THE BEAUTY OF ARCHITECTURAL COMPLEXITY

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ABSTRACT

The paper is an attempt to revisit the concept of beauty which is analyzed in reference to Vitruvian principles of architecture supplemented with idea, the fourth principle. The holistic approach to architecture may be the vehicle to explain universal patterns of beauty, possible to be understood as complex system – both the discipline and constructs created as a result of architectural ideas. One can argue that architectural entities start their existence with initial idea, then its purpose is defined, to be encased in structure and form. All these principal bricks architecture is built with exist on multiple layers, as abstracts or as physical manifestations. The beauty is therefore the perceptive phenomenon, in which man is able to decipher and comprehend expressed or tacit properties of the universe and convert them into his own interpretation of the environment and man-made culture or social patterns.

This paper is a tribute and humble contribution to pay respect to Professor Carlos Brebbia (1938–2018), whose grasp of complex reality opened many inspiring paths within science and animated multiple connections within scientific community for the benefit of knowledge and understanding of the nature.

Keywords: architectural idea (concept), architecture, beauty, complexity,

1 INTRODUCTION

The idea of beauty has always been at the center of theoretical considerations of what architecture constitutes. It contributes significantly to our understanding of the role of architecture, its impact or mutual connection between people and their creations, in this particular instance creations of a scale enabling them to alter the environment. Architecture appears to be a discipline of science and art at the same time, it provides common ground for antinomies – the domain of the objective, and the domain of the subjective. It blurs the boundaries and becomes an example of applied science which defies some of scientific principles, e.g. usual rejection of single-case-based theories or case studies which is hardly applicable in architecture – in case of this particular discipline most cases are unique and the process of extracting general principles, theorems or rules becomes vulnerable to approximations, analogies, uncertainties in causal connections.

When Gordon Graham ponders architecture as art, he rightfully sees architectural character as distinctive in comparison with other arts. Architecture raises several doubts about the applicability of aesthetical values as primary ones, because it is useful, purposeful, relevant, and it is both designed and built with the extensive use of ready-made objects [1]. Its usefulness is generally coerced, an inherent trait without which architecture loses its special status and may become something else, a sculpture, an object in space devoid of common meanings. This difference is at the same time significant yet intangible, without clear edges to what extent functionality defines perception of order and beauty. Functionality, being on the one hand related to intended purpose, and on the other hand attributed as a result of multiple unpredictable occurrences, exposes the inherent evolutionary process of how architecture matures, achieves its independence from creator, designer, in fact anyone involved in its inception into built environment. I would argue that what Nicolaus Pevsner defined as architectural "honesty", architectural truth, reflection of zeitgeist [2] is in fact the projection of

this particular feature the architecture has – the beauty within the innate order. It goes far beyond aesthetic properties, attempts to attach additional value to ordinary objects, enriches their values.

In this work the concept of architecture is investigated in context of its main components, which architectural theory in the past formulated as usefulness, durability, and beauty, supplemented with abstract notion of idea responsible for initiating and manifesting architecture in multiple aspects. It departs from tri-fold *utilitas*, *firmitas* and *venustas* and revisits modernist transformation of the three concepts. I argue that the notion of beauty implemented in architecture is different from the notion of form and aesthetics of architecture, and that even Vitruvian *venustas* was seen by the ancient author as indivisible from other values and in fact all them constitute the beauty and its definition as proposed herein. Therefore the paper starts with the introductory thoughts and perspective on this issue and provides considerations related to four architectural principles. There is superficiality and hidden qualities of architecture acting in unity, and their atomization, separation leads astray. The paper reviews four principles, discusses their interpretation, attempts to integrate these four elements, and proposes the insight into architecture relying on holistic view and exploits the perspective of complexity.

Architecture in its subtlety exposes human interpretation of holistic view of reality, including its holistic interpretation. This so-called truth, which Roger Scruton calls objectivity of architectural aesthetics [3], unveils the most fundamental significance of architecture, a discipline seemingly devoid of its own original, exclusive disciplinary field, one that is a combination of engineering, crafts, arts, rather than something autonomous. It is only an apparent lack of autonomy – its specificity lies in all-encompassing nature, in pursuit of synergy in preparation and performance of architecture. Thus the assertion that the beauty of architecture is in fact the reflection of its inherent complexity reveals the source of theoretical dilemmas in which beauty was mistakenly seen more as aesthetic attribute than multi-layered unity of various properties. This phenomenon, although diagnosed in different manner and described in different words, is a prevalent observation of many researchers of the theory of architecture, seen in the past as well as in the present [4].

One may argue that the concept of architectural beauty is more similar to ideas found in science, to the concept of the same beauty that is found in nature – hidden rules allowing for simultaneous existence of order and chaos supplementing each other and making nothing but superficial dichotomy discovered in the environment, regardless of whether natural or artificial (even virtual). The beauty found in scientific considerations, in mathematics or physics, as found in Heisenberg's memories [5], or the beauty discovered in sophisticated geometries of Parthenon in Athens which import distortions and deformations (related to human perception) necessary to transform perfect geometry into perfect beauty [6].

2 THE BEAUTY OF COMPLEXITY OF ARCHITECTURAL IDEA

The famous Vitruvian triad determines the most significant values of architecture considered throughout history of civilization. *Utilitas, firmitas et venustas* – the three principles that stem from human understanding of the environment, both natural and one being the result of man-made artifacts and entities. These principles offered short but accurate description of the nature of architecture – connection between inanimate objects and space imbued with purposeful thoughts and actions of people. It is important to see the intellectual domain as an integral part of the environment, despite the fact that it was obscured by modern rev-

olution in the 20th century. This transformative perspective is necessary to explain the erosion of holistic interpretation of architecture so prevalent in classic, ancient times, and hence the absence of complexity issues until they modestly reappear at the turn of the 21st century with works by Christopher Alexander [7] and those by Michael Mehaffy with Nikos Salingaros [8].

It is significant because architecture is, obviously, connected to architectural theory and its philosophical background, it is immersed in multi-science domain, making the meeting point for sometimes seemingly contradictory aspects of real life as well as scientific viewpoints. Therefore, the deformation of architectural principles affects the interpretation of the theory and is reflected in simplification of perception of architecture, in the end leading to misunderstanding and misdirecting contemporary thinking. *Utilitas*, *firmitas*, and *venustas* have been replaced with new ideas of function, structure, and form. While it may seem innocent, it replaces fundamental and abstract values with their restricted, fragmentary substitutes. Function is not an equivalent of usefulness – it is its contemporary, thus temporary, manifestation. Structure doesn't equal *firmitas*, because structure is only appearance, an effect of complex process of architectural embodiment. Finally, the term "form" is not compatible with *venustas*, even apart from etymological roots of "beauty" reflecting the feature of an object being saturated with particular universal value.

It is the understanding of unity of things exemplified in Stuart Burgess analysis of the beauty of peacock's tail [9]. The aesthetic complexity is the result of multiple coordinated phenomena: the shape, material, reactiveness to light, beholder's eye structure, light transmission, bird's movement and behavior. The perception is reduced to the admiration of shapes, variety of glittering colors, namely optical effects produced by thin-film interference, but comprehension of this phenomenon is impossible without seeing the emergence of the beauty from joint impact of multiple factors, some of them physical, others ideological, derivatives from human contemplative approach to reality. The conceptual pattern hidden in reality is exposed by Murray Gell-Mann, who points out that the organization of the universe is recognized in the balance between regularities and irregularities in information chains coded in living species and inanimate things [10]. Gell-Mann finds this self-regulating balance in the organization of complex adaptive systems. While he points towards the ability to process regularities and produce (or re-produce) schemes prolonging either life itself, or its modes of organization, what is interesting is innate imperfection of the system, which is required to allow for change, for adaptation, for improvement and re-adjustment to changing conditions. Architecture, being human creation, mirrors these schemes, and also mirrors the innate imperfections which at the same time bless architecture with ability to thrive, transform, adapt, as natural systems do.

Dealing with the idea, with the information, is what defines the start of emergence of architecture – from the intent to the embodiment. Necessity to organize patterns of social life is reflected in architecture in a selective way, however still conforming to the principles of complex adaptive systems. It requires, however, both regularities converted into schemes and imperfections retaining the system as an open one, indeterministic, self-organizing. While the former is often apparent and clearly recognized, e.g. patterns recognized by Alexander's team [11], the latter is rarely seen as inherent or positive force of architecture. Here it is important to make distinction between, what Alexander describes as "dead" or "bad" patterns, and irregular patterns which are test platforms for change and in-programmed instability, because only these atypical schemes are responsible for vitality and validity of the system (of architecture).

The beauty of the architectural idea lies in complexity of the concept mirroring what the idea attempts to define, solve, what it strives to anticipate – and its aesthetics is an integral component of thinking, also outside of aesthetic criteria of designed object. It is more the beauty of integrity, unity, than beauty of appearance. Appearance is only a robe, a skin that tells us how profound this complexity is and how it affects external, formal aspect of architecture, how it build "architectural experience". As we know, this experience is not constrained to superficial reception of building or space – its anchored in constant perceptive mechanisms, in continuous life experience. This is well explained by Helmut Leder et al. in their model of aesthetic appreciation and judgment, in which they emphasize context and input for experience, perpetuality in performing analyses, implicit memory integration, explicit classification, evaluation, and affective / emotional processing [12]. Subsequent steps of this experiencing may be determined as, respectively, external, objective or semi-objective/independent factors corresponding to context and input, unceasing process (perpetuality), cumulative comprehension of reality, resultant from integrating memories, and often comparative processes which can be linked to classification and evaluation. In other words, we simultaneously perceive and assess, and both integrated activities are producing our comprehension of the nature of things – the evaluation of their beauty. The creative process, e.g. architectural designing, is simply mirroring appreciation and judgment – it also uses spatial and temporal context and multiple sources of input, it requires constant re-evaluation due to wicked nature of architectural problems [13], it enacts inner memory, social memory, and semiologic code (which could be associated with sedimentation of social memories inscribed in abstracted signs) [14]. This wickedness, these irregularities are generators of the random, nodes of emergence, loci of opportunities which sometimes lead to errors, but sometimes allow for creation of a masterpiece. The imperfection assures this evolutionary bias, reflecting our evolutionary thinking also in perceptive and aesthetic spheres of our connection to reality. As Paul Hekkert writes, patterns generated by humans have this innate trait of adaptivity [15], and hence any architectural idea also contains elements of unpredictability, random results, with perpetual adaptivity.

3 THE BEAUTY IN ARCHITECTURAL FUNCTION

Function is the aspect of architecture that is immediately associated with usefulness, with practical performance of space. It is expected to provide the content, the result of transposition of an idea into something working, something practically responding to requirements. Function represents the role of space of becoming socially driven vessel, containment for different processes and interactions for which function-related labels are merely signaling the purpose – to give an example of such performance one may still refer to what Graham wrote on the purpose of architecture. He argues rightfully that while there is an initial purpose in the inception of piece of architecture, it is not permanent, it changes. At the same time he points out that future change of purpose or even seeming lack of thereof does not change this core value of architecture attributed to inherent potential of having a purpose [16]. Contrary to Graham and other researchers like Scruton, however, I would like to propose viewing particular sites as more than just arrangements in space conceived for admiration as they claim in case of those non-architectural places. Particularly I insist on rejection on Karstin Harries simplified interpretation of decorated shed, architecture reduced to the role of container [17]. Even if this is eligible from the perspective of designer allowing for specific approach to architecture as boundary, permissible for out- and inflows, restrained to determination of how transition between outside and inside grants the architect a comfort of dealing with limited number of problems, similarly to temporal aspect of architecture it doesn't refute unity of shell and content.

Function embodies specific architectural code inscribed in building to fulfill the tasks defined by the idea. It is not the set of volumes strung on some lines representing use-related patterns. These are more meaningful chambers conveying different messages, in good cases coherent with the entity, in bad ones dissonant. Herein evaluation appears, our perception of "appropriateness" of the function, connected to the appreciation of beauty of functional structure. Function is strong reference to beauty of the object, it initiates assessment and is inseparable from aesthetic principles, although not necessarily must play primary role [18]. Function brings understanding of internal structure, it brings comprehension of unifying qualities which make purposeful chains valid and beautiful. There are simple questions illustrating this unity – can we ignore aesthetic component in how function is distributed within architecture? Can we avoid calculating the importance of aesthetics of linking volumes in particular sets or chains to facilitate specific uses? Aren't these chains manifestations of inner order, profoundly connected to the beauty of spatial arrangements?

If we are unable to find answers instantly, the unstable elements of functional program of architecture give us the clue about the relevance of beauty. While idea quickly becomes something blurred or even fades, function remains, but fluctuates or at least is prone to fluctuations. This openness of functional program is unable to include all implicit possibilities of use, yet designed space purposefully or intuitively provide these possibilities, makes architectural object to deny any attempt to achieve equilibrium and promotes contained or forced self-organization. Alterations in program explore ability of architecture to absorb and use specific connection between program and volumes. While idea is responsible for insertion of intended elements as well as, function exhibits human-related order of architecture, the order of human interactions and processes.

4 THE BEAUTY IN COMPLEX STRUCTURE

Structure is different from function (and idea) significantly in that, apart from the processes of decay and decomposition, it is usually fixed and its potential capacity most often does not involve reconfiguration. The backbone for architectural form, structures do not divert from developing the aesthetically loaded constructs. If natural beauty is taken into account, it is next to impossible to point out any element which would be stripped from aesthetic content, although this content can be interpreted within the autonomy of any part, within the connection between part and entity, as well as within entity perceived in its entire spectrum of existence.

Interestingly, structural thread of these considerations reveal relationship between physical construction and (abstract) problem of truth. The architectural structure must follow rules of logic and support the performance – distribution of atoms support the rigidity of a crystal, leg bones assure dexterity and appropriate movement of a cat, structural veins of moth's wing granting lightness, flexibility, and extremely good aerodynamics. The elements of construction in architectural object play similar role and also express the purpose, the logic, the justification for existence. This kind of rapture becomes integrated on the field of bionics and bionic design, implying its Latin meaning – the way of life. In this way truth of life is revealed, natural laws get exposed, and examination of natural world and purposeful design of sophisticated structure for architectural building have this urge to understand universal principles and the science of the world in common. While idea is inherently complicated and function has little possibility to avoid similar trait, while form may be independent, structure is a component prone to optimization [19]. The nature, being the reference for humankind, shows how to compress, to use as little material as possible, how to innovate with materials [20]. Lan Ma reviews different levels and layers of implementation of bionics, and

determines also its structural importance [21], and what can be seen is intuitively appre-hended image of fascinating energy distribution of the system. Guy Battle and Christopher McCarthy describe it as sculpting with energy [22]. It may be easily observed in Antonio Gaudi's work for la Sagrada Familia, the hanging chain model of gravity lines turned upside down to expose the optimal energy distribution of the system necessary to be converted into physical, loadbearing matter [23].

So is there a beauty of structure? And if so is beauty an aesthetic concept or holistic con-cept in which one cannot separate the aesthetic component from the purpose and the performance of the object? Architectural structure may not be seen, but regardless of its vis-ibility it is intuitively assessed, examined in terms of truth versus lie or disguise. Contemporary architecture, using more organic, sculptural and also total forms in its appearance is, to some extent, a reflection of natural world, an imitation, sometimes a simulacrum, purposefully transformed and adjusted. And the language of new forms is in fact a closer approximation of the nature, the import of natural complexity integrated in shape – one which contains func-tion, provides shell for the content, supports itself. Structure doesn't change or change a little, but this doesn't disprove its share in complexity – the compactness, thinning down structural volume only ever allows for acquiring sophisticated, yet purposeful architectural shells. This co-evolutionary trait and connectivity linking fixed or mobile but sustaining structure to other components probably was never sufficiently explored. Structure adds logic of physical, mate-rial organization as reflection of human-related organization of spaces. Function is rightfully seen as "negative" of structure – matter separating or joining contained processes. Thus it becomes clear that instead of dichotomy these aspects explain the same idea, one following the other and *vice versa* – without any precedence.

5 COMPLEXITY OF ARCHITECTURAL FORM

It seems that understanding of complexity of form is the most apparent, simple task in com-parison to other components of architecture. However, at the same time, the notion of form is burdened with aesthetic content apparently replacing and erasing any competition. Form, if not restricted to shape resultant from construction, is seen as decorative, serving the purpose of admiration. This narrow view can be easily refuted by parallel to natural world, because after all social groups have some behavioral similarities to what can be observed in nature – the sense of place, urge to congregate and socialize. It's attractive abilities can remind of tree perfect for providing observation point for birds who appear there in flock (let's treat it as metaphor, not a literal association, with all provisions given by Bruno Latour while discuss-ing social interactions and distinctive nature of human experiential and cognitive abilities in such interactions [24]).

While many people interested in architecture may perceive that its output is brave and avant-garde, and that architectural trends are set by designers and their inventive, creative inner-selves, it is the opposite. The majority of architectural forms, even if produced by world renown brands, generate functional buildings, and just few are planned to be architectural icons – through careful process of economic planning, site selection, budget construction etc. Special conditions must be met to allow for such a result, and then the role of an attractor, a gathering point, a place to be in, to engage socially, is the major factor justifying any fanciful attributes architecture can have formally. So this apparent fancifulness is a result of complex interconnected social, economic and spatial processes usually far from being whimsical, even if we acknowledge some failures or exaggerated spendings. Processes are embodied in form which reflects all these phenomena in a sophisticated, complex manner, filtered through designer's interpretative imagination/thinking, transposed into structure and shell intended to

express the meaning, the content, and the promise of undetermined occurrences. Fortunately not all criteria must be reflected in equally masterful way and there is no need for any standard or dogma, but still holistic approach to beauty, called by Mike Schlaich "elegance" [25], is required. And architectural form triggers or responds to some social behaviors, accommodates them (by its attractiveness) or even creates. It is much more important for a form to have an implicit meaning, influence, and associative powers, than to express shape, color, and material, although the latter are necessary to convey the former.

The architectural form is addressed to everyone ready to receive signal, message, and to process it, interpret, evaluate – it is not admiration *per se*, it is instant comprehension of inner complexity of form as a reflection of interwoven threads of reality, again.

6 PROFOUND PERCEPTION OF COMPLEXITY?

We have reviewed different aspects of beauty of architecture and architectural entities. Vitruvian triad has been extended to initial component of architecture – the idea (ideological content). The inclusion of an idea is herein postulated as compulsory, because the immaterial is equally important in architecture and influential for its existence and performance as remaining, traditional virtues discussed in the ancient times by Vitruvius. The code to decipher this beauty is complexity, or maybe it would be more precise to say that beauty is what emerges from perceiving the code of complexity. Architecture doesn't mimic socio-spatial reality, it interprets it and exposes coherent (or incoherent) vision of social organization and uses tools defined as principles of complexity [26].

Architecture emerges from idea through purpose (function), and then it is nested within structure and manifested by form – forming link between immaterial and material, psychological and physical, mind and body, completed with subjective, personal experience acquired through reception of integrated entity. The user, the recipient, the observer receives instant, compacted information containing traits of all these four components. The perception of beauty becomes a discovery of truth hidden within social and cultural patterns, of how they work, how they interact and how they are composed into systems or sub-systems, analogous to complexity of universal, natural clusters or systems. This phenomenon touches human beings as well as constructs or other objects. Emilio Del Giudice and Alberto Tedeschi notice that human beings, as other living organisms, are coherent systems open to the external world and consequently be able to tune their own oscillations with the fluctuations of some part of the Universe [27] – and the feeling of beauty may be therefore interpreted as the decoding of this connection. Architecture becomes a vessel for anthropic perspective of understanding the sense of being, the sense of coherency present in all-encompassing, unified reality – all layers of this reality recognized with transdisciplinary approach required to understand holistic image: it builds the ontological axiom, the logical axiom, and the complexity axiom, as Basarab Nicolescu puts it [28]. The beauty is the knowledge of interdependencies (having similar properties to scientific knowledge, inherently contaminated with subjective perspective of a researcher – there is no objective science, only objectivized, although we strive to achieve this objectivity), simultaneously internal and external [29].

We observe in architecture (and in architectural objects) what Michael Baranger writes about complexity: non-linear interaction of constituents (or components), their interdependency, multi-scalar structure, generation of actions or behaviors, integrated connection or unity of chaos and order (which Baranger calls non-chaos), coexistence of competition and cooperation – integrated reinforcing or weakening impact of architectural factors [30]. And

when Stanley Stein and Michael McMordie critically assess the loss of central role of beauty, they imply not the superficial concept of beauty, rejecting the formalistic approach to this notion. They quote an important thought once put forth by Ludwig Wittgenstein referring to common attributes sought for in human rapture with reality that it is similarities and relationships [31], not repetitive, common patterns that build multidimensional experience of beauty – people communicating their understanding of nature enriched by social and cultural patterns through architecture, to each other and with the purpose to mark their presence. The imprint of primal, natural imperative can overcome limitations of assessment and knowledge as phenomena attached to particular spatio-temporal reality, thus to particular moment and particular being – because they have universal framework.

It is hard to believe that this approach to the notion of beauty can conclude or narrow down the discussion on how beauty should be interpreted. However, too many interpretations are fragmentary, focused on limited concept of what architecture is, particularly when it is perceived as formal expression of inanimate matter in which proportions or even mathematical relationships are treated instrumentally without looking for their hidden meaning. I would argue that architecture which is the unwanted muse among others, those who are representing seemingly more autonomous arts, requires more profound perception, and that this perception can be achieved through complexity and its principles. It seems that this framework and multi-layered picture of complexity and its image – the experience of universal beauty – can, to some extent, help overcome multiple apparent contradictions within the theory of architecture.

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