

Per Formative

Towards a Post Formal Paradigm in Architecture

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"---- Brick says: *I like an arch*"
Louis Kahn

Formalism was historically conceived as a stylistic motivated movement, but in fact- and in essence- it was more of a *raison d'être*. Its central iconic presence in art and architectural theory has brought formalism its quasi-religious status amongst designers as authors-of-form. The current expressionist crisis of formalism within the praxis of digital design however, conceals a deep vein of complexity and contradiction between *form* and *formation* in contemporary discourse. Form's obituary is rapidly being outlined as second generation baby-boomers chart out territories for a formal atheism, or, if I am not promoting too lofty a claim, a new religion. It is called, *The New Materiality*.

Is architectural design culture ready to abandon the dinosaur sanctuary of formal expression? In order to define, defend and deliver argumentation for a design process driven by something other than form, I have chosen to override entirely the stylistic content of form as defined by the 19th century German theoreticians that influenced the historians and canonical interpreters of modernism, Nicholas Pevsner and Siegfried Gideon. Such dismissiveness is indeed a principled one and necessary in order to formulate a non-biased account from the point of view of historical contingency. In other words: it is impossible to liberate oneself from the historical logic of the emergence of formalism as design ideology without first canceling it out by way of revisiting a completely new set of historical resources in order to promote the appearance of an alternative rationale. A populist argumentation of that genre has only brought about more thoughts of form in its many manifestations and there is now an urgent need to rearrange road maps of alternative historical precedents in order to articulate form's other and to resurrect some of nature's well kept secrets. Ecce Forma!

The Weave of Formalist Discourse: Form's Other

Woven into architectural discourse is a warp of the positive with its interwoven counter-form, the weft of the negative and prohibited. This interrelationship of the dominant positive and its forbidden dual is also the nature of ideological rhetoric. Bred into the revolutionary polemics of Modernism and into the weave of its evolutionary discourse is a dominance of the visual and formal attended by the subdued other: the material, the productive, and the tactile. Through a looking glass we see the other while its form appears faintly as a subtle reflection. That act of piercing the logic of the image in reflection, of seeing through the looking glass, is an act that identifies material's radicals, Otto, Hauser, Isler, or Prouvé, each having proffered a tentative foray towards a new logic of making.

The new materialism in architecture that has emerged as a phenomenon of late Postmodernism appears to be a sign of cultural stirring. With the assistance of advanced Material Sciences and a body of remarkable international structural engineers, architectural culture appears poised for transformation. But, in the short run, crossing the conceptual boundaries of the culture of praxis is not possible merely as a counter-cultural effort, an act of the trans-valuation of values. Thus the contemporary culture of geometrically complex surfaces, the dramatic level of interest in emerging materials and the appearance of paradoxical morphologies (e.g. the bird's nest, or the voronoi-based water cube) may be ironically interpreted as the smooth evolution of formal complexity from semantic, to geometric, to informed morphological expressionism. Will the real new paradigm please stand up?!

Since the middle of the 1990's, various architects and architectural historians have been attempting to theorize the emergence of a new paradigm. This period of re-theorizing architecture has been accompanied by realized work both in the form of few canonic built works, experimental architecture that has remained in project form, and the production of theoretical texts. It is as yet difficult to clearly determine the nature of this new paradigm in architecture, its generality and relevance, as well as its theoretical foundations.

If there is a cultural turn, than its vague parameters define a blurred outline still qualified by dallying with the culture of style and stardom. One senses the exhaustion of formalist modernism, its myopic narcissism faced with challenges of credibility, accountability, professionalism and ecological neglect. My objective is to trace certain of the characteristics of what I have termed a cultural turn, in order to identify the evolutionary, as well as revolutionary, nature of the dynamics of new and emerging architectural discourse. This discourse projects us very rapidly beyond the point of a dialectics of formalism through a new materialism and, beyond this, towards the indications in experimental approaches that we are in the

early stages of movement towards a new architecture. It is the tracing of the evolution of this theoretical discourse, beyond a dialectics of late postmodernism and the mapping of its new taxonomy and concepts that is the objective of my work here. Along the way, we will encounter and joust with the shibboleths of a transitional period. With some luck, we will emerge on the other side of the mirror.

From Myopic Seers to Slippery Paradigms

In undertaking such a work, a work that proposes that an imminent paradigm shift can be characterized through an analysis of the critical discourse, it seems important to consider in the beginning certain of the logical pitfalls and impediments that may lie in waiting.

What classes of fallacy might be encountered in such a work? The first might be referred to as the “myopic seer”. Basically, it refers to the problem of conceptualizing change within an existing semiotic framework and while attempting to justify the continuing intellectual validity of a prior position. A classic example may be found in Zevi’s, *Modern Language of Architecture* and in late thoughts which he propagated through his magazine *L’Architettura, Cronache e Storia*. Developed in books and articles, Zevi presented a theory of the new paradigm in architecture as continuing and expanding his interpretation of Modernism.

While strongly attributing the background of these cultural developments to the emergence and application of anti-rules corresponding to the language of architecture created by the great modernists Le Corbusier, Gropius, Mies van der Rohe, and Wright – Zevi makes a case for “both continuity and change”. However the dominant ideological underpinning of the thesis is that the new developments are committed to pluralism – that is, he returns to certain of the fundamental characteristics of Zevian post-modernism. The new complexity is thus distinguished by scale, or composition, rather than by substantive difference.

Aside from drafting an alternative system of architectural representation characterized by a free interpretation of function, an emphasis on dissonance, a dynamic of multidimensional vision, and independent interplay of elements, much of the conceptual framework repeats certain of the commitments to old friends and to familiar ideas. The most problematic of these tendencies is to frame his arguments in the language of formal analysis. The formal description and the exegesis of building form emphasizing a less restrained interpretation of form - follows in place of the more classical Beaux Art language with its focus on abstract principles of order, proportion, and symmetry - and repeats the emphasis upon the *primacy of formal content* as an indicator of deep cultural developments that came to characterize his writing. Thus the attempt to interpret epochal change while still maintaining the essentially modernist logic of the primacy

and self-awareness of formal content appears to be one form of fallacy to be circumvented. Perhaps such problems can be avoided by adopting a different method of analysis, and one much less dependent upon the actual formal analysis of buildings and projects.

In other words: Zevi promoted an organic marriage of engineering and design, and an integration of buildings into their surroundings, without disrupting the plethora of formalist values, relating to composition and representation, so inherent in the Modernist tradition. Moreover, anticipating the language of postmodern architecture, Zevi argues forcefully for complexity and against unity by means of the very same elements of the modern language of architecture identified throughout history, to discuss the process of architectural innovation. Zevi's critique was indeed uncompromising of any tendency in modern architecture towards classicism. However, such criticism was fueled by an anti-language that employed the very same formal indicators. This is almost as bad as breaking a taboo by giving it political legitimacy (rather than offering an alternative ideology). Ironically, Zevi will be remembered as the ultimate iconoclast and deconstructive prophet of formal fragmentation.

This appears to be part of a conceptual and taxonomic problem (lacking a new conceptual structure), and of a semiotic problem (re-using formal concepts). The method of discourse analysis, as compared to a process based upon formal analysis may help to overcome this problem. In addition, the mapping of concepts appears in itself to be of some potential value.

Forgiving Zevi, Forgetting Rowe: The Rejection of the Formal Organic

One of the predominant indicators of cultural shifts is the effort to replace the root sources of the logic of the period. Beyond Zevi's significant work and in the case of recent design practice, amongst dominant theoretical underpinnings has been the writing of Colin Rowe. Whether or not there was a direct influence that might be attributed to certain now canonic writings such as *The Mathematics of the Ideal Villa*, (1947), *Transparency*, (1963) and *Collage City*, (1978) is not the point here; the basic ideas of these writings deeply permeated design culture of the last decades and can legitimately be seen as theoretical explanations, if not as causes, for important design phenomena. These phenomena are now undergoing a profound process of reconsideration and critique as a new generation of designers and theoreticians distances itself intellectually and methodologically from the values and practices of formalism. It is here that Rowe's influence is being evaluated and reinterpreted as part of the process of cultural transformation in architectural thinking.

Contrary to Rowe, but not without passionate support for the Modernist movement, Zevi opposed the attribution of the Modernist project to International Architecture claiming against its re-reading with tools of the Classic language. Zevi rejected Rowe's formalism, claiming his was a rigid framework rooted in functionalism and composition - both divorced from context. Zevi's notion of the Organic was meant to bring closer the disciplines of design and engineering in the development of spaces integrated into their surroundings. However, Zevi's Organicism carried yet another dialect of and from the formalist project in suggesting its erosion and reformulation as organic – that is to say - contextual.

Contrasting Rowe and Zevi appears somewhat provocative particularly as they both represented significantly different approaches to form and formal generation. However, both of them, in their own way, treated form as the container of matter – whether structural or contextual - rather than the other way around.

Form, Formal, Formalist:

Information, Informative, Informed

Form relates to the physical properties of objects including shape and order, or gestalt. As a concept it contains an inherent ambiguity as pointed out by Forty: “There is in ‘form’ an inherent ambiguity between its meaning ‘shape’ on the one hand, and on the other ‘idea’ or ‘essence’: one describes the property of things as they are known to the senses, the other as they are known to the mind” (Forty, 2000, p.149). It is this duality of meanings that explains what has been described as the “formal project” of Colin Rowe. Among other things, this series of writings proposed a particular method for the analysis of architectural form and the beginning of a set of taxonomic categories for form in architecture. The types of categories that Rowe used were reductive in the sense that they were purely formal and ideational. That is, they eliminated other considerations from the totality of the factors of relevance to architecture such as material, structure, socio-cultural aspects, and contingent factors related to site, specific program, etc. They were ideational in the sense that they established an abstract conceptual order – *the mathematics* – that was intended to support his concept of ideal types as schema. Greg Lynn refers to this aspect of Rowe's early writing (including *Mathematics and Transparency*) as his formal-analytical phase (Lynn, 1993). In fact, one of the impacts of this work was to institutionalize the taxonomic aspect of formal analyses.

Formal, or *formalist*, indicates the emphasis upon form with the connotation of some means of rigorous representational description, or formalization. In this sense the term subsumes both the systemics of the

formal content as well as the method of *generation through formal representation*. As a pejorative term, it usually connotes the excessive reliance upon formal content and the resultant reductive effect. Lynn argues that Rowe's ideal and trans-historical formalism places emphasis on proportional systems, or particular plan, and other relationships, as the formal ordering system. As has been pointed out, this designation of formal categories served to encourage the development by others of formal taxonomic systems.

There was another meaning of the term formal that has had a broad impact on architectural design culture. Rowe never went so far as to propose a syntax *of design*, or a *method* of syntactic design. This was left to others, among them the "White Architects", of "the New York Five". What is implied in the phrase syntactic design is that a formal taxonomy can be developed into a formal, or syntactic, order that can then become the basis of a design method. The important distinction of this definition is that a formal system can become the basis for design generation. In this sense the particularities of the formal result are less significant than the fact that formal generation is based upon a formal vocabulary, the *a priori* representational definition of which is the source of the design method. That is precisely how formal taxonomies became an instrumental and operative medium. Bear these arguments in mind later *vis a vis* digital approaches with their continuity of formal models despite their transposition of computational methods and models.

Modern post-war formalism permeated world design culture. The exploitation of formal languages as generators of architectural form became a dominant characteristic of architecture since the 1970's. This is a broad generalization that attempts to subsume such tendencies as early examples of "syntactic design" later collage-motivated design, and "deconstructivist" works all within the formalist project. Regardless of the disparity of appearance of the works of diverse architects, the common denominator is the predominance of formal content and the exploitation of this content as the basis for design generation.

The Critique and Reinterpretation of Formalism

One of the great revolutions of Modern Art, that of *conceptual art*, or art as a form of critical self awareness, played an important role in the architecture and theory of recent decades. Conceptual architecture was the subject of a special issue of the Harvard Design Magazine (Number 19, Fall 2003-Winter 2004) entitled *Architecture as Conceptual Art?* The opening article by Eric Lum is an attack of the conceptualist (here read, formalist) position in architecture on the basis of its reductive qualities and its inappropriateness to the practice of architecture. The sculptor Sol Lewitt's statement, "the idea becomes a machine that makes the art", and the shift in emphasis upon process art were among the classes of ideas and

practices that influenced the New York Five and thus contributed to the crystallization of an American *new formalism*. Lum presents a strong case for the intellectual and aesthetic failure of the formalist project due to an inability to successfully deal with the conflict between conceptualism and the intrinsic materiality of architecture. In fact, the abandonment of the material and the tectonic by certain formalists is proposed as a form of artistic, as well as professional, loss of competence. The discrepancy between project conception/visualization and project realization is proposed as endemic to the formalist practice of design in which conceptual realization is so strongly identified with the ideological content and material realization is typically separated from the generative process. This schizophrenia of formalism, that radically separates conceptual content from material reality may be one of the greatest forces for a shift of paradigm. Lum presents the case for the existence of a conceptually rich architecture that is tectonically and materially motivated. However the point that hard-line conceptualism is more than an aesthetic position, it is a design method that is demonstrating its' severe limitations, has been made.

There are other critical positions that are less oppositional and attempt to identify certain of the root problems of formalism in order to suggest a resolution. Sanford Kwinter's paper, "Who's Afraid of Formalism?", first made an important semantic distinction: "The form problem, from the time of the pre-Socratics to the late 20th Century is, in fact, an almost unbroken concern with the mechanisms of formation, the process by which discernable patterns come to dissociate themselves from a less finely ordered field...What I call true formalism refers to any method that diagrams the proliferation of fundamental resonances and demonstrates how these accumulate into figures of order and shape" (Kwinter, 2000).

Here Kwinter while accepting *formation* as the *raison d'être* of a formal approach, skirts and cleverly bypasses some of the deleterious process and effects of formalism. Kwinter goes on to introduce certain important points that reconsider form from what might be considered a contemporary scientific point of view and one that is significant to emerging methods of thought and procedure in design. He proposes that *resultant form*, the results of formative processes, come about through the interaction of "internal rules and external (morphogenic) pressures..." If we assume that his internal rules are inherent in the materials of the problem of design and that morphogenic pressures are the contingent aspects of the ecology of site and program, then his position moves the concept of form into a much more contemporary position.

He then makes two additional contributions to the reformulation of the idea of the formal: he introduces the contemporary relevance of a discussion of Goethe's morphology, and in so doing, introduces a view of morphogenesis as an intricate procedural mechanism. "Goethe's formalism, like all rigorous and interesting

ones, actually marks a turning away from the simple structure of end products towards the active, ever-changing processes that bring them into being." (Kwinter, 2000).

Greg Lynn, in his article, "New Variations on the Rowe Complex" (Lynn, 1993), attempts to make certain of these concepts of the procedural more explicit in their requirement of a *new mathematics*. "What is necessary for a rigorous theorization of diversity and difference within the discipline of architecture is precisely an alternative mathematics of form: a formalism that is not reducible to ideal villas or other fixed types, but is in its essence freely differentiated" (Lynn, 1993). Lynn introduces the *Origins of Geometry* of Husserl of 1936 in order to further specify the qualities of such a new mathematics. In the place of *eidetic* or pure geometric forms, Lynn proposes a mathematics of form based upon "anexact yet rigorous proto-geometries (variations)" (Lynn, 1993). Here Lynn, too, in his reinterpretation of form *beyond Rowe* also brings us relatively up to date regarding some of the scientific foundations relating to formal generation. "An alternative mathematics of form that is both irreducible yet precise, and anexact yet rigorous would resist transcendent and universal ideological proclamations precisely because they cannot be idealized and reproduced identically...Where Rowe's logic is extensive, exact and reducible, an alternative mathematics of form would be emergent, indeterminate, differential, intensive, anexact, and creative." (Lynn,1993).

Who's Afraid of Performance?

From the early writings of modern theoreticians such as Giedeon, theories of form have dominated the discourse of architectural modernism. Arguments for a new formalism appeared in the early Nineties in the guise of towards yet another new architecture: Kipnis' brilliant essay is one such example (Kipnis, 1993). Other theoreticians began an exegesis on the phenomena of formalism (Kwinter, 2000) and its significance as a general model of thought and design. Kwinter is a threshold figure in this discourse, since he is among the few architectural theoreticians that attempt to bridge the territory between architecture and modernism's traditional partnership relationship with emerging technology (Kwinter, 2003).

Among the historical sources of this new discourse were the morphological studies of Goethe. Goethe is said to have rejected the Kantian-Newtonian model of form and to have proposed the first modern genetic theory of form. In his theory, formation and formative processes were more significant than appearance, and in his botanical studies he created formalisms for generation and evolution. Among contemporary biological theories of relevance to an architectural theory of emergence are some references in which general theoretical considerations such as adaptation, evolution and variation within species are introduced

and theoretical issues and problems are presented. Biological models of evolution and emergence transfigure the concepts and issues of morphogenesis and stimulate the development of new procedural approaches to the solution of design problems. Thus various theories of morphogenesis and evolution such as Catastrophe Theory (Thom) and Emergence (Holland) dealing in general with problems of emergence and the behavior of complex systems are proving to be relevant to the development of new architectural theories and design methods. This is particularly the case, if architectural systems are considered complex, dynamic systems intended to produce variation and heterogeneity in the solution of designs rather than the appearance of a static formal object as the instantiation of a particular style.

Formation without formalism is promoting new ways of thinking about form and its generation. Shifting antithetically from the formalist avant-garde of the current generation, this new conception appears to move architecture and architectural theory to a consolidation of design theory, emerging technologies, and new computational thinking. Concepts such as parametric design and performance-based design are now moving practice to a more materials, construction and environmental sensitivity. While shifting away from formalist theories and methods, such model of thinking about form is enabling designers to achieve new levels of innovation and creativity. The remarkable aspect of such a new *per formative* paradigm is that it is (or seeks to be) generative of unique solutions without dependence on existing formal techniques of form generation. Among the most promising aspects of recent development in design methodology related to this discourse has been the move to increase the viability of a research-related design process. The notion of architectural precedent knowledge in the form of building types is being reconsidered as the static conception of types loses relevance in contemporary architecture and urbanism. This research and experimental orientation is making multivalent, environmentally sensitive approaches possible and productive in actual design. The new paradigm has also elevated computational practice to the level of design thinking as digital design has become the theoretical hard-core of architectural theory. In doing so it has distanced computational interventions from categories of form and the boredom of technological expressionism.

The Recurrence and Vitality of Organic Fallacies

A thread of critique against the dominance of visual and formalist values and their oppositions in Modern Architecture is frequently proposed as an "alternative tradition" (Wilson, 2007) or as a "natural" or "organic" architecture (Gans and Kuz, 2003; Pearson, 2001). Early historians such as Zevi frequently promoted the organic fallaciously within the framework of formal indicators. Being at times both critical and proactive, arguments for the organic are thus an important alternative thread of the critical discourse

of modernism. The organic is also part of a contemporary interest in the study and modeling of natural developmental processes as models of design principles in nature generally associated with biomimetics (Jeronimidis, 2004).

The evolution of the organicist discourse from ideological positions of "natural architecture" to the more promising appropriation of new sciences within the epistemology of architectural knowledge is as eclectic and miscellaneous as its many interpretations. As a philosophy, and per its original designation, it is said to promote harmony between human habitation and the natural environment through the integration of a building into its site. Gaudi, Wright, Sullivan and Zevi have all blueprinted these ideas by implementing formal vocabularies and ordering principles. Wright, whose retrospective is currently displayed at the Guggenheim Museum, was said to have extended the term to include natural design processes sensitive to nature's special use of materials. Wright spoke of the building as a "unified organism" through which geometrical operations are composed around a central theme. However, here again was a process of explanation rather than germination, an analogy which has occurred in the form of the building after its authorship has been strongly determined by its formal system..

*"So here I stand before you preaching organic architecture: declaring organic architecture to be the modern ideal and the teaching so much needed if we are to see the whole of life, and to now serve the whole of life, holding no traditions essential to the great TRADITION. Nor cherishing any preconceived form fixing upon us either past, present or future, but instead exalting the simple laws of common sense or of super-sense if you prefer determining form by way of the nature of materials..." - **Frank Lloyd Wright, An Organic Architecture, 1939***

Other modernist architects, held complementary and often contending views regarding architecture's relation to nature and how best to emulate it. Post-war European modernists attempted to promote cybernetic and information models of life, as is also related to certain of the later works of Bucky Fuller.

Along with other noble theoretical legacies, these great players of twentieth century modernism have, unconsciously cultivated organic fallacies that have become defined by their formal language. Such organic fallacies resulted in an appropriation of nature and the organic as prescribed metaphor. However, when extended to include its literal attributions, and the stuff that nature is made of, one may approach an alternative paradigm of design rather than its visual language. Thus materiality becomes an *a priori* condition of design rather than its set of *a posteriori* effects.

The New Materialism and Its Problematics

Kwinter has referred to "material as the new space", and the breadth of interest and activity around new and innovative materials and material technologies is one of the dominant influences upon architectural design today and its associated research activities and industrial collaborations. So prominent is the drive for material innovation that it has been broadly absorbed into architectural design and into the research orientation of mainstream practice (Balmond, 2006; Addington and Schodek, 2004) as well as into academic research (Mori, 2002). This new materialism appears to be of diverse and complex influences upon contemporary design. On the one hand it has been quickly absorbed as a stylistic and formal phenomenon (Garcia, 2006) while its more profound and complex interrelations to science, technology and design are only now emerging (Antonelli, 2008).

Matter over Shape over Matter

To paraphrase Darwin: there is more to the origin of form than the preservation of favorite expressions in the struggle for style. Ours is a new kind of struggle and a New Materiality begins where Formalism ends, literally. By way of good practice we are educated to apply matter to any given shape. This assumes the predominance of shape over matter in processes of form-generation and the natural emphasis on the form of things. However, when inverted, we find that starting with matter is not as straightforward a process as we might anticipate. Shape, it appears, (still) rules over matter.

Plato distinguishes between two classes of form which are indeed centrally iconic but not widely understood; one relates to the outward appearance of an object, and the other – to the technical virtues inherent in it. The latter relates to “the form of an idea”, “the form of knowledge” or “a form of thinking”. These two concepts are interrelated in that, according to Plato, the appearance or shape of an object follows the form or the logic of its creation. Indeed, the more accepted definition – as coined by the Greeks – relates the notion of form, or shape, to vision and appearance. Thales, amongst other pre-Socratic philosophers, introduced the notion of substance to include the differences of shape over time and to indicate that forms are temporary contraptions of objects placed in their contexts be they material or immaterial. Socrates coined the term Hylomorphism which identifies substance as the culmination of matter and form. Interestingly, while “form” was treated by the Greeks as a singularity which caused plural representations of itself in particular objects, “matter” was considered particular in its own right rather than a secondary attribute of form. In a sense, “matter” was treated as a singularity without representation. From this, the world of forms removed from matter is a representational one, where

physical manifestation is captured as curatorial judgment to represent reality. It is clear that the fluency with which to unpack form's native designation requires some disambiguation. Such a noble cause depends on the historical context as much as it adheres to one interpretation or the other. But, clearly, the mission of parsing through the many forms of attending form is overwhelming in its conceptual and chronological scales.

Architecturally speaking, when we think of "form" we think of the shape of a thing and how it might be described in terms of its geometry. For thousands of years, the largest structures on earth were the pyramids, but rarely does one refer to the distribution of load when describing the shape of a monumental tetrahedron. The nature of this claim remains consistent across the periods from ancient Egypt to Bilbao. Form is a category of description as opposed to a causal condition as it might be described in nature.

The Miasmatic Rhetoric of Digital Architecture

The three sources of the emerging material paradigm in architecture are the *new sciences* (particularly the growing relevance of the organic precedents in the life sciences and the sciences of complexity); the diverse phenomena of the *emerging new materiality*; and the growing importance of *digital technologies and design media* in architecture. Beyond the growing pains of a surge of interest in computational geometry and its potential (Lynn, 1999; Lynn, 2008; Pottmann, *et alia*, 2007) for the creation of a new architecture, the digital in architecture has truly radical potential for rethinking architectural thought and procedure. The digital may be more of an epistemological revolution than a new architecture. Transcending the rhetoric of "digital architecture" appears to be a necessary purgative in order to get beyond the more superficial phenomena of the digital to its transformative role in thinking a new design. How can we become digitally transcendental?

Form Forbidden:

The Art and Artifice of Digital Materiality

The consolidation of relevant scientific precedents, the new materialism, and the potential of the digital as a medium of design environments has created the conditions for an architecture of artificial (designed) materialities. It is the computational role of creating an approach to a mediated materialism in architecture that is the subject of my research. The remainder of the article presents the theory, methods and achievements of this body of work as well as its implication for ecological impact. The new materiality as

an epistemology of design potentially presents a radical alternative to the formalist method so deeply ingrained in modernist design culture.

Contrary to the modernist design approach which promoted divisions of function implicit in the architectural elements (structure, façade, etc), design based upon performance and conditions of habitation postulates divisions of effect (structural, environmental, etc.) Our ability to quantify a building's structural and environmental performance assumes that differences of use and behavior must be accommodated for. Given such ability to predict and respond to performance criteria and desired effects, the new materialism aims at shifting practice to a condition of performance-based programming and material design. Design based upon material performance seeks to promote an approach whereby matter is distributed where needed responding to its structural, environmental or, indeed, social performance. In fostering material integration across various scales, architectural elements such as structure and façade are no longer divorced in function and/or behavior, but rather negotiated through the informed distribution of matter.

One significant consequence of design that is informed by performance is the incorporation of difference: gradients of structural and material effects emerge modulating their thickness, transparency, porosity and thermal absorption according to their assigned function or desired condition of stability (structure) and inhabitation (program). It is the approach to material computation which enables direct design in artificial, or designed, materials (Oxman, 2009). We discuss the concept of difference in terms of its implications on the built environment. Difference, describes a condition of non-homogenous organization where the heterogeneous organization of elements or materials acts as one medium to enable performance-based design.

Within those processes of computational design directly associated with materials, it is the computational potential for the control and variation of material structure (structurally, spatially and materially) that has been an objective of my work.

What is Material Computation?

The objective of Material Computation is the formalization of the generative processes of the design of materiality, or the complex properties of material systems. Prominent among the properties of compound materiality is that of heterogeneity, or structural/organizational variation. The computational production of heterogeneous materiality, in turn, produces material attributes that have important implications for the

efficiency of material behavior through design, and thus on characteristics such as contributions to sustainability.

The design objective of Material Computation is thus to establish integration between material properties and environmental performance requirements within form-generation processes. It is intended that this class of computational environments will be relevant to all fields of design, including product and building design, in which materiality is particularly significant across a range of scales. The theoretical foundations and experimental work in generating and evaluating the computational environment has been undertaken in the design fields of architecture and industrial design (Oxman, 2007, 2008).

Material Computation is an integrated series of computational processes that enable parametric variation of material properties and behavior as informed by the environment. This method has broad implications for the design process as well as for the uniquely adaptive character of the product of design. Currently such performative technologies are primarily analytical rather than synthetic (generative). However given the possibility to formulate and formalize classes of material systems, it is possible to conceive of simulation models that directly integrate performance simulation with design generation. Such an integrated approach would support performance-based design. I have merely sketched the outlines and objectives of the theory of Material Computation and the series of computational design methods that I have developed through experimental research accomplished over the past years. My objective here has been to present this work as a part of an intellectual transition to a new materiality that may be an antidote to formalism as a general paradigm of design.

Ecce Forma: Welcome the New Materiality

This is to be read as an epilogue for formalism and as the first shot fired for a prolegomenon of the new materiality. Defined by arbitrary stipulation or taken seriously: new ways of form-making require that we move beyond the formalist movement and its fashioners of stylistic tropes and producers of *trompe l'oeil*. The new materiality returns architecture and design to a rediscovery of the design foundations of a material tectonics – albeit by the virtual route of Material Computation. It is a movement back to the future of materiality.

Among the paradoxical conditions of a transitional period is the hanging on to residual value that is still attached to formal uniqueness and invention as an indicator of value in architectural design. If anything, the consumption of the image is still dominant despite the immanence of a different logic. This is particularly

the case in what might be referred to as “organicism”, the modeling of architectural objects as natural, or organic bodies. To some extent, the wonders of computational modeling are responsible. However the important question is whether non-Euclidian geometry is an intrinsic indicator of the new (natural?) paradigm in design. Or is it simply that we are now capable of rethinking form, from the ground up, without any prejudgment regarding form, or the constraints of construction technology. Computational form-finding would not become a necessary condition of a new architecture, but merely one possibility in the expanding formal vocabulary of performative design. If one important motive of the new theorists is to remove architecture and urbanism from the cycle of stylistic consumption, then blobs and folds are innovative as output and not as input.

The problems of such fallacies as a basis for cultural transformation are, as I have claimed, an obstacle to the slow ascendance of the inevitable wedding of science, technology and design; of design as a science of the artificial. Feverous proponents of style, think again. Perhaps we have finally breathed our last parametricity.

References

- Addington, Michelle and Schodek, Daniel (2004). *Smart Materials and Technologies in Architecture*, Architectural Press, London.
- Antonelli, Paola (2008). *Design and the Elastic Mind*, Exhibition Catalogue, the Museum of Modern Art (MOMA), New York.
- Balmond, Cecil (2006). Cecil Balmond, Special Issue of *A+U (Japan)*, November, 2006.
- Forty, A. (2000), *Words and Buildings: A Vocabulary of Modern Architecture*, London. Thames and Hudson
- Gans, Deborah and Kuz, Zehra, (2003). *The Organic Approach to Architecture*, Wiley-Academy, West Sussex, England.
- Garcia, Mark (ed.) (2006). *Architextiles*, *AD, Architectural Design* Volume 76, No. 6, London
- Gramazio, Fabio and Kohler, Matthias, (2008). *Digital Materiality in Architecture*, Lars Müller Publishers, Baden Switzerland
- Jeronimidis, G. (2004). "Biodynamics" *AD Architectural Design*, Volume 74, No.3, p. 90-96
- Kipnis, Jeff (1993). "Towards a New Architecture" in Lynn, Greg (ed.) *Folding in Architecture*, *AD* London
- Kwinter, Sanford (2003). "Who's Afraid of Formalism?" *Phylogenesis: FOA's Ark/Foreign Office Architects*, ed. Michael Kubo and Albert Ferré with FOA. Barcelona: Actar. Pp. 96-99. Originally published in *Any Magazine* no. 7/8 (1994).
- Kwinter, Sanford (2008). *Far From Equilibrium: Essays on Technology and Design Culture*, Actar, Barcelona.
- Lynn, Greg (1993) "New Variations on the Rowe Complex", *ANY* No. 768, 1994, pp. 38-43
- Lynn, Greg (1999). *Animate Form*, Princeton Architectural Press, N.Y.
- Lynn, Greg (2008). *Greg Lynn*, Rizzoli, New York
- Mori, Toshiko (2002). *Immaterial: Ultramaterial: Architecture, Design and Materials*, Harvard Design School, Cambridge and George Brazillier, New York
- Oxman, N. *Get Real: Towards Performance Driven Computational Geometry*. *International Journal of Architectural Computing (IJAC)*. 2007; 4(5): 663 -684.
- Oxman, N. and J. L. Rosenberg. "Material-based Design Computation: An Inquiry into Digital Simulation of Physical material Properties as Design Generators", *International Journal of Architectural Computing (IJAC)*. 2007; 5(1): 26-44.
- Oxman, N. *Rapid Gestalt(en)*. *Proceedings of Euro U-Rapid: International User's Conference on Rapid Prototyping, Rapid Tooling and Rapid Manufacturing*; 2008; Berlin, Germany, 61-69.

- Oxman, N. Oublier Domino: On the Evolution of Architectural Theory from Spatial to Performance-based Programming. Proceedings of Critical Digital Conference: What Matters? Harvard Graduate School of Design, Harvard University, 2008; Cambridge, MA, 393-403.
- Oxman, N. Rapid Craft: Machine Immanence and Naïve Materialization. Proceedings of IASS 2007, Shell and Spatial Structures: Structural Architecture: Towards the Future Looking to the Past, 2007; Venice, Italy; 269 – 276.
- Oxman, N., Rosenberg, J., L. Material Based Design Computation. Proceedings of CAADRIA: the 12th International Conference on Computer Aided Architectural Design Research in Asia. April 2007; Nanjing, China; 5-12.
- Oxman, N. FAB Finding. Proceedings of The 25th eCAADe Conference: Predicting the Future. September 2007; Frankfurt am Main, Germany; 785-792.
- Oxman, N. Rapid Craft: Material Experiments towards an Integrated Sensing Skin System. Proceedings of the 27th Annual Conference of the Association for Computer Aided Design in Architecture: Expanding Bodies: Art • Cities• Environment. October 2007; Halifax, Nova Scotia; 182-191.
- H. Pottmann, A. Asperl, M. Hofer and A. Kilian (2007). Architectural Geometry. Bentley Institute Press
- Pearson, David (2001). New Organic Architecture: the Breaking Wave, University of California Press, Berkeley and Los Angeles.
- Wilson, Colin St. John (2007). The Other Tradition of Modern Architecture: the Uncompleted Project, Black Dog Press, London.