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A Reason to Care About Parametric in Architecture

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ABSTRACT

Parameter design is not an uncommon area of expertise for architects. A variety of dynamic forces influence the design and construction of buildings, including climate, technology, use, character, location, culture, and ambience. There was no parametric design developed by the computer, nor did it redefine the properties or functions involved. However, the computer has provided an essential tool that has allowed architects to design and build intelligent buildings with extremely high-quality standards and values. In order to gain a deeper understanding of society and culture, it is critically important to examine the relationship between humans and the natural world, as well as the subsequent effects of their interaction. In this respect, cities are the direct reflections of their citizens, since their expressions of architecture have a direct impact on the quality of life of their residents.

The gap between architectural design ideas and the interpretation of those designs in a real built environment can be approached differently through the reverse process and effect. Parametric design strategies propose manageable and flexible solutions early in the process that respond to given conditions and outcomes. Architects have begun to use parametric design techniques in the creation of designs in order to suggest solutions at an earlier stage in the design development process. These techniques have obvious advantages for engineering and manufacturing processes. It is the objective of this paper to present novel approaches to enhance architects' contributions to building processes by coupling architectural design with parametric modelling methods. As a result, designers are able to understand the design objectives more clearly and can make better decisions with regards to finding solutions.

Keywords: Parametric design, techniques, buildings, architecture, tool.

1. INTRODUCTION

It is well known that parametric design has been increasingly involved in architecture over the last few decades; as generic as this may sound. Identifying the key characteristics of parametric design, tracing its history from its first application to its growth over time and the purpose for which it is being used today. It is important to understand and deal with all the complications and tranquilities that arise behind every "road not taken".

Our understanding of society is shaped in part by our exploration of human relations with the natural world, as well as the resulting implications of their interactions. The architectural expressions of cities directly influence the living conditions of their inhabitants; therefore, they are direct reflections of their inhabitants.

Source:www.google.com

Architects have used master plans as a means of designing and describing buildings in recent years.

They have outlined picture-perfect, complete cities in which all changes were avoided. The communication of architecture has been approached in various ways by a few, however.

Since these acronyms are used in this study, it is worth referring to two acronyms, CAD and BIM. As the name implies, computer-aided design or CAD refers to the use of computers as an assistive tool for designers. CAD's semantic domain is quite broad and even embraces parametric characteristics. Nevertheless, the point of reference in this study is 'traditional' CAD.

As a device for representation rather than computation, it corresponds to the concept of computer as a drawing tool. BIM is a relatively new buzzword in the construction industry, as opposed to CAD, which has been around for some time. In other words, it refers to the creation of a comprehensive database for a building, and is referred to as "Building Information Modelling". This collection of samples illustrates how architecture is constantly subject to changes in a variety of parameters depending on the use and context for which it is designed. A process-outcome intersection can be used to address the gap between conceptual architectural designs and their implementation into the built environment. An early stage of the process can be controlled and adaptable with parametric design techniques, allowing solutions to be controlled and adapted in response to existing situations and outcomes. According to the research a lot of main ideas are a part of parametric design, for example versioning, iterations, mass customization, and continuous differentiation. In order to better understand these terms, it may be helpful to provide a brief definition.

1.1 VERSIONING

In the context of software development, the term versioning refers to creating variations - or versions - of the same design solution in light of various varying circumstances. As an alternative to casting the prototype in a static CAD file format, parametric software allows the designer to wire the prototype - almost as if the prototype were a string puppet. When new forces and conditions arise, new versions of the design solution can be fabricated based on this wiring.

1.2 ITERATION

Iteration refers to cycling through or repetition of a set of steps that has been borrowed from the software development discipline (see a pattern here?). Iteration can create variation, in principle, in parametric architecture at every cycle of the same set of instructions. As an example, one could vary the size and shape of a floor plate in the construction of a skyscraper, or change the angle of a modular cladding system when it is tiled over an undulating surface. The use of iteration can not only produce variation, but it can also be an effective tool for optimizing and, in turn, reducing the amount of time spent on the optimization process. By iterating through many possibilities, each created with a different set of parameters, a designer can generate solutions and test them quickly using a fluid parametric system which can provide immediate feedback.

1.3 MASS-CUSTOMIZATION

The idea of mass production is one of the most important achievements of the industrial revolution. Thousands of copies of the same prototype can be produced by factories and robots. Since the advent of digital fabrication technologies, we are now able to modify the manufacturing instructions between different objects. The manufacturing process being parameterized and robotic, mass-customizing products often costs the same as mass-producing the same quantity of identical products.

1.4 CONTINUOUS DIFFERENTIATION

It is a term borrowed from the field of calculus that refers to the ability to create differences within a continuous field or rhythm in model-based work that is versioned, iterative, and mass-customized. Instead of simply variegated units within an overall group, curve or field, parametrically variable units maintain continuity with previous and subsequent units while uniquely responding to local conditions.

2.THE POSITION OF PARAMETRIC

Complexity and variety are combined in parametric architecture, rejecting homogeneous utilitarianism. An architectural wonder, urban design, interior design, and even fashion are all shared priorities. There is an interdependence and adaptability between all design elements.

In addition to being useful for any project regardless of size, it is particularly useful for complex structures with unconventional architectural designs. As a result of using parametric design, it is possible to streamline work, produce high quality designs, and deliver successful projects that have been designed using parametric design.

It is possible to use parametric design as a powerful tool to solve visual, material, and structural challenges. In spite of the fact that architects will still use the conventional "functional" method for designing, parametric is expected to give a more aesthetic and structural perspective to the design process.

3.THE STATE OF KNOWLEDGE ON PARAMETRIC

A study of parametric often involves examining two bodies of research: one that is concerned with electronic developments arising from technological advances, and the other that examines methodological issues related to design. It may be appropriate to ask how digital technology could be incorporated into the design process at a more general level. The use of parametric design as a means of acquiring a methodological perspective may be questioned, however, if one takes a more specific view. This is still a too broad question and, therefore, many 'why' and 'how' questions may arise as a result.

A good example is the field of architecture, both in terms of the design process and the creative process, but also in the production and manufacturing of buildings as well. Observation of the world of design in recent years reveals new trends resulting from symbiosis with digital artefacts. With the help of the digital, architects can realise their ideas and, more importantly, create new spaces.

Despite parametric design being a relatively new concept, the idea of using computer simulations in architecture has been around for much longer. Like any other digital artefact, computers offer two starting points for investigation: theoretical foundations and practical implications and ramifications. In the practical realm, efforts have tended to focus on the capabilities of a computer programme as a benefit to the design process. Consequently, the focus here tends to be on improving and extending such systems.

Theory-wise, the most important question revolved around the possibility of developing a system that could design independently of human supervision. A computer cannot simulate the process of forming judgments in design, according to some thinkers, such as Rittel, since the designer must imagine every possible solution before the computer program runs. A parametric design differs from conventional design in that all actions are parametrically related. This would result in the decision tree exhibiting a dynamic feature that would make the final design malleable and fully controllable. Parametric aspects are also important to consider, in relation to constraint, in terms of the concept of 'relation', which is considered a promising research topic by many researchers. Parametric design differs substantially from conventional design in the ability to link various design elements together. According to Woodbury, the key difference between parametric design and conventional design is the ability to form relationships.

The concept of defining relationships has not been regarded as part of design thinking, because conventional design activities were limited to adding and erasing. Designers, however, are able to take advantage of two extra capabilities in parametric packages, namely the capabilities to relate and repair. The concept of relation is synonymous with the concept of constraint from this perspective.

4.THE AMBIVALENT NATURE OF PARAMETRIC DESIGN

I believe that the ambivalent nature of parametric design can be observed in four significant areas. The purpose of this section is to explain and clarify these areas. The first area arises from an analysis of the term 'parametric design' itself. Etymologically, parametric design is a paradoxical term. The adjective 'parametric' refers to the term 'parameter," which is derived from the Greek 'para" meaning "tool" and the word 'metron" meaning 'to measure." "This, in turn, opens two windows of meaning - one that is particularly mathematical, reflecting a measurable factor that defines a system or sets the conditions for its operation, and another that is more general, describing the limits and scope of a particular process or activity. In short, 'parametric' can be defined as something precise.

In contrast, the meaning of the word 'design' is diametrically opposed to this notion of precision. While it derives from the Latin word 'designare," meaning 'to designate," it often implies an unpredictable or uncertain activity that deals with rather "indefinite" problems. It is the nature of design that definitive formulations are not possible.

The lexical contradiction between the two words 'parametric' and 'design' is a prelude to a more important area that can be called the second ambivalent area of parametrics: the relationship between mathematics and architecture. In this context, the term "parameter" appears in a historical perspective that recalls the revival of mathematics in architecture, since mathematics was once considered by many architects as an isolated pure science. This revival requires the formulation of a roadmap on which a harmony of technical precision can be plotted. In a sense, architecture is often about the creation of space, with mathematics serving as a tool to define and illustrate it. The ambivalence we have noted, however, stems precisely from this position. Architecture has always been a field with fairly clear goals, but usually without guiding rules. In contrast, mathematics is largely described as "a form of knowledge that is best understood as a game with many rules but no clear goal"

Architectural theory has always been centered on the concept of monad. In domains such as genetic architecture, the term 'monadology' is often used to describe the idea of extending and transforming propositions, especially those defining attributes and properties of relationships among monads. Karl Chu, in his essay, uses the term 'bit', which in one sense is equivalent to Mies van der Rohe's notion that architecture is the 'art of joining two bricks'.

The term "monad" appears within the theoretical framework, but the expression 'calculus' appears in more practical contexts within the structure of computer applications used in the creation of architectural forms. There are some architects who completely rely on calculus as a tool for creating form in architecture today.

There has been a shift in the way we view design in recent decades, which can only be described as the emergence of a new style of architectural design known as parametricism. The paradoxical phrase 'parametric design' may be resolved through parametricism in terms of meaning, especially if its methods and techniques have the potential to affect the nature of design and revolutionize the design process. It is however controversial to regard parametricism as a new architectural style, and a broad study of architectural practice must take place before such a designation can be made. On the other hand, returning to the third ambivalent position, certain methods or terms often contribute to increasing the ambivalence. Computer programs usually work with a set of algorithms. Unlike design problems, which are not well-defined, an

algorithm must be well-defined. Sometimes the results of the algorithm can be probabilistic, but not because the algorithm is not properly designed and programmed, but because the rules or functions used within the programming procedure have a stochastic property.

5.THE ROLE OF DESIGNER

The complexity of a design project may appear to be greater than it really is. There can be a number of unforeseen circumstances that can occur, sometimes outside the control of architects, as a result of which the direction of the project may be altered. Therefore, I will investigate the possible changes arising from the idea of "role" in order to examine the parametric approach in relation to the design process. A deeper exploration of the 'role' concept here focuses on the role of designers and their personal approach to parametric design, as well as the role of non-human actors such as sketching, physical modelling, and computer applications. It is possible that such a concept may evoke the Actor-Network Theory (ANT) and the concept that all actors are represented as part of a network. However, it is necessary to state that the mappings in this study are not illustrative and visual; they are narrative and textual, containing an array of arguments from a variety of perspectives.

There is a duality between tool-making and tool-using among practicing architects, although the pragmatic view has its share. There is a growing trend among some architects to move from being merely consumers to becoming innovators. In this context, we can also see the other side of this dichotomy, which is the side of the tool-makers, i.e., the architects who consider themselves to be members of the digerati. It emphasizes that architecture programming has gradually moved towards programming architecture, surpassing the limitations of conventional design. In particular, software cannot meet the needs of designers, according to young graduates of architecture schools. It is worth noting, however, that this statement is also seen among experienced architects, although perhaps for different reasons. In spite of technological advances, these older architects are likely to adhere to traditional pen and paper methods, continuing to act exactly as they have in decades past, ignoring the inexorable advancement of technology entirely.

Architects' perceptions of practice are changed by tool-making, as well as the notion of the 'homofaber homo fabricatus' cycle of design education is introduced. Although some schools offer courses in which students learn specific computer programming for architectural applications, there is a need for more time for this approach to tools to be tested and used globally. Toolmakers transmit advantages to tool users through their tools. As a result, some advantages can be seen as conveniences, and conveniences can result in conventions: 'some tools or the way they are used can enable certain forms and processes to be regarded as 'convenient', which can have a profoundly conservative impact on design. Furthermore, such conventions can result in a paradox in tool-making, which is caused by an emphasis on creativity.

When used by an individual with perceptive design skills, a creative tool can produce results that surpass the expectations of the original software developer. In light of the meaning of design creativity, this statement appears to be logical. According to him, the solution to this problem is for designers to become independent toolmakers.

Therefore, practitioners of architecture tend to favor this viewpoint, particularly those who have used scripting techniques to control AutoCAD software using programming languages such as Auto LISP.

This two-pronged approach seems to provide the designer with the necessary information to create a finalized scheme. The designer assumes at one point that he or she is making something while at the same time solving the design problem. It appears that, although there is frequently a distinction between two sides to the question of form in academic literature, this differentiation is not valid when it comes to the perspectives of practicing architects. Form-making has always been associated with architects, but in the course of their design process, they undertake a considerable amount of form finding.

6.THE ROLE OF SKETCHING AND PHYSICAL MODELLING

To what extent is sketching still a critical component of parametric design since pencil and paper are the archetypes of design - more specifically, pencils and erasers to add and subtract, and papers to record? Are physical models or sketches still required by the parametric designer? The use of these two tools, especially sketching, has traditionally been viewed as a symbol of externalization. Sketching is considered to be an essential part of the architectural process for many architects. However, a study on the process of sketching shows that even though sketches and externalisations generally are claimed to be essential to designing, they are not essential activities for expert architects during the early phases of conceptualization.

The existence of sophisticated software does not prevent architects from sketching or making models at the beginning, contrary to what is illustrated in literature and research related to sketching. The architects are able to manipulate the design at an early stage of construction with CAD packages such as Sketchup, a continuation of sketching techniques, but shortcomings such as the lack of a tangible drawing environment pose a barrier to adoption. Consequently, most architects do not begin designing on a computer screen, as a result of this belief. While the use of computer programs has reduced the importance of sketching in design, it is still possible to leave it out despite its reduction in use with the rise of the employ of computer programs. The process of sketching is also considered by some architects to be an effective technique for crystallizing their concepts and arranging them in an organized

manner. The act of hand sketching, therefore, represents a 'place of clarity' for them.
Even so, sketching and modelling are still relevant and recognized in the practice of architecture today. The parametric approach, on the other hand, shifts the fundamental function of visual judgment from thinking visually to some other realms, such as clarifications of ideas and collaborative thinking within a team.

7.THE ROLE OF COMPUTER PROGRAMS

Additionally, many researchers remain uncertain as to the extent to which computers are involved in architectural design. The presence of organic shapes, despite their imperfection, is evidence that organic shapes can be created. As a result of this viewpoint, functionality can be interpreted as authorizing the use of the computer in two distinct ways: for computerisation and computation during the design process. Computers often play an important role in architectural design as tools for representing architectural objects, while computer-aided design emphasizes the role of computers as discovery tools for calculating architectural objects.
The question remains as to which category encompasses parametric design, having epitomized such classification. It is important to note that parametrics' specificity is nearly equal to that of the use of computation in the design process of architecture. Others, however, believe that this is not necessary since parametric design has much larger implications than its connection to a computer program.
In order to find a solution, we must examine the origins of parametric design. For this, we must determine whether technological advancements or a systematisation of the design process within the domain of architecture led to the flourishing of the parametric approach. Similar to the discussion of duality (computation and computerisation), two positions may also be understood in terms of architectural practice. For the majority group that considers the computer only as an advanced tool for planning, the parametric approach is still a way of computerization. Therefore, it is not necessary to deal with complicated tasks such as computer programming.
Even though most practicing architects in the first group declare the primacy of computer software in design, it is only a tool that helps them shape the design process. Consequently, architectural form 'rarely emerges directly from computer-aided design. In other words, it helps architects explore formal possibilities and 'develop the right response to the climate, environment, and brief." Accordingly, computer packages here become aids rather than design tools.

8.THE ADVANTAGES OF PARAMETRIC DESIGN

Some recognisable facets of parametrics make it a more challenging form of design. Most architectural firms adopt a parametric approach for varying reasons. While some firms keep up with the latest software, such as parametric packages, as part of their competitive strategy, the majority view parametrics as an enhancement to design capabilities and effective functionality.
In general, the ability to explore more design alternatives and thus find better solutions to design problems is cited as the main advantage of parametric design. Unlike traditional CAD, which still relies heavily on sketches or physical modelling, some of the benefits of parametric design become apparent in the early stages of exploring design options. Parametric design provides architects with an excellent opportunity to explore more thrilling forms when they are specifically considering free-form designs.
But there are also major benefits in the later stages of the design process through automation of construction documentation and a greater degree of architectural control in production. Financial benefits also come from the reduction in man-hours spent exploring the design and the tedious activity of drawing details that can be extracted from architectural models.
It is reasonable to consider these as advantages of parametric design. Aside from these aspects, architects recognize several other distinguishing features of parametric design compared to traditional design methods. These aspects fall into three categories, namely the optimization of the design process, the ability to find a range of solutions to a design problem, and the more efficient design process.

9.THE DISADVANTAGES OF PARAMETRIC DESIGN

Architects argue that parametric design also brings disadvantages to their practice. Some disadvantages arise from the novelty of the computer programs used in parametric design. But some also arise from the parametric approach itself, which significantly changes not only the way architects design but also the role of the architect in a design firm.
This type of technique is quite feasible in areas such as product design, where parametrization requires consideration of only a few factors. In architecture, however, it becomes a serious challenge.
A problematic issue related to the parametric approach in general is that it never clarifies which parameters are required for the design. In other words, in a sense, it does not provide a methodological framework for the design, so architects still have to work out most parts of the design in their heads. Computer-based strategies such as the algorithmic method attempt to compensate for this shortcoming, although in these approaches the role of the architect is often replaced by the software.
Another problem arises from the fact that most parametric programs are designed and attached with a traditional workflow orientation in mind, but allow for more process thinking. In addition, operators of these systems must anticipate all project directions in advance to create the geometries and establish the relationships. Parametric programs should be designed with a parametric approach, and the developers of the

parametric packages really need to understand that approach, since they are essentially 'designing a design."

Not only in parametric design itself but in all software packages, the need for additional form – analysis software is a general shortcoming. Connecting from – generation software to form – analysis software remains a challenge, despite attempts by parametric packages to address this gap through the design of a structure for form generation.

Despite its discussed pre – eminence, parametric design is still on the margin or less well – known among architects, perhaps due to four main categories of disadvantages: unnecessary complexity with too much information, the problem of authorship, constraining creativity with a reactive structure, and learning and training difficulties, which can be classified as fundamental problems.

10.CONCLUSION

As a conclusion, I would like to emphasize that the change is rapid, and we need to move with it. The architect today enjoys being in his or her comfort zone, which enables them to design calmly and peacefully. In order to better understand our profession, we need to broaden our perspective. Whenever something is in development, we should take the time to understand why it is in development and how we can improve the process. Parametric design is an area that requires more engagement from architects, which can be challenging to some and easy to others. Ultimately, everyone perceives things differently, whether they are architects or not. The learning process is the same, but we will construct it differently, we will tell our story differently because of our different experiences. As a final point, the advantages and challenges of parametric design were discussed by a number of practicing architects. This is due to certain advantages that this new way of designing offers to them. As a result of geometric design, architects can set constraints to optimize the problem-solution space, generating a variety of potential solutions. The architect is responsible for engineering the design process. Nevertheless, many questions remain unanswered. As a result, parametric design in architecture should be considered just as important as it is necessary, but we must all be aware of what it is and how it can be used.

REFERENCES

[1] https://parametric-architecture.com/wp-content/uploads/2018/11/The-Challenges-of-Parametric-Design-in-Architecture-Today.pdf

[2] https://www.researchgate.net/publication/357016234_Importance_of_Parametric_Design_in_Architecture

[3] https://www.researchgate.net/publication/30874784_Parametric_Designing_in_Architecture

[4] https://purehost.bath.ac.uk/ws/portalfiles/portal/187941972/RHudsonEThesis.pdf

[5] https://softschool.ac/wp-content/uploads/2019/10/Parametric-Design-for-Architecture-SoftSchool.pdf

[6] https://www.google.com/search?q=parametric+architecture&tbm=isch&ictx=1&tbs=rimg:CUxo1SL57czjIghMaNUi-e3M4yoSCUxo1SL57czjEWYp9BV1GDnY