International Journal of Architecture (IJA)
Volume 3, Issue 2, July-December 2017, pp. 01–09, Article ID: IJA_03_02_001
Available online at http://www.iaeme.com/IJA/issues.asp?JType=IJA&VType=3&IType=2

DIGITAL BIOLOGICAL DESIGNING A LIVABLE RESIDENTIAL BUILDING

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ABSTRACT

The research focuses on the development that was witnessed by the design of contemporary residential buildings that was called recently living homes, the research focused on showing the role of digital technology in developing the design operation and pushing to an advanced stage by adding a substantial feature for housing represented in endurance as it is considered as an indicator of life, the problem of the research was represented in how to activate the concept of endurance in the design operation until reaching a living building. Therefore, the research aims to show the mechanism and the applying procedure to add endurance feature to the design operation and activating it practically and not only a theory of a living building.

Key words: permanence, the architectural- biological design, digital technology, a livable residential building.

Cite this Article: Dr. Kameelah A. Al-qassyi, Rana Mazin Mahdi and Enas Salim Abdul-Ahhad, Digital Biological Designing a Livable Residential Building. *International Journal of Architecture (IJA)*, 3(2), 2017, pp. 01–09.
http://www.iaeme.com/IJA/issues.asp?JType=IJA&VType=3&IType=2

1. INTRODUCTION

1.1. The Introduction and the Method of the Research

The architectures in recent years were concerned more in achieving the endurance aspect to support life in the built environment designed in the digital capacities that were made available by the technology revolution, and the progress reached a degree where the building acts like a living creature that grows with the nature and has a life cycle just like any other creature, by introducing the features and behavior into the design operation because architecture is a field that includes all the specialties, and today biology enters as a field that controls the design operation by the help of software and algorithms and electronic applications to connect the ideas of nature together to achieve a live building through modern design methods based on intelligence which a basic internal concept and not only superficial simulation, so, the research depended on the method as : the first show the concept of

electronic biological design as a design method to reach live buildings in general, and the second is analyzing design samples that represents the recent inventions by architects from architectural design and specially within the apartment buildings until reaching the research target.

1.2. The digital biological design (its definition and aims and peculiarities)

Dennis Dollens defined the digital biological design as the operation of merging the biological imitation with digital production showing his aim by configuring and producing architecture with shapes and behavior that imitates the act of nature, the designers depend on discovering biological molecular information to study the plants and algae and seeds as a stance from biology and genetics to specify how it grows in its environment to reach the ideas to build digital design that merges technology with nature and shoes digital animation that would be analyzed to see the architecture method in the nature and the design and technology together. (Dollens, 2006, p. 6)According to (Vincent) the digital biological design is defined as an attempt to deduce from the biological mechanism depending on developed computer software as a common practice in architecture design, by merging biological concepts and creatures functions in the design to become something increasingly common to reach integrated productions (Vincent,2009, p. 170), (Mann's) theories defined it as imitating the biological engineering executed by the tools and developed computer software in order to imitate the function and shapes and terrain of the natural frames that represents a model in the modern art and includes transferring to the culture of design the features and the strategies inspired from the new nature through abstract (Mann,2009, p. 86), and his definition came within theories of (Santulli, & Langella) that it is the design that demands specifying the relation between the design issues in order to process them in the light of the solutions the nature provides and the similarities with the problem to be resolved and the natural solution can be imagined on different stages based on biological mechanisms and the balance of the natural system and the natural vision of nature in addition to interpreting the code that is provided by biology and applying it to the culture of designing and this would provide new strategies that gives the product features by production tools that can create the outline of the development scenarios that are compatible with endurance and flexibility demands and the variety of its concepts (Santulli, & Langella, 2010,p. 2), and also (Hanafi and Naguib) gave another definition: as the new design inspired from natural biology that can lead to changing environmental culture and designing architecture shapes that creates successful connection and high quality products in the environment design in the contemporary architecture, (Hanafi & Naguib, 2013, p. 87).

The digital biological design aims to achieve vision expression; the frame design is completely different from fixed vision concept of construction and from the scientific mathematical examples, and the design of the frame model seeks to achieve elegance without losing safety and service, there are five substantial parts in the nature that represents the substantial director to develop biological building systems in the future and they engineering and the frame and movement mechanism and power efficiency and intelligence (Dai etal, 2013, p.410) and these aspects were introduced to the design operation distinguished the unique feature of the digital biological design, it is represented by focusing on designing the skin and building strategies inspired by other biological systems in order to be enduring and active and provides the elements of aesthetics of live nature with confirming the façade that consists on the double layer that is used to imitate nature and the principles of biological weather and reducing the consumption of energy and water compared to the traditional buildings and achieving excellent working conditions and enhancing their comfort and productivity.

So,the research define digital biological design as kind of design characterized by achieving the concepts of endurance and aesthetic elements of nature for merging the building and the nature by introducing biological design concepts inspired by living creatures and the data of environment and aesthetics and construction and culture and weather as milestones that will be digitally programmed to reach the final shape of the live building.

From what was set out above it is obvious that digital biological design is kind of design where the introduction of features and behavior of creatures in order to include it in the design operation, and represents a quality change in the design operation because the biological design was merely blind and superficial imitation of nature, but with the digital efficiency that represented successful tool that made the design go beyond the representation case to the active imitation of a building that is connected with the nature as an if it is growing from it biologically like a creature that has a full life cycle and it can be recycled (Raoa,2014,p.p.103-104).The most special features of the biological design is represented by its ability to create life framework that acts like living creatures not on the category of a single building but also on the category of a living city that looks like urban scenery and dynamic environmental system. That is evolving continuously, The buildings, in them, they adapt with their environments which has made a great change about the visualization of the surface of the structure. The outer surface is designed as if it is the living skin, instead of using the inert materials system, and it is used to build and protect, to act like it's the fine membrane which is the connection between the inside and the outside, the skin is considered as the epidermis which has many stomata that allows the processes of exchange that happens between the gasses and the transpiration in plants, the surface allows the light, air, and water to enter into the home, because it automatically directs its self towards sun lights , the air and the winds will be guided and directed into the building and filter it to provide refined and breathable air. The active skin will be capable of collecting the water from the rain and filter it so it is pure, and then reuse it again by recycling it(Naguib & Hanafi ,2013, pp:85-93). The skin will also be capable of absorbing the humidity from the weather; the waste will be turned into energy and to produce the biogas, which is used a lot. One of the features of the electronic biological architecture is that it activates the beauty side of nature in its designs, and to get to this level of beauty in the designs, it is required to analyze the nature (its forms, abilities, its structures, and its behavior). And not only be satisfied with using mimicking (Naguib & Hanafi ,2013,p:86). The evolution of the digital techniques has contributed a lot in presenting the chance to combine all the specifics as the regulations of the design , the current architecture designs when they resort to nature they don’t just look for the bio-ecological regeneration ,or search for clues on how to take energy from the sun ,and how to heat and cold the buildings or manufacturing the materials ,and even how to design communities ,and also how to limit or stop the bad effects of the buildings on the environment ,but also searches on how to create buildings which have a positive effect on both the environment and the organisms ,because buildings around the world and in the future will be designed to operate just like organisms. What that means is that buildings will adapt with all what it takes from abilities to adapt with the energy and water that is surrounds them. Meanwhile ,the main role of the engineer will be designing buildings that simulates the natural systems and have capacity to reconnect the people with the nature, the living accommodation has the feature of having a multiple layers tegument, and it is made of combining the structural structure as a shell that provides the protection and durability, and the building materials which is characterized by its electronic structure (e-window,e-door,e-wall,etc.) to function together to achieve the flow and exchange of energy and recycle like biological living cells(Naguib & Hanafi ,2013,p.96)

2. PERMANENCE

It means endurance and continuity in the level of required function in two substantial conditions: the functional use of the space and the continuity of its use and production (5), it also merges the ideas of super technology with the basic cellular functions in order to create the living frame that acts like natural creatures so that the apartment buildings and the urban view look as if they are in contiguous dynamic evolvement within the city landscape according to the concept of living dynamics , so, substantial changes will occur in the configuration of surfaces to be closer like live skin instead of inert material systems that is used only for construction and protecting only, and that will make the building act like a membrane that achieves the connection between the outside and the inside on different levels (environmental, functional, aesthetic) in the housing (Raoa, , 2014.p:103).

2.1. A Livable Houses

The live houses are defined as the buildings that adapt with its environment, so, it acts like a live creator and it is usually called smart buildings because intelligence is behavior and the inner attitude directed for adaptation until reaching endurance and live sustainability for the longest time possible, and the technological development had a big role in the emergence of smart buildings because it depends on systems and new applications in order to achieve the integrity of the environment systems with the building's systems, such as using the energy and controlling the temperature and light and sound and the work place and communications, and it can be said that the level of the building's intelligence depends on the amount it achieves and the amount of technology used and the amount of possibilities it contains that can be acted within, and on the level of urban expansion that it works within and deals with its other components such as buildings and networks and facilities, and when the building adapts to its environment by unifying the relation between function and the shape, the achievement is done of a live building that adapts with its environment like living creator, so, the shape adapts according to the features of the function and the circumstances that the building is subject to, and the amount of adaptation depends on its live outer layer, because it is the separating border between the inner and outer environment (NESSAR, and ALSEKKA,2007 p. 2), designing livable houses and built to fulfill the changing needs of the occupants through their lives, and the livable houses include the substantial features of easy to live in that makes it easier and safer for use with the simplicity of moving in and around them and capable of adapting easily and effective regarding the cost, and it should respond to the changing needs of the occupants and enhances the quality of life of all the occupants in all stages of lives, (Verwer, 2010, p:8).

2.2. The Indicators of the Digital Biological Design

the research focuses on showing the application mechanism to activate the endurance in the digital biological design to give the buildings the feature of life through the analysis of the architecture theories that provided detailed indications for design models specifically on the level of apartment buildings as samples the represents the of the research focus.

2.3. First: The application mechanism that were provided by (Dennis Dollens)[1]

Dennis Dollens focused on the ideas of natural frames regarding the construction, aesthetics and how it interacts with the material to introduce the product, for example, a creator is taken to start investigating every part of it and its features by light scanning not visually only but also its quality by the cooperation of sciences, because thinking consists on configuration regarding materials, aesthetics, mechanical and technical and endurance, and to entice the creative thinking of the designer, the designer uses the genetic and genetic architecture

through programs such as the program (X-frog) that has the capacity to produce models according to algorithms and move it to numeric media to the design 3D its sole depend on the scale of plants growth in order to make changes in natural practical algorithm ,to control the architectural design in engineering way that make the design to follow natural way which distributed the leafs and flowers according to intrusion the light and shade and air flow, this is what called electronic interbreeding which produce systems and mechanical structures which are mixing the architectural with plants characteristics, then start to manufacture the plants designs 'which have 100% replace ratio in all its engineering designs as (cylinders, spaces, deformations,prismatic crystals, cubic ,tornados) that make building will be a part of nature which are regarded as rewards for creation which satisfied all the scientist, designers, architect as drawing, engineering, building, production and produce. (Dennis Dollens) in his suggestion of (cylinders lodgings project (pagoda tower) (fig.1) the experimental growth of (x -frog) by using system (L) for numeric frames and support the shapes of arbitrations and movement and activated the living features like heat, light and sensing screens through the leaves that are used to be as like as the living shape to achieve esthetical and functional role as like as that it is doing the transpiration and gazes exchanging which are found in plants. all these had been established by using (x-frog/Rhino/3Ds max) programs (Dollens,2006,p.p. 147-156)

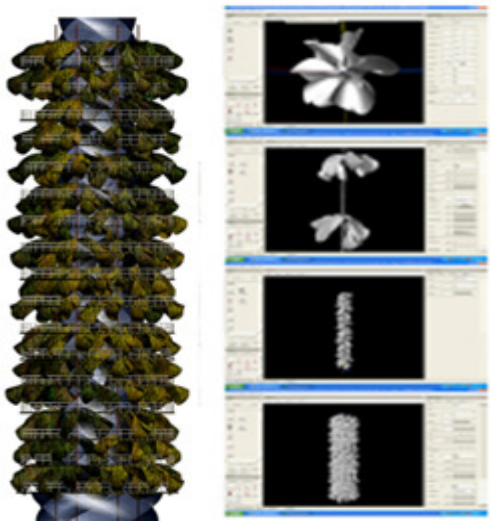

Figure 1 Pagoda Tower, source: (Dollens , 2006, p.23)

In his suggestion of project (E –tree Branch & tendril)(fig.2) developed the electronic branches which consist the living building and roofs industry as structural holds of different directions, sags from trees branches while it grow secondly growth depend on flowers, leaves and roots which reprogrammed as a living areas for typical buildings then the conformation of flowers and leaves as geometric figures.(Dollens,2006,p.150)

Figure 2 eTree Branch & Tendril Dollens, source: (Dollens , 2006, p.23)

2.4. Secondly: The practical ways introduces by (Keith Evan Geen)

(Keith Evan Geen) concentrated on liveliness as an indicator to achieve the characteristics of eternity and activated it writhen designable process by complex interfering between living systems of nature and no living of building, and be inspired from life circle to find building behave as living creatures adopted the living environment in such a way cannot recognize the real one after disappearing the boundaries of (geometric-natural). That including new cultural biological and architectural concept, (Keith EvanGreen) concentrated on characteristics' and behaviors like elastic and adaptation where it is called cultivating life (Keith ,2005, p.522)throw design suggestion "smile mold architecture"adopted the concept that included in mold which are consisted of living units on the level of modern cities, the concept concentrated upon fourth dimension by including the circle life of the mold in logical way to derive architectural, the central point is believing that mold depend basically on food availability and to keep it self within the one cell where it is hard to find food that make it to develop into individual creature of multiple cells to be morecomplex by his ability to departure new nutrition sources by finding food in short distant, this design is inspired through a living movable unit (fig. 3/ a) according to the definition of ameba which are a living creature which are able to change its shape. Ameba is consisted of movable units which are called the system parts as six employments (work, sleeping, relax, cleanness, food, utilities), (fig. 3/b) On the second stage of live the food are exhausted that it moved to ask for food so the units are collected in living structure of multiple cells to exchange to big living creature and her start the shape of tornado but it connected with techniques (fig. 3/c) In the third stage of mold circle living, after gathering in center of tornado to consist (pseudo plasmodium) to migrate for places for continuity then the groups are changed to cooperative ones for working and living in this critical units called " point of no returning ", where the creature either returning back or move to more developing stage. It depend on the nutrition material found there to end as institution of investment by growing a new creature in same location this is a represent of real states developments according to what is suitable for movable unites the living design is developing the humanity and life theory as a whole by developing living theories(Keith ,2005, p.p.520-530) .

Figure 3 Slime Mold Architecture, source (Keith,2005,p.528)

2.5. Third: Applied processes introduced by Foster [(3)]

(Foster) introduced his sustainable design(Chesa Futura 2000-2003) (fig.4) in nature response indicator, the modal is curved in for site capacities and in accordance with its limitations, the initial sketches of the internal designs has been interpreted and formed as parametric model despite being relatively simple in regard to sections and schematics the potential possibilities were infinite, the key feature to control the model is to divide it into two sections with three degrees slope, the principle of using the parallel surfaces is which separate the roof from the wall and what is beneath provided many possibilities, considering the wall as shell connected to polarized network is the best way to determine the elements position such as radial site windows, four sections and subdivisions had been specified inside each section, whereas all unites can be used side panel or window which give great flexibility and control. Systems of

Interconnection Basic Reference Model also provided. After specifying the windows of the side panels, the operation of Logic Unit has applied to create the ported shell. Appliance of the floor panels provided section related shape for achieving maximum angle of view. (Branko,2003,P.135-136)

In brief, the initial modeling process is not regarded significant, but the significant part of this project is process of creating new generations of models whether digital or physical to be used by engineers to develop the construction process. It become possible to located any element by the polarized network, and creating intersection plane with the design surface in order to specify the vector shift and locating the element in addition of being able precisely to locate the models and the locations of elements in the space, so, it became possible to generate a matrix of segments for each place of sides and producing the models for execution schemes. Both the scheme and the segment keeps being in a contiguous change until reaching the late stages of the project and that enables a programmer to renew the surface of the design in smooth and reliable way. The software tools have developed in a way that enabled the design operation to become circular operation instead of being linear. The liberty to discover multiple recurrence in the design is proved to be the key of the best solution (Branko ,2003p.p.139- 140). CAD was introduced in order to provide execution schemes of the model makers, the digital technology allows to start making digital models that can be afterwards passed to the manufacturing premium location by using manufacturing machines by using computers with continuous dialogue between the engineering drawing and computer and physical models, also, there will be preview of the project models and CAD models and the provided pictures. And the models of hidden lines and models of CNC cuts and engineering drawing models, each generation of digital model led to the production of the next physical model, also, new level of details were discovered. In this stage there was a need to study how to control the wooden boards production that will form the house regarding windows openings and cutting them by CNC machine, then assembling them on the model, in order to represent wooden boards of this size of the required type with high precision (Branko ,2003,p.p.142- 143). This building with unusual combination regarding the shape and materials and assembling them, the outer layer of the building is made of natural traditional local material processed by high technology (Branko ,2003page 147).

Figure 4 Chesa Futura house, source: (BRANKO,2003,p.142)

Throw reviewing previous design projects, It wassubmit the theoretical framework of the biological design as follows in (table 1):

Table 1 The theoretical framework of digital biological design/ the source: the researchers			
Definition of endurance	Transferring nature to the design and blending in with nature by planting life in the building depending on the design transferring the features and behavior of the living creature to the building		
Indications of endurance	Vital, response, flexibility, adaptation, responding to the location and its vital limitation, biological growth, evolving with the nature.		
Design mechanism that achieves endurance	The structure of the assembling	Depends on the assembly of units within the frame	
	Method of assembly	The units assembled as one unit and an integrated system	
	Assembly evolving pattern	Producing new units in the site	Environmental-cultural aspects
	Features of the unit	Mobile and self-adaptive	
	Shape	Changing- renewed	
	Function	Versatile (work, sleeping, relaxing, hygiene, food, bathrooms)	
	Connectivity of the units	Electronic sockets for connecting and assembling and disassembling	
	Material	Natural, Local, supported by advanced technology	
	On manufacturing level	Electronic precision	

3. CONCLUSIONS

- The research defined the digital biological design as kind of designs where the features and behavior of living creatures is introduced to in order to activate it in the design operation, and it represents a big advance in quality in the design operation, because the biological design was blind and superficial imitation of nature, but with the digital efficiency that represented a successful tool to move beyond the superficial imitation to the real incarnation of a building connected to the nature as if it is growing from it like a creature that has a life cycle and can be recycled.
- The most distinguished feature of the electronic biological design is in its ability to create live frameworks that works like living creatures and activating the aesthetic aspect of nature in the shape and function
- The apartment building that is fit for residing an interpretation of the principles of nature leading to the design and blending in with it by planting life in the building depending on the design by transferring the features and behavior of the living creature to the buildings, and regarding its most important indications, they are: vitality, response, flexibility, adaptation, responding to the location and its vital limitations, biological growth, evolving with the nature.

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