Architectural assemblages and materializations - Changing notions of tectonics and materiality in contemporary architecture

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Architectural assemblages and materializations – changing notions of tectonics and materiality in contemporary architecture

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ABSTRACT: The discussions on architectural tectonics have been growing during the last decades, not least in relation to the development of digital technologies and their use in architectural design. During the same period there has been a "material turn" within other disciplines and several theoretical frameworks relating to materiality, artefacts, assemblages and performance have been developed and discussed. This paper presents some of these discussions and theories with relation to the built environment. The aim is to contribute to the critical understanding and further development of central concepts and tectonic theories in contemporary architecture.

1 INTRODUCTION

The last decade has shown an increasing interest for the architectural tectonics, especially in relation to digital tools for design and manufacturing. There has during the same period been an increasing interest for materiality, structure and physical construction of space and objects, within architecture as well as within other disciplines. The practical work and concrete making of the material world and built environments have also come more into focus.

Several central notions and concepts in architecture are in need of elaboration in the contemporary situation where there have been radical changes due to new means for imagining, projecting, and producing buildings and spaces on different scales. In disciplines adjacent to architecture, several theoretical frameworks have developed and changed, and several of these frameworks relate to materiality, objects, assemblages, expression, and performance, and are therefore of great interest for design as well. In architecture, several conceptual frameworks have been developed, where some use the potential to articulate notions close to architectural practice but in a fruitful exchange with more theoretical perspectives. Could we see some relations between the theoretical frameworks and approaches developed in other disciplines and in the field of architecture and design? How do or could central concepts in architecture, such as tectonic, develop in the contemporary technological and cultural context?

This paper will present and inquire some of these discussions and theoretical frameworks with relation to the built environment that during last decades have developed especially around tectonics and digital architecture. The study draws from recent debates around assemblage theory, materialism and post-humanist theory, and will in dialogue with these theoretical frameworks discuss the changing notions of tectonics and materiality in the work of some architectural practices. The aim and intention with the paper is to contribute to the critical understanding and further development of central concepts and tectonic theories in contemporary architecture.

2 THE FIELD OF ACTORS, NETWORKS, MATERIALITIES, OBJECTS

To understand and use the potential of architecture in contemporary technological and societal situations, is urgent and pressing and here conceptual elaboration in close relation to practice is of great importance. Issues of architectural knowledge and articulation of concepts central for architecture as a "making discipline" and "material practice" are also needed to be addressed, and here are concepts relating to tectonics and materiality central. There have been lots of discussions and publication on the theme of tectonics, not least in relation to the development of digital technologies and their use in architectural design (See e.g. Leach, Turnbull, and Williams 2004; Liu and Lim 2009; Spuybroek 2011). Current theoretical developments have ontological as well as epistemological implications, and further articulations of the epistemology of architecture are not least of importance in contemporary multi-disciplinary collaborations in the production of the built environment. But architecture and the built material environment have also come into focus in other and adjacent disciplines, where an increasing interest for materiality, artefacts and physical construction of space and objects is obvious. This has made some critics and theoreticians talk about a "structural turn" or "tectonic turn" within architecture (Leach, Turnbull, and Williams 2004, 4; Oxman and Oxman 2010) as well as a "material turn" within other disciplines (See e.g. Henare, Holbraad, and Wastell 2007; Daston 2008; Coole and Frost 2010). While still taking the discipline and practice of architecture as a point of departure for developing new theoretical frameworks, it can also from that perspective be of interest to see what, and learn from, interactions and approaches towards the physical world that is being developed today.

The issue of emergence has been considered and discussed to what extent it influences and changes our notions of form and architecture. Michael Hensel, Achim Menges and Michael Weinstock has argued that to engage with emergence requires more than the development of new materials and innovative production technologies, but rather an understanding of the behaviour of complex systems and the mathematics of their processes, and of the systematic transference of that knowledge to design and production. Emergence demands new strategies for design, strategies that are derived from the evolutionary development of living systems, from their material properties and metabolisms, and from their adaptive response to changes in their environment (Hensel, Menges, and Weinstock 2010, 11). Hensel stresses the attention to rethink the prevailing prejudice based on which architecture and engineering strategises material assemblies as mono-functional building subsystems or elements that are optimised towards only single objectives. He has instead conducted inquiries into performative systems that cannot be reduced to mono-functional elements, and from this developed a different understanding of the material envelope as an element of exchanges as well as defining relations between the built environment and climate (Hensel 2010).

There has been lots of debates and discussion on the role of the material, physical objects and artefacts in many disciplines as well as on the distinctions and relations between the human and the non-human, not least in the relation a increasingly wide-spread use of actor-network-theory also in architecture. John Law has written that actor-network-theory may be understood as a *semiotics of materiality*. But this semiotics should be distinguished from the versions of post-structuralist thinking that attend only to language and symbolic expressions. "It takes the semiotic insight, that of relationality of entities, the notion that they are produced in relations, and applies this ruthlessly to all materials – and not simply to those that are linguistic" (Law 1999, 4). He tells two stories around actor-network-theory, one that is about this relational materiality, and another that has to do with *performativity*. This second story builds upon the semiotic approach that entities achieve their form from the relations in which they are located, but also that they are *performed* in, by, and through those relations. "So that is two stories, two forms of naming, stories that tell of *relational materiality* on the one hand, and *performativity* on the other. The two, of course, go together. If relations do not hold fast by themselves, then they have to be performed" (Law 1999, 4).

As is commonly known, actor-network-theory put a new and precise role to non-humans in analysing social constructions. There is an obvious shift of attention also to the material and non-human world of artefacts as actors with agency. Bruno Latour has written that one of his intentions has been to redefine the notion of social by going back to its original meaning and making it able to trace connections again. He also says that after having done extensive work on

the "assemblages" of nature, it is necessary to scrutinize more thoroughly the exact content of what is "assembled" within society, how associations are made. Since both social and association share the same origin in the Latin word *socius*, Latour argues that sociology could be redefined from the "science of the social", to the "tracing of associations". "In this meaning of the adjective, social does not designate a thing among other things, like a black sheep among other white sheep, but *a type of connection* between things that are not themselves social" (Latour 2005, 5).

Latour has together with Albena Yaneva called for a reconceptualization of architectural theory and the way we look at objects. They say that the problem with buildings is that they look desperately static, while a building, as everybody knows, is not a static object but a moving *project*, that after it has been built constantly ages, is changed by its users, being rebuilt and transformed by all that happens outside and inside. The advantages if abandoning the static view of buildings would be that also the divide between "subjective" and "objective" dimensions could be abandoned and that justice could at last be paid to the many material dimensions of things. "Matter is much too multidimensional, much too active, complex, surprising, and counterintuitive to be simply what is represented in the ghost-like rendering of CAD screen shots. Architectural design embraces a complex conglomerate of many surprising agencies that are rarely taken into account by architectural theory" (Latour and Yaneva 2008, 86). They argue that such accounts of design would also reveal how architects are attached to non-humans such as physical models, renderings and computers.

3 A THEORY OF ASSEMBLAGES

An important point of reference in the recent discussions is the notion of assemblage theory as developed by Manuel DeLanda, mainly building upon and with great influence from the thinking and writings of Gilles Deleuze. This is a theory meant to apply to wide variety of wholes constructed from heterogeneous parts. Entities from atoms and molecules to biological organisms, species and ecosystems may, according to DeLanda, be usefully treated as assemblages (Delanda 2006, 3). Assemblage theory can also be applied to social entities, and by that it makes possible to cut across the nature-culture divide or break open the traditional border between these domains into a continuum to be analyzed in other ways.

To make these analyses and the explanations of synthesis possible for wholes that are at the same time irreducible and decomposable, DeLanda uses the concept of *assemblages* (DeLanda 2011, 184–185). Central in assemblage theory is the account that the synthesis of the properties of a whole is not reducible to its parts. DeLanda contrasts assemblages with Hegelian totalities, where in totalities the parts form a seamless whole, an organic unity. The parts of an assemblage do not form a seamless whole. Assemblages are rather wholes whose properties emerge from interactions between parts (Delanda 2006, 4–5). Here there are different kinds of relations between parts, and DeLanda talks about relations of interiority and *relations of exteriority*.

A theory of totalities are based upon the concept of *relations of interiority*, where the component parts are constituted by their relations to other parts in the whole. A detached part from such a whole ceases to be what it is, since being that particular part is a constitutive property of the part. The main theoretical alternative today to Hegelian organic totalities is, according to DeLanda, assemblages, which are wholes characterized by *relations of exteriority*. These relations imply that that a component part is not constituted by its relations, and a part of an assemblage may be detached from it and plugged into a different assemblage where its interactions are different. A theory of assemblages and the exteriority of relations imply certain autonomy for the parts and terms they relate into a whole. "Relations of exteriority guarantee that assemblages may be taken apart while at the same time allowing that the interactions between parts may result in a true synthesis" (Delanda 2006, 11). The heterogeneity of components is also an important characteristic of assemblages, and that the complex interactions between component parts are crucial for the emergence of properties of the whole.

In addition to the exteriority of relations, DeLanda argues that the concept of assemblage is defined along two dimensions or axis (Delanda 2006, 9–11). One of the dimensions or axis is the variable material and expressive roles the component may play in the assemblage; from a purely material role at one end of the axis to a purely expressive role on the other. These roles

are variable and may occur in mixtures, and a component may play a mixture of material and expressive roles by exercising different sets of capacities. The other axis or dimension is the variable stabilizing and destabilizing processes where the component become involved. On one end are the processes that stabilize the identity of the assemblage by increasing internal homogeneity or sharpening its boundaries, and on the other are processes destabilizing the identity by increased heterogeneity or blurred borders. These extremes are also respectively discussed as processes of territorialization and deterritorialization.

According to DeLanda, assemblages always exist in populations, and as the assemblages forming these collective interact with each other, these populations of assemblages have some properties of their own (Delanda 2006, 16–17). The interactions between assemblages generate properties on another level. This leads to the possibility that larger assemblages may emerge, in which the members of the population, the smaller assemblages, are the component parts. Through this DeLanda is able to use the theory of assemblages to analyze on different scales of society as well as the built environment, to move between assemblages on different levels.

An important aspect in assemblage theory is the concept of emergence, but it is not a completely open ended emergence. Here DeLanda refers to the concept of the phylum or the body-plan (see e.g. DeLanda 2002) that defines a space of possibilities, and this space has a topological structure setting the dimensions of the space or the degrees of freedom. This space of possibilities comes from the diagrammatic, genetic structure and the overall connectivity and the set of possible capacities of an assemblage to interact. The properties of the whole on different scales emerge from the interactions between parts, and this approach may be characterized as ontologically "bottom-up" (Delanda 2006, 29–32).

In his book *A New Philosophy of Society* DeLanda mainly analyses social entities and assemblages, but also buildings and the built environment on different scales; he looks at individual buildings, neighbourhoods, cities as assemblages. He discusses the material role played by components, e.g. loadbearing structures and connectivity of spaces, and how assemblages have changed in history through new building technologies like reinforced concrete, steel structure, and inventions like escalators, elevators and ventilation systems. Also the expressive roles of components are dicussed, like facades, spatial form, furniture, décor treatment of walls, floors, ceilings, and how these physical expressions often go together with linguistic expressions – e.g. the Gothic churches – forming various assemblages (Delanda 2006, 96–100).

4 NOVEL TECTONICS AND MATERIAL PRACTICES

Part of the discussion and theoretical as well as practical developments on tectonics and materiality are Jesse Reiser and Nanako Umemoto, who also contribute to notions on architectural approaches both in thinking and acting in contemporary situations. They argue that the Cartesian paradigm, that heavily has influenced architects' notion of space, is loosing its grip and that there is a shift from the notion of the fixed background, of ordinates and coordinates, to a notion of space and matter being one. At a fundamental level this "changes the way architecture is thought about and designed, and the way it emerges at a material fact". Reiser & Umemoto argues that, our view on the world "defined by a fixed field and unchanging essences has been superceded by a matter field that is defined locally only in and through its own interactions". Here architecture is not simply reducible to the container and the contained, but there are far more complex relations and dynamic exchanges "between the life of matter and the matter of our lives". They see architecture as a material practice, where it is more interesting to ask "what does this do?" rather than "what does this mean?", and this reveals their approach which, as many architects today, has a strong focus on performance and the materiality of architecture (Reiser+Umemoto 2006, 23–24, 34).

Most architecture is not resolved within the logic of one single model or one material only, but "architecture deals with assemblies involving multiple models, surfaces, and materials". Modern architecture has through the rational system of construction it employs rather resolved itself as a whole that is no greater than the sum of its parts, Reiser & Umemoto argues. They ask themselves how to manage and work with these diverse organizations and elements, not merely as an accumulation of the different but as multiplicities within an emergent organization such that the whole is greater than the sum of its parts. Here their concept of "fineness" becomes cru-

cial, and it encompasses an examination of architecture on all scales. “Fineness breaks down the gross fabric of building into finer and finer parts such that it can register small differences while maintaining an overall coherence. The fineness argument is encapsulated in the densities of a sponge: too fine and it acts like a homogeneous solid; too course and it becomes constrained to its members. Architecture must perform similarly, at just the right balance between material geometry and force” (Reiser+Umemoto 2006, 38). They say that since most architecture deals with assembled materials it must be prepared in a way to maximize the propagation of effects. “This requires that the field operate under three criteria: sufficient quantity of elements, connectivity, and relatively close range of scale. These are the constituents of fineness”(Reiser+Umemoto 2006, 177).

In their approach, each element in a structure has no intrinsic or stable meaning outside its contextual relationships, and the meaning is acquired in relation to the specific behaviour and effects they are seeking in a particular zone of the project. Often this leads to a blurring of borders, e.g. between ornament and structure. They take the examples of tension rods in a meshwork that generate a column-like zone of structure that is at once structural and atmospheric. In the classical model an orderly alternation of columns and intercolumnar spaces or infill ornaments would have been deployed, while they use a continuous rod field with degrees of greater and lesser density, where the denser areas act in a column-like manner which shade off into zones acting predominantly as ornamental screens (Reiser+Umemoto 2006, 40). The classicist and modernist approaches deal architecturally and methodologically mostly with top-down hierarchies. Reiser & Umemoto do instead promote a way of working that is within a hierarchy that is not nested in scale and distinct from the orders that lie above and below it. They say that they are rather using organizational principles that promote communication across scales, and where the particular is able to influence the general and vice versa. “This methodology, in contrast to the reductive models of modernism, enables the emergence of new organizations and new architectural effects out of wholes that are not reducible to their parts. These emergent organizations become legible not as parts to a whole but as whole-whole relationships” (Reiser+Umemoto 2006, 50).

To consciously look for and work with these dynamic relations, emergent phenomena and organizations in the material world is central in the approach of Reiser + Umemoto. They say that the legacy of the essentialist approach to architecture, which elevates rationality above matter, precludes the productive and rich capacity of matter to define or influence geometry (Reiser+Umemoto 2006, 74). Their argument is that it is especially important to allow this dynamic to operate, not so much concerning developments of new materials in architecture but as a way of reconceiving tectonics and organization.

5 BUILDING COMPONENTS IN SWARM TECTONICS

Kas Oosterhuis has an approach from what he calls a theory and practice of architecture based on the principles of swarm behaviour. This builds from his opinion and view that all building components must be designed to be active actors. Buildings and their constitutive components can no longer be seen as passive objects, and this is on several levels in line with theoretical and technological developments in the fields surrounding architecture today. This calls for new conceptual frameworks and notions, but also dramatic changes in the way design and manufacturing processes are organized as well as how we interact with built structures. The new kind of building he envisages is based on the invasion of digital technologies into the building industry, such as parametric design, file-to-factory production, the process of mass customization, and embedded intelligent agents and sensors. “Step-by-step we are balancing the familiar top-down control with emergent bottom-up behaviour. We are rethinking the basic building blocks and we are building bottom-up bi-directional relationships between all constituent building components” (Oosterhuis 2011, 13).

Oosterhuis has developed a notion about “swarm architecture”, a concept he introduced in 2001 and then elaborated further in different contexts (Oosterhuis 2003a; Oosterhuis 2003b; Oosterhuis 2006). He views the process of design and construction as well as the building and its performance as dynamic and developing in real-time with possible behaviours emerging as in a swarm. Here all building elements could act as intelligent actors, as active members in the

swarm, in active relation with their environment, constantly calculating and reacting. He has said that his objective from the beginning has been to treat all possible building components as interacting elements that have bi-directional relations with each other. This could lay the foundation for an architecture that is not static, but animated in real-time. Not animated in the same way as Greg Lynn has described it (see e.g. Lynn 1999), who claimed the right to kill the animation, but through keeping the structure constantly "informed" like a flock of birds. Oosterhuis see no reason to freeze the motion and flows of information, but rather to develop new ways of using Information and Communication Technologies to sustain the information flow throughout the complete lifecycle of the built structure. "The informed building blocks thus become actors in an environment of interacting complex adaptive systems" (Oosterhuis 2011, 17).

The basic building blocks need in this context to be redefined. "They are not bricks and mortar, neither are they exclusively bits and bytes." It is rather the merger of bits and atoms that interests Oosterhuis, the merger of the material real and the virtual real, the merger of the physical materials and the immaterial information and relations. Parts interact and through their relations form the whole of the building. "The building components are like cells in a body, small processors of information working together while constituting the building body as a whole" (Oosterhuis 2011, 23). With his office ONL he has been building architectural project for many years, but Oosterhuis has also since long been doing material experiments and building small pavilions with information driven architecture that form, what he calls, "building bodies" which show real-time behaviours. "The building body is is a vectorial body, shaped by interior and exterior vectors. … The building body is a well-balanced structural integrity" (Oosterhuis 2003b, 19). These "building bodies" – or hyperbodies – are complex wholes, a complexly integrated system of custom made building elements formed by the forces they are exposed to. These new architectures emerge from contemporary kinds of industrial production and design tools, where information technologies not only influence the conception of the design and the production processes but also are embedded in the materials and components, influencing our experience of and interaction with the built.

6 TECTONIC ARTICULATIONS IN AN ARCHITECTURE OF CONTINUITY

Information technologies and computerized tools for design continuously urge us to rethink built architecture, architectural practice and the our interaction with tools and materials. Detlef Martin has written about Lars Spuybroek that he has always used the computer as a constructive medium, not as a representational one. The computer enables complex geometries that can also be enacted in other media or materials and at other scales, but rather than falling into the usual trap of neo-Platonism easily done through the digital tools – ideas first, materializations second – Spuybroek has developed a rigorously materialist practice in which there is continuity between design and fabrication. Detlef also argues that continuity is the central tactic of Spuybroek for addressing the schism between form and tectonics, which continues to plague contemporary design (Mertins 2008, 7–8).

Spuybroek describes himself having "a radically materialist view, but one so radical that it becomes strange, indeterminate and even vitalist". It is a view that he argues to mean that for the body "experience counts as the main form of involvement", and for architecture, "tectonics counts as the main form of articulation" (Spuybroek 2008a, 15). He argues that we have to rethink tectonics and the whole process of aesthetic experience and how it relates to architecture generated from active matter. A materialist theory of perception and sensation must according to Spuybroek run parallel to a materialist theory of architecture, and this theorized materiality does not need to be applied to buildings as such but more to the organization of the built; "and organization means architecture, not building". This is, according to Spuybroek, why Semper's tectonic theory of the four elements earth, wood, textile, fire is not a concept of architectural elements, of components that are jointed, even though it has often been understood that way. Spuybroek sees Semper's four elements more as states of aggregation, of density or rigidity, than actual building materials. Tectonics consists of a materiality that informs the organization of things as much as their physical structure.

With influence from Frei Otto's research and experiments with material, empirical computers to find and generate architectural forms, Spuybroek develops what he calls a "Semperian rever-

sal", a reversal of the order of the four elements. Rather than starting with the earth and strong wooden frames to support the weaker textiles, he turns it around (Spuybroek 2008a, 20). He tries to find ways to work from the soft and weak, letting the weak component fibers move, find each other, intermingle and lock each other, and start to build structure and rigidity – as in Frei Otto's material experiments. The adding of the soft to the rigid is instead turned into a transformation of soft into rigid. This is according to Spuybroek a constructivism in architecture; the mobility of agency is transferred into structure, and while form is being generated it necessarily becomes structured.

Program and form are complementary, Spuybroek argues, they are extensities, with one filling the space left by the other. In contrast, experience and tectonics are congruent, he continues, they are intensities, both filling the same space. Concerning architectural form, we do not need to completely rely on Vitruvius, and he instead notes three scales of design, "not *utilitas, firmitas and venustas* but *massing, structure and texture*, the three physical scales of architecture" (Spuybroek 2008a, 21).

Tectonics is crucial in creating the continuity Spuybroek strives for, and it works in all directions, and across all scales, not only on that of structure but also on that of massing as much as on that of texture. It has the potential to create a continuity that works differently than most of architectural thinking since Alberti. Spuybroek argues that since Alberti's theory of architecture, structure has been equated with abstract, mechanical geometry, and ornament with organic beauty. Geometry needed to be made more empathetic with ornament that operates on the smallest scale of texture, while massing was governed by proportion, harmony, and what Alberti calls *concinnitas*, the way a building is put together organically. For Alberti, the parts are totally subordinated to a preexisting whole. But in Spuybroek's view it is different: "In our world it all works immanently; the parts "find" a whole; it doesn't preexist. We see, we apprehend, the parts through sensation and construct the whole, which corresponds with massing, which is the realm of tectonics understood as configurational, rhytmic and patterned (...) – and such description fits human experience as much as architectural form" (Spuybroek 2008a, 21–22).

Architecture works in a continuum, where the scales of structure generate one another, like the Gothic column moving up from the floor as bundles of ribs, disentangles into a fan-shaped top and reentangles into a reticulated vault where the fans interweave in another way. "Continuously varying states of aggregation operate on singularities ("column", "fan", "vault"). So singularities aren't elements (which always exist beforehand), but emerge from relations, from continuity." And he summarizes: "In short, tectonics is not the subordination of all articulation to structure; and architecture of continuity is one of tectonic articulation where empathy (on the smallest scale) and massing (on the largest scale) are *implied in structure*, but only in a structure that transforms on its own to cross scales" (Spuybroek 2008a, 22–23).

This does not mean that buildings no longer are made of parts and elements, but the continuity Spuybroek talks about has the capacity to oscillate between expressive singularities and more neutral generality, i.e. between discrete elements, and fully merged and general states. In Spuybroek's view, continuity includes several poles, architecture can work on continua of different scales and dimensions where things still can be articulated and expressed clearly. "Concluding that buildings are made up of parts, of elements, doesn't mean that architecture should be based on elementarism; on the contrary, an architecture of continuity fuses the hard and the soft, tectonics with textile, abstraction with empathy, and matter with expressivity" (Spuybroek 2008a, 26).

Spuybroek has also more explicitly referred to the thinking of DeLanda. Spuybroek argues that since it is the parts that define the whole and not vice versa, because the logic of relations is based on exteriority, building and design must follow the same upward transition between dimensions. If you follow what he calls "an assembly theory of design", described as a material design methodology based on agency, you have to work your way up in dimensions. He also refers to the contemporary design methodologies of generative and parametric techniques where no morphology resulting from these epigenetic processes can be fully Euclidean or elementary, because "it is the relations that produce the elements, not the other way around" and it is the variable that comes before the elementary. The logic of relations is a logic of continuity, Spuybroek argues, and all shapes generated through intensive processes are transformative shapes and have a transformative or transitive geometry. "It is only because the dimensions are

not given beforehand and emerge afterwards that they turn out continuous instead of discrete. In other words, with a transitive geometry, the dimensions of building are not mechanically added up but organically synthesized" (Spuybroek 2008b, 199).

7 CONCLUDING REMARKS

From this short presentation and discussion on some of the developments of theories and notions it is obvious that there are interesting parallels and interactions between the different theoretical frameworks. Some concepts and notions have similarities and are used recurrently, like assemblages, emergence, interactions, communication and continuity across scales, wholes that are not reducible to their parts. DeLanda's dimensions of variable material and expressive roles that components may play in assemblages have clear connections to the ontological and representational aspects in more traditional theories of tectonics. All this shows interesting approaches that could form a platform for further developments of central concepts and tectonics theories in contemporary architecture.

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