FABRICATION



HANNAH's Ashen Cabin turns waste into structure through robotics

"The small cabin was built by HANNAH, the small practice headed by Leslie Lok and Sasa Zivkovic, assistant professors of architecture at Cornell (Zivkovic also heads the school's Robotic Construction Laboratory, or RCL). When AN last visited in 2018, the cabin was still unenclosed; the project was assembled in two parts, with the first phase consisting of nine interlocking, 3D-printed concrete segments forming the footing, cabin floor, chimney, and interior fixtures."

Source: The Architect's Newspaper

fabrication, and use of a material based on the waste produced at the Digital Fabrication Lab. From a variety of trends in technology such as the BIM or the virtual and augmented reality, a test was carried at the Digital Fabrication Lab, mixing different digital and material technologies, in order to assess its effectiveness and deficiencies related to the SDG9. A preliminary matrix of the case study would show the targets capable of being covered by taking advantage of such tools and systems to provide guidelines for further steps to tackle SDG 9. Conclusions were drawn both as scientific results and initiatives to take into consideration in order to contribute in the impact that recommendations should cause on such an ambitious goal."

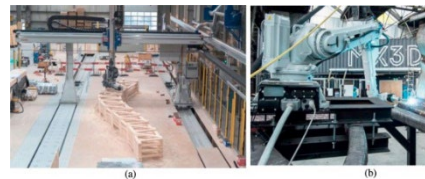
Source: BAU Journal - Creative Sustainable Development

The Fabrication Commons: Creative Agency Through Intuitive Interfaces

"To engage a broader audience with digital fabrication, I propose a user-centric ecosystem that attempts to seamlessly link all of the individual elements of the workflow. My research involves designing a series of prototypes for inexperienced makers that lower the barriers of complex workflows. By doing this, anyone can be empowered to shape their environment and cater to their needs and desires without relying on mass-produced goods."

Source: UWSpace

CONCRETE FABRICATION



Opportunities and challenges for structural engineering of digitally fabricated concrete

"In this paper, we provide a systematic overview of a number of DFC structural projects developed thus far. A comprehensive discussion about structural engineering details is provided, addressing the related fundamental structural issues and envisioning opportunities and challenges toward achieving the full potential of DFC."

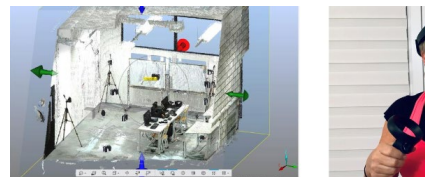
Source: Cement and Concrete Research

Energy-saving potential of 3D printed concrete building with integrated living wall

"This study presents the immense opportunities brought by digital fabrication and construction to extend the design space and function integration in buildings."

Source: Energy and Buildings

DIGITAL DESIGN



Adoption of AI in Digital Design: A qualitative study about the effects on the profession

"The development of new technology plays a major role in today's society and several different industries. While some technologies have more or less an impact upon the whole working sector, one of the more recent and controversial technologies is Artificial Intelligence (AI). In recent years, this technology has evolved continuously and is spreading across several different industries. As it is clear that AI is reshaping the workplace, it is relevant to

3D PRINTING



3D Printing and Architecture

"Here are some major trends in using 3D printing for the architecture industry that will help determine the answer to that question."

Source: Machine Design

How 3D printing is changing the world

"3D printing has also made innovative waves in the construction industry, etching a path to more affordable housing for lower income brackets. New Story, a non-profit organization, recently showed that 3D printing-designed housing will be accessible to the masses. "

Source: Asia Times

3D Printed Formwork for Topology Optimized Reinforced Concrete Walls

"In this study, the authors are focused on two areas of technology: 3D printing and computational topology optimization (a mathematical technique for optimizing structural geometry). In using the two together, the significant benefits include the ability to build structures that are lighter in weight, aesthetically and architecturally pleasing, and reduced in volume. The team built two small-scale sample structures to test the idea for their concept, specifically in using 3D printed formwork for use with complex reinforced concrete (RC) structures. "

Source: 3DPrint.com

Belgian Construction Group Designates BESIX 3D to Specialize in Concrete 3D Printing

"Motivated by its continued interests in offering niche solutions, Belgian construction company BESIX Group has created BESIX 3D, focused on concrete 3D printing. Born from an idea 'shortlisted' by Unleash—an internal innovation program at BESIX Group—BESIX 3D is the product of expansive market research"

Source: 3DPrint.com

3D Printing with Cement: Novel Spray-Based Materials

"With a focus on 3D printing with concrete, Lu Bing notes the 'remarkable progress' being made with such materials—promoting more expanded automation in construction, decreasing the need for labor, and improving efficiency over traditional techniques. This is true in many different applications feeling the positive impacts of 3D printing too, from the medical industry to automotive and aerospace. Construction has seen its uses in bridges and a variety of different aspects of infrastructure—not to mention homes."

Source: 3DPrint.com

examine how and to what extent it is affecting the digital design profession."

Source: Jönköping University

Integrated Parametric Design and Production Planning:

A Luminaire Design Case Study

"The paper describes how to extend the parametric design process by including feedback from the production process and iterating a design towards a realizable object, considering real world constraints such as production costs and manufacturing time. In this paper, we report on our experiences with integrated design and production workflows from teaching a Master level digital design and production class, in which we give students a task to design and produce a luminaire based on a given production infrastructure"

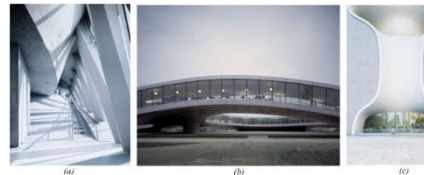
Source: SimAUD

A study on the BIM Design Process in the Free-form Design Project: -Focused on the Dongdaemun Design Plaza(DDP) Project-

"Since the 21st century a free-form building has been noticeably constructed. Now the definition "the monumental architecture is a free-form one." has come to be established. As a free-form building became a landmark of the city and a factor rising a value of the building all around the world, it is currently required to consider a more efficient design process. Therefore this research aims to learn approaches of the lasting free-form design process by considering the design process of Dongdaemun Design Plaza(DDP) designed by 'Zaha Hadid' that is a typical free-form building of Korea and the correlation between the design in the conceptual stage and the BIM(Building Information Modeling) design in practical stage."

Source: The International Promotion Agency of Culture Technology

ROBOTIC FABRICATION



Form to Fabrication

"In this study, we discuss how to prototype a creative idea with different fabrication approaches in the framework of student studio course. The student groups compare two different digital fabrication techniques using robots. The task of the students is to design and fabricate a full-scale textile concrete furniture. In order to cast respectively laminate the concrete, students need to build a formwork."

Source: Duerr, Henning

A pedagogical protocol for iterative robotic fabrication on remote grounds

"This paper puts forth a pedagogical protocol and iterative framework for digital landscaping using robotic tools. The framework is demonstrated through an intensive workshop led by the authors. To situate the discussion, digital landscaping is linked to several conditions that characterize practice and relate to pedagogy."

Source: Archnet-IJAR

The Parametric Process: A Strategic Analysis on Digital Design Technology in Landscape Architecture

"Digital design technology is emerging in landscape architecture, however, there is a gap in design education

and in practice regarding skills training and knowledge pertaining to digital design technology. The objective of this study is to investigate the efficiencies of using 'parametric design' for landscape designs and in the practice of landscape architecture."

Source: Guelph

Robotic processing of crooked sawlogs for use in architectural construction

"In this paper, ideas and methods for utilising crooked sawlogs in construction are presented. The paper discusses a current problematic reality and, through a selected scenario, proposes a workflow that handles a series of challenges that arises when working with irregular wood. Through an investigative working method and by utilising computation and digital manufacturing technologies, the workflow integrates material properties with architectural design tools."

Source: Construction Robotics

Robotic stacking: structurally informed free-form timber structure system using standard and non-standard components

"This thesis is based on the hypothesis that the synchronization of digital design and robotic fabrication can result in new architectural possibilities. The research investigates differentiation and variability in the design of a structurally informed timber structure. This structure takes advantage of additive stacking through the robotic assembly of generic building elements. The aim of the project is to establish a closer link between robotic design research and contemporary building practice. This aim is achieved by developing an integrative approach to both structure and aesthetic potential through an optimized hybrid system using both standard and non-standard (easily manipulated during fabrication) components. The idea is to create complex geometries and differentiation while benefiting from the concepts of automation and repeatability."

Source: Zahra Falamarzi Khanehzenyani

3D PRINTING



Enhancing 3D printing for repair

"To analyse why most repairers can't use 3D printing and how the 3D printing process can be changed, the context of repairers, makers, 3D printing and reverse engineering was explored. The main findings were translated into design requirements that were used as guidelines in a conceptualisation process."

Source: TU Delft Industrial Design Engineering

Digital soil: Robotically 3D-printed granular bio-composites

"This article proposes a novel fabrication framework that combines high-resolution three-dimensional-printed biodegradable materials with a novel robotic-additive manufacturing process for soil structures. Furthermore, the research reflects on concepts such as affordance and tolerance within the field of digital fabrication, especially in regards to bio-materials and robotic fabrication. Soil as a building material has a long tradition."

Source: International Journal of Architectural Computing

Additive Manufacturing of Reinforced Concrete—Development of a 3D Printing

Technology for Cementitious Composites with Metallic Reinforcement

"The paper describes the conceptual design and development of the process and demonstrates the results of preliminary investigations on its feasibility. As AMoRC enables the operation of rebar welding and concrete extrusion process with synchronized feed rates, combination of both processes in one hybrid print head for digital fabrication of RC is a key-advantage of the proposed method."

Source: Applied Sciences

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