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The foundations of morphology in digital architecture

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Abstract :

The transformation taking place in the digital age and its impact on architecture is part of the continuous dynamism throughout history, which creates multiple forms of patterns over time, and from that, digital morphology will be clarified, which is defined as "the study of structure and shape and their behavior in the surrounding environment" and the morphological system in architecture and extracting the most prominent characteristics Intellectual and physical systems of morphological access to establish the foundations and rules for reading those systems. Thus, the research problem is "the need to explore the concept of digital morphology and the rules of its formation in architecture." The objectives of the research are determined by "reaching a concept of digital morphology in architecture and building a theoretical framework for the intellectual and physical characteristics of digital morphology and its foundations in architecture." Reaching to identify the problem from the previous literature and then moving on to summarizing the most prominent intellectual characteristics and physical features by summarizing those literature on the concept of morphology and from studying and analyzing various illustrative examples that verify the research need.

Keywords: digital morphology, morphological systems, rules of morphology, intellectual and physical properties of digital morphologies**.**

Definition of morphology:

The term morphology refers to the study of form and structure, without regard to function. Especially in the following:

In biology: morphology (biology) is the study of the shape and structure of humans, animals and plants. (wikipedia)

In geology: morphology (the earth), the study of the structure of rocks and the reform of the earth. (Gawdat, 1995)

In linguistics: morphology (linguistics) is also called morphology, which is the study of the internal structure of morphemes (words and semantics of structure) (Bold, 1983)

In computing: digital morphology (Al-Zoubi, 1978)

In architecture: morphology (architecture) the study of form and structural structure based on two- and three-dimensional symmetries to be used in the design of buildings and structures, and it is applied in every science according to its data (Wikipedia)

In biology, or the science of the study of form: it is concerned with studying the shape and structure of living organisms or one of its members in terms of external appearance and cellular composition: the type of cells, their components, and the types of tissues present in these neighborhoods (Al-Zoubi, 1978)

The word morph: means a shape or a syllable, and in morphology the shape or internal structure of an object is studied with structural connotations.

In architecture, Steadman defines morphology as formal studies related to the ends of geometric places and the possible shapes and forms taken by each of the buildings and their elevations. While Schulz's definition is the most comprehensive of the term morphology, as he took the existential structure of man that can be employed to understand traditional and unconventional forms.) .

We conclude from this that morphology in architecture is the science in which various products are formed based on the basic data of forms (morphemes), and studies the basic systems and rules that govern their existence and give the justification the basis for what they are with the different techniques and design processes that are subject to them to serve as the main engine that is determined According to him, the outputs are of different types.

Morphology of Digital Architecture:

Morphology is concerned with the study of form in terms of its physical formation and its interrelationship with the surrounding conditions, i.e. its study in the case of (change) and (evolution), which means the coherence of the characteristics of movement and dynamism in the interpretation of shapes and bodies. As for digital morphology: it is the science that studies the formation (physical, digital) of digitally generated bodies in various disciplines and scientific fields in relation to the multi-potentially changing surrounding conditions, which give the characteristics of (change), (evolution) and (flexibility) and lack of stability in its reading and interpretation. Those bodies morphology is based on taxonomy or internal morphology in defining bodies, patterns, and levels.

Stanislav Roudavski points out that the goal of digital morphology is to create architecturally meaningful products that are functionally and behaviorally adaptable for growth and natural upgrading, which requires shedding light on the optimal activities and mechanisms to achieve that goal and determining the role of the designer in controlling the process of designing those products and employing those events (Schulz, 1972)

From the previous definitions and general propositions in the field of architecture and other knowledge and scientific fields, it was possible to reach a procedural definition of the concept “It is a science concerned with the study of the origins of digital architecture forms and the identification of formal patterns based on the analysis of the structural characteristics of the mental image (patterns) and the topological relationships among them to achieve the emergence or generation of physical phenomena In a specific place, provided that the features of the emerging basic forms are preserved and the structural relationships follow according to strict computer-analytical mathematical systems (algorithms) and enable the analytical ability of the product without distortion for the purpose of reaching a dynamic architecture capable of change, adaptation and improvement quickly and with high accuracy.

Theoretical framework:

2- Morphological system in architecture:

System is a complex and organized entity that combines and connects things or parts that are combined in a unified composition, and that it represents an interactive group of sub-systems that constitute a whole larger entity than the parts that make up it. As for philosophically, the system represents a language or something that is one system in everything to form a coherent and interdependent whole. (Mazkoor Ibrahim, 1983, p. 207)

As for the morphological system, it means the way in which the elements and aggregative processes (relations) of the form are determined, such as generation, derivation and reflection under a specific law, where the morphemes unite to form larger units to represent the regular formal entity that carries the changing formal characteristics, and this entity is the one who enters the fusion processes and achieves the product of the processes Generative, and accordingly, the morphological system is a formative principle with formative foundations that bear interconnected relationships that are strongly concluded under systematic processes. (Hauser, Chomsky. & fitch, 2002)

2-1 Intellectual characteristics of the morphology:

This paragraph aims to define the most important morphological structures by studying the structural content, intellectually and materially, as diagnosed in the literature on digital architecture and the experiences of its architects.

2-1-1 intangible structure:

Digitization has changed the nature of our understanding of the physical world and reformulated the physical concepts of structures by transcending the concepts of (physical) by transcending the use of tangible materials. And how to employ it in the production of architecture, and this changes one of the most essential dimensions in architecture, which is the physical feature, and this means moving from rigid architecture with a physical presence to a flexible, intangible architecture.

Therefore, this transition (from material to immaterial) is related to digital technology and everything that is imaginary or illusory (virtual) is based on the abstraction of reality and dependence on supernatural forces through virtual technical creativity and representation of facts that are still under design, and in order to achieve the immaterial structure, reality is enhanced through Merging reality with illusory fictional images and relying on graphic exaggeration, dazzling and visual manipulation, which results in the fading of the borders between reality and non-reality. Or the limits of space and time, combining data with date and reality.

Picon summarizes the impact of immaterialism on the nature of architecture by achieving geometric fluidity within specific volumetric and surface morphologies, which is impossible to create barometric diversity and generate dynamic products from them with those standard qualities without the intervention of digital technology, and as a result appeared the so-called hypersurface, which Stephen Perrella formulated by forming Architecture by projecting it superficially on Cartesian coordinates. Thus, the morphological formations of immaterial structures developed with the synonymous development of materials, the increase in the relationship between matter and information, and the architects’ interest in renewable materials to achieve and formulate their ideas and generate their products. (mandour2004,p195)

From this, it can be concluded that the concepts of immateriality and digital virtuality are one of the most important morphological transformations in the architecture of architecture, on the basis of which the processes of morphological creation differed, and the new materialism dominated the harsh presence of materialism, dissolving its limits, and striving to generate more flexible, fluid and dynamic products that combine the visible form and the virtually invisible thought. Within realistic limits.

2-1-2 Non-standard structure:

It is obvious that physical liberation is an important factor for liberating architecture from its realistic measurements and restrictions, as the transition from engineering concepts to non-Euclidean and the adoption of immaterialism in design led to the formulation of the so-called (free form), which one of its most important characteristics is that it is not subject to human or material standardization. It has the characteristics of chaos, complexity, fractal topology, and digital conformation. The concept of (non-linearity) also plays a prominent role in defining its properties that make them extremely complex systems whose forms cannot be analyzed except by analyzing the systems of multiple relationships between the elements and separating their formations into smaller formations and knowing the nature of the autonomous systems and the surrounding forces that affect the formulation of their structure. The outputs are multi-relational characterized by self-system and non-linearity, as well as the possibility of analyzing them into formations capable of abstraction and simplification. (Karabagh,2006,p7).

The non-standard structure coincided with the concept of engineering determinism, and it was characterized by an endlessly variable behavior that does not depend on a traditional design process, but rather goes beyond that through the foundations of self-organization and digital generation, which contributes to stimulating its behavior. On the basis of it, the indefinite growing standardization is carried out, which is what gave these outputs the characteristic of non-scale. (Kolarevic, 2003, p26).

As a result of this and as a result of liberation from the constraints of orthogonal Euclidean geometry with a specific scale, immeasurable forms took a different approach to modeling and production through the so-called (quantitative assignment and synthesis), which organized the relationship between the theoretical and intellectual requirement of the form and between the digital capabilities in adapting matter to unlimited growing morphologies (immeasurable architecture).). (Oxman, 2010, p107).

2-1-3 Interactive structure:

The concept of interaction in architecture changed its dimensions and the nature of the relationship between it and the human being in terms of the immediate response to many psychological, physiological, environmental and communicative requirements through interaction methods between the user and the physical environment of the building, as well as between the building and the surrounding external environment. This makes interaction one of the most important necessities for defining digital structures in contemporary architecture. The interactive structure identifies two main levels of interaction. The first represents the physical response to external inputs for morphogenesis or morphology, while the second level represents the relationship of the architect or user with the computer and stimulating data in order to produce creative configurations that respond to his needs and desires. No matter how complex and intertwined with each other.

As the feature of transparency accompanied the architecture of modernity, Saggio sees that the interactive structure will be the model accompanying the products of contemporary digital architecture and represents a new challenge that transfers the structure from the subject to the subject (engineering objectivity to the subjectivity of information synthesis). The structure bears its interactive characteristics since the beginning of the design process and the invention of the style that is decided for that structure to deal according to it, and the interactive architecture is characterized by being possible for every time. (Saj,2013,p237-238)

We conclude from this that the interactive structure relies on computer software to produce its complex forms that respond to the immediate requirements and develops the formal and structural trends of architecture in a way that achieves the maximum degree of utilitarianism and adaptation to developments and internal and external influences. Based on the above-mentioned classification, it can be summarized that morphological structures in the digital age are characterized by being a free, unmeasured structure that moves away from everything that is fixed, rigid and of specific dimensions, and tries to displace ideas in the direction of adapting the shape to form itself, its growth and adaptation. The dominance of the material over the designer's thought and the decay of his role in the design and operational process of the building.

-2-2Physical features of the morphological form:

2-2-1 Membrane Morphologies:

The interruption of communication with the sources of generating forms and the symbolism of anthropomorphism that afflicts the generation in the prevailing design is manifested in the (hard control) that the architectural designer must exercise in the buildings he designs. The designer must determine the exact location and shape of all elements before any physical action must take place in the design process, and engineering control must be given to the largest possible number of points necessary to describe the system being built. However, this design approach fails to note the potential for self-organization inherent in physical systems. This suggests that there is a design process based on the "easy control" strategy that needs a minimum selection of the active elements within the system intrinsic to the morphological construction process. Materiality and structurality are achieved through a series of membrane structures developed by Michael Hensel as exhibition structures for different locations. Membrane structures are of particular interest for such exploration, because any resulting formation is closely related to the material properties and the pre-tensile formation process. (Saj,2013,p115)

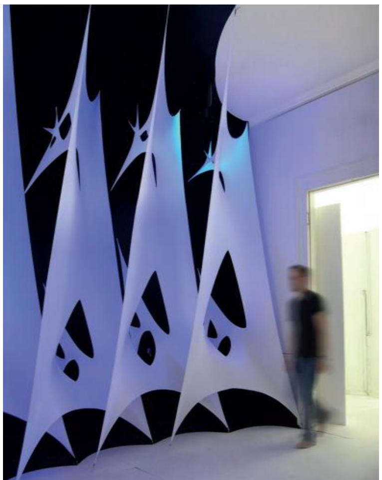


Figure 1 - Morphological

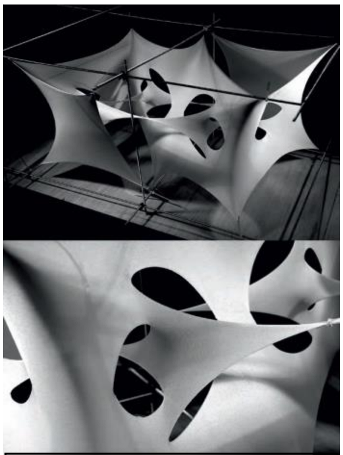


Figure 2- Dynamic elasticity of the morphological

In the project presented here and as in Figure No. 1 and Figure No. 2, the material is made of nylon fabric with different flexibility in the longitudinal and horizontal direction, with the fabric containing holes that cut the fabric, which makes the behavior of the membrane changes dramatically, and although placing the holes in the membrane is a decision Critical, however, broadens the performance of the formal system. Whereas traditional form-finding methods focus on the structural behavior of physical form and focus on monoparametric evaluation criteria, this approach focuses on exploring multiparametric boundaries, so the additional capacity of the perforated membrane system allows visual permeability and makes the material relevant. In essence, the structural model. In order to be effective in this relationship, there were two basic and decisive processes for the design process: the first is the boundary specifications and subsequent numbers operations in each membrane spot defined within the boundaries and cut lines in any cut or overlapping region of the membranes in order to coordinate the space function. The second is to determine the action of the anchor points and the active points within the membrane to transfer loads through the boundaries of the shape.

2-2-2Surface Actuation:

Most investigations of any form focus on the exercise of power over the strategic point system, which leads to the "total" manipulation of the overall system. In this context, Global refers to the totality of the system, while the partial describes it as the component unit of the system. It is important to realize that the self-organizing capacity of physical systems is not limited to the form-finding processes of the "whole" as mentioned above. It can also be propagated in a "partial" manner. One of those applications is the project developed by Kellner and David in the context of Michael Hensel's Proto Studio Building at the Rice School of Architecture. Complex by partial detonation (Kolarevic, 2003, p52)

Preliminary experiments confirmed that a series of very simple rectangular wooden elements fastened to a large sheet of timber could be deployed as partial drives. Each rectangular partial patch is fixed by four corner screws that tighten each two opposite each other with an oblique line, and two flexible ones remain, allowing adjustment and flexible movement of the surface as a whole, allowing tension, bending and bending. It represents the joints of linking the elements and the joints of changing the size and shape depending on the torque within the barometric programming of movement within the limits The flexibility of the screw and the patch depends on the behavior of the system to be reversed on the shape and from this produces the geometric model for this shape. (Kolarevic, 2003, p56).

In this project illustrated in Figure 3, the digital component is defined as an open engineering framework that is extendable based on the “logic” of a system of materials that combine their capabilities and limitations in their manufacture with the inclinations and self-forming constraints of the material. Through the complex physical studies of the behavior of twisted and curved strips of paper, and its basic geometrical features, such as bending points, the development of the ability of surface synergies and deflections and their formulation in the digital component. This component describes non-metric paper-based aggregates and a broader system can then be created by the process of multiplying the components into polymorphic compositional classes. (Saj,2013,p118)

Numerical structural analyzes reveal the behavior of loads affecting all points of the system. These behavioral tendencies of the system interact with external forces and mutate them to move through flows that spread over the topography of the overall structure of the shape, so the resulting patterns are formed according to the parallelism of the force with a set of varying conditions such as lighting, local function, and the limits of flexibility and dynamics, and this achieves the increasing differentiation of morphological forms with the presence of multiple criteria within the performance of one system They control the formation and allow flexibility to change and allow scalability, torsion, and openness within the barometric limits of the formation, so these processes will remain consistent with the constraints imposed on stereotaxic and aggregation of tape paper films.

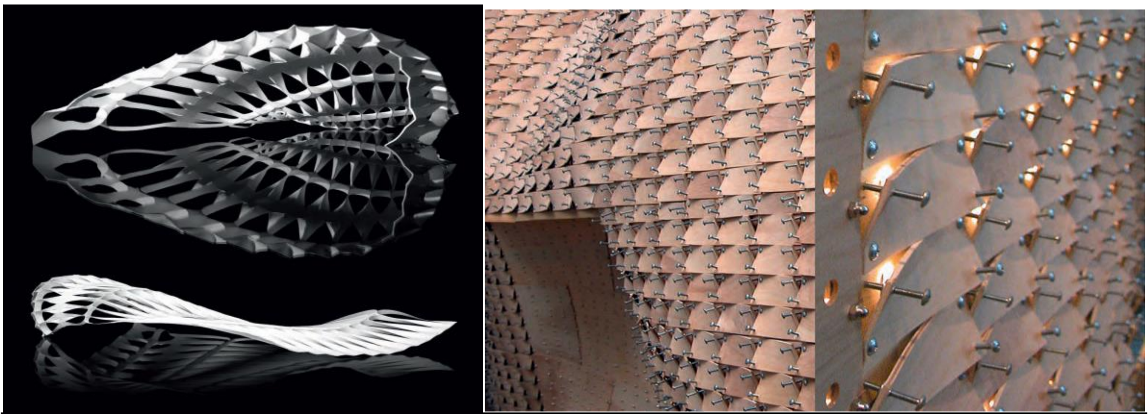


Figure 3 matapatch project

2.2.3Honeycomb Morphologies:

The development of the polymorphic cellular architecture was investigated by Andrew Kudless and Michael Weinstock based on the design programs led by Michael Hensel and based on the experience of paper-tape membrane materials, as manufacturing and assembly are an integral part of the logic of digital-physical configuration that has spread over many forms, configurations and digital approaches . In this project, the focus was on the algorithmic generation of honeycomb shapes as a basic shape-generating system, which are geometrically regular and bendable regularly due to the consistent and dimensional cell sizes and bear the phenomenon of mass production. However, computer-assisted manufacturing has become an integral part of the shape generation process. In this particular case, including manufacturing constraints in the system derivation rules requires consideration of three aspects of building a prototype on a larger scale. These rules are first: To ensure the continuity of the topography, all the cells generated need to remain hexagonal and transverse with the adjacent cell walls. . (Saj,2013,p120)

Second: The laser cutting of the materials that make up the composition requires attention to the areas of interconnection between the elements, so the product is distinguished by being a product related to the "connected production technique". Third: The logistics of the required assembly is characterized by a structural sequence. Each pair of walls associated with its neighboring cells cannot be combined with non-matching cells. Therefore, the resulting digital generation process is characterized by a sequence.

The final peaks of the strips of cells remain open, subject to continuity and geometric manipulation by the designer, from which the ability to achieve a change in geometric surface properties is achieved. . (menges,2005)

The algorithm loops that are formed depend on the principle of repetition to generate the overall system model, and the algorithm paragraphs change in thickness, size, depth and dynamic direction, which allows changing the shape according to the change of algorithm particles. This unique system adapts to the structural, environmental and other forces within the overall system that ensures the possibilities of physical technology and production limits, generation rationing and boundary definition to become in itself a major interface for negotiating multiple performance criteria.

2-2-4- Fibrous Surfaces

The geometric seed of the shape grows by writing the rules that determine how the elements are interconnected and moved to change the shape and this particular process needs a graph of cuts and edges during digital growth because all parts of the surface are constantly moving and changing until they settle in a new formation and continue to differ and grow on more than one position in each position It settles in a certain pattern that has distinct features. The algorithm creates a network of lines on the surface indicating the position of each element and its related nodes. . (Saj,2013,p120)

The last project, as in Figure 4, contains the methods presented by component differentiation and diffusion with the growth of digital simulation. This collaborative project aims to develop a differentiated surface structure that consists of a dense network of interlocking "organ" parts from a set of simple and straight basic elements to achieve complexity in a material system This system focuses on the digital generation techniques provided in coordination with the CNC cutting processes for production. (menges,2005)

The main component of the system is defined as a three-axis vector based rough, membrane component that depends on the computer in the application of the barometric program to establish the general digital component through engineering relations that remain constant in all possible cases of the material element and the system's obstacles are variable with the change of the intended technology and the passable process of production. In the application of the software the digital component is established generic by engineering relations that remain constant in all possible states of the physical component and the changing production constraints of the intended and practical machinery technology. (menges,2005)

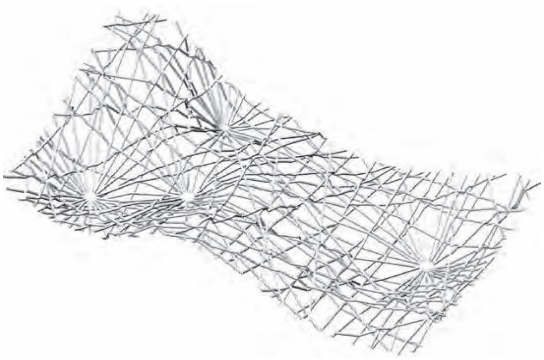


Figure 4- The bird's nest shape model

2-3-Digital engineering rules reading systems:

Some design techniques aim to read and analyze morphological shapes, and many methods of reading shapes have emerged based on engineering rules and morphologically analyzing models and products for the purpose of producing new designs and models or for the purpose of analyzing and assigning them to morphological systems derived from them, and the most prominent of these systems will be clarified:

2-3-1 Lindenmayer Systems (LS)

This type of system appeared in 1899, as a technique of synthesis of shapes as well as reading them according to the rules and principles of (LS) to produce other shapes based on this system. Lindenmayer Systems (LS) is defined as a mathematical algorithm developed by the scientist Lindenmayer. The LS organization consists of a set of laws that adopt a string-rewriting algorithm. This algorithm is represented by simple modeling of plants and their growth processes. Recently, this Systems in CAD software applications as a design aid to produce rapid forms.

As for the design, LS systems produce very complex two-dimensional and three-dimensional formations that start with a simple element and in an iterative process, a simple element or part is replaced according to certain rules. The products of this system are closer to natural shapes with the possibility of creating unfamiliar shapes.

To create this system, it requires a set of alphabetic symbols, preliminaries, and a set of productive rules. It uses various transformational processes and depends on the principle of iterative steps, and it depends on four symbols A= {F,f,+,-} where the sign means + turning counterclockwise at a certain angle, while the sign - Refers to turning clockwise at a certain angle, while the F means moving forward one step drawing a straight line, and the f sign means moving forward without drawing a straight line (Al-Muqram, 2008, p. 168).

2-3-2 Genetic algorithem (GA):

This concept appeared in 1960 and is considered as a technique that has two functions, the first is to read the shapes as input in the form of a set of problems and then find solutions, while the second function is synthetic that produces and generates new forms.

Genetic logarithms are defined as a computational technique based on the principle of evolution, given that it is based on natural evolutionary processes. Genetic algorithms were invented by John Holland in the sixties of the last century and developed at the University of Michigan in 1960 to 1970, and the main goal of the invention of this technique was to study the phenomenon of adaptation that occurs in nature, and to develop ways that can be imported from the mechanisms of natural adaptation in computer systems (Mitchell, 1996, p.7)

As for the design, the logarithmic technique comes as an effective solution to some contemporary architecture problems represented by the level of complexity and the amount of information in most architectural projects, such as projects to develop construction systems that need to reduce the total weight of buildings, as well as reduce material costs and increase the effectiveness and complexity of buildings. This system has also become one of the systems that are increasingly in demand globally, as it is one of the best systems for improving production, especially for large project structures that need many details and thousands of elements and complex morphological structures, both at the level of mathematical and engineering operations, to reach the integration in design and production (Fasoulaki, 2008, p1) . This technology works in two ways:

The first: Logarithmism as a tool to reach the best integrative design (as optimization tools) (and will be focused on in a later section of this chapter as a mechanism for all morphological strategies) by reading the shapes as inputs in the form of a set of problems for which solutions exist to reach the best performance of the building In terms of acoustics, structural, lighting, power, with the highest degree of reliability and the lowest cost, for example, algorithms were used as a new approach in a project for the Swimming Center for the 2008 Olympic Games in Beijing, to select and validate section sizes for the design of 25,000 steel sections which were crucial in feasibility studies. The feasibility of the project surface. (Fasoulaki, 2008, p4).

The second: Logarithm has a synthetic function as a tool for generating shapes, one of which is the use of a logarithmic technique that works repeatedly, sequentially and continuously, as in the Serpentine Gallery Pavilion /2002 project in London when Toyo Ito & Cecil Balmond adopted a complex network of concentric squares from a series From solid structures and voids, extending to reach the shape of the ceiling and walls that appear every time with different openings as in Figure 6, this is in addition to adopting this technique in planning spaces and architectural forms. (Dr. Kotnik, 2007, p12)

2-3-3 CA Cellular automata:

This system was spread in the forties of the last century as a system of reading the shape and analyzing the formal properties of the products in the form of a group of cells on the basis of which shapes are generated. Where the cellular automata (CA) is defined as a system of cells based on a network of a specific shape that develops over time according to a set of laws derived from the state of neighboring cells. This system is partially or completely complicated by the type of network that varies from single lines to binary networks and even Cartesian networks and random networks, and this system is characterized by being very sensitive to the virtual formal contexts. (Wolfram, 2002)

The CA system tends to follow the form follows function because the emergent form is a form that is produced according to the required function. In solving social influences and taking into account the conditions of the neighborhoods in urban design or zoning. And as in Figure 7 (GU, NING. SINGH, 2010, p.3)

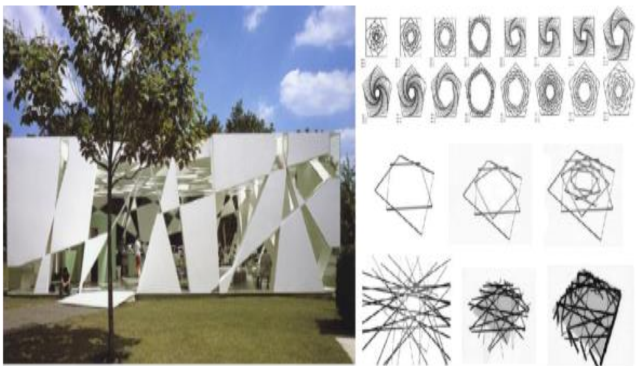


Figure 6 shows the use of genetic algorithms in the Gallery Pavilion project

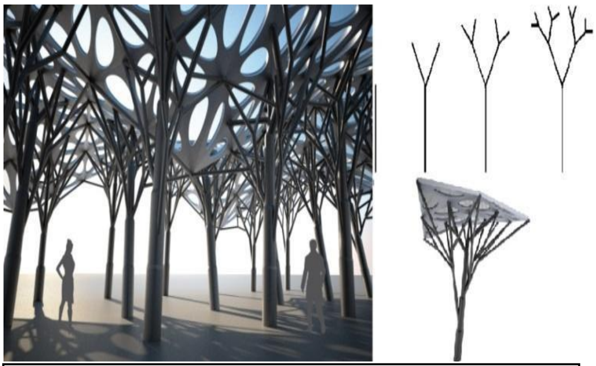


Figure 5: A structure developed using LS-systems .as part of the "Blurring Structures" project

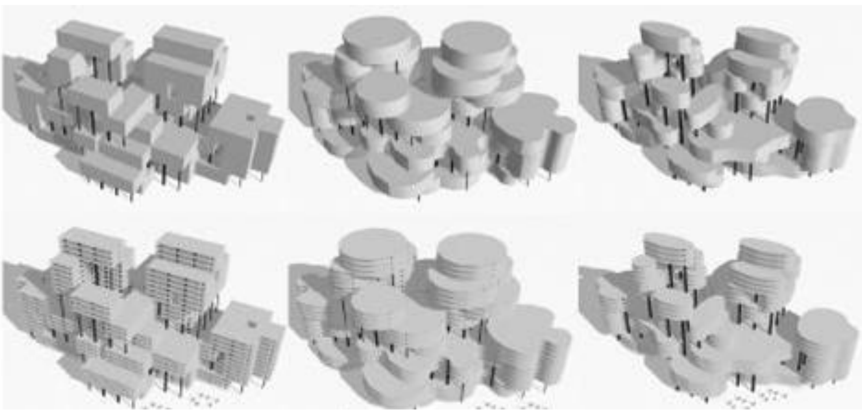


Figure 7 shows designs based on cell growth method in Cellular System technology

2-3-4 Shape Grammars (SG) Base System:

This system appeared in 1891 as a technique for reading shapes and analyzing their languages in order to generate new shapes on the basis that the rules of shape are a set of laws governing the shape and can generate a set of designs in a specific language. (GU, N. & SINGH, 2010, p3)

The rules of form were first introduced in the 1970s by George Stiny and James Gips, whose paper "Shape Grammars and Generative Specification" was published in the arts and includes a set of rules for a number of Stiny paintings (Özkar, 2008, p.8), and after A project was presented in the form of two exercises within the architectural field related to the aspect of composition formal. In the first exercise, the rules of form are used to analyze the language of existing designs to understand them, while the second exercise uses the rules of geometric form for the composition and creation of an original form. Thus, the rules of the form are a generative descriptive tool and the rules are The same description of the forms of designs generated.

Stiny has identified four basic elements on which the formal base system works (Stiny, G., 1980, p.6):

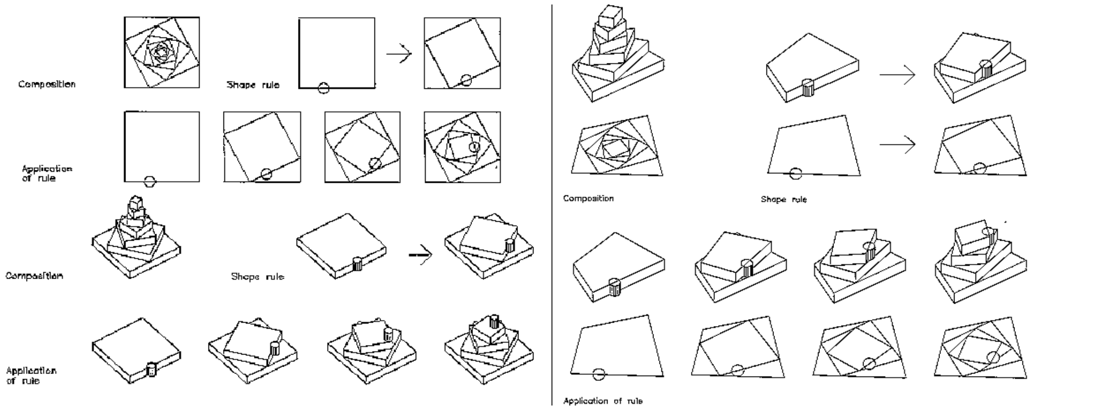
A finite set of shapes denoted by (S).

A finite set of symbols (L).

A finite set of shape rules, denoted by (R).

The initial shape is denoted by (I).

The shape rules system is concerned with applying and developing laws that work on the generative forms of different morphologies based on a certain formal rule that consists of a primary form and a specific law that develops to produce a more complex shape, for example by rotating and placing - a square within another according to a specific scale as in Figure 8. There are several areas of application of the rules of form in the architectural field, as well as in art and decoration, and the design of various products. This technology enables the designer in the architectural field to analyze the designs of others and generate different other designs, or create new forms using computer programs. (GU, N. & SINGH, 2010, p6)



- Figure 8 shows some simple laws in applying the rule of a shape

conclude from the foregoing that there are several systems that govern the geometric rules of shapes that differ among themselves according to the modeling processes and mechanisms of design work, and on the basis of which the resulting morphological systems differ. The relationship between the product and the formal basis or the formal basis remains an uninterrupted reciprocal relationship that depends on the degree of complexity and the arithmetic operations that take place on it according to functional or formal requirements**.**

2-4- Evolution and morphological development of forms:

A study by (Chouchoulas, 2003) presented the concept of the formal emergence and development of geometric morphologies under the title "Shape Evolution" through which the process of morphological evolution of shapes was linked to genetic algorithms and their analogy with engineering algorithms for architectural design and explained the role of each of them in regulating the process of emergence and development of shapes in the processes of biological growth and architectural design Chouchoulas seeks to develop a way that inspires the architectural designer to find design solutions that meet the functional need and take into account the formal creativity by focusing on a formal base and its genetic algorithm. By the designer in conjunction with achieving the best functional performance and to generate new designs generation and new languages of detail and simulation. (Chouchoulas,2003,p.1)

The success of the genetic algorithm is demonstrated through its ability to search for and improve problems and not require complex strategies and solutions, as it serves as a means of evaluating solutions and evaluating designs according to their performance in several areas at the same time.

The critical interface between the shape rule and the genetic algorithm lies in the use of a design's shape code or genotype on which the genetic algorithm operates.

Adopting the principle of formality in design means using the minimum design vocabulary and its development through a design algorithm in the same language, for example, the process of designing a horizontal or vertical block measuring 4M x 4M x 4M and an apartment measuring 4M x 4M x 16M based on three basic laws and their Euclidean transformations and design evaluation According to the size, height, density, the number of apartments and the number of blocks for movement, in addition to the spaces, the shape of the apartment, the number of balconies, the cost and other measurable characteristics through engineering arrangement and algorithmic calculation, the result comes by choosing in favor of the preferred designs with the highest degrees and thus raising the level of fitness, as shown in Figure No. 9 (Chouchoulas,2003,p.4)

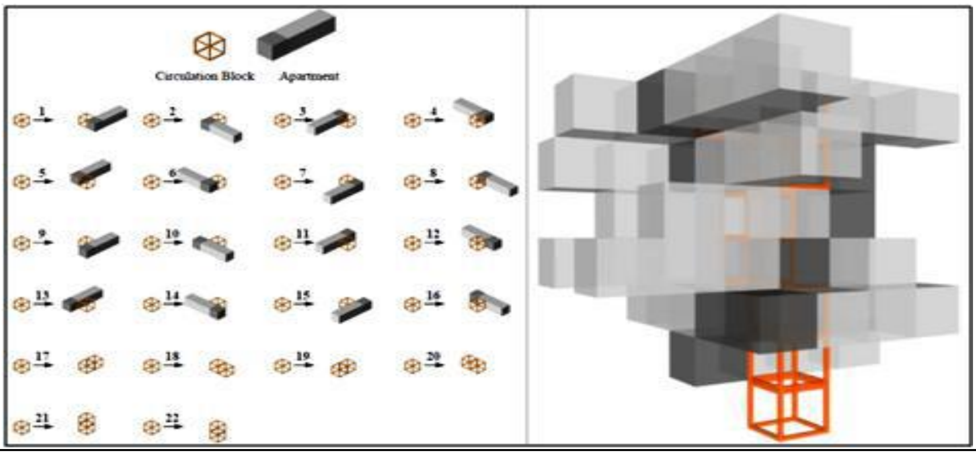


Figure 9 shows on the left the vocabulary and laws of the shape rules for the apartment and on the right the design using a blade - shape code

conclude from the foregoing that the focus on finding concepts to develop the design process and searching for solutions is the most important characteristic of the formal base strategy, and that the goal of morphological changes lies in choosing the best alignment for the design solution and compatibility with design requirements and formal aesthetics based on evaluation criteria with a wide range of variables, which gives the designer Freedom to choose and evaluate alternatives.

2-5- Rules of morphological design:

The concept of morphology has an effective role in the advancement of architectural knowledge because it is able to activate the link between design and its social, functional and aesthetic consequences. The creative interaction between thought and intuition regarding how to take shape helps clarify strategic design options early in the design process. The importance of briefing and evaluation is also emphasized as basic components that will enable the building of space into a morphological turn that follows a dynamic design-specific, which means that the designer must interact with new tools to be able to achieve his result (Kalay, 2004).

Architects and architects of exterior and interior landscapes resort to creating details and physical systems that occupy space in a flexible and visually perceptible manner. . Design in its broadest sense involves complexity and synthesis. In contrast to analysts or critics, designers put things together, bringing new things into being and dealing with many variables and limitations that may be known in advance or discovered during the design that are sometimes unintended to them or transverse. Designers manipulate variables, reconcile conflicting values and maneuver around constraints, a process that, although some points are more important than others, yields unique answers.

Many metaphors have been used to describe morphological knowledge and to identify the differences between hard and soft materials and between natural and artificial. The process of morphological design is a reflection of work as it starts from a premise based on uncertainty, uniqueness, conflict and the search for innovation and renewal, relying on many interacting materials and competencies that model knowledge of work and design is an essential process for artistic practice in this profession. (Oxman, 2008, p.p90-120)

We conclude from this that the concept of morphology is included in the description of knowledge of the design process by defining and visualizing the physical structures before commencing the architectural work, in addition to the importance of this concept to metaphor and enhance the overlap with other fields and scientific fields that have a direct relationship with the concept of morphology to enhance the dynamism of the design process in the field architecture.

3- Conclusion:

Morphology in architecture is the science in which various products are formed based on the basic data of shapes (morphemes), and studies the basic systems and rules that govern their existence and give the justification for what they are with the different techniques and design processes that are subject to them to serve as the basic engine according to which the outputs are determined of different styles.

Morphological system means the way in which the elements and assemblies (relationships) of the form are determined, such as generation, derivation and reflection under a specific law, where the morphemes unite to form larger units to represent the regular formal entity that carries the changing formal characteristics.

The most prominent intellectual characteristics of the morphological form are immaterial, non-standard and interactive, through which the physical features of digital morphologies are determined.

Read the physical features of digital morphologies through: morphological membrane, blasting surfaces, surface algorithm, and fibrous surfaces.

The rules of digital morphology are determined through four basic reading systems based on the digital precursors of each formation.

The system of rules of form is concerned with the application and development of laws that work on the generative forms of different morphologies, depending on a certain formal rule of an elementary form and a specific law.

Adopting the principle of formality in design means using the minimum number of design vocabulary and its development.

-4 References:

Wikipedia.

Jawdat, Ahmed Abdul-Jabbar: The Structure of the Architectural Image in the Light of Islamic Epistemology, Master's thesis submitted to the Department of Architecture, College of Engineering, University of Baghdad 1995.

Bold, Hazolds: Plant Morphology, translated by: Dr. Abdel Halim Nasr and others, second edition, Dar Al-Nahda, Cairo, 1983.

Al-Zoubi, Yehia Youssef: The effect of environmental conditions on architectural morphology and the dialectic of form in architecture, PhD thesis in architecture, presented to the Department of Architecture, Faculty of Engineering, Cairo University, 1978.

Al-Zoubi, Yehia Youssef: The effect of environmental conditions on architectural morphology and the dialectic of form in architecture, PhD thesis in architecture, presented to the Department of Architecture, Faculty of Engineering, Cairo University, 1978.

Schulz, c. Norberge: Existence, space & architecture, cox & w, Yman Ltd, London 1972.

Mazkour, Ibrahim, "The Philosophical Dictionary", The General Authority for Amiri Press Affairs, Cairo, 1983

Hauser , M. D. , Chomsky , N. , & Fitch , W. T.(2002). The faculty of language: What it is, who has it, and how did it evolve? Science, 298, 1569 – 1579

Mandour, Mohamed Alaa.2004. From Hard Architecture to soft architecture form in the 21st Century 1st ASCAAD International Conference, e-Design in architecture Kfupm, Dhahran, Saudi Arabia , 2004

Karabag, Kutay. 2006 . An Approach to Architectural Form Through the Complexity Theories. in http://www.kytaykarabag.name.tr.

kolarevic, banko (ed.) 2003. Architecture in the digital age: Design and Manufacturing. Taylor & Francis Group , New York and London.

Oxman, R. (2010) **Morphogenesis in the Theory and Methodology of Digital Tectonics** , Journal of the International Association For Shell And Spatial Structures. 51(3): 195–205

SAJ , 2013 : PERFORMATIVE MORPHOLOGY IN ARCHITECTURE **,** approval date 01 06 2013 UDK BROJEVI: 72.01 ; 7.05 ID BROJ: 202946572

Menges, Achim. 2007. Computational Morphogenesis : Integral Form Generation and Materirialization processes. In : 3rd Int ASCAAD conference on em,bodying virtual architecture , egypt.

Al-Muqram, Asmaa Muhammad Husayn, Al-Kasriya in Architecture, his doctoral thesis submitted to the Department of Architectural Engineering, University of Technology, Baghdad, Iraq. 2008

Mitchell, Melanie, An Introduction to Genetic Algorithms, Massachusetts Institute of Technology, Cambridge, Massachusetts, United States ,1996

Fasoulaki , E. Genetic Algorithms in Architecture: a Necessity or a Trend? , Department of Architecture, Massachusetts Institute of Technology , Cambridge, Massachusetts, United States ,2008

Dr. Kotnik ,T. Algorithmic Architecture Introduction to the MAS Colloquia, 2007.

Wolfram, S, A new kind of science, Wolfram Media 2002.

GU , NING . SINGH , VISHAL School of Architecture and Built Environment , University of Newcastle, Australia & MERRICK, KATHRYN , University of New South Wales, Australia , A FRAMEWORK TO INTEGRATE GENERATIVE DESIGN TECHNIQUES FOR ENHANCING DESIGN AUTOMATION , 2010 .

Krawczyk , Robert J. , Architectural Interpretation of Cellular Automata , College of Architecture, Illinois Institute of Technology, Chicago, IL, USA , 2002 .

Özkar ,M. Middle East Technical University Ankara , Ph.D. Kotsopoulos,S. Digital Design Fabrication Group School of Architecture and Planning Massachusetts Institute of Technology Cambridge USA , INTRODUCTION TO SHAPE GRAMMARS , 2008 .

Knight ,T. APPLICATIONS IN ARCHITECTURAL DESIGN, AND EDUCATION AND PRACTICE , Department of Architecture School of Architecture and Planning Massachusetts Institute of Technology Cambridge , 1999

GU,N. & SINGH,V. School of Architecture and Built Environment University of Newcastle , Australia, MERRICK,K. University of New South Wales, Australia , A FRAMEWORK TO INTEGRATE GENERATIVE DESIGN TECHNIQUES FOR ENHANCING DESIGN AUTOMATION , 2010 .

Stiny, G. Introduction to shape and shape grammars, centre of Configurational studies , the open University , Milton Keynes , England , 1980 .

Chouchoulas , ORESTES . SHAPE EVOLUTION (An Algorithmic Method for Conceptual Architectural Design Combining Shape Grammars and Genetic Algorithms) , University of Bath , United Kingdom , 2003 .

Kalay,Y. E., Architecture’s New Media: Principles,Theories, and Methods of Computeraided Design, MIT Press, Cambridge, 2004.

Oxman, R., Digital architecture as a challenge for design pedagogy: theory, knowledge, models and medium, Design Studies, 2008.