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Computational design as an approach to sustainable regional architecture in the Arab world

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Abstract

In the last two decades, architecture in the Arab world has undergone dramatic changes. Such changes were driven by three major paradigms; globalization, environment, and technology. However, these changes seem to ignore the rich architectural heritage of the region, especially Islamic architecture, trying to use technology breakthroughs in design and construction to replicate the same western building forms and concepts. This research discusses the current state of contemporary architecture in the Arab world, then reviews computational design as an innovative design tool, highlights its potentials to revisit regional architectural heritage in a contemporary way.

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1. Introduction

Digital design had-and still has- the greatest influence on the architectural products worldwide, started as just a tool to make precise and complex blueprints (computer aided design (CAD)), then to smarter tools that generate information 3D model (building information modeling (BIM)) for the whole building including all drawings, plans and workshop details. However, in fact, Computational design was the phase that revolutionized the role of computer in the "Form finding" process, now and in the future. Generative, Bio morphogenetic, Parametric and algorithmic

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design are all synonyms and sub-Disciplines for computational design, aiming to use "Artificial Intelligence" and advanced mathematics to generate and control far futuristic, complex organic forms, with no need to manual old-fashioned manipulation. Besides, Digital fabrication techniques made it possible to easily build these forms at astonishing accuracy and time management.

Computational design is a term that differs from, but is often confused with computer-aided design (CAD). Generally, CAD is about using computer as a digital drawing tool, to automate some routine processes and digitizing drawings. In simple words, the computer is not involved in the "thinking" phase of design. In contrast, computational design is more about using the algorithmic power of computer-through coding- to explore limitless iterations of forms, problem solving, very complex geometric calculations, and rationalization. The application of computational design can cover many aspects, including industrial design, animation, simulation and others. However, the architectural application of this technology is very promising, changing the way architects are approaching form finding process and manufacturing. In this case, computational design tools can be used in all phases of building, including design (shape grammars, building information modelling (BIM)), construction (Digital fabrication, construction phases simulation), and management (smart building control, environmental responsive utilities).

The use of computational design tools can not only speed up the design process of the building, but it also offer the designer's imagination free space to explore ultimately complex building shapes, unlikely to be built by traditional tools. It also integrate all the phases of design together in one comprehensive model, whose parts can be precisely fabricated with minimal need for human drafting. However, the adoption of this trend in the Arab world did not serve the local architectural identity. Most of these projects were designed by foreign designers who aimed to replicate the western glass towers through these tools, but they did not make use of the rich Islamic architectural culture, neither in form nor in behavior. It is interesting how Islamic architecture, especially geometric patterns, have a genuine mathematical nature, which make it perfect for the application of computational design tools. These tools can be used to produce new forms inspired by the local culture, or preserve the existing architectural heritage through 3D scanning and BIM documentation.

1.1. Problem statement

The main problem of the study is that the Architectural identity crisis in the Arab world has reached a critical point, driven by imported technology, design traditions and materials. Local architects have abandoned the rich sustainable regional architecture and calligraphy to follow non reliable thinking framework, leading to distorted skylines and unsuccessful forms both socially and environmentally. The future of our identity relies on how we could study, pioneer and apply state of art technology to revive local architectural heritage.

Besides, there are a number of sub-problems can be described as follows:

- Lack of local studies on impacts of digital design tools on architectural identity.
- The need for sustainability in buildings through a local approach. .
- Lack of studies about "Contemporary Islamic architecture".
- Lack of studies proposing theoretical and practical methodology for a "Regional Computational Architecture".

1.2. Significance of study

The significance of the study can lie in the following points:

- Its attempt to use the computational design processes to articulate a framework to reinvent regional Arab architecture, to proof how much successful can it be to sustain physical and nonphysical needs of environment and society.
- It focuses on creative futuristic design processes and techniques, including generative modelling, algorithmic architecture, immersing virtual environments and digital fabrication. That can be considered a forward step

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