Computing Architectural Materiality: The Hyper-natural Aspirations of the New Paradigm

Maria Voyatzaki

Computing Architectural Materiality: The Hyper-natural Aspirations of the New Paradigm

Maria Voyatzaki

ABSTRACT

The article is based on the premise that in the history of architecture there has always been an intimate relationship between architectural ideas and the various perceptions of the alive. On this premise the article focuses on and investigates the relationship of the contemporary architectural paradigm labeled as digital, parametric or morphogenetic with the alive. Its objective is to reveal its new profound reasonings which lead and nourish its creative expression; to articulate its new ethos with the extended use of advanced information technologies for the creation of architectural forms, but also for the generation of a broad spectrum of new building materials with properties predefined by the architect. The immaterial, the hybrid, the composite, the mutable, the transformable, the interactive, the dynamic, do not only appear as properties of certain architectural creations or building materials, but also as values expressing this ethos and declaring a new relationship or a reconsidered admiration of the natural, the living, the alive. The article concludes that the new hyper-natural aspiration of the contemporary paradigm constitutes a new dynamic expression of architectural materiality and its guiding intellect.

1. Living body and architectural materiality

Architecture as the art of blending culture with feeling (senses) manifests itself through materials by virtue of values that are always strongly related to the way each era in the history of the humanities perceives the living being, the alive. Building materials and construction techniques act as the mediators for this blending. Marc Mimram [1] argues that architects «do not work on the form but on the meaning of form», that is the idea. This idea which lies behind any decision related to the way the 'artificial' is handled always represents, among other things, a particular way of perceiving the living being.

From the Renaissance to date, architecture has maintained the living being as a constant reference point for the generation of form since, this as a concept, focuses on the alive and on the human in particular, the being that, among all other beings, touches perfection. The human-live being has always been regarded as, and continues to be, a kind of model, an ideal, an exemplar, loved and admired at times as the utmost beauty (Renaissance), at other times as the optimum expression of functionality and of the ideal machine (Modern Movement) while at times as the expressive skin of the (social and cultural) body (Post-Modern) and finally as the gathering of (genetic) information and data that control the evolution of life.

In their effort to create architectural forms, architects have the body as their reference point, the architectural creation as an artifact that mimics the living being, encapsulates a specific relationship between the alive and the artifact, the natural and the fabricated. Meanwhile, the fact that building materials used in each historical period are perceived as the combination of the natural aspect of materiality with the technology of the period, reinforces the conceptual and ontological ambiguity of this relationship between the alive and the artifact.

Nowadays, more than ever before, the taxonomy of the living, the natural and the fabricated artifact appear totally merged and depend exclusively upon the way the alive is perceived in each historical period of contemporary society. Is a piece of natural marble less artificial than a glazed panel that, designed with interference in its molecular structure, has acquired new properties that enable it to adjust as an alive to the natural environment and climatic changes? Is an MDF panel less artificial than a specially processed glazed panel that loses its transparency when the structural positioning of its crystals changes due to the change of the electric field that controls them? Is a shoe less artificial than a computer? This is a question posed by Antoine Picon [2] in his effort to investigate the characteristics of the contemporary technological context in which we live. This way, he reminds us of the absence of the clear-cut distinction between what is alive and what is artificial and as a consequence, stresses the practical difficulty for a transitional process from one to the other.

If we had to follow the traditional taxonomy of the alive and the artifact, we could easily conclude that the former materials are undoubtedly less artificial than the latter as they can, in no time, return to their initial, natural state. If, however, we could adopt a different way of looking at it, a way that is becoming increasingly familiar, through which nature can be understood in terms of information flow, processes, relationships among distinct areas, genetic codes and decoding, then we could consider the latter materials as being more life-simulating. Similarly, we could consider as more 'artificial', a genetically modified living organism.

In the last fifteen years we are increasingly experiencing production processes in which the artifacts tend to acquire properties of the alive, a process of naturalisation of the artifact. We could, therefore, argue that there are no longer fundamental differentiations between the world of artifacts and the natural world, as the former tends to be formed as a particular version of the latter. In this context, a new architectural paradigm emerges based upon a new conception of the building not as an artifact imitating some selected properties of the alive, but as an alive as such.

2. Modernism and the materiality of the functional body of architecture

In the rational approach of the Modern Movement, for grasping and describing the complexity of the living being, common notions in use were those of function, typology and later on, system. Through these notions particular ways of comprehending the building as an artifact or as a machine (to live in) emerged alongside values and ideas that defined the choice and the technique of building materials. Modernity stripped off the 'body' of architecture, the ornamental garments of the 19th century, in order to better demonstrate and enhance its new body, clear, honest and purified. It is interesting to note that notions such as the skeleton, frame and brickwork constituted a particular way of understanding the building through terms proportional to the live and natural, and which directed the construction towards those materials that could, through their properties, better respond to the expressive demands of the concept.

The typological classification of materials in bearing and non-bearing formed a distinct compositional/design ethos and style. The building material, as a prefabricated building product coming directly from the industry, had certain positions in the construction system by default. In the design process, a form was conceived as the duality of a load-bearing 'organism' and its brickwork, where the architect com-posed building materials offered by the building industry in order to be consistent to the design principles and to comply with the constraints of the building. The choice of a material in the appropriate position was considered as the way to best portray and attribute values such as clarity, honesty and sincerity, which constituted the fundamental design values of the time. The conception of the natural itself was also based on the alive. Giedion

prompted the architects of his times to «listen to the material and to reveal the hidden life of its amorphous nature» [3]. The enhancement of the nature of a material, as a projection of the natural dimension of the artifact and as the revelation of the way the alive blends into the artifact, or as process in which the living becomes an artifact, was a fundamental idea in the manipulation of building materiality.

From Viollet-le-Duc to Louis Kahn, from Gotffried Semper to Le Corbusier and Jørn Utzon, 'honesty' of the construction emerges as the constant value of architecture. Kahn always felt the live nature of a brick when he declared that it 'wishes' to form an arch, and asserted that its nature was undermined through its use as cladding or ornamentation. The enhancement of the nature and the texture of materials as well as the testimony of their construction methods and the enhancement of the trace of the construction as a source of satisfaction is dominant in the Modern Movement: from the Corbusian wooden frames and the joints between materials invented by Carlo Scarpa at Gavina shopwindow in Bologna [4], to a Jørn Utzon's apparent traces of the drill on the stone and holes of the nails on the doors at his residence in Majorca [5].

3. Materiality of the skin in post – modern architecture

The articulation of the architectural body on bearing and non-load bearing elements as established in the Modern Movement, created the conditions for the materiality of the non-load bearing elements to assert their independence in the 1960s and to become the building elements capable of alluding to meanings. The building elevation is no longer the inseparable part of a whole, but that part of the building that opens up to the city and informs about its body. It is understood as the expressive body, capable of recording and tracing contents and references that define its creation and form, its social and cultural existence.

Freeing the building elevation from the functional indoor space constitutes a special highpoint in the history of contemporary architecture as it is accompanied by the simultaneous enhancement and recognition of the material as a focal point of the architectural creation. Even though building materials have always been inseparable and integrated with architecture, they have always been seen as the assistants of form and the allies of structure [6], thus maintaining an inferior position compared to form. Since form has always been the focal point of architecture, building materiality has been seating on the fence of the overall design process. Either due to the fact that the aesthetic codes were relatively limited or defined by the dominant tendencies and, at times, manifestos or due to the fact that the available pallette of materials was relatively limited, the choice of materials engaged the architect, to a lesser extent, when designing the form of a building.

The emergence of meaning as a focal point of architecture has attributed to materials a new and central role, that of the agent of meaning and has

become the signifier with which the architect 'syntaxes' the meaning of a building. The material is now considered to encompass a plethora of meanings which refer to the origin of the building, the cultural context that enhanced it, its functional value and properties, its life cycle, the know-how of its process and the legends that accompany it. Through this perspective, material choice is the structural element of the design of form and therefore an inseparable part of the design process. Architects can no longer think of form as an independent question; on the contrary, they have to conceive it and elaborate on it together with its materiality. This new relationship between form and its materiality renders the building material an expressive aspect of form, and its selection a creative challenge for the designer. This perspective opens up the production of building materials to a new spectrum of choices and possibilities that will broaden the expressive vocabulary of architects contributing to the generation of increasingly genuine architectural forms.

Freeing the elevation of a building element and, on a number of occasions, its detachment from the rest of the building, gave the building facade a new substance and a new appreciation. As building skin or as artifact-cladding, the building elevation gradually overcomes its exclusive expressive and communicative aspect in order to acquire other roles such as the protection of the body of the building from the environment, climate, noise and other internal or external stimuli. The elevation is an intelligent façade or skin, to use the term more consistently, that reacts dynamically to stimuli -what it is designed to do [7].

Building materiality acquires intelligence, which Bensaud-Vincent [8] following Toshinori Tagaki classifies onto three levels. The first level concerns the functions of senses, the processing and acting on behalf of the intelligent skin. The second level concerns the functions of self-diagnosis, self-repair, seft-devaluation, self-learning that it can fulfill. Lastly, the third level concerns functions of high intelligence such as adaptation to human or social values, source management, reliability, life quality etc. For the several levels of intelligence there is a wide range of materials that can be classified into four categories. The sensitive components that gather data around the environment, the active components, that modify the environmental or their internal state in order to encounter the changes of the given conditions, the adaptive components that combine the properties of the sensitive and the active components and last but not least, those components that are in a position to learn and select from the way in which they will react.

Contemporary application enables the production of a wide range of materials, the composites, the properties of which are the sum of the properties of their ingredients ensuring the highest of properties of the whole. The capacity to control the properties of materials through the new digital technologies enables architects to predefine the properties of the material that can best serve the form that they design in order for it to fulfil

a number of specifications [9]. This capacity has a direct impact on the design process, which eventually becomes the design of materials of which the architectural form will be made. This new practice becomes a very interesting innovation in the domain of architectural design in which the materiality of a building is structured through the process within which the architectural form is generated. In this context, the design of architectural forms is being perceived as the analogous of the genetic process, a morphogenesis that generates simultaneously forms and their materiality and which gradually transforms into a new architectural paradigm, the digital.

4. Digital architecture and new materials

In contemporary architecture we are increasingly realising an entirely different perception in the way the materiality of architecture is handled. This perception reflects an overall transformation of the way we understand architecture which runs parallel with the respective transformation of the relationship between the alive and the artifact. The perception of the alive as a framework for the management of genetic data and codes replaces the image of the live organism in a state of functional balance that Modernism had as an ideal in the making of the artifact as well as the image of the intelligent skin that expresses meanings and dynamically adapts to the stimuli, an image initiated after Modernism. Advanced contemporary technologies give opportunities to the artifact to acquire properties of the alive and to the natural to be in a position to acquire properties of the artifact. The notion of the hybrid takes a central position in architects' mental processes whilst the in-between appears as an ingredient of architectural theory. The building is no longer perceived as a machine the functional-mechanical parts of which mimic the organs of a living being and it is not an artificial extension of the human body, an artificial skin with natural properties that, with interference in its genetic code, acquires the ability to transform, mutate, adapt, change. On the contrary, it is itself a living being that is created from the development of the genetic code – algorithm that is responsible for the properties of the form as well as the properties of its matter. This designed building with the aid of computers transforms, mutates, adapts and changes until the architect decides on its frozen, final form [9]. Every initiation of change presupposes the adaptation of each genetic code-algorithm from which the desired improvements of the designed form will emerge.

In this new context we could distinguish three distinct ways of handling the materiality of a building. The first concerns the diminution of the importance of the distinction between load-bearing and non load-bearing building materials. With the exploitation of digital technologies in design and construction, complex structures render the traditional distinctions of the type increasingly impossible. A typical example is Ether/i, the double skin tessellated aluminum, designed in 1995 for the

United Nations 50th anniversary exhibition, in Geneve Switzerland, by dECOi, Source Architects [10].

The second characteristic concerns the integration of the creation of a material in the design process. The experimentation in form generation is simultaneous and identical with the experimentation in the material that not only will best express the idea, but will be an inseparable and indistinguishable part of it. As material is born with the form, its production as well as its manufacturing and place in the construction constitute part of the same design process-question. In contemporary architectural examples such as in the work of Peter Eisenman, Greg Lynn, UN Studio, Fabio Gramazio and Matthias Kohler it could be argued that there is a shift of emphasis from the design of architectural forms to the design of architectural properties which are, in turn, responsible for the genesis of forms and, as a consequence, the selection of materials. A case in point constitute the experiments that Gramazio and Kohler deployed in their work by bricklaying, at the Gantenbein vineyard façade [11].

While a few years back, the exclusive, one-off production of a building material or a component was impossible due to the high cost entailed and only eminent architects and clients with high budget could afford to think of it as a possibility or an option, nowadays building industries receive a file of the design of a component, price it rapidly, proceed to its manufacturing and deliver it to the site within a few days.

The third characteristic, which emerges from the second one, is the increasing use of new materials which are produced through new digital production technologies that enable the architect to give uses to a new pallette of materials, as well as to imagine new and unknown properties [12]. In contrast to the current practice, where building materials are produced in the building industry with specific dimensions and specifications shifting their potential design interest into the way they are combined and assembled, the new approach demands the pre-definition of the desired characteristics and properties to be investigated during the design process in order for the material to better ensure the occasional demands. Such is the case of the 15 000 anodised aluminum disks used at Selfridges Department store at Birmingham by Future Systems [13]. Toshiko Mori, likewise, experiments with panels created with transparent aerogel sheets, deriving originally from silicone, processed with coal and filled with color resins to produce changeable surfaces [9].

5. The materiality of architecture as the hyper-nature of the artifact

New materials with changeable properties, with different degrees of transparency, translucent, blurred, bright [14], folded, compressed or moveable that often 'melt' through light and data systems appear with contemporary architectural ideas. With interference in the molecular structure and with the aid of nanotechnology foams or other composites,

paints and other coatings [14] change their appearance, their proof capacity and even their structural strength [15]. Materials that manipulate in particular ways light, heat, dampness, [15] sound are used in conjunction with immaterial materials such as light, sound, vapor, odor, in order to create 'forms' and 'spaces' that stimulate the senses attributing to the building the properties of an artificial cladding that asserts for the intelligence of the natural and the living but also for the aesthetics of high technology [5]. A case of immaterial 'material' is the cloud, made of artificial fog, was the key feature of the Swiss Expo Pavilion by Diller and Scofidio in 2002. A simulation process of agriculture spaying machines took place for it to be feasible [15].

The broad spectrum of new building materials available nowadays to architecture deliberates the research in new architectural forms and spaces with properties hard to think of not long ago. The more the definition of properties of building materials becomes a vital part of the design process, the more the demands for further research in new technologies, applications, and products. New building materials, with interference in their molecular structure, form gradually a new aesthetic, new preferences but also a new vocabulary from which the new ethos of contemporary architecture emerges. An ethos expressed by terms like the immaterial, the hybrid, the composite and the mutable that not only appear as properties that advertise certain building materials. They are also registered as values within the same theoretical discourse as through these terms the building, as an artifact, declares and manifests its new relationship as well as its renewed admiration to the natural, the living, the alive. The shift of a great deal of the focus of architects' interest from the design process to the design of the 'genetic material' of the form and in turn of the design of the material that will materialise it, portrays the contemporary version of the architectural artifact as a living organism. It is interesting to note that this new approach to the living appears deliberated from its reference to human existence. It has to do with a hyper-human nature that undertakes to become the reference point of architectural creation as this is evident in Oosterhuis's hyperbodies [16, 17] and in Novak's allogenesis [18]. A familiar image is the NSA Muscle exhibited at Centre Pompidou in 2003 by Kas Oosterhuis and his team [17]. If this reference to the living constitutes a metaphysic foundation of architecture in the entire spectrum of history, the contemporary architectural paradigm with its hyper-natural aspiration seems to hold new and extremely interesting adventures for the materiality of architecture and its intellect.

References

1. Mimram, M., 'Matière à Penser', Rencontre, *Poïesis*, Architecture, Arts, Sciences et Philosophie, 'La Part de la Technique', 1999, no 10, 13-20.
2. Picon, A., 'Villes et Paysages de la Technologie Contemporaine' *Poïesis*, Architecture, Arts, Sciences et Philosophie, 'La Part de la Technique', 1999, no 10, 13-20, 61.

3. Weston, R., Materials, *Form and Architecture*, Laurence King Publishing Ltd, London, 2003, 79.

4. Ford, E., *The Details of Modern Architecture,* Volume 2 1928-88, MIT Press: Massachusetts, 1996, 371.

5. Weston, R., Materials, *Form and Architecture*, Laurence King Publishing Ltd, London, 2003, 113.

6. Slessor, C., Material Witnesses, *The Architectural Review*, 2000, 207, 43.

7. Schittich, C., ed., *Building Skins: Concepts Layers Materials*, Birkhäuser, Munich, 2001, 86-87.

8. Bensaud-Vincent, B., *Eloge du mixte. Des composites aux materiaux intelligents*, Techniques et Architecture, 2000, 448, 82.

9. Mori, T., *Immaterial/Ultramaterial: Architecture, Design and Materials*, George Brasiller, New York, 2002.

10. Kolarevich, B., ed., *Architecture in the Digital Age – Design and Manufacturing*, First published 2003 Spon Press New York, 2003, 169.

11. Gramazio, F. and Kohler, M. *Digital Materiality in Architecture*, Lars Muller Publishers, Germany, 2008, 99.

12. Stungo, N., ed., *Dare to be Different: Why do Architects Strive to Use Unusual Materials*, RIBA Journal, July 2003, 70, 24-26

13. *Outrage in Birmingham*, Architectural Review, October 2003, 24-5

14. *Mise en Œuvre: Matériaux Imprimés, Gravés, Sculptés, Sérigraphies en Façade*, Techniques et Architecture, 2003, 466, juin-juillet, 126-137.

15. Diller, E. and Scofidio, R., The Making of Nothing, Harry N. Abrams: New York, 2002, $\sigma\varepsilon\gamma$. 73, 368)

16. Oosterhuis, K., Hyperbodies: Towards an e-motive Architecture, Birkhäuser, Basel, 2003, 27-31.

17. Oosterhuis, *K., ONL Scenario Hyperbody Logic, From Experience to Transformation*, AADCU Publication, Rotterdam, 2006, 5-8.

18. Novak, M., *Transvergence, Allogenesis: Notes on the Production of the Alien Speciation*, Architectural Design: Reflexive Final, 64-71, found on: http://www.mat.ucsb.edu/~marcos/transvergence.pdf [12-5-2008].

Maria Voyatzaki

Aristotle University of Thessaloniki

Department of Architecture

University Campus 54 124 Thessaloniki Greece

mvoyat@arch.auth.gr