

The Architecture of continuity

Lars Spuybroek

Essays and Conversations

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Foreword

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by Detlef Mertins

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Time and again, we have been surprised and astonished as Lars Spuybroek has broken new paths for making architecture and pioneered new theoretical constructs for thinking about it. In a decade of synthetic experimental projects, he has amassed formidable new expertise, not for its own sake nor for that of the free play of imagination, but in order to address problems and limitations of the discipline. These problems, he points out, are generally not new to architecture, although their reemergence in the context of new technologies and new media gives them a sense of urgency that often makes them *seem* new. The essays assembled here make that abundantly clear, for they have been selected, augmented and thoroughly rewritten into an informal treatise as well as a resounding manifesto. In dialogue with theorists from different disciplines and eras – Deleuze and Virilio, Varela and Arnheim, Semper and Otto, Ruskin and Worringer all populate these pages – he addresses issues of technology, experience, methodology and aesthetics in turn. He draws distinctions – self-engineered rather than engineered, variation rather than randomness, active rather than passive – which result in nothing less than a new ethos of design.

For generations, one of the classic problems of architecture has been the translation from drawing to building – from what the imagination can produce in representations on paper, canvas and computer screens to what craftsmen and laborers can fashion with their materials, assembly lines and machines. But for designers of complex topologies, as Spuybroek observes, this problem has been stubbornly demanding, as they have labored to architecturalize digital tools as well as digital discourse. His response, in turn, has been radical and radically effective, for he sidesteps the issue of representation altogether to redefine the problem in other terms. In his hands, the computer has always been a *constructive* medium, not a representational one. It enables complex geometries that can also be enacted in other media or materials and at other scales, either before or after their life in the computer. Critical of "translation" for its residual neo-

Platonism – ideas first, materializations second – Spuybroek has developed a rigorously materialist practice in which there is continuity between design and fabrication. Continuity, as his book's title suggests, is his fundamental tactic for addressing the schism between form and tectonics, which continues to plague contemporary design. It is, moreover, a principle that permeates his entire ethos, oriented toward the activation of potential through what he calls vagueness.

One of the most powerful agents of continuity for Spuybroek is the paradigm of organization, for it underpins not only computing but all phenomena in nature – of life as well as matter, including human life, its societies and their material cultures. Spuybroek has never treated the computer as simply a tool but rather as a model of organization, and hence of mind and matter as well. He recasts construction as the ongoing process of change in organizations and seeks to learn from analogous organizations in different material regimes and at different scales. For his first projects, he turned to the geometry of splines – developed for designing and building ships – to achieve continuity between the construction of computer models and the steel frames of his pavilions. Later, he adapted Frei Otto's use of analogical models, which reiterate form-finding processes found in nature by hanging chains, wetting wool threads or making soap bubbles and later stretching fabrics or weaving lattices at the scale of buildings.

Leapfrogging backward over the 20th century, Spuybroek has more recently discovered a similar yet different form of continuity in Gottfried Semper's theory that architecture began with textile techniques that then came to "inhabit stone." He takes up the idea that material organizations can inhabit other materials to develop structures whose form and rigidity emerge by weaving together flexible strips of soft material. Spuybroek solves the problem of form with techniques that are not formal but rather material. He resolves the old opposition between structure and ornament by developing continuities of organization. For him, structures should

emerge through bottom-up processes rather than ones in which the results are determined in advance and then engineered for construction. Wary, however, of the naïve utopianism of the desire for pure presence, Spuybroek directs his experiments toward attaining ever greater control with which to achieve desired qualities and capacities, be they aesthetic or performative.

Problems of continuity across scales, the integration of parts and wholes, and variation and variability are all longstanding concerns of the discipline of architecture that have resurfaced among the digerati working with continuously varied and complex topologies. Here, too, Spuybroek swerves, this time away from the classical tradition, which has dominated these problems, even among the younger generation. To be as explicit about this as possible, he has embarked on an alternative history, mining the Gothic and its numerous anti-classical progeny, including the Picturesque and Art Nouveau. This history contains a rich body of expertise in curved lines – from Hogarth to Horta, from attached to loose – interwoven with structural analyses of bundled ribs, and passages from Ruskin and Worringer that seem remarkably contemporary.

Generations of avant-gardes have cut their teeth on another set of problems: the division between artifice and nature, technology and art, art and life. These are classic problems of modernity whose discontinuities were engendered by the process of modernization, with its translation of experience into new media and its reductive reifications and alienation, be it the alienation of labor, of audiences or even of designers. In response to these historical issues, Spuybroek employs another, conceptual kind of continuity: a habit of mind that favors bound dualities over binary oppositions. Through both/and rather than either/or thinking, he discovers new vitalities in the evolving machine and new im-mediacies in the body refigured by new technologies. But why should continuity in architecture be so important today in the multiple ways that Spuybroek suggests? Almost twenty years ago, Deleuze observed that the forces of information technology had

combined with those of genetics and biotechnology to restructure knowledge and social relations, displacing the paradigm of power through division, compartmentalization and discipline that had characterized modernity in favor of one apparently more open, but governed through control and modulation. Spuybroek - now a citizen of this society of control - rehearses in the field of architecture techniques that enact a "certain openness of mind." He produces continuities and vagueness to engender moments of play within the networks of continuous control that govern life today. As an architect, he cultivates control over generative processes so that their results may in turn open new horizons of experience and action.

Continuity is at issue as well in the interaction between people and buildings, for Spuybroek considers the body too as a kind of wet computer, continually practicing, coping and adapting within a continuum of uncertainty. Critical of the modernist open plan as too passive in its neutrality, he pursues an architecture of vagueness imbued with active potential, indeterminate yet charged with tendencies toward determination. He cites Varela, who understands cognition as a form of embodied action in which body and world are structurally coupled and interactively transform each other. If reality is the effect produced by synchronizing the rhythms of our bodies with those of the world, Spuybroek suggests that buildings could embody greater potential for action, not in a rigid functionalism, but to afford opportunities for exercising the capacities of the body through which we experience freedom.

In this context, the shift from classical to Gothic assumes another significance. Where the classical object closes in on itself - holds itself tightly together - the Gothic, Picturesque and Art Nouveau are extensive, barely objects at all but rather loose assemblies whose limits are unclear. Where self-sameness is the goal of classical form, the serpentine line is continually self-estranging, becoming other. For Henri van de Velde, the line is a force, possessing life and animating the perceptions of observers. Similarly,

for Spuybroek, the inherently empathetic nature of materiality is the basis for a politics of the object, enacted through the material logics of architecture, which are understood as continuous with those of the world. It is the "burning surfaces" of space, he concludes, that "make us catch fire. That is true continuity."

Experience, Tectonics and Continuity

Introduction

The Twilight of the Gods

Whatever happened to architecture? Any observation of the current goings-on in architecture, even for the shortest of moments, by the shallowest of minds, the critic most disoriented, cannot result in anything but the acknowledgment that architecture is in the most confused state it has been in decades. Architecture is in its slumber phase: there are no thoughts, no styles, no debates, no stakes, nothing but vast global success. We live in a global era of cuteness. We have cute architecture, cute critics, cute magazines, cute books. Cute colors, cute forms, cute materials. We seem to have arrived at the same point where we were almost 200 years ago, when we had to figure out what style to build in¹, not because we didn't have a style but because we had too many of them. It was Gothic on Monday morning, classical on Tuesday, and Wednesday was reserved for the rural picturesque. Thursday there might be an eclectic experiment, and Fridays ended in desperation. Most contemporary architects probably experience all this in a single day. To bypass such unnerving situations, the average large office today, similarly to large fashion houses like Prada and DKNY, has a principal flying all over the world with projects by the directors (all between 25 and 30 years old) that precisely cover this five-day range. There's one director for minimalism, one for high-tech, one for traditionalism, one for formalist streamlining, one for desperation (which they call the R&D department). And even this view is probably too rosy, because such a setup would still allow for some kind of positive tension, for a potentially fertile neurosis. The truth, of course, is that we have analyzed all the tension away, negotiated all the different positions: we can mix in enough traditionalism with high-tech to make it a railway station in a historic city center, or mix in enough streamlining with high-tech to make it an airport, or mix in enough minimalism to put it in Germany, add in enough signature to make it a museum, or enough desperation to take it to China. And all the critics give it the nod.

So what has actually happened to architecture?

I think the best way of understanding our current position

is through aesthetics, since it covers all aspects of architecture – not just how we make it or how we design it, but also how we get others to agree with it and to discuss it. Aesthetics is the widest scope one can take for looking at design. What is an aesthetic experience today? It is not the revelation of the century to say that there has been a major shift in the platform for aesthetic appreciation – the magazine – which has moved from being mainly language-based to being fully image-based. We are in the final stages of what I call the "Kantian trap": aesthetic experience leading to a cognitive moment of critical judgment. Now, Kant has been accused of many things, and often unjustly so, but with him aesthetic experience did give way to critical judgment and taste – the intermission when everybody gets up to discuss the play became as important as the play itself, and this led directly to reviews. This moment of critique led inevitably, fatally, to an architecture of criticality, where architecture in its turn discusses its own reviews, and all design features become illustrations for a previous or later debate. At this point, architecture considers everything as language – its history, its ordering system, its aesthetics – and all there is left to do is analyze it, comment on it and deconstruct it. Every fading architectural movement is one of language: whether from the 2nd century, the 16th or the 20th, everything ends in rhetorical mannerism. It always ends in language. And where has this architecture of criticality led us? Straight into "visual culture." There are still critics – and architects – who believe criticality resists visual culture, but in fact it precedes it and is incorporated by it. What exactly does it mean to be, as Koolhaas proposes, critical to ¥€\$? Is that NO ¥€\$ or YES ¥€\$? Either one will do; it doesn't matter. In semiotics there can be nothing outside the global empire of signs themselves, whatever their content: signs function on their own, thanks to or in spite of their content. Who cares about content? Certainly not the signs that are supposed to embody it. And now, to return to our main question: what constitutes an aesthetic experience in the realm of semiotics? An unraveling of the subtext, a decoding of messages and a reclaiming of them? That is not an experience; that is read-

ing, interpretation, judgment. It all turned out the wrong way around: Kant's judgment was supposed to come at the end, and now it comes beforehand. But we are already far beyond interpretation or decoding, and all we can offer things today is the briefest glance, the faintest smile – the flimsiest acknowledgment of a sign's existence. We look at signs as they look at each other. And today the glossy magazines' editorial pages have moved onto ubiquitous designer websites, and the magazines have become even more visual, like websites on paper. A deader dead end can hardly be imagined – and architecture blindly follows.

Architecture and the Lamp of Life

This book, written over the course of many years, argues for exactly the opposite; not wholly unexpectedly. It proposes a radically materialist view, but one so radical that it becomes strange, indeterminate and even vitalist. It is not so much a scientific vitalism (which would not be very scientific) but one that is committed to the aesthetic, where the perception of matter resonates with matter itself, where the sensed, the seen and the structured share the same continuum. Such a materialist view means nothing more or less than that when looking at the body, *experience counts as the main form of involvement*, and when looking at architecture, *tectonics counts as the main form of articulation*. In this view, life pervades everything – experiencing bodies and structured matter, the organic and the inorganic – a view that is particularly convenient when theorizing about architecture, since it exists at the crossroads of both. Of course it requires quite some imagination to view not only people and trees but also cracked mud, foam and clouds – let alone buildings – as alive, and one shouldn't really, unless one defines life not so much as breathing and reproducing forms of matter but more fundamentally as "sensitive" and "irritable" matter, as Diderot and his contemporaries did². In the early stages of the 18th century, when science was slowly moving away from Descartes' mechanistic physics toward, for instance, a chemistry dealing with the problem of fermentation and a biology deal-

ing with the problem of regeneration, early Enlightenment philosophers began to view matter as something active rather than passive, as substance with intrinsic movement, rather than movement being external to matter. In their view, one could no longer draw a clear line between matter and life. And we can't, we shouldn't, and that is as far back as we have to go to tackle the problem of contemporary aesthetics and architecture. From that point on, we have to create our own new path through history, rethinking aesthetic experience, rethinking tectonics, to finally come out on the other side of the problem.

We must simply rethink the whole process of aesthetic experience and how it relates to an architecture generated from active matter. In the second half of this book, I make many references to previous moments involving a vitalist aesthetics. One is the rise of the Picturesque movement, which emphatically positioned itself between beauty and the sublime and led up to people like John Ruskin, who so heroically stated that architecture had reached its definitive low point in the Renaissance³, when structure and ornament became forever separated. His best chapter in *The Stones of Venice*, "The Nature of Gothic," and that in *The Seven Lamps of Architecture*, "The Lamp of Life," are quoted here over and over. Moving away from universalist classicism, Ruskin tried to advocate an architecture of life, which was by necessity Gothic because of its "changefulness and savageness"⁴. Another such moment came with Wilhelm Worringer, the German art historian who startled the art community with his thesis *Abstraction and Empathy*, and even more with *Form in Gothic* three years later, which advocated an expressionist reading of the Gothic, in which geometry itself came alive. Worringer was one of the first to map a way out of the dilemma between structure (abstraction) and empathy (ornament), which is still one of the deepest rifts in architecture, in the form of high-tech Polytechnique vs. sculpturist Beaux-Arts (see the chapter entitled "Steel and Freedom"). What I have found completely liberating is to be deeply involved with historical figures like these without at any point feeling the need to become historicist. It has to do not with history being a

supplier of architectural form but simply with tracking down kindred thought. For Coleridge, Ruskin and Hogarth, taking life as an aesthetic subject was occasion to become not speculative but accurate. I find there to be no comparison in rating them against our contemporaries, or against what we have come to know, in our 20th-century idiom, as the avant-garde, which is simply a military view of mediated taste. In tracing this historical path of life in forms, it is evident that, as I have stated above, "life" must split itself into two modalities, one concerning human corporeality and experience and the other the materiality of structures and forms. These two materialities again meet and interact in life itself, which of course raises the main question of how they affect each other and how such mutual influence reunites them.

Roughly stated, half the essays and conversations reason from experience to structure (these include "Motor Geometry" and "Sensograms at Work"), and the other half from structure to experience ("Steel and Freedom," "Machining Architecture").

Sensation, Perception, Action and Construction

The aesthetic experience we pursue is of a radically different nature from critical judgment, in Kant's time as well as our own. Now, before elaborating the aesthetics, we must focus on experience itself. According to John Dewey⁵, who built an important segment of his philosophy on the notion of experience, like his contemporary William James, nothing can be more noncognitive and nonlinguistic. Experience, for Dewey, starts with pure sensation or feeling and leads more to a knowing-how - a bodily, skillful form of reflection, a motor memory - than to a knowing-what, i.e. knowledge or judgment. But all theories of experience seem to work directly as aesthetic theories, since corporeality involves an agency of the senses. The fact that our lives seem to revolve around aesthetics more than ethics is discussed at length in this volume in my conversation with Arjen Mulder, entitled "The Lives

That Are Hidden." This means we are immediately outside the reach of Kant's critique, since experience beginning with sensation directly leads to a very specific relationship between perception and action, in which one is embedded in the other. It forms one of the central arguments in this book: that there is no action without perception, and no perception without action (see, for example, "The Primacy of Experience"). Perception is not something that happens to us, or in us, but something we do, as Alva Noë⁶, the latest exponent of such thinking in cognitive philosophy, says. This way of looking at experience, as an inherently aesthetic modality of human nature, then inescapably points in a direction where seen and sensed forms constitute activities. In the book's development of these ideas, many scholars and aestheticians are discussed, such as Susanne Langer, with her concept of living form; one of the earliest is William Hogarth, who as far as I know was the first person to use the word "picturesque". In "The Aesthetics of Variation," I discuss his concept of the serpentine line – the line of variation – as applied in the hairstyles of his day as well in his paintings and drawings. Hogarth found a path between the world of beauty, a world of ideal static forms, and that of the sublime, one of only forces and dynamics. He found a way to deal with forces before they become forms, as neither pure forces any longer nor forms just yet. In modern terms, he dealt with process, but without serving up pure force, as in action painting. He wanted his art to "work" and developed his aesthetics accordingly. Here, we can already discern a parallelism between perception on the one hand and the perceived object on the other. What makes one work also makes the other work. The making of an artwork somehow runs parallel with the seeing of that artwork. This is something that doesn't happen with the sublime or with beauty, or in 20th-century terms, with either abstraction or realism. The fact of the matter is that both perception and object are *constructed* during a process, which is of course the final pillar under the all-encompassing concept of life's materiality: next to sensation, action and perception, we find construction as the final dimension of experience. This specifies our aforementioned vitalism as a kind of con-

structivism. Life constructs. Agency builds. There is no other way of understanding our sense impressions than as constructs, as blocks or rhythms, or as assemblies. So, when a theory of experience evokes an aesthetic theory, and that theory can accordingly be applied to any work of art or built structure, they automatically start to short-circuit and loop. Life is shared. This aesthetic of agency is theorized at several points in the book as *sensuous*, a concept which comes very close to Worringer's concept of empathy. Sensuousness is not about the pure collecting of atomic sense data, but nor is it judgmental contemplation. It is *corporeal reflection*, so to speak, a resonating of the body, with a wide range of actions implied. It is a shift from emotion to feeling and from lived experience to life experience. Empathy is generally explained as a "feeling into,"⁸ involving not so much a sharing of the same feeling between a person and an object (which would be close to animism), but a much more general and impersonal sharing of life itself.

Earthwork, Wooden Frame, Textile Wall and Fireplace

As stated before, a materialist theory of perception and sensation must run parallel with a materialist theory of architecture. On first thought, one would expect that such a theory would simply lead us to engineering, more of a theory *without* architecture. But of course, a theorized materiality doesn't need to be applied to building as such but more to the organization of the built – and organization means architecture, not building. This is why Gottfried Semper's tectonic theory of the four elements⁹ (earth, wood, textile, fire) is not a concept of architectural elements, of components that need to be jointed, though it is often understood as such. His four elements are much more states of aggregation, of density or rigidity, than actual building materials. Semper was well aware that architecture, in his time at least, was monolithic. He argued that the four elements didn't inform building so much as

architecture, which was made of stone anyway. Tectonics consists of a materiality that informs the organization of things as much as their physical structure. Many scholars have struggled with this, but Semper's theory explicitly steers between what he called mere engineering and speculative aesthetics, the latter of which would mean to simply cast ideas in stone. He refuted both blind materialism and blind idealism; or, in terms of architecture schools, he refuted the Polytechnique as much as he did the Beaux-Arts. Tectonics is exactly that: an aesthetic, not poetic¹⁰, use of structure, and in our terms this means a structure that is made sensuous. I have always paralleled Semper's four elements to the four experiential dimensions discussed above. The earth-work is the first surface; it creates the plan. The plan is the surface of action. The wooden frame is the structure, the realm of construction. The textile *Bekleidung* creates the wall, the surface of perception. The hearth, the fire, constitutes the realm of sensation. But, as with experience, these four categories cannot be simply added up; rather, they multiply, intertwine and bring forth each other. This is why in chapters like "The Structure of Vagueness" and "Machining Architecture" I have tried to rethink Semper's materialism in a more processual, active form. I was happy to find this in the original and long-ranging research of Frei Otto, who, however close to engineering (and therefore to the frame part of Semper's categorization), developed ways for active matter to "find form"¹¹, as he so strikingly puts it. Frei Otto, following Gaudi in this sense, created material, empirical computers to generate architectural forms, in what is known as analog computing. In the conversation with Ludovica Tramontin in this book, entitled "Textile Tectonics," I call this the "Semperian reversal": the reversal of the *order* of the four elements. Instead of starting with earth and a wooden frame to support the weaker textile fibers, I reason the other way around: weak threads move, find each other, and lock into each other, building structure and rigidity. So instead of adding the soft to the rigid, as Semper did, we see a *transformation of soft into rigid*. This is nothing more or less than the application of the concepts of constructivism to archi-

itecture, meaning that the mobility of agency is transferred into structure. While form is being generated, it necessarily becomes structured, because if it didn't, it wouldn't hold. It is all (a process of) constructivism.

When we look at this twin materialism, of the body's corporeality on the one hand and the building's tectonics on the other, we see a theory of architectural form emerge that can safely concentrate on the object of the building itself, since the other part deals with experience, which involves as much routine and habit as "program" normally would. Program and form are still complementary; they are extensities, with one filling the space left by the other. Experience and tectonics are congruent; they are intensities, both filling the same space (that's why their relation is sensuous and why there is so much empathy between them). So there is no need to go back to Vitruvius. If we consider architectural form, we immediately note the three scales of design: not *utilitas, firmitas and venustas* but *massing, structure and texture*, the three physical scales of architecture. A reworking of Semper's four elements into three scales would suffice to have life live in its full complexity both as the realm of action and as the realm of sensation and perception. Tectonics works in all directions, horizontally as much as vertically, and across all scales, on that of massing as much as that of texture. It creates a continuity we haven't enjoyed in architecture since Alberti broke it up into separate realms. Since his theory of architecture, structure has been equated with abstract, mechanical geometry, and ornament with organic beauty. And because geometry lacks empathy, it needed to be corrected with ornament that operated on the smallest scale (that of texture), while massing was governed by proportion, harmony and what he called *concinnitas*, the way a building is organically put together¹². So architectural aesthetics is evidently an aesthetics of the whole and the parts, like any other aesthetics. But for Alberti, the parts are totally subordinated to the power of a preexisting whole, to purposiveness, not all that differently from Kant's sense impressions being subordinated to an apriority of concepts. 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 in the realm of tectonics understood as configurational, rhythmic and patterned (see "The Architecture of Continuity" and "The Aesthetics of Variation") – and such description fits human experience as much as architectural form.

With Worringer, we see a radical shift when he theorizes the Gothic as healing that separation of structure and ornament, or in his words, abstraction and empathy – or, in Kant's words, the mechanical and the organic. The Gothic merges both positions; it is what Worringer calls "vitalized geometry"¹³. It doesn't have to decorate the structure with organic elements, since movement and life itself have become part of the structure. The Gothic is nonorganic; it is repetitive and not symmetrical, restless and not balanced. It is *the structure that has itself become sensuous and the ornament that has become material*. We see a continuity of scales, of dimensions, occurring in the Gothic. To clarify this notion, I discuss some of the ideas of the famous metallurgist Cyril Stanley Smith in the last conversation in this book, "Steel and Freedom." For Smith, who distinguished between three scales of material aggregation – "Structure, Substructure, Superstructure," corresponding with our order of structure, texture and massing – looking at aluminum alloys wasn't so different from looking at paintings. He was particularly interested in the mixture of regularity and irregularity in metal structures. He saw not a lattice of atoms that simply added up into a block of metal but lattices organized by aggregates. When a metal structure grows by itself, it does so not by addition but by aggregation: it breaks into singularities ("dislocations"¹⁴, what I call transformations throughout the book) that make the structure expressive and empathetic in itself. The scales of structure generate one another from continuity, like the Gothic column that moves up from the floor as a bundle of ribs, subsequently disentangles into a fan-shaped top and reentangles into a reticulated vault where all four column-fans start to interweave. 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. Going from line to surface necessitates a transformation, a shift, but without breaking continuity. Continuity in architecture does *not* mean organically smoothed-out forms but an architecture of singularities – sudden changes in a system that organizes the previous state by a matter of shifting scale, like column-line to vault-surface. In short, tectonics is not the subordination of all articulation to structure; an 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 a structure that transforms on its own to cross scales.

Finality, Ambiguity, Continuity and Generality

Here we have arrived at the final argument: that of continuity. All the aforementioned constructivism, all the sensuousness, all the material agency spring from only one thing: sharing, or better, continuity. When Charles Sanders Peirce wrote *The Logic of Continuity*, he was convinced it would create a revolutionary change in mathematics and logic (and it did, but much later than he had hoped). Peirce is present in many discussions and arguments in these essays, especially the one that deals more directly with his ideas, "The Structure of Vagueness." Philosophically speaking, Peirce's concept of continuity is not too different from Deleuze's plane of immanence (the plane of life, of undivided consistency) or Spinoza's monist substance: all germinates from one. Or, as Peirce says, "all things so swim in continua"¹⁵. Continuity is part of real things, and therefore things are necessarily vague, since they are one and many at the same time. If you look at a bird, for example, obviously it is a finalized form with clear contours, but that doesn't help you to understand what a bird is; you have to see it fly first, which makes it less clear, and then you can only understand its flight when you take the air into account,

which makes it completely vague. So vagueness is not a lack of logic (though it is a lack of determinacy); on the contrary, the logic of vagueness is exactly what constitutes relations. All logic concerns relationality, that which we generally indicate by "rules" or "rule-based systems" (see "Machining Architecture"). When that same bird flies into the forest to pick up a twig to build its nest, everything that makes the twig a component is in such a relational logic itself. If there can be no continuity between elements, there can be no material agency for forms to find themselves; if there can be no continuity of natural forms, there can be no evolution; if there can be no continuity of tectonics, there can be no jumping of dimensions; if there can be no continuity of empathy, there can be no aesthetics. And this is particularly important to architects, since we tend to think in an elementarist way.

Elements are the simplest state of being; they are defined by an internal code, an identity or purpose, that which makes a screw a screw and a column a column. This form of determinism is generally denoted as finalism; each object is a finality. A column is a finality, as is a beam, or a room. Most architecture we know of operates on this level: classicism and most of modernism work with predefined elements.

When on one side of the formal spectrum we have the abovementioned determinism, then logically on the opposite side we should have an indeterminism - what is called generality. In architecture, we know this from architects like Mies van der Rohe, who mostly tries to generalize differences into a single state of being, a neutral average. A space frame is another generality architects are familiar with, since all the members are abstracted into the same state. All minimalists strive for such a form of generality, to reduce all form back into a single form.

Now that we have defined the two extremes of our formal modalities as finality and generality, we can more clearly see the two in between: ambiguity and continuity. Ambiguity is a dual state of being, like two determined states overlapping or working simultaneously. In the conversation entitled "The Aesthetics of

Variation," I name Robert Venturi as the strongest advocate of this form of architecture, but I also think of Pirro Ligorio, who bent a façade into a ceiling (Mannerism offers dozens of examples). A gallery in any typical baroque palace also counts as an ambiguity, being a corridor and a room at the same time. And I remember a wall by Adolf Loos, just behind the entrance of Haus Müller, in which there is an opening so large that it can be interpreted as either two columns or a wall with an opening in it.

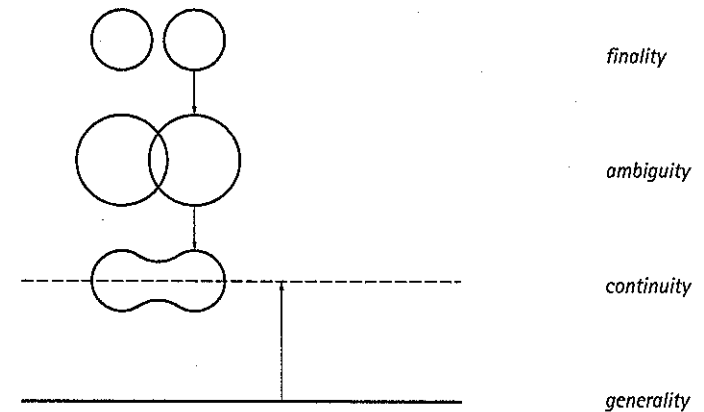


Diagram of the four modalities of architectural form.

Finally, after finality and ambiguity, we have continuity as the last mode of existence before generality. Continuity includes both sides: singularities, i.e. discrete states, and fully merged and generalized states. In continuity, all is materialized, the objects as much as the relations between them. So it tends toward generality, but things can still articulate and express themselves, on the condition that they never leave the continuity. I hold finality and ambiguity to be typical linguistic states (and therefore defunct), while continuity in all its characteristics is material. Generality I hold to be the most abstract, mathematical state of being, which

is unstructured and therefore a misconception of continuity, like the statement that when all is one, all is the same. Unity is not uniformity. Materializing the generic without differentiation is simply a misunderstanding of continuity. In the Gothic, which is the architecture of continuity *per se*, all elements are in a constant state of transition, column becoming vault, vault becoming window, window tracery becoming wall, and on and on: all movement is passed on, without ever dissipating. The relations have become external; it is the relations that create the whole, not the parts.

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 with the soft, tectonics with textile, abstraction with empathy, and matter with expressivity.

Technologies and Techniques

If we broaden the definition of technology for a moment and state that it consists of a constant handling and processing of matter, than we can apply this definition to both the materialities – the body's and the building's – that we had so carefully differentiated before into a realm of experience and one of tectonics. If there is a life of forms, technology is certainly its accelerator. Matter already moves of its own accord, but technology speeds it up. There is in technology always a great force of convergence at work, a channeling of potentials, which then diverge into millions of objects. A simple ruler seems to specify only the narrowest and simplest set of forms, but how large that set is! It is the same with a keyboard, a knife or a hammer. Of course, my own roots lie in technology, as the earlier writings in the first half of this book clearly show. On the other hand, an essay like "The Motorization of Reality," which short-circuits matter and mind completely via the technological, I could have written yesterday. "All concepts are motor-concepts," I write in that essay, meaning not only that all thought is action, a view Dewey would have subscribed to, but that the continuous production of the real is inherently and

immanently "motorized," and as much a product of time as of technologies. Machines and technology pervade the book, from human experience ("Motor Geometry") to design methodology ("Machining Architecture") and fabrication techniques ("Steel and Freedom"). Technologies have a tendency to become techniques; since their realm of existence is that of operationality and work, they can potentially work upon any object. Their specificity tends to become generalized. Computers are a final step in this abstraction of work. They can work on anything. Therefore, it must be stated explicitly at this point that the realm of the sensuous, of empathy, can be revived in architecture only because we are shifting more and more from (a) manual design techniques to process-driven computing techniques and (b) manual labor to computer-aided manufacturing. Let's recall for a moment that all the examples derived from Ruskin, Hogarth and Worringer concern handcrafted elaboration, often of a pre-industrial, and sometimes even an anti-industrial, nature. If we take Semper's notion of art as more praxis than poesis, of an art emerging from weaving and from craftsmanlike precision and delicacy, as a proposal for our times, it can only be supported by a decisive shift in craft itself. When we propose that ornament become structural (and structure become sensuous), this must be supported by (a) the industrial capacity to actually provide such complexity of variation and (b) the transference of the typical intricacy of handicraft to design and computer modeling. Craftsmanship becomes digital skill; the proposed shift concerns a technological upscaling as much as a material one. Now, this in no way means the materiality of craft is replaced by a digital immateriality (whatever that may be), that craft is transferred completely to the design studio and our designs are cut, milled and coated by five-axis robots that never sleep or strike. On the contrary, as we move from *performed products to informed half-products*, this will necessarily mean architects will have to spend more time in factories rather than less, conduct more experiments and make more prototypes. When architects suddenly stop having to choose from a catalog, it means they need much more knowhow, or what Polyani calls

"tacit knowledge"¹⁶, a form of implicit knowledge that involves direct experience of how things are made and done.

It also means architects need a much higher level of education in order to master digital tools, which started with simple CAD applications in the 1980s and moved on to the high-end modeling software of the 1990s and then to the generative component systems we use now. It is obvious today that educating architects to use these at a skillful level is not as simple as we thought it would be 10 years ago; the software programs of the airplane and automobile industries are far above the level of our typical CAD systems, especially since they involve fabrication, its processes and its economy. It is also clear by now that mastering the tools is a job for the architects themselves and not their draftsmen. And we should also keep in mind that these tools can only be taught when conceptualized within architecture itself, i.e., as design techniques and not as technologies, first of all because the programs are far too wide-ranging to teach in a course (a typical 3D modeling package comes with a manual of a few thousand pages), and second because functions like "copy," "paste," "lathe," "loft," "blend" and "smooth" are by no means innocent, either for architectural theory and methodology or for fabrication. In general, architecture resists such a complete immersion in technology, as the Beaux-Arts was by default opposed to the Polytechnique, but it is evident that digital technologies are of a far more abstract nature than pure engineering. I think the necessary reunion of the Beaux-Arts and the Polytechnique is a question not only of closing the gap between structure and empathy but also that between technology and methodology.

Conclusion

What will happen to architecture? Some who have written off digital architecture have probably mistaken it for yet another style in the ever-widening estuary of multiplying and branching languages we were so used to in postwar western architecture. Meanwhile, digital architecture has been getting an education; it

has slowly learned to "architecturalize" its tools¹⁷, but it has also refused to associate itself with (or as) a group, indicating its wider scope and deeper significance. The digital turn has proved a much larger one than we thought at first, mainly because it involves a much deeper, more encompassing change at all levels of architecture: its experience, its methodologies, its history, its structure, its fabrication process, its aesthetics, its clients, its critics, its teachers, everything. I don't think singling out one or two components allows us to sufficiently grasp its complexity. Nor do I think we do it justice by applying it only to form, or structure, or decoration. We should resist easy solutions and refuse to take shortcuts. I think digitization is as inevitable as the Renaissance was after the tools of perspective, as modernism was after movies and trains, as postmodernism was after cars and television – but we must theorize digitization at the most fundamental levels of architecture, at the levels where we can start to repair the rift between the materiality of tectonic structure and the sensuousness of human experience.

Rotterdam/Atlanta, June 2008

1. Heinrich Hübsch, "Im welchem Style sollen wir bauen?" (1828).
2. Denis Diderot. *Romeau's Nephew and D'Alembert's Dream* (Penguin, 1976) and *Principes philosophiques sur la matière et le mouvement* (1770). The principle of irritability was already earlier conceptualized by Albrecht von Haller and the concept of movement being inherent to matter by John Toland in his *Letters to Serena* (1704).
3. John Ruskin. *The Stones of Venice* (Pallas, 2005): 207. On the topic of the Renaissance: "its main mistake [...] was the unwholesome demand of perfection."
4. Ibid. Book Two, Chapter IV, "The Nature of Gothic": 142. Separately edited by William Morris as *The Nature of Gothic* (republished with Garland, 1977).
5. John Dewey. *Art and Experience*. (Perigee, 2005): 21–3. And also: William James. *Essays in Radical Empiricism*, especially chapters II and VI (University of Nebraska Press, 1996).
6. Alva Noë. *Action in Perception*. (MIT Press, 2004): 1
7. William Hogarth. *The Analysis of Beauty*. (Yale University Press, 1997): 50. More than forty years later, in 1796, Uvedale Price published his *On the Picturesque* (Woodstock, 2000), defining it explicitly as "a station between beauty and sublime."
8. For a thorough discussion of the concept of *Einfühlung*, see H. Mallgrave and E. Ikononov, eds. *Empathy, Form, and Space: Problems in German Aesthetics 1873–1893* (Getty Center, 2003). Worringer's use of the notion of empathy ends a 35-year history that started with Robert Vischer and was carried forward by Heinrich Wölfflin. *Einfühlung* (with variations like *Zufühlung* and *Ausfühlung*) was a directly sensed con-

- nection of the body to built form, as experienced in dreams where, for instance, a headache is visualized as ants crawling over the ceiling of a room. This later became known as Symbolism, which we understand today as linguistic and archetypal, but in the late 19th century the connection was expressly nonlinguistic.
9. Gottfried Semper. *Die Vier Elemente der Baukunst* (Braunschweig, 1851). Later translated by Harry Mallgrave as *The Four Elements of Architecture* (Cambridge, 1989).
 10. This refers to Kenneth Frampton's *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture* (MIT Press, 1995). In the last chapter of this volume, "Steel and Freedom," I praise Frampton for his strong and ongoing defense of tectonics, but on the other hand move away from his position because it is fully based on structure as creating a (Heideggerian) place in the world, with empathy and sensuousness subordinated to metaphysics or poesis. To again make the praxis of the sensuous a *language* to express something external to it does not conceive the relationship between experience and tectonics as existing of itself. To use tectonics to experience the world is something radically different from experiencing tectonics itself.
 11. Frei Otto and Bodo Rasch. *Finding Form: Towards an Architecture of the Minimal*. (Menges, 1995).
 12. For a thorough discussion of Alberti's organicism see: Caroline van Eck, *Organicism in Nineteenth-Century Architecture* (Architectura Et Natura Press, 1994): 45–56. We must draw a clear line between such organicism (including the more naturalist versions by architects like Frank Lloyd Wright) and the approach we are proposing. Organicism does not use properties such as agency, complexity or mobility to produce architecture, it *mimics* life by either using "natural" proportions, "natural" variety or "natural" materials.
 13. Wilhelm Worringer. *Form in Gothic* (Schocken, 1964): 41. As quoted on many occasions by Gilles Deleuze, for instance in: *Francis Bacon: The Logic of Sensation* (Continuum, 2004): 46 and 129.
 14. Cyril Stanley Smith. "Structure, Substructure, Superstructure," in: *In Search of Structure*. (MIT 1981): 54–68. Also in: Gyorgy Kepes. *Structure in Art and Science* (Braziller, 1965): 29–41. Dislocations are not simple cracks in a coherent lattice of packed atoms. They are films or interfaces that allow metal to be ductile instead of brittle and deal with a variety of loads. In this view, a dislocation should not be understood as a disconnection but as a complex, sliding form of connectivity.
 15. Charles S. Peirce. *Collected Papers of Charles Sanders Peirce, Volume 1, Principles of Philosophy* (Cambridge, 1932): 1.171
 16. Michael Polyani. *The Tacit Dimension* (Anchor, 1967). Also of interest: Richard Sennet. *The Craftsman* (Yale University Press, 2008).
 17. In the early years of digital architecture all such design (including my own) seemed to concentrate on hall-like, single-story buildings, often without any windows. A lot of digital design still favors dome-like ("blob") roofs or sculpturist massing. This will cause it to become increasingly trapped in the realm of exceptional typologies and inevitably die out. Only a process of persistent reevaluation will enable it to deal with windows (without puncturing them out), structure (without inserting columns afterwards), multistory systems (without filling in the section), entrances people can find (without adding an awning), façades that align with historical environments (without cutting the building off), public spaces that deal with the urban fabric (without subtracting them as antiforms), and all the other inherent architectural issues. Major progress has been made by shifting topological thinking from the world of *forms* to that of *systems*, and shifting along the way from animation to variation. Since systems are inherently articulated they can much more easily than forms absorb the layering of floors, the spacing of columns or windows, et cetera. Systems operate on variation, from lower-scale, gradual deformations to higher-scale transformations. My stance is that such a move can only be accom-

plished by a fully tectonic understanding of scale issues, in opposition to formal or programmatic approaches, which immediately wind up in an either/or position. While the formal and programmatic do not automatically result in structure and aesthetics, tectonics does lead to form and program. Again, the architecture of continuity is not one of smoothness but of articulation. For more thorough discussions of these topics, see the essays "The Structure of Vagueness" and "Machining Architecture" in addition to the conversations in the second half of this book.