

## **The Impact of Digital Development of parametric design on designing Architectural Ceramics units**

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The effects of the digital and information revolution and the technology and computer technology in the architectural arena, whether in the areas of architectural design or areas of manufacturing advanced building materials and smart or modern construction methods. It represents a new phase that marks the beginning of the transformation of global architecture with the beginning of the second decade of the twenty-first century, which in turn constitutes the gateway to future architecture.

And the need to make the most of all aspects of technological development in ceramic architectural work in all areas related to it, both in terms of architectural design to find new languages and vocabulary for architectural formation commensurate with the spirit of the times, or with regard to the use of ceramics and methods of construction and technical implementation and others to serve the architectural work and development community development The incident in the era of digital revolution using digital applications in the field of architecture and contribution and development of applications, especially in the field of triple printing of ceramic architectural units

The design of parameters from a software point of view is the establishment of a parametric model whereby the initial elements formed together are referenced using a number of clearly defined variables and constraints. Thus, the completed final form may be altered, modified and regenerated, within the limits of conformity with the pre-determined conditions. The parametric model can also be updated by changing the parameter values while maintaining the relationships between its constituent elements. Specialized CAD programs are also being renewed to develop their capabilities that can allow users to work with the parameters of standard geometric shapes

Parametric architecture has been able to integrate all architectural elements and turned them into elements or determinants of logarithmic easy to convert and form, which helps to strengthen the relations between the components and forms of the project and the relationship of the building with its surroundings and the shift from the classical geometric models (cube, cylinder, pyramid, ball) on which the classic architecture and talk. These forms, if combined to form the final architectural composition of buildings, do not achieve strong formative relationships among themselves, but create an architectural and urban chaos as they gather together without language unite

On the other hand, there are more convergent forms that generate harmonious clusters, which are achieved by parametric architecture. The lines that draw the classic geometric shapes are inflexible, the lines

Design in the field of parametric architecture are flexible lines easy and smooth and can form soft and different blocks but always there is a strong correlation between them

One of the pioneers in this field is the structural engineer and architect Fry Otto, who used the tents architecture in his projects through the use of structurally proven forms in a natural way as in natural forms. \* 2

Frei Otto did not use the computer but did experiments on tents. Today, through the use of digital logarithmic programs, forms similar to natural organic forms can be found and made structurally constructed through digital structural calculations.

By examining the experiences of many architects who have used and developed information technology techniques, elements have emerged to indicate the impact on architectural thought.

### Some expressed this in three directions:

A - In the form of sculptural architecture, free from the constraints of traditional forms and heading towards the irregularity in form or spaces or surfaces and was the architect Frank Gehry on top of these architects



B - Some expressed the change of content and turn the building into something like an organism and the exploitation of the benefits of technology and the principles of smart architecture to achieve sustainability such as Norman Foster

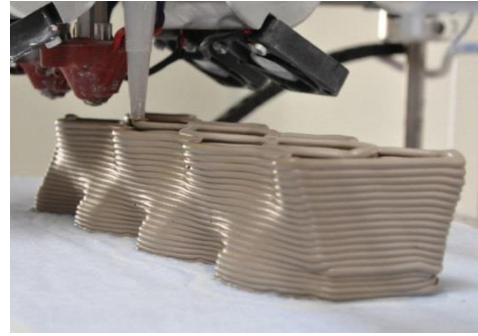


C - Some benefited from the possibilities of this technology in the development of curricula and design theories and redefine architecture through their work in the form of interactive architecture and mobile architecture (unlike static architecture) and media architecture and information and interactive architecture.



- **Digitally manufacturing ceramic tiles**

The printing of 3D models of ceramic tiles with complex design structure has recently evolved, and more sophisticated 3D printing designs have also been produced not only for modeling the edges of adjacent tiles, but also calculating the cutting that controls the course of unit printing, and for creating the tile structure. The use of network algorithms and space topology involves studying spatial characteristics to create structures based on specific criteria. Different types of clay and fire conditions are used depending on the nature of each project.

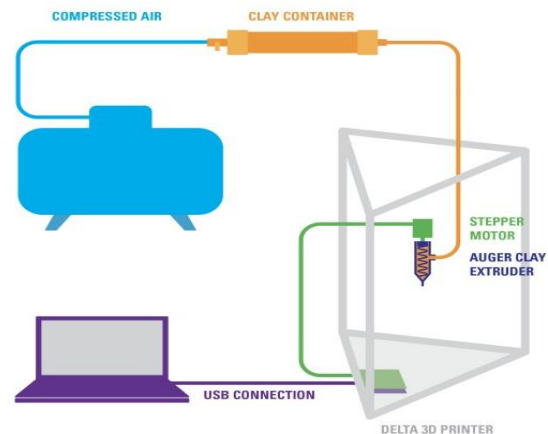


Three-dimensional printing is one of the manufacturing techniques in addition, where the pieces are manufactured by dividing the three-dimensional designs into small layers using computer programs and then manufactured using 3D printers by printing one layer over the other until the final shape is formed. This system differs from the Milling and Sculpture systems, which waste more than 90% of the material used in manufacturing and 3D printers allow developers to print complex overlapping parts.

- **3D printing building bricks**

3D printed tiles actually take architecture to a new place, as the structure of each tile is often placed to create a larger picture in design and computational geometry. We find how to build large structures of small units with a single repetitive shape - Figure 16 - and this is one of the possibilities that can be achieved by computational design and digital manufacture of ceramics as a material.

Previously, the use of ceramic tiles in architectural cladding was limited compared to the rates of use now due to the techniques of installing tiles on the wall using insufficient adhesives to ensure that they do not fall after a short time in addition to problems associated with the accumulation of bacteria on the surfaces, especially in places with high humidity, which is a major challenge. It is an impetus for the development of materials and techniques of production and installation of ceramic tiles in the facades



**Research results:**

- Open new horizons and different perceptions of the use of ceramics in architectural vocabulary, both internal and external
- The importance of standardization has diminished in favor of pluralism and diversity in the formation and emancipation of thought, while the architectural solution was an inevitable necessity of the results of the industrial revolution, which calls for standardization and large-scale production so as to achieve ease and speed of production for purely economic reasons

**Research Recommendations:**

- The need to develop academic programs in architectural education institutions, both in terms of design courses architectural or other, to suit those modern technological variables produced by the digital revolution, in order to define Students are trained in modern digital technologies and their applications in all fields of architectural work.
- The need for the attention of specialized architectural research centers, whether in universities or relevant research bodies and others - Supporting serious scientific research in order to employ modern digital technology and its applications and development in the areas of architecture in accordance with the conditions of society and its potential and requirements.

**References:**

- Rizal Muslimin, Parametric Fabrication for Traditional Ceramics Massachusetts Institute of Technology, 2010
- Jason O. Vollen, Kelly Winn, Jed Laver EMERGING BUILDING TECHNOLOGIES IN CERAMICS: PERFORMANCE MASONRY SYSTEM, USA, 2007
- Foster, Norman. (2005). Reflections, Prestel Publishers, London
- Agnoletto, M. (2006). Masterpieces of Modern Architecture, VMB Publishers, Vercelli
- Isenberg, Barbara. (2009). Conversations with Frank Gehry, Knopf; First Edition, New York

**Sources of images and shapes:**

- <https://amazing-architectural-design-pictures-for-skyscrapers-tall-commercial-buildings> (accessed on 15/6/2019)
- <http://www.bezalel.ac.il/en/galleries/artwork/?id=13864&exhibition=1753&refereru=%2Fen%2Fgalleries%2Fportfolios%2F%3Fp%3D18%26id%3D2314> (accessed on 7/4/2019)
- [https://www.architectmagazine.com/awards/r-d-awards/award-building-bytes\\_o](https://www.architectmagazine.com/awards/r-d-awards/award-building-bytes_o) (accessed on 26/2/2019)
- <https://www.pinterest.com/pin/484277766158090882/visual-search/> (accessed on 25/8/2018)
- <https://www.3dprintingmedia.network/architchen-taiwan-ceramic-3d-parametric-design/> (accessed on 13/7/2019)