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Beautiful tectonics – Corporeal aesthetic in tectonics as sustainable parameter

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ABSTRACT: This paper investigates corporeal aesthetics in tectonics as sustainable parameter. Today, the focus on reducing CO2 emissions has led to stricter insulation demands and, as a result, thick dimensioned outer walls, floors and roofs. Frequently, the result is that structural elements are hidden in a thick layer of insulation, and tectonic features are veiled in gypsum boards with poor material and tectonic character. This paper aims at presenting structural principles and tectonic articulation as an aesthetic significant part of sustainable building culture. Research conducted by a design proposal is investigated and analysed. It is argued that bodily absorbed, aesthetic knowledge of materials properties, structural elements and tectonic articulation may give people a feeling of connectedness to the world – and, by extension, inspire them to take better care of the house and consequently the world's resources.

1 INTRODUCTION

Through history, the importance of tectonics as a critical part in the work of architecture has changed. In traditional architecture as well as in the works of modern architects such as Wright, Perret, van der Rohe, Kahn, Utzon, Scarpa and others, the consideration of structural elements and tectonic articulation has been an integral part of architectural design (Frampton, 1995). Today, the focus on reducing CO2 emissions has led to stricter insulation demands and, as a result, thick dimensioned outer walls, floors and roofs. Frequently, the result is that structural elements are hidden in a thick layer of insulation, and tectonic features are veiled in gypsum boards with poor material and tectonic character. Furthermore, development in digital culture that accelerates vision as a privileged sense (Pallasmaa, 2000) has resulted in architecture designed as shallow pictures intended to be experienced quickly on a computer screen in a constant flux of competing pictures empty of any understanding of material qualities or a meaningful relation to gravity. The structural hierarchy seems to disappear, and tectonic articulation becomes blurred. In contemporary building, it seems as if material understanding and tectonic knowledge have disappeared as part of the architect's vocabulary and, by extension, as a sustainable parameter. Poor tectonics weakens architectural experience and hence the incitement to take better care of the house and, consequently, the world's resources.

2 BACKGROUND AND RESEARCH QUESTION

General architectural practice today seems to be influenced by increasing economic pressure from the construction industry. As pointed out by Hvejsel et al. (2015), 'everyday architecture' that is characterized by poor materials and bad detailing is often considered 'a-tectonic'. The narrow focus on reducing CO2 emission leads producers of insulation to recommend 285 mm insulation (0.14 W/m²K) for a traditionally constructed lightweight outer wall and 335 mm insulation (0.12 W/m²K) for a new building energy class 2020 (Rockwool, 2016), thus hiding structural elements and weakening tectonic articulation.

This paper regards durability as essential in sustainable building culture. As a consequence of the economic model developed by Georgescu-Roegen (1971), keeping material in a system as long as possible is a way to slow the degradation of natural resources. However, today, only technical questions seem to be addressed, whereas functional and, in particular, aesthetic questions concerning durability seem to have a secondary role. As argued by Andersen (2017) in continuation of Vitruvius (1914), sustainable building culture may be understood as a synthesis of three parameters: technical quality may support a long physical life of the building, programmatic adaptability may ensure the building is used in accordance with the changing needs and architectural quality, understood as heritage values and experiential qualities, may allow for aesthetic durability.

This paper aims at presenting structural principles and tectonic articulation as an aesthetic significant part of sustainable building culture. A house interpreting a basic structural principle is designed and investigated. The assumption is that a characteristic structure and tectonic articulation may contribute to reinserting the human scale and the felt body as a measure for architectural quality – and, by extension, that bodily experienced, aesthetic perceived tectonics may inspire durability.

First, research conducted by a design project for a small building is presented. The house has an open plan and a characteristic internal structure inspired by traditional building techniques and typology (building form). The design permits multiple uses and allows the characteristic roof structure to be experienced independently of the thickness of the insulation. Second, the perception of the building is described seen through a phenomenological-hermeneutic lens. It is pointed out that the characteristic roof structure and tectonic articulation experienced through sensing or affective involvement may allow a corporeal communication between the body of the house and the body of the perceiver. Third, this feeling of identification is discussed in relation to the question of sustainability. It is argued that structural clarity and tectonic articulation through sensing or affective involvement may give the perceiver a feeling of meaningful connectedness that may inspire maintenance and, as result, slow the degradation of material resources.

The question is how structural clarity and tectonic articulation (again) can be meaningful in architectural design. How can the perception of structural clarity and tectonic articulation be described? In what sense may this perception be sustainable? In other words, can “beautiful tectonics”, which is understood as bodily felt, aesthetic perception of structural hierarchy, and tectonic articulation have a sustainable potential?

3 RESEARCH METHOD AND SELECTION PROCESS

According to the EAAE Charter on Architectural Research, “Architectural research is original investigation undertaken in order to generate knowledge, insights and understanding based on competencies, methods and tools proper to the discipline of architecture” (EAAE, 2018). As design is the essential feature in architecture, research in which design is part of the process is called research by design. In research by design, EAAE (2018) points out, “the architectural design process forms the pathway through which new insights, knowledge, practices or products come into being”.

In continuation of this, the research method of this paper is a 'reflective practice' as described by Schön (1986; 2001). Here, continuous action and analysis is performed when a practitioner is working with a complex and/or unique problem. It concerns the experience of the architect, the understanding of the specific situation and a reflection on the presumed outcome. Central to Schön’s understanding is 'knowing-in-action', the general, practical knowledge we exhibit in our intelligent, physical performance; 'reflection-in-action', in which experience, knowledge and intuition work in interchange with action, and 'reflection on reflection-in-action', which is the retrospective analysis, which again indirectly may influence a future action. In a 'reflective dialogue with the situation' in a larger 'network of choice', the reflective practice investigates the so-called 'Normative/ Descriptive Design Domains', in this case relating to technical matters that are expected to have a sustainable potential in building culture. The reflective practice as a method is assumed to be able to handle the complexity and unique character of the architectural project.

The design is inspired by the traditional timber-frame house and the tectonics of wood. The properties of wood, basic structural principles and the tectonics of joinery including stabilizing

diagonal ties and struts make the foundation of the architectural design. Wooden construction has many advantages in modern building practice (Hegger, et al., 2006). Wood is a renewable building material that is very durable when used correctly. The material is universally available and easy to work. Wood has a high CO2 storage capacity and an excellent material cycle performance. In addition, the design is inspired by the traditional barn house typology (building form). In Scandinavia, the single-room, long house has been known since prehistoric time (Faber, 1963). The traditional elongated, adaptable plan often has a characteristic interior structure as a consequence of the structural system. In modern times, agricultural buildings with a similar layout have proved to have the longest lifespan (Østergaard, et al., 2018), possibly because of the adaptable plan.

The project material consists of a set of simple drawings that present the interior timber structure and the exterior figure of the house (Figs 1-4). Questions concerning the place and use as well as cladding, colour, textural quality and light conditions have been left out in an attempt to focus solely on the structural and tectonic motifs. The aim has been to design a simple, adaptable space with no interior loadbearing walls but with a characteristic, visible construction. Although the project is not built – and, therefore, does not contain the level of complexity of a completed work –, the design is assumed to reflect authentic architectural knowledge.

First, a series of freehand sketches and sketch models have been done. Second, the design has been developed in AutoCAD. Third, the drawings have been processed and completed in Illustrator and Photoshop. The shape of the building and the construction principle have been continuously adjusted through the working process in close consideration of the spatial character. The projected draft has been continuously evaluated in relation to the motif and either refused or adjusted and finally accepted when the design is recognized to synthesize the individual elements into a new architectural whole.

The second part of the investigation is an analysis and reflection on the architectural project, or a 'reflection on reflection-in-action', which is also called 'reflective research' (Schön, 1986; 2001). The first part of the analysis – which in itself may be understood as a production of architectural knowledge – is considered as empirical material, which is analysed seen through a phenomeno-

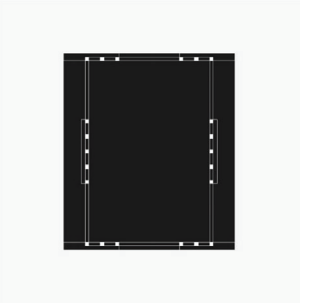

Figure 1. Plan.

Figure 2. Cross section.

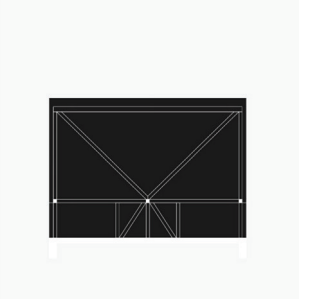

Figure 3. Longitudinal section.

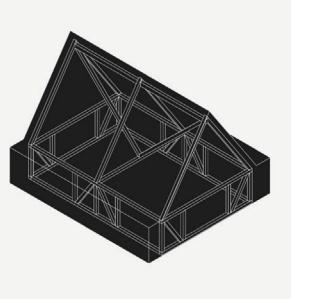

Figure 4. Axonometric projection.

logical-hermeneutic lens (Andersen, 2018). First, the architectural phenomena are experienced. Second, the phenomena are described. Third, the phenomena are discussed hermeneutically. The aim is to identify and uncover architectural properties that may characterise beautiful tectonics – in order to make them operational in future architectural design processes.

Finally, the architectural design project developed as a 'reflective practice' and the subsequent reflection and hermeneutic discussion define a basis for outlining strategies for an architectural practice for a future sustainable building culture.

4 THEORETICAL FRAMEWORK

4.1 *Aesthetics*

The concept of aesthetics was founded by Alexander Gottlieb Baumgarten (1954) who defined *noeta* as the object of logic, whereas things perceived was defined as the science of *aesthetic*. Baumgarten does not consider logic and aesthetics as contradictory, but rather as two mutually complementary ways to knowledge. For Baumgarten, aesthetics is not just a matter of taste, but rather a scientific question: *episteme aisthetike*. Aesthetics is thus the philosophy of aesthetic knowledge identified with the experience of beauty.

Corresponding to this, Heidegger (2011a, p.127) describe the work of art as aesthetic knowledge, but on its own premise, "*a becoming and happening of truth*". Describing a painting of a pair of peasant shoes, Heidegger argues for them to be understood both as a thing in itself, equipment that may be used for walking as well as the unconcealment of its Being. Art is about beauty, not in the banal understanding of the word, but rather as a question of disclosure. To Heidegger (2011a, p.116) "Beauty is one way in which truth essentially occurs as unconcealment". In continuation of this, Gadamer (2004, p.84) points out that "art is knowledge and experiencing an artwork means sharing in that knowledge".

In continuation, this paper understands aesthetics not as based on judgement or semiotics but rather as aesthetic knowledge. It is about transcending the categories subject and object in favour of understanding art and architecture as an event taking place in the meeting between the body of architecture and the body of the perceiver.

4.2 *The body*

Hermann Schmitz (2017a; 2017b) takes the body as the basis for the conception of human experience, distinguishing the material body from the felt body. The material body is what we can see and touch, whereas the felt body is the location of affective involvement which manifests itself in corporeal impulses. According to Schmitz (2017b), what is phenomenologically given is the felt body in its dynamic tendencies of 'expansion' and 'contraction'. In the basic, non-reflective form of the body, the five basic existential dimensions of here, now, being, this and I, are fused together in 'life in the primitive present'.

To Schmitz, the often nonspecific, diffusely localised corporeal feelings oscillate between corporeal expansion and contraction in a pulsating rhythm without drawing on the material body or the five senses. The corporeal feelings are impulses like fear and pain; emotions like happiness and sadness; perceptual movements like breathing in and out and perceptual directions like the extension of the gaze. Corporeal communication takes place when a body is absorbed by a corporeal dynamic that connects it with the surroundings; it may be another body or a physical object. According to Schmitz (2017a, p.122), the body is a "resonating antenna spreading and absorbing feelings as atmospheres". The communication is taking place through movement in itself or suggestions of movement in objects (whether static or in motion) and through synesthetic characters, i.e. form or colour associations. By means of suggestions of movement and synesthetic characters, the corporeal feelings as atmospheres are strengthened or lowered through pure sensation or affective involvement. As a result, bodily communication makes situations, defined by being whole, meaningful and complex.

In continuation, this paper understands architecture as an event taking place as communication between the body of the perceiver and the body of the building. The space of the felt body is – in contrast to the abstract Euclidian space (x,y,z) – defined by the downward pull of gravity and the upward push of the standing body; in front of and behind; to the one side and the other.

4.3 *Tectonics*

Structural principles and tectonic articulation in this phenomenological understanding is one way in which communication through the suggestion of movement is taking place. Tectonics may be described as connecting materials in accordance with their technical properties. Heidegger (2011b, p.253) points out that to the Greek *tikto* means "to bring forth or to produce". The Greek word for technique means neither art nor craft but rather "to make something appear, within what is present, as this or that, in this way or in that way" (Heidegger, 2011b, p.253).

Gottfried Semper (1989) distinguishes between the tectonics of the lightweight frame and the heavyweight stereotomics of the earthwork. To Frampton (1995, p.2), tectonics is a fundamental parameter in architecture arguing that "[…] the built invariably comes into existence out of the constantly evolving interplay of three converging vectors, the topos, the typos, and the tectonic". Eduard Sekler (1965) argues for understanding architectural experience as a totality nourished from a 'fullness of being' and not only intellectual understanding. Manelius (2012) applies Sekler's model for tectonics and specifies it to concrete emphasising the expressed quality and the clarity of the constructed, structural principle.

In the Master's Program in Architectural Heritage, Transformation and Conservation at The Royal Danish Academy of Fine Arts, the term tectonics is used to describe the art of constructing a space by joining materials according to its properties aiming at an experiential effect (Andersen, 2015). Three different principles are used: the tectonics of joints describe lightweight linear components, e.g. wood or steel, connected in the corners using the forces of tension and compression to create a spatial matrix. The tectonics of stacking describe heavyweight materials, e.g. bricks or stone, stacked in bond using gravity to lock the individual elements into a solid structure. The tectonics of casting do not determine, as opposed to the former two techniques, the form since it is created by pouring a liquid material, e.g. concrete or plaster, into a formwork. The tectonics of joints define the space as an open geometric matrix making it necessary to have a secondary element, originally wickerwork, to close the space physically, whereas the tectonics of stacking and the tectonics of casting simultaneously defines and closes the space using the same material.

Gadamer (2004, p.313) points out that the Greek understands *techne* as "the skill, the knowledge of the craftsman who knows how to make some specific thing". In this paper, tectonics is thus understood as meaningful production that presents matter processed in a specific way and connected according to material properties. Eventually, tectonics is a question of meaningful understanding of the world. In other words, in this paper, tectonics is understood in a broad sense as the synthesis of technique and aesthetics where the qualities of materials processed in a specific way and connected according to its properties creates a spatial character that through bodily experience creates meaning.

4.4 *Sustainability*

Sustainability and the concept of circular economy seem to have gained momentum in academia as well as in architectural practice. However, there seems to be many different understandings of what it means, including the ideas of 'design for disassembly', 're- and upcycling', 'life cycle scenarios' as well as 'transformation and conservation'.

The concept of sustainability is defined in the Brundtland Report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN, 2018). In the widest sense of the word, sustainability is to "promote harmony among human beings and between humanity and nature" (UN, 2018).

Georgescu-Roegens (1971) flow-fund model of production, inspired by the laws of thermodynamics, describe the earth as a closed system. Energy, but not matter is exchanged with the rest of

the universe. Nothing is created and nothing is destroyed, only transformed. Inside the system, natural resources flow through the economy and end up as waste and pollution. Recycling of material resources is possible, but only by adding additional energy and material resources. Consequently, it may be argued that resources must be kept in the economic system as long as possible. In other words, to slow the degradation of natural resources (the entropy law), reuse is better than recycling that again is better than single use.

As proposed by Kirchherr et al. (2016, p.224-225), the circular economy may be defined as "[…] an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes […] with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations". The authors recommend that the gradations proposed by van Buren et al. (2016) may serve as a starting point for future deliberations on circular economy. This definition comprises a hierarchy of nine R's: (1) Refuse, (2) Reduce, (3) Reuse, (4) Repair, (5) Refurbish, (6) Remanufacture, (7) Repurpose, (8) Recycle and (9) Recover energy (van Buren et al., 2016, p.3).

In continuation, this paper regards durability – i.e. keeping material resources in the building system as long as possible as a way to reduce – as an essential principle for sustainable building culture, superior to reuse, recycle and recover. As pointed out above, sustainable building culture may be understood as a synthesis of technical quality that may support the long physical life of the building; programmatic flexibility that may ensure the building may be used in accordance with the changing needs and architectural quality that may allow for aesthetic durability, i.e. longevity due to corporeal communication.

5 RESULTS AND ANALYSIS

5.5 *Architectural design*

In wooden construction, stability in every direction is achieved through either diagonal ties and struts or stable wall plates – alternatively stability is secured through solid cores extending through all the floors (Deplazes, 2009). Geometrically, this stability is represented by the triangle, the simplest stable structural configuration. The design proposal for a house (Figs 1-4) is an architectural interpretation of this basic structural principle. The building has a rectangular plan and a pitched roof with a high incline. The interior is a single, adaptable space with no internal loadbearing walls or columns. The external walls are loadbearing and stable by means of a traditional timber-frame construction with diagonal braces in the plane of the wall. Two bays of posts and braces in each direction create the structural and stabilising system of the walls. Two large internal timber triangles, one inside the other, ties the structure in each direction and secures stability as the only visible structural elements inside the interior space.

The functionally adaptable interior space allows secondary elements such as walls or volumes to subdivide the large space and accommodate functions such as a kitchen and bath. Secondary spaces, porches and pergolas may be attached as elements outside the principle structure. Joints are made as traditional wooden joints, except the metal fitting in the centre of the house connecting the two large triangular beams.

5.2 *Phenomenological description*

On the one hand, the low first floor and attached pergola give the exterior figure of the building the impression of resting calmly on the ground. On the other hand, the sharp pitched roof with a high incline gives a feeling of an excited rise towards the sky. Internally, the contracting feeling of the longitudinal and transverse beams in the timber roof structure ties the longitudinal and transverse expansion of the space created by wall openings between the bay elements together. The sideway feeling of stability of the triangular roof is balanced with the perpendicular triangular configuration of the internal structure. The upward feeling of pull inside the tall, pitched space counteracts the

downward feeling of push performed by gravity. As suggestions of movements the exterior figure and the interior space in combination with the structural principle and tectonic articulation performed by the material properties of wood give the house an ambiguous feeling of 'rest' and 'rise', 'contraction' and 'expansion', 'pull' and 'push'. These double tendencies balanced in one single structure give the building a feeling of perfect, dynamic balance.

As described above, corporeal communication takes place between the body of the building and the body of the perceiver when absorbed by a corporeal dynamic. In this case, structural elements and tectonic articulation communicate with the human body by means of suggestions of movement. Through pure sensation or affective involvement, the building investigated gives the perceiver a corporeal feeling of dynamic equilibrium.

6 DISCUSSION

The question is how structural clarity and tectonic articulation (again) can be meaningful in architectural design. As an architectural design object, the design of the house is always unique. The design process is non-linear, not repeatable and the result cannot be verified in a scientific way. Furthermore, an architectural design in drawing does not include all the aspects of a build project. As mentioned above, the aspects concerning place and use as well as cladding, colour, textural quality and light conditions have been left out in an attempt to focus solely on the structural elements and tectonic properties. Nevertheless, the design presents one way in which a building with an open plan and a characteristic structure, inspired by traditional building technique and typology (building form) may be designed. The house permits multiple uses and allows the characteristic structure and tectonic articulation to be experienced independently of the thickness of the insulation. The design proposal is one way in which structural clarity and tectonic articulation (again) may be meaningful in architectural design.

How may the perception of structural clarity and tectonic articulation be described? In continuation of Schmitz, corporeal communication as resonance takes place between the body of the perceiver and the material, structural and tectonic properties of the house. As Pallasmaa (2005, p.64) points out, the "authenticity of architectural experience is grounded in the tectonic language of building and the comprehensibility of the act of construction to the senses". A 'bodily identification' is taking place when the body is in a dialogue and interaction with the work of architecture. The loadbearing columns relate to the bones allowing the body to rise up against gravity. Ties resonate with muscles and tendons absorbing tension and assisting the body to keep balance. Natural forces perceived as 'rest' and 'rise', 'contraction' and 'expansion', 'pull' and 'push' resonate with the felt body. Sekler (1965, p. 92) points out that it is all about "the tectonic statement: the noble gesture which makes visible a play of forces, of load and support in column and entablature, calling forth our empathetic participation in the experience". Thus, the human body identifies with the structural elements and tectonic articulation through suggestions of movement as resonance.

The house thus presents one way in which a characteristic structure and tectonic articulation perceived through sensing or affective involvement may cause communication and identification between the body of the house and the felt body of the perceiver. As pointed out by Gadamer (2004, p.113), experiencing a work of art is a transformative process that changes the object as well as the perceiver since "one knows and recognizes something and oneself". Through corporeal communication, the perceiver understands something, in this case the properties of wood, structural forces and tectonic knowledge. Ultimately, the perceiver understands themselves as a part of the world.

As pointed out above, aesthetics is the philosophy of aesthetic knowledge identified with the experience of beauty. Referring to Plato, Gadamer (2004, p.476) points out that "The beautiful is of itself truly "most radiant" (to ekphanestaton)". In continuation, beauty in the case of tectonics may be defined as the corporeal feeling of clarity we may experience through pure sensation or affective involvement when we understand the qualities of materials processed in a specific way that is connected according to its properties and creates a meaningful spatial character.

Therefore, in what sense may this corporeal connection support a sustainable development. It may be argued that identification and understanding through sensing or affective involvement may

make maintenance, repair, reuse and, as a result, longevity more likely. If this is true, then structural clarity and tectonic articulation through sensing or affective involvement giving the perceiver a feeling of meaningful connectedness to the world may assist in keeping materials in the system longer and slow the degradation of natural resources.

7 CONCLUSION

The question is can 'beautiful tectonics' be understood as a bodily felt, aesthetic perception of structural hierarchy and tectonic articulation have a sustainable potential. As argued above, material properties, structural principle and tectonic articulation may allow bodily communication as resonance through sensing or affective involvement. Bodily identification between the body of the house and the felt body of the perceiver may create meaningful situations that may be repeated over time. Thus, bodily absorbed, aesthetic knowledge of materials properties, structural elements and tectonic articulation may give human being a feeling of connectedness to the world – and, by extension, inspire them to take better care of the house and consequently the world's resources. In other words, beautiful tectonics may have a critical, sustainable potential.

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