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Marcin Wójcik
Technological University Dublin, marcin.wojcik@dit.ie

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Counterculture, Ju-jitsu and Emancipation of Wood

Marcin Wójcik, The Oslo School of Architecture and Design, Norway

Abstract
This paper sets out to formulate the notion of material-oriented design in wood. In this respect I propose an alternative ontology, where the material is seen as an equal rights partner to the designer. Further, I contrast the constructivist and evolutionary types of management, where in the latter systems are produced with minimal waste and energy expense. I discuss the implications of the approach on an example of five experimental projects, including my own in more detail. I advance that material-oriented design challenges the established form-matter relationship, design process, our understanding of authorship and bears an environmentally friendly potential.

Keywords
wood; material-oriented design; experimental design; New Materialism; material agency

Our approach to wood in architecture has been affected by the spirits of the Scientific Revolution, Enlightenment, and Industrial Revolution. Considering the material's high strength, low weight, low cost and abundance, “timber remains the world’s most successful fibre composite” (Dinwoodie, 2000, p. 2), nevertheless it has lost market shares as raw material. It is not an optimal material for mass-production processes, due to its variability, inconsistent makeup and difficult to predict behaviour. The methods of wood remanufacture, focused on homogenising and standardising the material, are not without impact on the environment, effect of energy- and chemicals-intensive processes.

Is the raw material really used to its full potential following this model? In the context of arising ecological concerns, are there new efficiencies and effectiveness yet to be discovered? Could the disadvantageous traits be used to benefit? If so, what kind of reference frame that would entail?

The countercultural project
Striving to address these questions I propose to formulate a notion of material-oriented design. The material perspective, however not non-existent, is rare in the design disciplines¹. As a result of the long established hierarchy that has prioritised form over material and idea over its manifestation “material is rarely examined beyond its aesthetic or technological capacities to act as a servant to form” (Lloyd Thomas, 2007). In this context material-oriented design appears as a countercultural project – it opposes the well-established hierarchies and the accepted order.

¹ In architectural theory the perspective started to shift in the mid-2000s. While traditionally materials were concerned either in technical or aesthetical terms, some other perspectives began to come forth: emancipating material as the outright counterpart to form (Weston, 2003), biographies of materials, such as iron (Rinke, 2010), concrete (Forty, 2012), or steel (Fry & Willis, 2015), or contextualising materials vis-à-vis modern technologies (Addington & Schodek, 2005; Fernandez, 2006; Kolarevic & Klinger, 2008; Schröpfer, Carpenter, & Viray, 2011).
I propose to base the project on the metaphysical foundation of New Materialism. The New Materialism discourse acknowledges both human and non-human agency in the production of form and strives to reconfigure and to think past the well-established dichotomies: nature-culture, body-thought, concrete-abstract, subject-object, human-nonhuman, matter-mind, real-ideal, digital-manual, formal-material etc. (Dolphijn & van der Tuin, 2012). The New Materialism proponents, such as Canadian philosopher Brian Massumi (b. 1956) or Mexican-American philosopher and artist Manuel DeLanda (b. 1952), argue in favour of recognition of the potential of matter to self-organise, and see it as a potential path of development for design (DeLanda, 2001; Massumi, 1992).

This, however, cannot be achieved by the existing design methods, not capable of embracing that perspective, e.g. material behaviour as a design potential eludes the means of design, from drawings to building information models (BIM). In order to address the challenge, a change of the frame of reference is necessary. To this end, I try to establish theoretical and methodological frameworks for material-oriented design.

The emancipation of wood

Architectural design is a complex entanglement highly affected by a variety of factors belonging to a wide range of disciplines. The tectonic quality of architecture emerges from the interplay between material, economical, technological, environmental or cultural factors. I propose to look at material agency in this complex interplay.

Material agency

British philosopher and sociologist Andrew Pickering (b. 1948) had formulated a shift in science studies from epistemology to ontology. More specifically, he indicates a shift from representational understanding – being an accumulation of data and knowledge -- towards performative condition characterised by “dance of agency” (Pickering, 1995, p. 21). This dance occurs between both human and nonhuman actors. Pickering sees material agency as undefined, constantly changing in time:

The contours of material agency are never decisively known in advance, scientists continually have to explore them in their work, problems always arise and have to be solved in the development of, say, new machines (Pickering, 1995, p. 14).

Architecture, not unlike science or engineering, encounters resistance and unpredictability of matter. From the designer’s perspective these are seen as inconvenient problems to overcome. In this light heterogeneous material and its behaviour cannot become design potentials. In my view this situation is a result of the long established hierarchy, where material manifestation is below the form and idea, additionally amplified by the 19th century industrial standards where material is passive in the production processes.

An alternative ontology is offered by the actor-network theory (ANT)². In the view of ANT actants are both human and nonhuman actors with equal ability to act. In ANT the concepts of agency and intentionality do not have to be bound together. At the same time, this is neither an anthropocentric nor a hierarchical concept. Central to the theory is a web of relations, being both material -- between things, and immaterial -- between concepts. In order to see architecture through this lens, emancipation of material is prerequisite. Latour describes a nature-culture hybrid that in the context of materiality and architecture may be understood as a synthesis of materials and cultural ideas. I argue that this concept is central to the material-oriented design.

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² ANT was developed in 1980s in France by science and technology scholars: Bruno Latour (b. 1947), Michael Callon (b. 1945), John Law (b. 1946) et al.
In 1990s French philosopher Michel Serres (b. 1930) proposed that objects -- inanimate matter and nature -- become legal subjects. For Serres, this subjectivity of objects is a necessary condition for bringing back the equilibrium to the world facing ecological disaster. As a remedy, Serres proposes natural contract – between human and nonhuman actors, not unlike our social contract – between humans (Serres, 1995). Serres thus linked material agency and ecology.

ANT established science, technology and society as a field of human and nonhuman agency in a symmetrical rather than hierarchical fashion. This approach has the capacity to embrace the unknown arising from the material side by the process of cooperation. Pickering says that “disciplined human agency and captured material agency are (...) constitutively intertwined; they are interactively stabilized” 3 (Pickering, 1995, p. 17).

That approach provided a theoretical framework for material performativity. Michael Hensel extended that formulation into the realm of architecture. In this view architecture is identified as a domain of active agency (Hensel, 2010), where the “spatial and material organisation complex” is defined as a “synthesis of the various scales and their complex interactions” (Hensel, 2011, p. 4). While in the industrial tradition architects and engineers prefer materials that can be considered homogeneous and predictable -- as exemplified by the case of steel and iron -- Hensel postulates dynamic condition required by the spatial and material organisation characterised by active agency. E.g. wood structure must be understood in relation to environmental conditions affecting its growth. Higher in the hierarchical organisation system, material behaviour is determined by the material properties and environmental conditions. This in turn has to be harnessed by architectural design, what is the basis of the “instrumentalisation of material behaviour as performative capacity” (Hensel, 2011, p. 8).

Beyond hylomorphism

Hylomorphism, a concept introduced by Aristotle (ca. 385-322 BC) in his Metaphysics, distinguished between form and matter. Matter -- hyle -- became the substrate out of which all physical things were made, while form was the structure -- morphe -- that gave them their characteristics and attributes. In the view of Aristotelian hylomorphism a thing is a unity of form and matter. This stance, however not seeing material as active in the form-giving process, laid a foundation for materialist approaches and was prerequisite for the recognition of material agency. The often attributed to Michelangelo (1475–1564) proverb: every block of stone has a statue inside it and it is the task of the sculptor to discover it – actually originated in Metaphysics where Aristotle remarks that we can speak of seeing Hermes in the uncarved stone. The mid-20th century philosophy started to question the concept of hylomorphism as being insufficient. In 1950s Martin Heidegger (1889–1976) posited that the fusion of form and matter is additionally controlled by the purposes served by the thing: “[the] serviceability is never assigned and added on afterwards to beings” (Heidegger, 2002, p. 10). The material choice in design is informed by this serviceability. French philosopher Gilbert Simondon (1924–1989) criticised hylomorphism as being based on a hierarchical relation where form is superior to matter and is not concerned with the transformative processes. Reflecting on a make-up of an adze, he points to “the progressive heterogeneity of tempering at certain points”. The gradual change of material properties -- being instrumental in the functioning of the tool -- eludes the dichotomies of form-matter or form-structure, and further:

The tool is not made of matter and form only. It is made up of technical elements arranged for a certain system of usage and assembled into a stable structure by the manufacturing process. The tool retains within it the result of the functioning of a technical ensemble. The

3 Pickering credits this observation to Engels' coproduction, later recalled by Callon and Latour, and dubbed by Law heterogeneous engineering (Pickering, 1995, p. 17).
production of a good adze requires a technical ensemble of foundry, forge, and tempering (Simondon, 1958, p. 84).

The thread of the heterogeneity of materials was picked up by Gilles Deleuze (1925-1995) and Felix Guattari (1930-1992) in their seminal *A Thousand Plateaus: Capitalism and Schizophrenia* in 1980. When discussing Simondon, Deleuze and Guattari reflect on “the variable undulations and torsions of the fibers guiding the operation of splitting” wood: (...) it is a question of surrendering to the wood, then following where it leads by connecting operations to a materiality instead of imposing a form upon a matter (Deleuze & Guattari, 2005, p. 408).

In such formulation matter can only be followed, what obviously transgresses the hylomorphic conception. Deleuze and Guattari credit Simondon in this respect:

Simondon demonstrates that the hylomorphic model leaves many things, active and affective, by the wayside (Deleuze & Guattari, 2005, p. 408).

In this light, there is a spectre of potential in following the material, available after transcending the hylomorphic model. These *many things, active and affective* could be accessed, to our advantage, by entering into the Serres’ *natural contract* and making the Latour’s *nature-culture hybrids*.

**Tectonics and time**

The material focus engenders the problem of time in architecture. Materials change and perform in time. Shifting perspective to the material agency also requires refocusing from static to dynamic aspects of materials. This in turn triggers both change of the method of design and the way in which materials are used.

To this end I look into the discussion of architectural tectonics. The notion of tectonics brings about two important implications. Firstly, the term tectonics is inseparable from materiality, e.g. Antoine Picon sees it as “based on prescriptions regarding the proper use of materials” (Picon, 2010, p. 161). Secondly, the tectonic discussion -- in contrast to earlier theories that focused on the imitation of objects -- concerned the processes behind making a building\(^4\).

The tectonic discourse, besides redirecting the interest towards the rational principles, introduced the idea of dynamic relations as informing design.

In the case of wood, the undesired by the current industry phenomena -- when seen through the lens of tectonics, agency and performativity -- could become generators for new tectonic systems. I argue that these systems would have a capacity to reduce the environmental footprint of construction: e.g. in my previous work it has been demonstrated that wood shrinkage from green to dry can replace metal connectors or adhesives in wood construction (Wójcik & Strumiłło, 2014a, 2014b).

I propose to see the discourse of tectonics as a move towards rational principles in architecture. Central to tectonics is the division made between the ornamental, artistic and symbolic versus structural, constructive and rational attitudes. A parallel could be drawn between these notions and the opposition of *representational* and *ontological* aspects of architecture, as presented by architectural historian Kenneth Frampton (1995)\(^5\). Following on

\(^4\) In 1840s Karl Bötticher (1806–1889) defined architectural tectonics as the activity of forming a building.

\(^5\) Frampton partly attributed this idea to Semper, however he also points to (1995, pp. 71, 82) some earlier analogies in Bötticher, who in a similar vein to the ontological and representational aspects of architecture, opposed *Kernform* (core form) against *Kunstform* (art form), and designated the representational to the Greek and the ontological to the Gothic already in the first half of the 19th century (Frampton, 1995, pp. 71, 82). In Bötticher, Kernform achieves an intrinsic, or ontological
the notion of representational and ontological material-form relationship I propose to extend its meaning onto the understanding of the use of material. Under this framework I use the notions of representational and ontological use of material. In today’s parlance the term materiality usually refers to the former, while material logic to the latter, corresponding respectively to the soft and hard narratives of the use of material in construction.

Ju-jitsu of matter and energy

The discussion about form – matter relationship in architecture could be enriched by some observations of biological systems. Julian Vincent, British pioneer of biomimetics, argues, that our technology kills the information of raw materials, with a substantial expense of energy to make the material ordered with imposed shape and structure for the final product. Quite the opposite, the biological systems use information and structure rather than energy to solve technical problems. In live organisms information, stored in DNA, is used to drive specific reaction at the cellular level and self-assemble structures (Vincent, Bogatyrev, Bogatyrev, Bowyer, & Pahl, 2006, pp. 474-478). Vincent argues that conversely to nature, where “shape is cheap but material is expensive”, in engineering “material is cheap and shape, resulting from energy-intensive processing, is expensive”. Vincent points to our ability to tap abundant and cheap fossil fuels during the Industrial Revolution as a key turning point in our relationship with nature. The scarcity of material in nature leads to several rational solutions, such as blurring the distinction between structure and material, multifunctional use of material, hierarchical structural organisation or oblivion of waste. There is definitely something momentous we could learn about resources management from nature.

To relate the discussion back to architecture I advance to use the concept of periodization of wood construction introduced by Christoph Schindler (2009). The model integrates fabrication with manual, industrial and information technology and is based, in a cybernetic fashion, on the relation between three categories: matter, energy, and information in each respective period. Schindler identifies three waves of technology in the history of wood construction: (1) hand-tool, (2) machine-tool and (3) information-tool technology. (1) In the first wave, dominant in the preindustrial era, the main operator of energy-matter-information was the man’s hand, and the main intellectual achievement was the design of the tool. The tool operated by hand followed the growth direction of the tree and the fibre direction of the wood. Natural shapes of wood were incorporated in the design. Parts playing the same role in the building structure, even when sharing the same dimensions were not interchangeable. (2) The machine-tool technology is connected with the Industrial Revolution of the 19th century when machines substituted repetitive physical operations, while a human operator processed information. The design of the interconnection of power machine and machine tool was the crucial intellectual achievement. The working process was adjusted not to the potential of the hand, but to the potential of the machine what resulted in homogenisation of status, while Kunstform extrinsic, corresponding to representation, what prepared the ground for radical technological innovation: introduction of iron as a material representing dynamic character of the industrial society. Also Schwarzer (1993, p. 273) attributes the introduction of this concept to architectural thinking to Bötticher.

\[6\] This is especially important in the context of arising environmental concerns. Various efforts are geared towards providing a reference frame for material use in this regard. The concept of Life Cycle Assessment seeks to quantitify the environmental impact of products over their entire lifecycle. Accordingly to the 2006 EU Eco-Innovation Panel material innovation should satisfy human needs and bring quality to life “with a life-cycle-wide minimal use of natural resources (material including energy, and surface area) per unit output, and a minimal release of toxic substances”. This notion is largely based on the concept of the ecological rucksack of materials and its measure – MIPS (material intensity, or material input, computed as mass per unit service), as introduced in early 1990s. The goal of MIPS is to maximise the amount of units of service with minimised use of material and material-intensive energy (Hinterberger & Schmidt-Bleek, 1999, p. 53).
wood and mass production of wood-based products and standardised building components.

(3) The third wave in the Schindler’s model began when machines started to replace both physical and intellectual operations. The highest achievement was the interconnection of power machine, machine tool and information machine.

I pose that this formulation can be expanded vis-à-vis the problem of material agency in design. From this perspective, the hand-tool technology (1) has the capacity to integrate material agency into the design, while the machine-tool technology (2) has not. The evidence of that are: (1) for the hand-tool technology – use of hand tools in connection with material traits (e.g. grain direction) and incorporation of naturally grown shapes in designs, and (2) for the machine-tool technology the efforts towards standardisation and homogenisation of material (e.g. wood-based panels).

While some characteristics of the information-tool technology (3) take after the hand-tool technology (1), e.g. non-standardised and non-interchangeable components, I pose that the role of material agency could also bear resemblance in the two respective periods. In other words, while the machine-tool technology (2) supressed material agency, a new potential has been opened for it by the information-tool technology (3). Such potential though requires a management strategy.

One possible management strategy is the concept of networked thinking, as originated by a German biochemist and ecologist Frederic Vester (1925-2003). Based on systemic and cybernetic approaches, in unison with the Vincent’s theory, Vester opposes constructivist against evolutionary types of management. In the former the system is produced at great expense of material and energy, in the latter it emerges spontaneously at little expense. The 4th rule of his eight basic rules of bio-cybernetics outlines the strategy: “exploiting existing forces in accordance with the ju-jitsu principle rather than fighting against them with the boxing method” (Vester, 2007, p. 160). This formulation transcends the framework of resilience. While resilience is the ability to absorb and release stresses, no gains are sought after in being exposed to the stress. The main goal is to bounce back and remain unaffected. Quite the contrary, Vester’s 4th rule, reflecting the bio-cybernetic stance, takes inspiration from the martial arts strategy of exploiting the opponent’s force. This insight opens a new perspective when applied to our understanding of material in construction.

The New Materialism of wood

While the possibility of application of the concepts of New Materialism and bio-cybernetics in architecture may sound vague, recently a series of researches attempted to take heterogeneous material properties into the production of form. I would like to discuss the ones dealing with wood (Figure 1, left to right): (i) Helen & Hard Ratatosk Pavilion at the V&A Museum in London, (ii) Hironori Yoshida Digitized Grain (iii) Christoph Schindler at al. Serial Branches, (iv) Ryan Luke Johns and Nicholas Foley Bandsawn Bands.

Figure 1.
The projects are of limited scale, ranging from a pavilion (i), through an art installation (ii) to furniture (iii, iv). Nevertheless, their innovative approach to the design process and technology points into a very promising direction for the material-oriented design in wood. They emancipate the material in the production of form, minimise the energy use in favour of the information use, and strive to challenge the commonplace design practice.

(i) Helen & Hard’s project breaks away with the conventional design sequence: finding, scanning and digital modelling of the ash trees became the initial rather than the final design phase. As a result, the sketch phase was omitted as an inadequate work method for heterogeneous material: “[the] forms were dictated largely by the shapes of discarded branches, and therefore could never have been predicted in a preliminary sketch”. Material idiosyncrasies -- organic shapes, knots, holes and fibres -- led the design and construction (Stangeland & Kropf, 2012, pp. 172-179).

(ii) Yoshida’s project seeks to translate the craftsman’s interaction with natural materials into a fully automated Scan-To-Production process. The wood grain is digitally scanned, image-processed and transferred into motion paths for a CNC machine. As a result, the grain pattern of wood is replaced by polyester resin, based on colour analysis. “The Scan-To-Production (STP) process, through the use of digital scanning and robotic fabrication, proposes to take material irregularities as design input, to distinguish and create meaningful order from material noise” (Yoshida & In, 2013).

(iii) Schindler’s project took inspiration from the Viking boatbuilders and vernacular joinery, where superior strength was achieved by using naturally forked hardwood pieces. As a result of a trial and error process a method was devised to minimise the amount of information necessary to compute the shapes for design: all branches were planed on both sides resulting in two parallel evenly distanced surfaces. The project demonstrates how “although we claim to explore the benefits of digital tools, our thinking is bound to the heritage of industrialization: we are used to work with measurable geometry, minimal tolerance and reliable material constraints” (Schindler, Tamke, Tabatabai, & Bereuter, 2013).

(iv) Johns and Foley in their project reverse the commonplace logic of digital manufacture: “rather than transferring material, (…) from a curved tree into dimensional lumber which is then re-machined into curvilinear digitally designed geometry” the authors “take the tree as the starting point for design and move directly to digital fabrication. This leap in the production sequence enables more sustainable material efficiency while simultaneously conferring the natural aesthetic advantage of beauty’s found geometries.” The devised technique uses a robotically operated bandsaw to cut series of strips following the curvatures “which, when rotated and laminated can approximate doubly-curved and digitally defined geometry”. As a result of the “close relationship between available material and designed geometry” the process yields “practically zero-waste”. Interestingly, some tool operations are closely connected to material features, e.g. the robot cut speed is programmed as a value proportionate to the curvature of the cut, resultant from the grain pattern (Johns & Foley, 2014).

In all these examples the material properties are equal rights partners to the designer. Helen & Hard (i) or Yoshida (ii) partly cede responsibility regarding the design to the material. Should the material had different features, it would have resulted in different shapes or patterns. In this case one cannot fully claim the authorship. A hypothesis can be formulated as to whether is this a necessary trade-off, the natural contract, where -- by surrendering to the material -- we can access new territories of unknown architecture, effects, affects and effectiveness? The projects seem to tentatively confirm this hypothesis. As Johns and Foley (iv) say their method is “one of few woodworking techniques which are explicitly not subtractive, but transformative” (Johns & Foley, 2014, p. 25) indicating the potential for the approach regarding minimising waste in digital manufacture. Strikingly, this applies to other presented projects: Helen & Hard (i) or Schindler (iii) also dodge waste and pollution. Intricate forms are result of naturally grown shapes and mindful handling of information,
rather than sculptural milling. In this regard all four projects rely on 3-dimensional and 2-dimensional scans and digital image or model processing to form a nature-culture hybrid, used as a starting point for the design. It is telling that none of the projects could stick to the conventional design method, where a conceptual sketch through iterations becomes a working drawing. Not only drawings representing final forms were difficult or impossible to produce, but also obsolete. For the final product more important were process sequences and strategies regarding digitising and operating material information.

The Swelling Vault – a self-bending shape

I argue that -- however the presented projects are legitimate examples of New Materialism of wood – there still is undiscovered potential under the framework of material-oriented design. One yet little explored area remains the utilisation of dynamic, or kinetic, relations informing design. I pose that such approach opens design towards harnessing emergent phenomena. By emergence in this context I understand a process where form is produced through interaction between small components, while the meaningful properties of the form are not exhibited by the components themselves.

In order to illustrate the approach, as well as investigate its implications, I carried out an experiment together with the students of design at the Hochschule Luzern. The main goal was to device a method for harvesting phenomena resultant from kinetics of material behaviour, and thus to extend the notion of material-oriented design in wood.

Parquet buckling, that became an inspiration for the project, is a well-known and undesired phenomenon caused by increased moisture content in wood. The aim of the experiment was to replicate it and to test how the buckled shape has been affected by various block patterns, and also how the emergent shapes could be predicted by digital simulations.

The aforementioned DeLanda sees digital simulations as prerequisite for harnessing emergent phenomena:

[Digital] simulations are partly responsible for the restoration of the legitimacy of the concept of emergence because they can stage interactions between virtual entities from which properties, tendencies, and capacities actually emerge (…). [S]imulations can play the role of laboratory experiments in the study of emergence complementing the role of mathematics in deciphering the structure of possibility spaces. And philosophy can be the mechanism through which these insights can be synthesized into an emergent materialist worldview that finally does justice to the creative powers of matter and energy. (DeLanda, 2011, p. 6)

It was decided to lay two different patterns: checkered, using square blocks laid with alternating grain orientation; and herringbone, using elongated rectangular blocks (Figure 2). As a connection between the blocks The Lamello Joining System (biscuit joint) was chosen and no adhesives were applied.

7 The project was made possible thanks to the invitation and support from the Hochschule Luzern, Design & Kunst, and especially Christoph Schindler and Sebastian Kraft.
After laying out the patterns warm water was poured on (Figure 3), and the pieces were left to soak in for the wood to swell. A few days later the surfaces have bulged up, the checkered patterned shape was rather regular and domed (Figure 4), while the herringbone formed a conical, almost ruled surface (Figure 4). Both resultant shapes were very strong. Four people weighting ca. 280 kg could step on a 3.2 m² piece not causing any damage (Figure 3).

It remains to be tested to what degree the deformation is reversible when the moisture content drops. Should it reverse too much, the surface could be sealed to fix it in the warped shape.
In parallel, a digital simulation model was devised to compare the results with the empirical tests. Swelling of wood was estimated using a formula based on the equation from Covington and Fewell (1975). Comparison of the estimated elongation of the surface (1730.6 mm) to the empirical (1726.7 mm) yields only 0.2% discrepancy, and results in ca. 6% discrepancy between the measured 132 mm and calculated 140 mm for the sagitta (Figure 5, where solid line indicates measured and dashed line estimated shape). As for now, the digital simulation is only operational to predict the bulging for checkered patterns. Had the model been fully working, it would have been possible to predict resultant 3-dimensional forms from flat patterns.

Figure 5.

Material takes command. Discussion

New ontology

The Swelling Vault project explores the symmetrical and reciprocal relation of the natural contract. In the process of forming neither the designer’s nor the material agency could be seen as superior. In this view, the concepts of agency and intentionality are decoupled. The form is emergent, where its main property – the curvature -- is not reducible to the properties of its constituent parts. The system behaviour is anticipated by means of computer simulation.

The reciprocal relation between the designer and the material can be describes as a dance of agency, where none of those two could be omitted nor prioritised. Any imbalance would invalidate the process. However the designer and the material are equally valid, there obviously are important differences between them. At different stages of the process one or the other comes to the fore: the designer in the preparatory stage specifying the layout of the
blocks in order to achieve – within tolerances -- desired result, and the material in the final stage, where the totality of material and environmental factors give the vault its final shape.

A prerequisite for the balance to be operational is that the material is seen and used in the ontological terms. Not only pieces of other material looking like wood, but even some other species of wood, would not perform the task. For the natural contract to be valid, a total understanding and acceptance of the material behaviour is necessary. In a way, that may be seen as yet another come back of the clichéd 18th century concept of truth to materials\(^{8}\), this time in a purely ontological understanding of material without any references to moral values.

**Bio-cybernetic process**

The project harnesses an emergent, moisture induced phenomenon, rather than uses external energy for forming. Therefore it conforms to the bio-cybernetic and biomimetic models. The shape, achieved with negligible use of energy and waste, becomes cheap. The *ju-jitsu principle* is applied in the process as the ability not only to accept setbacks but also to turn them into advantages. In the project the material characteristic usually seen as disadvantageous -- moisture related dimensional instability -- is exploited. The change of perspective, allowed by the countercultural design approach, allowed not only to even up or compensate for it, but also to turn it into design strategy. And even more, this strategy results in palpable and quantifiable gains – the shape is achieved with a minimal environmental rucksack.

Not unlike in the case of the four aforementioned projects, also the *Swelling Vault* required rethinking of the design process. The predominant design methods are rooted in the Renaissance, when design was concerned with imitation of objects. Quite the contrary, the process captured dynamic relations, where the shape could be specified only within the material limitations. Within the system not all forms are possible, and any simulated design negotiated between the designer and the material is only a simulated approximation. The designer’s control is through material selection, shaping of the wooden blocks and laying them out in various orientations and patterns. The simulation as a design method allows only for interaction through a trial and error process. One possible way of development may be application of a strategy called reverse engineering: a shape would be specified by a designer, than computer program would generate the best possible shape match, and choose the appropriate material and pattern.

As a result of the project, two conclusions concerning the design process arose: digital tools are essential for simulation of the dance of agencies at the early design stage, and as this prediction cannot be 100% accurate, appropriate tolerances must be embedded in the design.

**Cultural performance**

Are we, designers, loosing control over the designs by including material actants in the nature-culture hybrid process? Sharing the authorship with – to some degree – unpredictable, and also demanding partner, may seem counterproductive towards achieving design goals. The approach bears resemblances with the digital turn in architecture, that

\(^{8}\) The concept of truth to materials surfaced for the first time in Italy in the mid-18th century when Carlo Lodoli (1690-1761), as a countermeasure to the Baroque and the influence of the Classics, formulated an entirely new notion of truth, not understood in the Classical sense as synonymous with beauty, but associated with consistency. For Lodoli the form of the ornaments must be consistent with the materials in which they were made (Forty, 2000, pp. 294, 296).
have already questioned the Modernist idea of the standard and the Renaissance idea of the author (Carpo, 2009, p. 53). In exchange – besides the aforementioned energy and material savings -- it offers a return to the pre-industrial and pre-modern models: the relation between the subject and object of design in the digital chain mirrors the Medieval master builder approach, or the distributed authorship of Wikipedia echoes the Medieval manuscript read-and-write mode. In particular the later brings similar controversy as the nature-cultural hybrid process due to its inconsistencies and unreliability. Obviously Encyclopaedia Brittanica is much more stable and reliable, but cannot match Wikipedia in speed of reaction or availability. Analogically, the available Swelling Vault shapes are limited by the system capacity to take shapes, and its final shape is a few per cent off the predicted height, but it has been achieved with a negligible environmental rucksack. I propose to see it as a necessary trade-off that has to be made if we want to access the benefits that come with this approach.

As the discussed projects may suggest, the unpredictability and idiosyncrasy resulting from the approach is a design opportunity. Design that follows material yields objects that cannot be reproduced, thus resulting in cultural performance not seen since the pre-industrial times. Just like the subject-object relation in design process or the question of authorship, the cultural role of material in material-oriented design takes after the pre-Modern and pre-industrial models. Are we ready for the material to take command?

References


Marcin Wójcik

Marcin Wójcik is an architect, researcher and educator. He graduated from the Technical University of Szczecin (diploma in 1996) and the Swiss Federal Institute of Technology (ETH) in Zurich (postgraduate diploma in Computer Aided Architectural Design in 2004). Marcin has worked as architect and designer in Ireland, Switzerland and Poland. He received his professional license in 2002. Between 2005 and 2012 he was a lecturer at the Dublin School of Architecture at the Dublin Institute of Technology (DIT), where he became a Digital Studio module author and leader. Since 2012 he has been a PhD research fellow at the Oslo School of Architecture and Design (AHO).