ARCHITECTURE IN THE DIGITAL AGE · DESIGN AND MANUFACTURING

EDITED BY BRANKO KOLAREVIC

Spon Press

16 OTHER CHALLENGES

ANTONINO SAGGIO

16

OTHER CHALLENGES

ANTONINO SAGGIO

16.1.
Saint Paul's Conversion (1600–1601), Santa Maria del Popolo, Rome, artist Caravaggio.

The first issue to be addressed is the difference between our public image – what we represent – and what we really think. This chapter will try to describe not the result but the process, not the theory but the spirit, not the object but the subject.[1]

I will start with a word that is very important for me. That word is "sostanze" in Italian, and "substances" in English. It comes from Edoardo Persico, who borrowed it from Saint Paul. In the conclusion of his 1935 Conference titled "Profezia dell'architettura," Persico said:

> "For a century, the history of art in Europe has not merely been a series of particular actions and reactions but a movement of collective consciousness. Recognizing this means discovering the contribution of current architecture. And it does not matter if this premise is denied by those who should most defend it, or betrayed by those who, in vain, most fear it. It still stirs up the secret faith of the era all the same. The substance of things hoped for."

We are facing a very important moment of transition, and because of that transition, we are at the same time facing a crisis. The industrial society is being replaced by an information society, and that transition is changing completely the rules of the game – of all games, including those of architecture. If the dynamo for the former was large industry and the machine, then for the latter it is the places of the tertiary sector. The machine of today is the computer – it is driven by the systems of formalization, transmission and development of information. If the very rich then were industrialists, today they are the producers, not even of hardware, but of software for software. This, of course, has all been well known since Alvin Toffler wrote "The Third Wave."[2] But today we have begun to understand how that wave is transforming the terrain of our discipline.

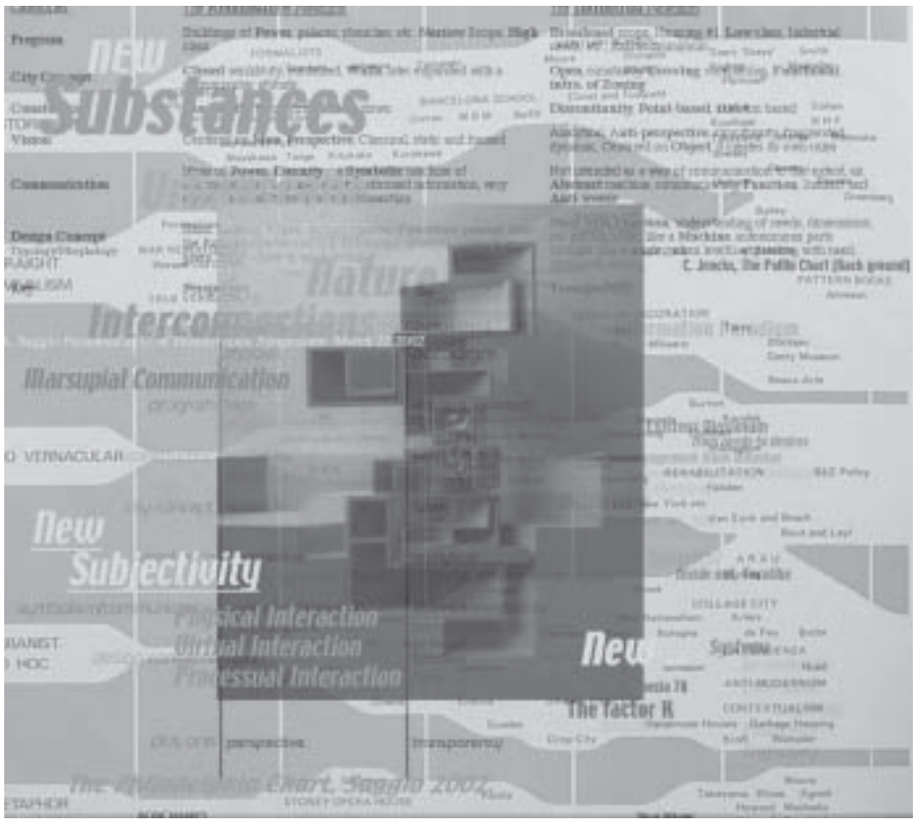
We have to understand that the current transition also presents opportunities for new visions and new aesthetics. Facing these challenges and understanding how to transform the crisis into new values is the potentiality of Modernity that I care the most about.

I used the "Postmodern" table by Charles Jencks as a background for what I call the "Philadelphia Chart" (figure 16.2) to emphasize a key difference – I think that our task as architects and critics is not to engage in the labeling of various "stylistic" movements, but to delve into the reality of the contemporary. I used "Drillings into the future" as a subtitle for my book on Peter Eisenman;[3] in my view, his half submerged *House XI* embodies the idea that the contemporary condition deals simultaneously with both the past and the future.

URBANSCAPE

What then are the new substances? Architecture is blooming again. Interesting buildings are being built everywhere (except in Italy). New ideas are emerging from the crisis of transition; we have new architectural methods.

I will start with the simplest example to illustrate the new condition – the phenomenon is known as "brown areas" and the key word is "urbanscape." The information society has less and less need for great tracts of land to produce manufactured goods, particularly those located in the cities. The vegetables we buy at the supermarket are 90% "information;" the same, only more so, is true for electrical appliances or automobiles. More and more people produce goods that are "pure" information. Throughout the Western world, large land areas are liberated from factories (which could become increasingly smaller, less polluting and less destructive); great resources are once again put into play, first of all, those abandoned by industrial production. Designing today within those "brown" areas implies a profound reconsideration of the city and its functioning, simultaneously opening-up new methods of both expressive and aesthetic research. The morphological typologies and categories of urban analysis, derived in the 1960s and 1970s from studies of a consolidated, structured city, have become more and more ineffective and indeterminate if used to define the design parameters. New methods of looking at the city have emerged that examine the complexity, interchange and interweaving of architecture and the environment. It is only natural that architects should move further away from the metaphysics of De Chirico, of a city of archetypes fixed in the memory, and look at the research of artists more attentive to the phenomena of stratification, residuality and hybridization – towards the sackcloth and cracks of Burri, the torn posters of Rotella, the American neo-expressionism of Pollock or Rauschenberg, and obviously the toughest battlefronts of Pop-Art or "Arte Povera." Architecture insinuates itself into the weave of existence. It uses and relaunches pre-existing objects, such as the ready-made ones. With its dynamic declarations, it creates spaces in the cracks "between" the new and what already exists. But beyond

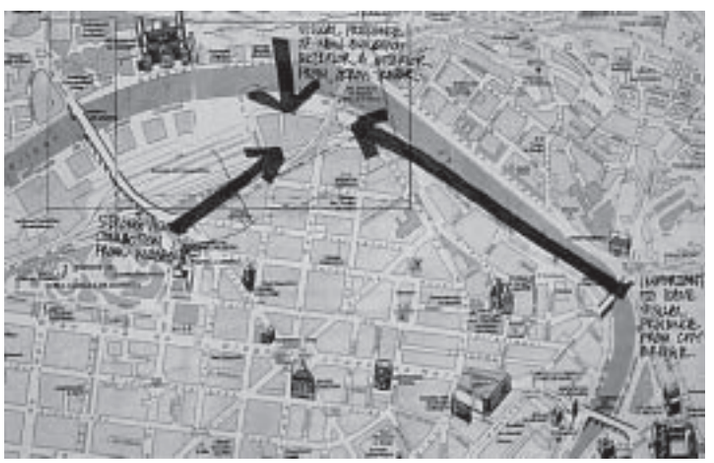


16.2.
The "*Philadelphia Chart 2002*" – the image is a combination of notes, key words and concepts. Background – the chart by Charles Jencks (1977); foreground – *House XI* (1978), architect Peter Eisenman.

the expressive choices, or the frightening "twisted scrap iron," a very different idea of architecture for the city is being acknowledged.

Consideration of the most successful works leads to their definition as operations of "urbanscape." They are the great works of rethinking the city, its intersections, its dynamic flows, its complex links. There are two key works: one is in Bilbao – seemingly a plastic exercise along futurist lines, in reality an urban intersection which creates new civic spaces; the second one is in Tourcoing – an apparent conservation of pre-existing structures that actually invents a interstitial space between a new shelter and the pre-existing roofs in a fluidly mediating, multi-media, digital vision of Piranesi-like winding ravines.

It was Frank Gehry who selected the actual site where the *Guggenheim Museum* was to be built (figure 16.3). He chose the most untypical site that was incredibly depressed, very messy. He selected an urban junction that would be impossible to select if one were to use "normal" architectural parameters. But those parameters are changing now; we now understand how to deal with complexity, how to use architecture to address problems and reshape spaces in an urban fashion. That idea was not clear at all 15 years ago. It became very clear now, as projects by my students at Pittsburgh's Carnegie-Mellon University and Rome's La Sapienza show (figure 16.4 and 16.5). We know what "urbanscape" is, we can teach that approach clearly.



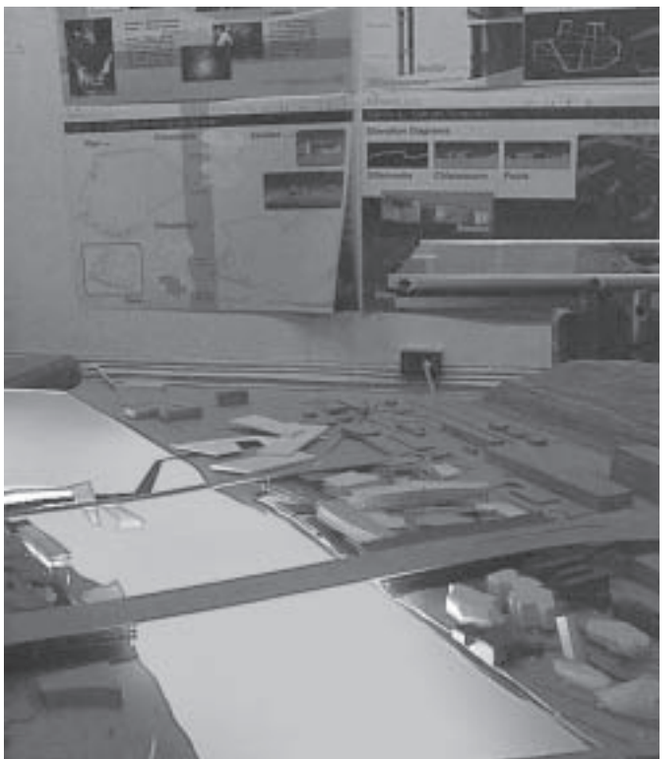
16.3.
Frank Gehry's sketch on the map of Bilbao showing the future location of the Guggenheim Museum.

UN-NATURE

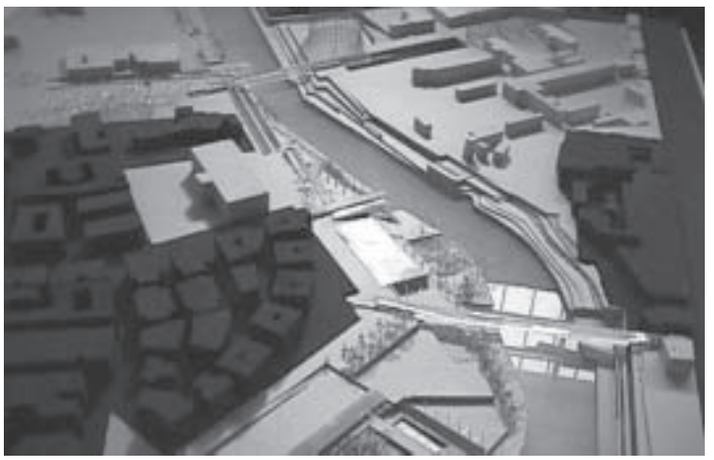
The second "substance" is related to our understanding of nature. Because of the information technology we have a great opportunity to deal with nature again. Our idea of nature is in some way "unnatural;" we are recreating it with a set of completely new tools. The motto of "rebuilding nature" captures our half artificial, half ecological attitude.

The relationship between the new conception of nature and the information technology is at least five fold. Firstly, the post-industrial man of the electronic civilization can re-settle his accounts with nature; if manufacturing industries had exploited natural resources, then information industries can appreciate and value them within new production systems. Secondly, this structural change of direction opens in the inner cities of the West (and in other regions) the opportunity for a "compensation" of historical proportions. We can now insert greenery, nature and recreational equipment into the high-density zones. Thirdly, the idea of the "fenced park" tends to be substituted by new parts of an integrated city in which – alongside a substantial presence of nature – interactive activities of the information society are also present. If homogenous zoning was the method of planning the industrial city, then multi-functionality and integration define the needs of the information city. Fourthly, aside from creating these opportunities, computers also allow their concrete realization. Interactive systems of illumination, information, sound and other controls can make these new parts of cities active, lively, participatory, and rich in events. Fifthly, the nature shaped by these forces is no longer one that is floral, or art deco, or even that of the masters of organicism. It has become much more complex, much meaner, much more "hidden," as Heraclitus once said. It is investigated by architects with an anti-romantic eye through the new formalisms of contemporary science (fractals, DNA, atoms, the relationship between life and matter). In other words, different categories of complexity have emerged. The figures of flows, waves, whirlpools, cracks and liquid crystals are born within this context. The key word here becomes "fluidity;" it describes the constant mutation of information and puts architecture alongside the most advanced frontiers, from biological engineering to new fertile, overlapping areas of morphogenesis, bioengineering, etc. The fifth level of connection between the nature and the computer is crucial, because the computer becomes not only the driving force that initiated the change, as understood in Marxian structural terms, but it shapes at the same time this new hybrid concept of architecture and nature. How to otherwise design a building as a cloud, or campus as a telluric crack?

The key work here might be one of the rejected projects from the Competition for the Church of the Year 2000 in Rome – a project by Peter Eisenman (figure 16.6) that saw the church as a terrestrial



16.4.
Liquid Strips Exhibition, Fitz-Gibbon Saggio Studio IV, Carnegie-Mellon University, Pittsburgh, December 2001.



16.5.
Reusing of the Tiber's Edges, student I . Benassi (advisor A. Saggio), La Sapienza University, Rome, 1999.

16.6.
Peter Eisenman's competition entry for the Church of the Year 2000 in Rome (1996).

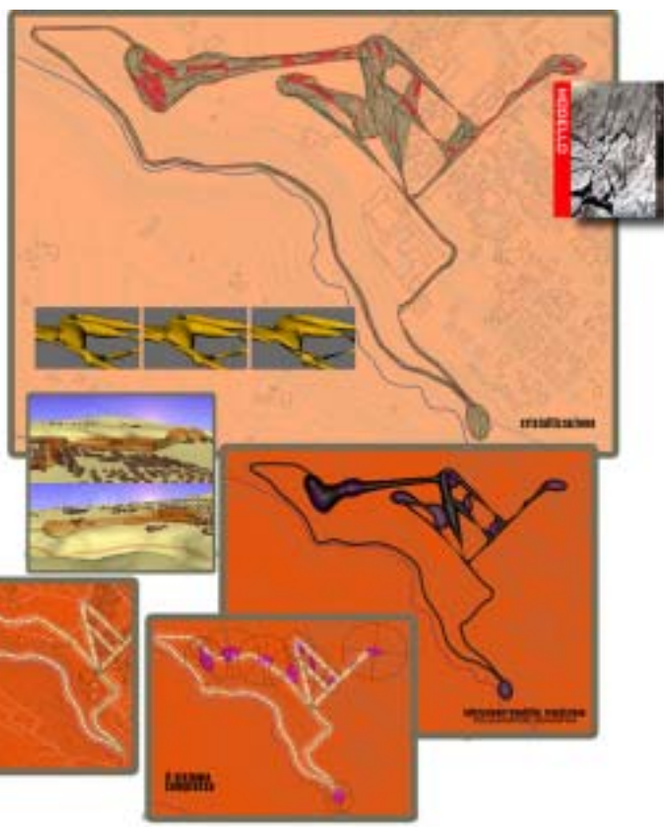
dance between continental plates that deform the land, patterned around a zigzagging canyon which recalls the ravines dug out by streams of water in soft rock.

MARSUPIAL COMMUNICATION

Another thing that we are starting to understand is what I would call the "marsupial communication." Information technology is also about communication. Architecture has much in common with other disciplines, from advertisement to art to other forms of communication. Instead of manifesting an absolutely objective logic (separation of structure and content, coherence between interior function and exterior form, division into zones appropriate for different uses), inherited from the early Modernism, we can start to readdress the issue of communication. The functional is substituted with narration; a building is no longer good if it just works efficiently – it must both give and say more, and even rely on symbols and stories when that is useful. Can we dig in our heels and call upon a different ethics, a different morality? Perhaps, one more time; the central question is merely "how?" The communicative moment could certainly be that of the large Disney hotels with swans, seven dwarfs and cowboy hats, but it cannot be an artificial application of forms and contents symbolic of a boxy architecture, which are entirely foreign to this notion. It requires a narration that pervades the essence of the building and intimately ingrains itself into its fiber. In other words, we need to see "what" communication is desired and possible; we need to seek one that does not just follow the weak, half-hearted celebration of economic or political power.

The key work that captures this new spirit of communication might be in Helsinki, where a new museum (figure 16.8) has been conceived by Steven Holl using the same layered structure that the optic nerves have in the brain. The anatomical metaphor is placed over the rhetorical figure of the same name. The operation has been so successful that it has been confirmed in the very name given to the museum (Kiasma).

But why "marsupial"? Well, that word captures the fact that architecture is on one side part of the great world of communication (so it cannot be divided from cinema, advertisements, music, etc.), and, on the other side, it uses communication as a tool of its new essence. Content and context, inside and outside, are naturally merged.



16.7.
Campus for the Research of Vulcano Laziale, Grottaferrata, students F. Ceci and M. Rucci (advisor A. Saggio), La Sapienza, Rome, 2001.

16.9.
Stone House, Stendorf, Austria (1986), architect Günther Domenig.

16.8.
The *Kiasma Museum* (1998), Helsinki, Finland, architect Steven Holl.

SUPER-FUNCTIONALITY

The buildings mentioned so far are in fact "communication machines." Their primary value is in their capacity to employ rhetorical figures, to communicate metaphorically, which does not detract at all from what I call "super-functionality." If we compare functionality of the museum in Bilbao with its namesake in New York finished in 1959 by Frank Lloyd Wright, we can see how much we have gained in terms of pure functionality. The modernist architect had to have a closed system of consistencies: form follows function, construction reveals form, the key spatial concept (i.e. the ramp of New York's Guggenheim) creates a clear hierarchy of all subsequent choices. Contrary to that, we operate today in a system liberated from the obsession towards consistency. Design today is akin to a network of integrated processes rather than an assembly line; each stratum of architecture finds its own optimum in the points of contact with other strata. We know that the exterior image may differ from the interior spatiality, because they have not only to tell different stories, but also adhere to different reasoning for different functions. In one case, spaces had to be shaped in ten different ways to show artworks properly and, in another, provide fifteen different ways to intersect the urban context. There are many ways to build architecture, each one depending primarily on the economic reasoning, and not at all on an "inner" ethic of the design. As a result of this process of liberation, we have a greater ability to create efficient and really functional architecture. The relationship with urban space, the conceptual and expressive research into image, the organization of different uses, the most efficient methods of construction, the optimization of the technological machinery, they all frequently manage to attain a much higher level of efficiency if liberated from the cage of a final destiny of immanent coherency.

SYSTEM/SPACE

After addressing urbanscape, un-nature, marsupial communication and super-functionality, I want to conclude the first part by discussing the changes in spatial conception. I would argue that we are moving away from the idea of an "organ/space" towards a concept of "system/space" using a synthetic formula.

The New Objectivity spirit of the 1920s sought a direct relationship between space and its function, leading to the notion of a

16.10.
Exhibition Play (2002), Rome, by _ma0/ emmeazero: the world of videogames.

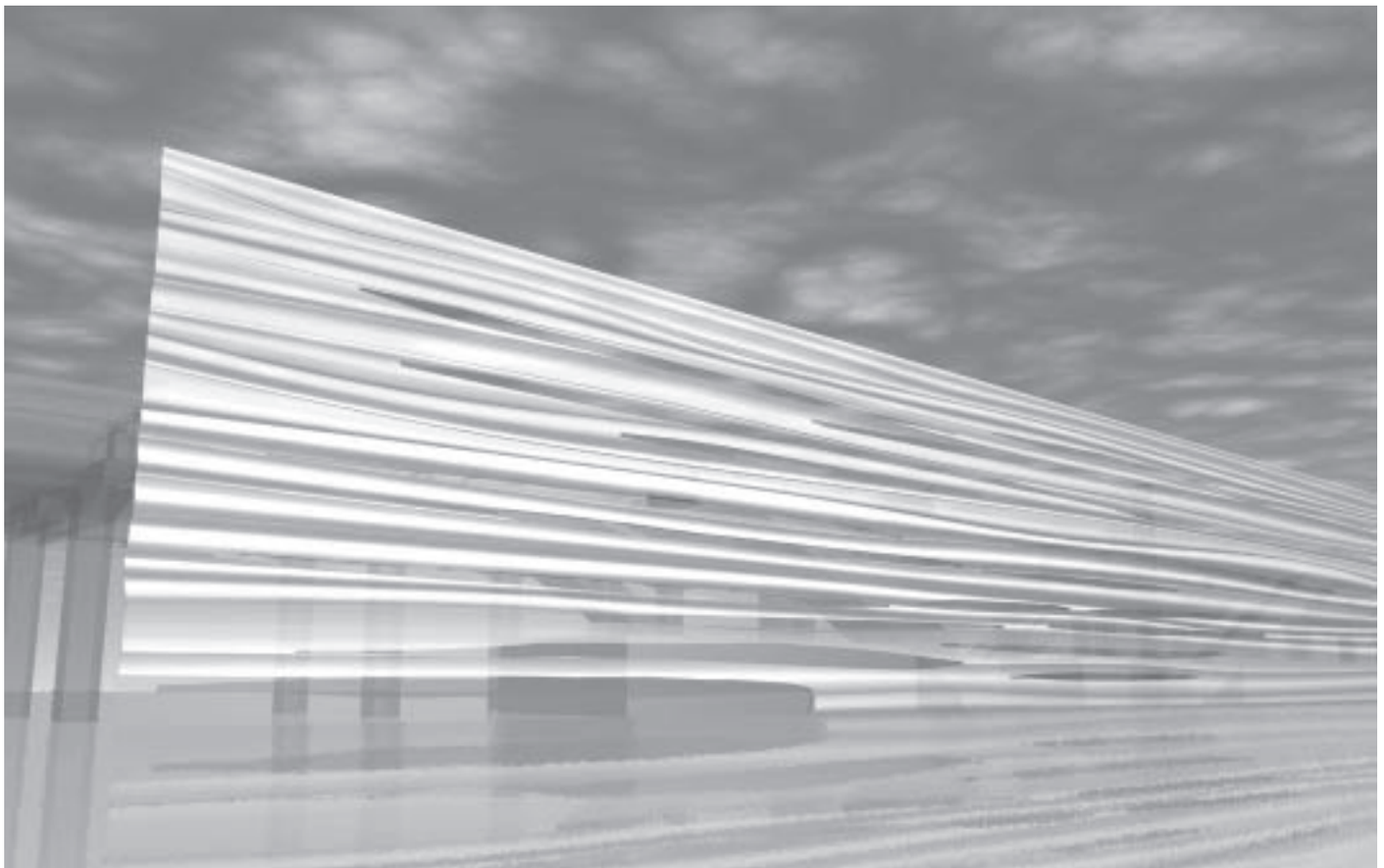
16.11.
The *Nord Holland Pavilion* (2002), Floriade, architect Kas Oosterhuis.

"spatial organ." (The meaning of this term is associated with traditional medicine, which maintains that organs perform specific tasks.) That explains the centrality of the interior space, the idea of interior space as the motor of architecture. It is precisely this idea that has been de facto modified and enhanced in a number of recent projects. Over the last ten to fifteen years we have seen the emergence of a spatial concept of interiority and exteriority that makes public space an equally fundamental element in architecture. Interior life is spilling over into the exterior; new figures are emerging in the "in-between" space: the emersion, the crack, the topological figures of non-linear equations, the figures of the palimpsest, spiral, partial immersions, etc., supporting an idea of space as a system of interacting forces. These systems are not just machinic manifestations of their own internal logics, but rather expressions of interrelations that exist within and outside a given context. If we take these new positions to an extreme, we could argue that there are no more primary elements, but only "connections." Architecture is made in concert with the space it shapes; interior life spills over naturally into exterior life.

Interior and exterior are annulled as distinct entities in a continuous flux that dizzyingly spins on itself, as manifested in the *Stone House* in Stendorf, Austria, a continuous work in progress designed by Günther Domenig (figure 16.9).

THE CHALLENGES

In this second part of the chapter, I will move towards a more unstable territory, where new ideas, new desires, new hopes live. To articulate a framework for operating within that new territory, I will focus on an important contemporary shift from "object to subject" – a change on a macro scale that has direct impact in architecture: from the standardization of needs to the personalization of desires, from a formal language based on abstraction to the new use of narration, from the syntax of the mechanism to the presence of metaphorical figures, and, in the context of construction, from the point structure system to structural ribs, from a serial way of creating identical objects to highly customized pieces, from the overall, consistent engagement of form, function and construction within a piece of architecture to the disengagement of parts and elements in order to pursue specific goals. Even more importantly, the way in which we think and design is



16.12.
Tukuba Express Station (2002), Kashiwa-shi, Chiba-ken, Japan, architect Makoto Sei Watanabe/Architect's Office.

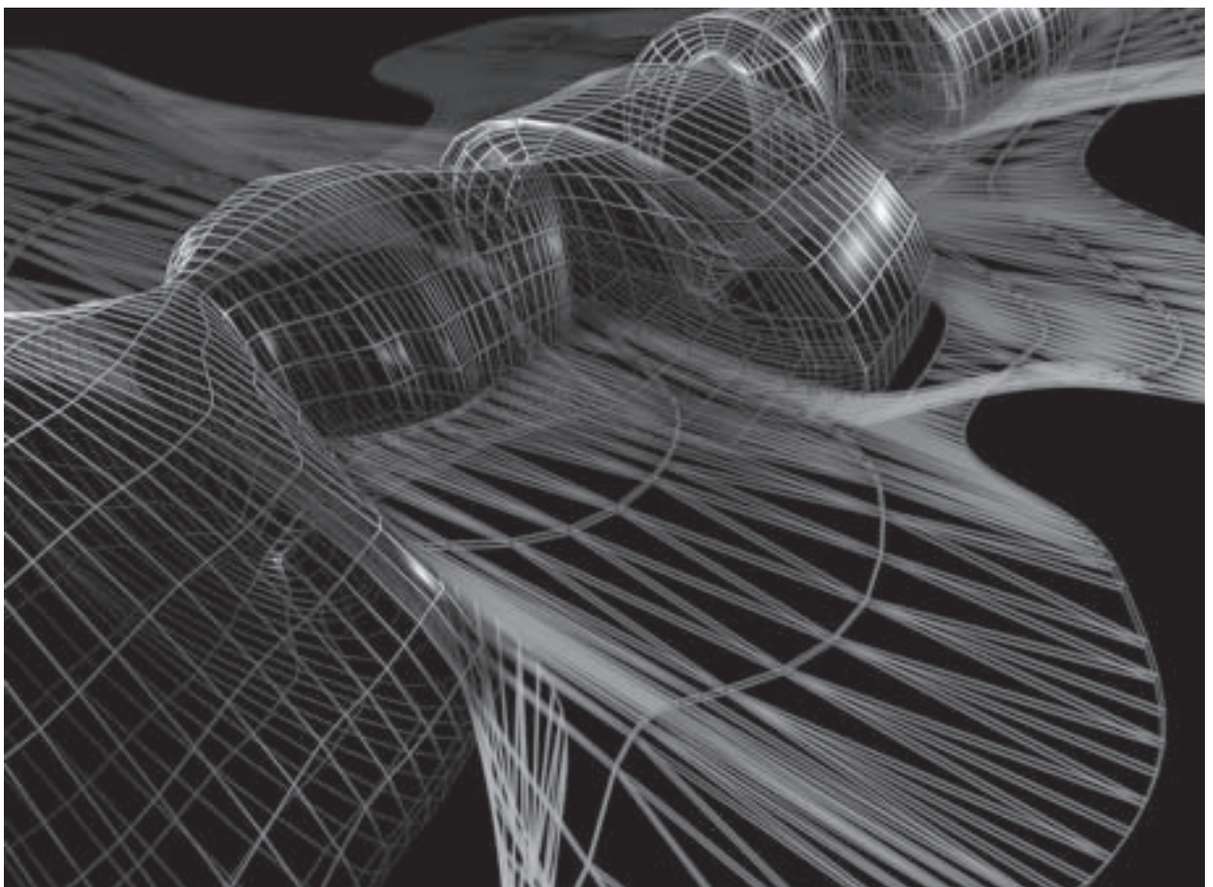
changing accordingly, as the center shifts away from the objectivity of the machine to the subjectivity of information. We do not adhere any more to the notion of theory "transferred into reality," as was the case with Functionalism, Rationalism, Neo-Plasticism, and also Cubism and Surrealism, and even Fascism and Communism. Today, we tend to take on an extended and generalized "what if" approach. The world of anti-dogmatic thinking, "hypotheses," and "the principle of contradiction" is embedded in the contemporary approaches to architectural issues. It is exactly this epistemological shift that provides a very strong link to information technologies.

INTERCONNECTION

The essence of information technology is not the singular bits of information (their immense number and the speed and easiness of their transportability) but the fact that the bits are "interconnected." We can regroup the bits and organize them into hierarchies of innumerable relationships. We can introduce variations; change the order or interfacing of the connections; form different worlds.

An interesting line of thinking connects the rhetorical figures of speech, the metaphorical use of images in contemporary architecture, and the free paths of the hypertext. The rhetorical figures of speech create actual interconnections, a method of relating various data in order to send messages, convey meaning, and convince. The metaphorical use of images in contemporary architecture marks a new phase in which architecture moves from the "objectivity" of the machine to the "subjectivity" of information. The hypertext is one of the most powerful structures of information technology because it allows the user to create and navigate metaphors at the same time, as the Internet shows.

Interactivity is the key element of that conceptual chain. It offers the possibility to arrange and organize information as a mobile web of data that can be manipulated by a "what if" approach. In design, interactivity opens the possibility of working on an architecture that is not only metaphorical, but is also a "creator of metaphors," leaving its own decodification open, free, structured or non-structured, and suggesting and offering the user a possibility of constructing his or her own "story."



16.13.
Lehrter Bahnhof (2002), Berlin, Germany, architect Pongratz Perbellini Architects.

There are at least three levels of interactivity in architecture, with physical interactivity being the most complex and encompassing the other two. Physical interactivity means that the architecture itself changes; the building's environment is modified according to the situation. We are starting to see its uses not only in some of the recently designed houses (for the wealthy), but also in exhibition halls, museums and other buildings. New experiments are demonstrating not only the modification of an outside situation (i.e. the number of visitors, intensity of natural illumination, various characteristics of exterior climate), but also an architecture that changes according to the variations in moods and feelings of the inhabitants.

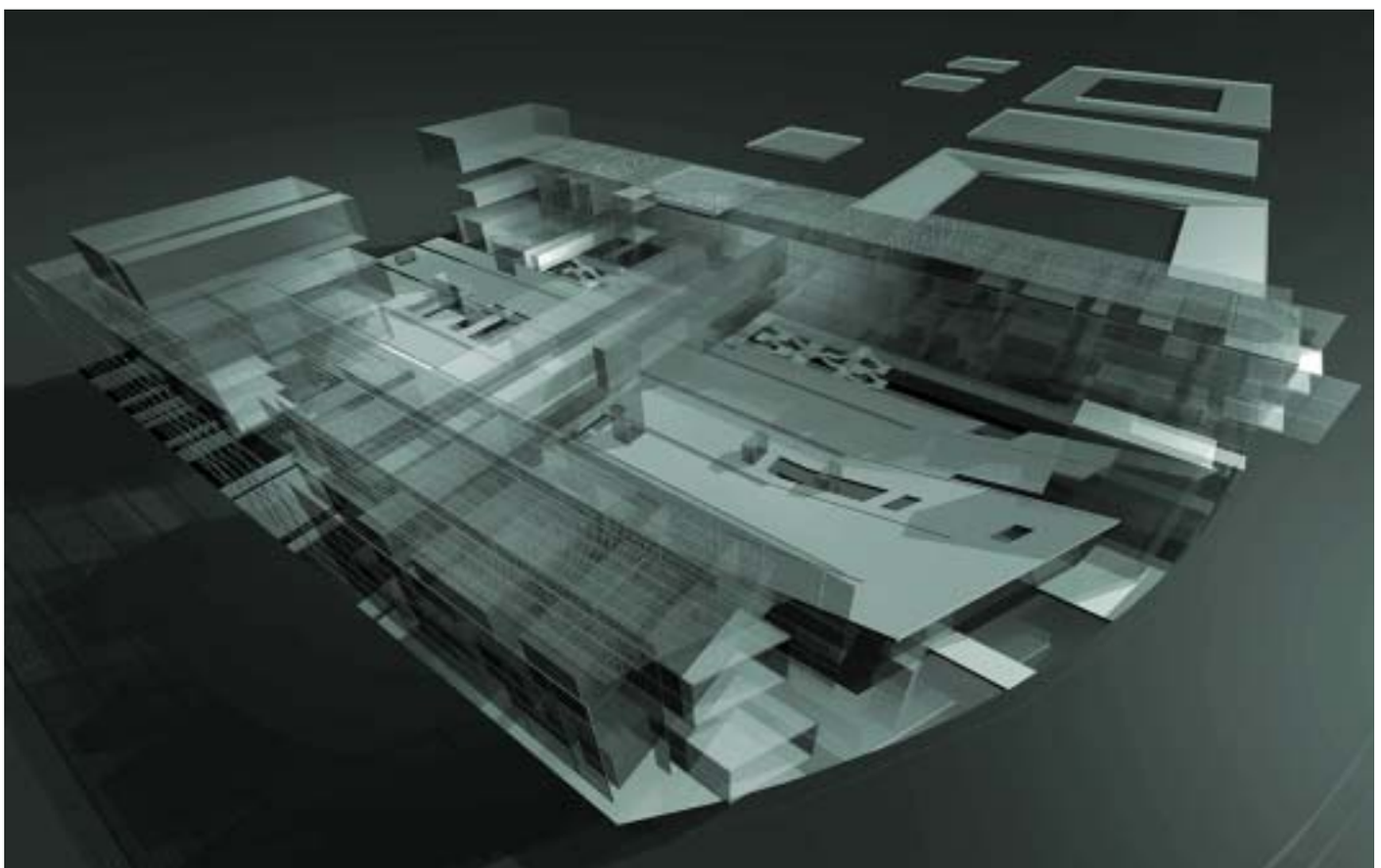
The second and simpler level of interactivity combines reality and virtuality in ways that would have been inconceivable in the past. Advances in projection systems, used almost under the building's skin, allow us to intervene in ways that resemble new mass-media illusionism, bringing vitality to degraded situations or circumstances in which interventions were impossible. Projects of this kind were carried out on archaeological sites, in degraded suburbs and historic city centers, representing a decisive step towards the presence of information technology in the city landscape and scenery.

The third level of interactivity is perhaps even more widespread – it is the interactivity within the process of architectural design itself. It is that "what if" way of thinking discussed earlier. Efficiency is not the only advantage here; interactivity in the design process also means creating an increasingly fluid way of achieving the best possible architecture on every occasion.

TRANSPARENCY VERSUS INTERACTIVITY

The crucial aspect of interactivity is its role as a catalyst for a new aesthetic condition in architecture. Under new aesthetic I am not referring to a new stylistic condition, but a condition that captures the very complex and articulated technical, ethical, scientific and functional data of a contemporary situation, moving it to a higher level of synthetic, emotional, intuitive knowledge.

Interactivity will be one of the key architectural paradigms in the future. It will play a role similar to that of transparency in the Modern movement; transparency in the 1920s defined both an



16.14.
Housing Complex (2002), Eur Velodromo, Rome, architect Nemesi Studio: the winning competition project.

aesthetic and an ethic – it showed what the new industrial world really was and what it has to be. The implications of transparency were functional, spatial, hygienical, constructive and aesthetical, all at once. Thus, the shift from objectivity to subjectivity again comes to the forefront. If transparency provided the aesthetics and the ethics, the reason and the technique for a world that rationally wished to see the progress of civilization and better standards of living for the vast masses of workers in industry, interactivity may serve to focus contemporary thought on an architecture that, having overcome the objectivity of our needs, can respond to the subjectivity of our wishes. New experiments show that the new subjectivity implies not only user's desires, but also a fascinating path that brings life, knowledge and intelligence to the buildings themselves.

NEW AESTHETIC

Interactivity is therefore a central challenge in the territories explored by the new architecture these days. Living in the solid substances of urbanscapes, in the un-nature system space, a few architects-pioneers are digging into a tough terrain. The real challenge is not of technical nature (although difficult and deserving all our attention); the real problem is, the crisis is, the interesting question is: what is the aesthetic meaning of interactivity? How can we build an architecture that has the consciousness of being interactive?

It is one thing is to understand this as a very promising direction, and another to really understand how to address the crisis. As a comparison, I think we are in a situation similar to that of Bruno Taut's *Pavilion* at 1914 Werkbund. Taut realized that transparency was the issue at stake, but his half literary and half romantic approach was exactly the opposite of what emerged ten years later within the "Neue Sachlichkeit." It is interesting to note that the technology of Taut was basically the same as that of Gropius' *Bauhaus*, but it was the thinking behind the technology that needed to make leaps.

With interactivity as a catalyst, we should try to contemplate the elements of the new aesthetics of the information technology. Some interesting possibilities emerge around the issue of "vision;" the macro shift from object to subject brings with it, in the field of

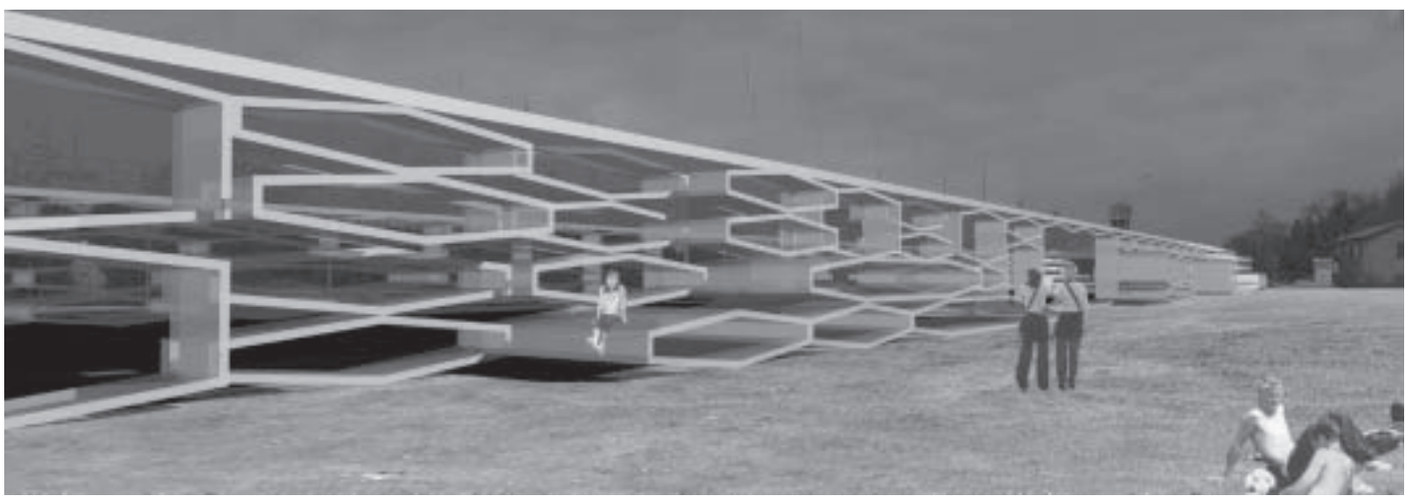
16.15.
Wind Lounge (2002), Fiumicino Airport, Rome, architect Lightarchitecture Gianni Ranaulo.

vision, the shift from an externalized vision to some kind of internalized vision. The horizon of typical functionalist architecture was flattened on the ground, as if architecture were to be seen from an airplane. The *Bauhaus* building was fully understood when its rotating wings were perceived together with the screws of an airplane. That "object-building" was in its machinic perception conquering the world. Contrary to that, we are today in a world that has moved its viewpoint "inside" itself. Our horizon is not flattened on the ground, but is revolving within itself, as some kind of a Möbius strip. It is like the vision of a probe exploring our own body. The object and the subject, the thing and our perception of it, are not divided, but are indissolubly merged together. This approach was already very evident in some works of architecture that were looking at more extreme tendencies of Expressionism (Johnson and Gehry were discussing endlessly the influence of Kiesler in their Lewis House project of the mid-1990s). But the really interesting thing begins to happen when information technologies start to permeate the design thinking. We know how much architecture is influenced today by the topological geometry, by the mathematic logic of non-linear equations, by a world of hypotheses that can be tested only using a computer and that postulate the "non-difference" between inside and outside. Object and subject are merged together in the contemporary vision that goes from our feeling of landscape and nature to the new geometry, each time defining its own "territory."

PERSPECTIVAL/MECHANICAL/INFORMATIONAL

When dealing with information technology, particularly interesting is the fact that architecture embodies our understanding of space; in many aspects it "builds" what our scientific knowledge is. To put it to an extreme, architecture mirrors knowledge. But then, how can one understand the pyramid without having the feeling that some basic issues of trigonometry were to be known? How can one imagine the perfection of Roman architecture if not with some kind of geometrical calculation, which, of course, could not have been done with the impractical Roman numerical system?

The tools and the objects built with those tools are extremely connected and mutually influential. This means that architecture transforms itself to adhere to a new level of knowledge when it



16.16.
Parking building (2002), Nuovo Salario, Rome, architects Ian+, L. Negrini: the winning competition entry.

16.19.
Steve Jobs looking at an early Apple circuit board (circa 1976).

emerges. The invention of perspective required a complete change in the conception of architecture. Symmetry, proportions and unified systems of elements were conceived to make a "perspectival" architecture. The concepts of gothic architecture had to be completely modified to adhere to the philosophical, scientific and even social understanding of an "all" real, an "all human" space. And again, later on, the perspectival idea of architecture had to be completely dismantled to adhere to the industrial and mechanical, analytical and non-perspectival space of the functionalist architecture.

To start thinking at an "informational" architecture, we have to look inside the scientific paradigms of information technology. This movement towards the "inside" also has an opposite one. The conceptions of space changed dramatically in various moments of history, and it is always almost impossible to "imagine" what a new space can be. It seems inconceivable when we are immersed in one condition that somewhere "out there" is another type of space, another way to conceive and make things.

Nowadays, we are creating an idea of space that still does not yet exist completely, but one that we begin to intuit and begin to shape. Consider the wonderful metaphor of fish presented in the "Architecture of Intelligence" by Derrick De Kerckhove.[4] Fish know only the fluid that, just like air, surrounds them. They know nothing either of what the sea or lake or river really is, and know even less about the space in which we humans live. Only a jump beyond that aquatic surface can open up the sensation of another space that definitely exists, even if it is neither frequented nor understood .

We need to make that jump, to move out of the condition of a mechanical space to start conceiving the space of information technology. Throughout history we have lived in different spaces, and architects, using different sets of rules and different knowledge, have given them form: the informal space, gestural and primitive, pre-Miletus (and pre-alphabet); the space arterialized and geometrized by the Greeks and Romans; the sacred and mystic space before Giotto; the perspective space of the Renaissance; the industrial and mechanical, analytical and non-perspective space of the modern Movement. Each new space on arriving has required

16.17.
Rob Brill Residence and Studio (1998), Silverlake, California, USA, architect Jones Partners Architecture.

16.18.
Miyake (2002), Paris, France, architect Ammar Eloueini Digit-all Studio, with C. Parmentier.

16.20.
The Amerzone,
Casterman Microids,
Benoit Sokal (1999).

new principles and new alphabets that have been created through difficult, exhausting, rough but exciting processes. That is our task too.

I will close the chapter with two citations. The first is the famous quote by Martin Luther King: "I have a dream."[5] The second one is by Jaron Lanier: "Art is about people not to commit suicide."[6] What this means in the end is that the information technology must act as an intensifier of our basic tendencies: if we want a new architecture that incorporates the crucial and mobile aspects of our time, if we believe that art is the highest form of knowledge and of salvation, if we think that technologies must reinforce a consciousness of progress and of widespread rights, then we must first have the courage to dream it.

NOTES

1 The text and images of my presentations, whether they are course lectures or symposium speeches, are immediately accessible through the Internet at http://www.citicord.uniroma1.it/saggio.

For me, the web is first an ethic and, only secondarily, an aesthetic. The people I admire the most share this vision, and the public appreciates it much more than one would expect.

2 Alvin Toffler. *The Third Wave*. New York: Morrow, 1980.

3 Antonino Saggio. *Peter Eisenman: Trivellazioni nel futuro.* Torino: Testo & Immagine, 1996.

4 Derrick Kerckhove. *Architecture of Intelligence.* Basel: Birkhåuser, Basel, 2001.

5 Martin Luther King, Washington, August 28, 1963.

6 Jaron Lanier, Pittsburgh, September 19, 2001.

APPENDIX

APPENDIX
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Branko Kolarevic joined the University of Pennsylvania (Penn) in 1999, where he teaches design and digital media courses. Prior to joining Penn, he taught at universities in North America (Boston, Los Angeles and Miami) and in Asia (Hong Kong). He has lectured worldwide on digital media in design, most recently on the "virtual design studio," "relations-based design" and "digital architectures." In 2000, he founded the Digital Design Research Lab (DDRL) at Penn.

He has published extensively in the proceedings for ACADIA, CAADRIA and SIGRADI, and has written the textbook *Architectural Modeling and Rendering* (Wiley, 1998) and co-edited with Loukas Kalisperis the *Proceedings of the ACADIA 1995 Conference, Computing in Design: Enabling, Capturing, and Sharing Design Ideas*. He is also the Review Editor in Architecture for the *Automation in Construction*. He is the Past President of the Association for Computer Aided Design in Architecture (ACADIA). In 1998, he chaired the ACADIA's organizing committee for the first Internet-based design competition for the *Library for the Information Age*. Most recently he organized and chaired a two-day international symposium on "Designing and Manufacturing Architecture in the Digital Age," which was held at Penn in March 2002.

He received Doctor of Design (1993) and Master in Design Studies (1989) degrees from Harvard University Graduate School of Design. He also holds the Diploma Engineer of Architecture degree from the University of Belgrade, Faculty of Architecture (1986).

http://www.gsfa.upenn.edu/ddrl/

ROBERT AISH
Director of Research
Bentley Systems
Exton, USA

Dr. Robert Aish is the Director of Research at Bentley Systems. He is a graduate of the School of Industrial Design at the Royal College of Art, London. He has a PhD in Human Computer Interaction, from the Man-Machine Lab at the University of Essex. His post-doctoral research was on the development of computer-aided design tools for design participation at the ABACUS research group at the University of Strathclyde.

As a software developer, he wrote building services applications for Arup, architectural modeling applications for YRM and shipbuilding applications for Intergraph. His role at Bentley is to establish how object-oriented technologies can be harnessed to create a more appropriate design paradigm for architecture and building engineering. Rather than focus on specific application semantics, his research is aimed at identifying the common abstractions that underlie the open-ended design process, which characterizes the AEC (architecture, engineering and construction)domain. These abstractions include design dependencies, deferral management and extensibility. His research has resulted in the implementation of a new package called 'CustomObjects' which is intended to be a framework within which the design research community and inspired architectural practitioners can innovate.

http://www.bentley.com

MARK BURRY
Professor of Innovation
RMIT University
Melbourne, Australia

Professor Mark Burry was born in Christchurch, New Zealand. He is a practicing architect and recently took up a position at RMIT University in Melbourne, Australia, as Professor of Innovation (Spatial Information Architecture). Prior to this post, he held the Chair in Architecture and Building at Deakin University for five years. He has published internationally on two main themes: the life and work of the architect Antoni Gaudí in Barcelona, and putting theory into practice with regard to "challenging" architecture. He has also published widely on broader issues of design, construction and the use of computers in design theory and practice.

As Consultant Architect to the *Temple Sagrada Familia*, he has been a key member within the small team untangling the mysteries of Gaudí's compositional strategies for the Sagrada Familia, especially those coming from his later years, the implications of which are only now becoming fully apparent as they are resolved for building purposes. He has been active with the project, and the museum associated with it, since 1979. Currently, his time is divided between researching and teaching design and associated advanced computer applications, interpreting Gaudí's *Passion Façade* design for construction during the coming years, and collaborating with other local and international practices, principally dECOi in Paris.

http://www.sial.rmit.edu.au/~mburry

BERNARD CACHE

Principal
Objectile
Paris, France

In the area of CAD/CAM, Bernard Cache started working with Jean-Louis Jammot in 1987 on software applications that would make the concept of "objectile" become a reality. (Objectile is the name given by Gilles Deleuze to a series of variable objects that are industrially manufactured on numerically controlled machines.) Their first experiments were conducted on abstract structures and furniture. In 1995, Bernard Cache and Patrick Beaucé started Objectile, a company that digitally manufactures wooden panels to be used as building or furniture components. Alongside collaborations with other architects, Cache and Beaucé are now working on "fully associative" procedures between design and manufacture at the architectural scale. Their recent projects include a series of demonstration pavilions for Batimat, the international building trade fair in Paris – the *Semper Pavillion* (1999) and the *Philibert De L'Orme Pavillion* (2001).

Bernard Cache has degrees in architecture from EPFL (Ecole Politechnique de Lausanne), philosophy from Institut Supérieur de Philosophie de Paris VIII (under Gilles Deleuze's supervision), and economics from ESSEC (Ecole Supérieure des Sciences Economiques et Commerciales). From 1985 to 1995 he worked as an economist while conducting personal research in architecture theory and in CAD/CAM. His book *Earth Moves* was published in 1989 (MIT Press). His articles have been published in several magazines, including *L'Architecture d'Aujourd'hui* and *ANY*. His research is now focused mainly on a contemporary reading of Gottfried Semper's *Der Stil*.

http://www.objectile.com/

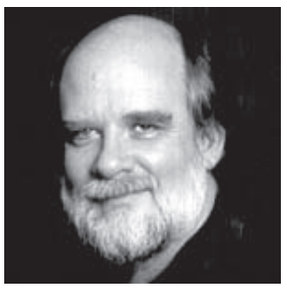
BERNHARD FRANKEN

Principal
franken architekten
Frankfurt, Germany

Bernhard Franken is an architect and engineer pursuing a medial concept featuring a coherent digital process from design to production. Starting out with a creative idea, both form and realization are developed digitally.

Bernhard Franken´s independent architectural language and philosophy have solicited broad interest in various international exhibitions – among them, at the Deutsche Architektur Museum in Frankfurt and the Nederlands Architecture Institute (NAI), Rotterdam – and he has received several renowned awards. He has been Assistant Professor at the TU Darmstadt and visiting Professor at Kassel University. His architectural firm, *franken architekten,* develops design concepts through digital parametric design, ensuring both consistency and perfection in all phases of the project. The exhibition pavilions he designed for the BMW group over the past years demonstrate the synergies resulting from digital design and manufacture.

http://www.franken-architekten.de



JAMES M. GLYMPH, FAIA

Principal
Gehry Partners, LLP
Santa Monica, USA

Jim Glymph joined Frank O. Gehry & Associates (FOG/A) in late 1989. His interest in building technology and how that technology influences design, as well as his understanding of how integration of design, invention and the building process can enhance the development process of a project, complements Frank Gehry's work.

Jim Glymph encourages a special relationship among architects, engineers, craftsmen and fabricators, one that is characterized by design collaboration at a technical level and facilitated by the application of unique computer technologies. The rapid feedback that these collaborations allow creates not only a better understanding of the building process, but also a better control of construction costs, while at the same time permitting the exploration of new design possibilities.

In 1991, Jim Glymph became a principal at FOG/A and since then he has directed projects in the United States, Europe and Asia; notably the "Dancing Building" in Prague, Czech Republic, the *Experience Music Project* in Seattle, the *Stata Center* at the Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts, and the *Walt Disney Concert Hall* in Los Angeles, California. The principals of FOG/A – Frank Gehry, Randy Jefferson and Jim Glymph – have, over the past ten years, gradually transformed FOG/A from a studio with a skeleton staff of young architects to a firm with an experienced staff of over 100 talented designers and architects. Under the direction of the three principals, FOG/A became Gehry Partners, LLP in 2001.

MARK GOULTHORPE

Principal
dECOi Architects
Paris, France

The dECOi atelier was created by Mark Goulthorpe in 1991 as a forward-looking architectural practice, whose design callibre was quickly established by winning entries in several international competitions, and with awards from various cultural institutions around the world. This has been reinforced by numerous publications, international lectures and conferences, and frequent guest-professorships, including a design unit at the renowned Architectural Association in London and the Ecole Speciale in Paris.

dECOi's portfolio ranges from pure design and artwork through interior design to architecture and urbanism, and at every scale their work has received acclaim for its sensual contemporary aesthetic. Based in Paris and London, dECOi has developed a supple working practice to be able to bring its design skill to bear effectively in an international arena. This has resulted in a high level of technical expertise, a fully computerized working practice and an extensive network of affiliations with engineering support groups in Europe and Asia, such as Ove Arup (London) and Rice Francis Ritchie (Paris). This has extended to a recent collaboration with Foster and Partners to offer creative technical input to various projects of theirs.

dECOi has received awards from the Royal Academy in London, the French Ministry of Culture and the Architectural League of New York, and has represented France at the Venice Biennale and the United Nations. They were selected by the *Architects Design Journal* in its international survey of 30 'Emerging Voices' at the RIBA in London, and were awarded second place in the BD 'Young Architect of the Year' Competition, 1999. Most recently, they have been invited as international representatives at the Venice Biennale 2000, and to exhibit ten years of work at the FRAC Centre in Orleans, France.

http://www.hyposurface.com/

SULAN KOLATAN

Principal
Kolatan/Mac Donald Studio
New York, USA

Sulan Kolatan was born in Istanbul, Turkey. She received a Diplom-Ingenieur degree from Rheinisch-Westfalische Technische Hochschule Aachen, Germany, and a Master of Science in Architecture and Building Design from Columbia University. She divided her time equally between Istanbul and Koln until 1982. After finishing her graduate studies at Columbia, she settled in New York. In addition to their practice, she has taught architecture at Barnard College, Ohio State University, and at the University of Pennsylvania. Since 1990, she has been teaching at Columbia University's Graduate School of Architecture, Planning and Preservation.

In 1988 Sulan Kolatan and Bill Mac Donald founded Kolatan/Mac Donald Studio. The firm has received the 48th Annual Progressive Architecture Award, the 1999 AIA Projects Award, the 44th Annual Progressive Architecture Citation Award, the Forty under Forty Award, the Emerging Voices Award, the Fifth Young Architects Award, and the New York Foundation for the Arts Grant and Fellowship.

The work produced by Kolatan/Mac Donald Studio is in the permanent collections of the Museum of Modern Art in New York, the San Francisco Museum of Modern Art, the FRAC Centre in Orleans, France, and the Avery Library Collection. In addition, the Kolatan/Mac Donald Studio has been exhibited in a number of distinguished venues, such as the Deutsches Architektur Museum in Frankfurt, Germany, the Museum of Modern Art in New York, the Cooper Hewitt Smithsonian Institute, Artists Space in New York, MACBA Barcelona, MAC Vienna, and the Carnegie Museum Pittsburgh. Their recent work has been featured in numerous publications.

http://www.kolatanmacdonaldstudio.com

CHRIS LUEBKEMAN

Director
Arup Research+Development
London, UK

Dr. Chris Luebkeman is a bridge builder of many kinds. He has been formally educated as a geologist, structural engineer and architect. He is a *cum laude* Bachelor of Engineering (Honors) graduate of Vanderbilt University and a Master of Science (Civil Engineering) graduate of Cornell University. In 1992, he completed a doctorate in architecture at the ETH (Swiss Federal Institute of Technology) in Zurich, Switzerland. In 1987, he joined the design office of Santiago Calatrava where he introduced structural computer modeling. Since leaving Switzerland, he has since been a faculty member of the Departments of Architecture at the University of Oregon, the Chinese University of Hong Kong and the Massachusetts Institute of Technology (MIT). His architectural practice focused on low-impact zero-energy homes, his engineering practice focused on mobile and deployable structures, and his teaching practice on the integration of building systems. His research program at MIT, which continues today, is titled "house_n: MIT's intelligent home of the future."

Chris Luebkeman joined Arup in 1999 to become joint Director of Research and Development. He is jointly responsible for developing the role of the group with a focus on design research and has particular responsibility for future projects. Since joining the firm he has facilitated the creation of an eCommerce strategy, has initiated research projects on the designer's desktop of the future, and has encouraged thinking about the evolution of the firm's skills networks into a knowledge network. He is a member of Arup's Design and Technical Executive which promotes the highest standards of design and technical skill to ensure that Arup is one of the world's leading practitioners in its chosen fields.

http://www.arup.com

BRENDAN MACFARLANE

Principal
Jakob + MacFarlane
Paris, France

Brendan MacFarlane received his Bachelor of Architecture degree at the Southern California Institute of Architecture (1984) and his Master of Architecture degree at the Harvard Graduate School of Design (1990). He has taught at the Bartlett School of Architecture in London (1996–98) and at the Ecole Spéciale d'Architecture in Paris (1998–99).

Dominique Jakob, his partner, received her degree in art history at the Université de Paris 1 (1990) before obtaining her degree in architecture at the Ecole d'Architecture Paris-Villemin (1991). She has taught at the Ecole Spéciale d'Architecture (1998–99) and the Ecole d'Architecture Paris-Villemin since 1994.

Their main projects include the *T House*, La Garenne Colombes, France (1998), the restaurant *Georges* at the Centre Georges Pompidou, Paris (2000), and the reconstruction of the *Theatre of Pont-Audemer*, France (2000). They have participated in the International Competition for the construction of *Musée Branly* in Paris. Currently they are working on the project for a *Communication Center* for Renault in Paris and have finished a *Bookshop: Books by Artists* in Paris.

WILLIAM J. MITCHELL

Professor of Architecture and Media Arts and Sciences
Dean of the School of Architecture and Planning, MIT
Cambridge, USA

William J. Mitchell is Professor of Architecture and Media Arts and Sciences and Dean of the School of Architecture and Planning at MIT. He also serves as Architectural Adviser to the President of MIT. Among his publications are *E-Topia: Urban Life Jim — But Not As We Know It* (MIT Press, 1999), *High Technology and Low-Income Communities*, with Donald A. Schon and Bish Sanyal (MIT Press, 1999), *City of Bits: Space, Place, and the Infobahn* (MIT Press, 1995), *The Reconfigured Eye: Visual Truth in the Post-Photographic Era* (MIT Press, 1992), *The Logic of Architecture: Design, Computation, and Cognition* (MIT Press, 1990), *The Poetics of Gardens*, with Charles W. Moore and William Turnbull Jr. (MIT Press, 1988), and *Computer-Aided Architectural Design* (Van Nostrand Reinhold, 1977).

Before coming to MIT, he was the G. Ware and Edythe M. Travelstead Professor of Architecture and Director of the Master in Design Studies Program at the Harvard Graduate School of Design. He previously served as Head of the Architecture/Urban Design Program at UCLA's Graduate School of Architecture and Urban Planning, and he has also taught at Yale, Carnegie-Mellon and Cambridge Universities. In spring 1999, he was the visiting Thomas Jefferson Professor at the University of Virginia.

He holds a Bachelor of Architecture degree from the University of Melbourne, Master of Environmental Design from Yale University and Master of Arts from Cambridge. He is a Fellow of the Royal Australian Institute of Architects, a Fellow of the American Academy of Arts and Sciences, and a recipient of honorary doctorates from the University of Melbourne and the New Jersey Institute of Technology. In 1997, he was awarded the annual Appreciation Prize of the Architectural Institute of Japan for his "achievements in the development of architectural design theory in the information age as well as worldwide promotion of CAD education."

http://architecture.mit.edu/people/profiles/prmitche.html

JON H. PITTMAN, AIA
Vice President, Strategy and Business Development
Building Industry Division, Autodesk, Inc.
San Rafael, USA

Jon Pittman is Vice President of Strategy and Business Development for Autodesk's Building Industry Division, the world's leading design software company. He and his team are responsible for leading the Building Industry Division's business development and strategy initiatives, and supporting its marketing team with market and competitive analysis. With over 20 years of experience in computer-aided design, computer graphics, and Internet industries, Jon Pittman has held a variety of corporate venture, business development, product development, product management, and technical strategy positions at Autodesk, SDRC, Alias|Wavefront and HOK Architects. In addition to the work in the corporate world, Jon Pittman has been an Assistant Professor at Cornell University's Program of Computer Graphics and an instructor in user-interface design at the Art Center College of Design. Mr. Pittman holds a Bachelor of Architecture and a Master of Business Administration in Marketing and Finance from the University of Cincinnati. He also holds a Master of Science in Computer Graphics from Cornell University. He is a licensed architect and an instrument-rated private pilot.

http://www.autodesk.com

ALI RAHIM
Assistant Professor of Architecture
University of Pennsylvania
Philadelphia, USA

Ali Rahim is principal of the Contemporary Architecture Practice in New York City and an Assistant Professor of Architecture at the University of Pennsylvania. His books include *Contemporary Techniques in Architecture* (Academy Editions/Wiley, February 2002) and *Contemporary Processes in Architecture* (Academy Editions/Wiley, August 2000). He has won competitions for a shopping mall and steel museum, as well as a one-acre naval memorial. He is the recipient of the Honor Award for Excellence in Design from Columbia University, where he received his Master of Architecture. His projects have been published in several journals and in forthcoming books and journals published by Actar Press, Barcelona, Columbia University Press, Lusitania Press, New York, and Academy Editions/Wiley, London.

ANTONINO SAGGIO

Professor of Architectural Design
University La Sapienza
Rome, Italy

Antonino Saggio is the founder and editor of the book series *IT Revolution in Architecture* published in English by Birkhäuser, in Italian by Testo&Immagine and in Chinese by Prominence Publishing. His most recent books are: *Giuseppe Terragni Life and Works* (Laterza, 1995), *Peter Eisenman* (Testo&Immagine, 1996) and *Frank O. Gehry* (Testo&Immagine, 1997). He is the co-founder of the magazine *il Progetto*, and his essays have appeared in several international catalogues, books and magazines.

Antonino Saggio won awards in design competitions early in his career, and received academic research grants from institutions such as the Fulbright Commission, the Graham Foundation and the Council of Italian Research. He holds a professional degree in architecture (1979), a diploma of planning from the University of Rome, a Master of Science degree from Carnegie-Mellon, and a PhD from the Italian Ministry of Research. He has been lecturing at several universities in Europe, Africa and the United States. He is currently Professor of Architectural Design at La Sapienza, Rome.

http://www.citicord.uniroma1.it/saggio/

HUGH WHITEHEAD

Director, Specialist Modelling Group
Foster and Partners
London, UK

Hugh Whitehead graduated from Liverpool University in 1973 where he was awarded a First Class Honors Degree for research on optimization applied in an architectural context. The thesis explored the potential for using mathematical optimization techniques as an aid to design, but also researched the problems of how to construct a solution space, which can then be explored programmatically. Hugh Whitehead then spent eight years as an architect working on large planning projects in the Middle East and Africa, before joining YRM in London when they had just bought their first computer-aided design (CAD) system. During the next 12 years he became an Associate and CAD Applications Manager. He also specialized in model building for design and visualization, which led to the formation of a successful consultancy. During the next two years Hugh Whitehead worked on six winning entries for millennium competitions and had four animations broadcast on national television, including the award winning *Stadium Australia* for the Sydney Olympics.

In 1998 Hugh Whitehead was invited to join Foster and Partners to set up a new Specialist Modelling Group (SMG), whose brief is to carry out research and development in an environment that is intensely project driven. The SMG specializes in helping to solve geometry problems, from concept design stage through to fabrication and construction.

http://www.fosterandpartners.com

CHRIS I. YESSIOS
CEO and President
auto•des•sys, Inc.
Columbus, USA

Chris I. Yessios holds a PhD in Computer Aided Design from Carnegie-Mellon University (1973) and his formal education includes a Bachelor of Architecture (1967) and a Diploma in Law (1962), both from the Aristotelian University in Greece. He taught and researched at the Ohio State University from 1973 to 1995, where he was a Professor of Computer Aided Design and Director of the Graduate Program in Computer Aided Architectural Design. During his tenure he wrote and published more than 100 research papers and chapters, and conducted research worth millions of dollars that resulted in a number of prototypical computer-aided design (CAD) and three-dimensional modeling systems. In 1990, with an ex-student, he founded auto•des•sys, a company that produces three-dimensional modeling software, such as form•Z. He has been the CEO and President of the company since its inception.

http://www.formz.com

NORBERT W. YOUNG, JR., FAIA
President, Construction Information Group
McGraw-Hill
New York, USA

Norbert W. Young, Jr. is President of the McGraw-Hill Construction Information Group, the leading source of project news, product information, industry analysis and editorial coverage for design and construction professionals. Norbert Young joined the McGraw-Hill companies in December 1997 as Vice-President, Editorial, for F.W. Dodge. Prior to joining Dodge, Norbert Young spent eight years with the Bovis Construction Group, a global leader in the management of high-profile construction projects. In 1994, he was appointed President for the newly created Bovis Management Systems (BMS), which was established to serve the construction and project management needs for both private and public sector clients on a national, as well as a global basis. During the 1980s, Norbert Young was a partner at Toombs Development Company, New Canaan, CT. He started his career in Philadelphia as an architect, where he gained 12 years of experience covering a wide range of building types and projects. He holds a Master of Architecture degree from the University of Pennsylvania and a Bachelor of Arts degree from Bowdoin College, Brunswick, Maine.

A registered architect, his professional affiliations include membership of the Urban Land Institute, the American Institute of Architects and the International Alliance for Interoperability (IAI), where he serves as Chairman of the IAI North-American Board of Directors. In addition, he serves as a trustee of the National Building Museum, as well as a regent of the American Architectural Foundation. In February 2000, the American Institute of Architects elevated him to its prestigious College of Fellows, an honor awarded to members who have made contributions of national significance to the profession.

http://www.construction.com/

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CHALLENGES AHEAD

ROBERT AISH
MARK BURRY
BERNHARD FRANKEN
MARK GOULTHORPE
SULAN KOLATAN
CHRIS LUEBKEMAN
BRENDAN MACFARLANE
ALI RAHIM
ANTONINO SAGGIO
BRANKO KOLAREVIC

22

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ANTONINO SAGGIO
BRANKO KOLAREVIC

KOLAREVIC: In this discussion we will seek out common threads in what I believe will be different and divergent perspectives on what the future has in store for our professions. I invite our panelists to summarize from their own point of view the unique possibilities, opportunities and challenges that we are likely to face in the future.

SAGGIO: I have identified five themes, all of which have something to do with the issue of construction. The first theme is *engagement/disengagement*, related to the Utzon/Gehry comparison that Bill Mitchell talked about. The second theme is *classical consistency versus anti-classical movements*, or "Foster's Chapel versus Gehry's Hair." We have seen these two very different approaches clearly depicted during the symposium. The third is "let's design a mess and make it anyway," which is kind of a joke, but is really how some architects think. You can design almost anything and then go to Arup's where they will find a way to build it. The fourth one is "bones versus skin" that shows two different approaches to construction. The fifth one stems from the method of working and the role of imagination in it, as in "imagination is more important than knowledge" (to borrow Einstein's words from Chris Luebkeman's presentation), which opens up the whole issue of simulation and the "imaginative" role of computers.

LUEBKEMAN: I will talk about the challenges. I think there are some lessons in the history of technology that are very important to pull out. If you look at the introduction of any new technology, you could argue whether that has been the new technology in the past 30 years. The first phase that it goes through is *imitation*. The second one is some outrageous or *injudicious application*, and the third is *appropriate application*. I think we have come to the point very recently where we are beginning to see appropriate application, and that for me was one of the most interesting challenges, possibilities and opportunities. It is for us to continue to define that appropriate application, the appropriate spatial articulation, the appropriate machine language. It is for us to push for that appropriate application, which will be different for all of our different contexts. We have to guard against the continuation of the outrageous or injudicious. It is absolutely crucial to go through that phase, so one can then say "no, let's find out what is right." This has happened repeatedly through history.

KOLATAN: I would hope though that this kind of categorization of appropriate use is not misunderstood. Design intelligence exists at different levels. Some outrageous or injudicious application might be very intelligent indeed. I am not sure that one wants to already begin to become so regulatory about it.

The last time there was this much joy and optimism in architecture was probably in the 1960s. However, it seems to me that we are in danger of falling into some of the same holes that the 1960s generation fell into. One of them is perhaps an extreme reliance on technology. We ought to be careful about trusting a new technology to create perfect solutions on its own. The other one is the projection of a prescriptive future. I might be completely wrong in this, but my sense is that despite much talk about flexibility, for instance, or unpredictability, there is a tendency toward the prescriptive. I think this is also a potential danger that we must avoid. Perhaps you can be more specific in terms of your definition of what is an appropriate application versus a non-appropriate application of this technology.

LUEBKEMAN: What is appropriate is for each one of us to determine. It is the unique aspect we bring to our profession. It is crucial to understand and respect the context in which one stands or from which one wants to speak. We have seen in the symposium presentations some amazingly appropriate applications of technology, as a design methodology, a design language moving into a machine language, as Bill Mitchell said. That is entirely appropriate for what it is and how it is. Those things could not have been done in any other way. For me, that is incredibly powerful and incredibly strong. It is something we have to continue to push for.

GOULTHORPE: I sense that as the technology is more clearly understood, there is a tendency to fall back into techno-rationalism. I think several speakers have said that architects have to use their tools in sensible ways. I think that is insufficient for a cultural discourse. I think that it is entirely valid for architects to be dreaming or using technologies in "inappropriate" ways. The presentation by Ali Rahim dreams of a giant stereo-lithography machine, or giant particle cintering machine, that can distribute material as a density in space – what a delicious thought! It is probably unattainable, except in crude form at this point, but I think it is perfectly valid that architects should be dreaming in that sense. There is no 'right' way to use technology! One might as well say that there is a 'right' way to use a pencil!

I find that we are increasingly moving in our work from a scriptural paradigm to a digital one. I think architects must concentrate on what is that shift. It is a shift in creative thinking, in creative process, which I don't think is being articulated well enough in schools. Brendan MacFarlane says he wants to manifest his idea. Increasingly, I work without an idea. I am trying to generate open-endedly, release a fluid and creative process, which I am then sampling and editing. You have to go beyond what is prescriptive. There are many people increasingly working in non-linear, cyclical creative ways, which seems to me wholly appropriate to these new technologies.

I think digital technologies are essentially technologies of communication and not simply of manufacture. They have changed entirely the possibilities for the way architecture is developed and conceived. Every day I am in contact with technical specialists around the world. I think that creates an entirely different paradigm for architectural production. The gathering of dispersed expertise gives us all sorts of new possibilities, such as the dynamic architecture that I hinted at, which would be unthinkable if I was working in a traditional manner. Once you have stitched together a different way of working, it prescribes a wholly different creative attitude from architects. One remarks that in the current generation of emergent offices very few of them have a single name, a signature. That marks a huge psychological shift. dECOi operates as a sort of anonymous rubric, a leitmotif that functions beautifully to allow people to gather without feeling they are being dominated by a single, creative mind. They seem happy to work in clusters on things.

I think all of these things demand changes in education, in practice, which is why I think it is a philosophical shift. The shift to a digital paradigm is the most fundamental technological shift humanity has probably ever encountered; the change from hieroglyphics to alphabetics codification, or the invention of mechanical print, are both seemingly minor by comparison. This is an extraordinary change, happening very quickly – a philosophical change, properly speaking. I think if it was addressed as such in academia, not simply as an appropriation of technique, then I think we would be witnessing a far more felicitous practice emerging than simply how curved are the panels, etc. We should be addressing, fundamentally, patterns of creativity, patterns of association, etc. I think that is the challenge.

KOLAREVIC: Chris Luebkeman called for five-dimensional design worlds, where the fifth dimension is meant to be performative. I think that Ali Rahim's presentation actually hinted at those five-dimensional worlds in a very poetic and convincing fashion. I would argue perhaps that is an opportunity, that is a possibility we should seek out – the creation of this five-dimensional design world.

I also want to ask our panelists to ponder the 1960s Sulan Kolatan mentioned. Peter Zellner wrote in one of his essays that "there is a strange resemblance between the efforts of the digital neo-avantgarde to induce a new state of formlessness in architecture and the now obsolete utopian designs of the 60s." Do you actually see that there is a danger of this becoming yet another Utopia? Or, do you actually believe that it is going to become a reality?

MACFARLANE: I would like to answer that question only through the project we did for *Pompidou*, because I think we

have been accused of being utopian. For us it was a project that is absolutely *specific* to its situation and its site. It is a project that isn't, we hope, in continual dialogue with its site and its situation. It is possible that it alludes to the 1960s, but I would hope that it takes on a contemporality of its own (the project isn't about that). I think it is the specificity of the situation that is interesting, which is why I was trying to underline its importance. Through abstract interests in the technique we are trying to find a way through to the specific problems, dealing with specificities now, dealing with unique conditions.

AISH: I will address Chris Luebkeman's references to performance-based design. When I worked at Arup's, I participated in the development of some of the first generation of the performance tools. I think that there is a whole area of how we design the design tools. That is my preoccupation, and I am probably the only software developer in this group.

We are looking at things at a different level of abstraction, which I think is quite interesting to you as users of these tools. You are using a disparate group of tools, many of them not intentionally designed for architecture. The kinds of dimensions I consider important are *intuition* on one side and *formality* on the other. I think when we look at architecture (my view of it), it is both about dimension and the precision of dimension, and also about things like proportion, which are relationships that you can establish.

Then in performance-based design, there is the idea that when we design, we suspend the laws of physics momentarily (i.e. let's see what the shape is like before we have to build it). But I think *time* – the fourth dimension – is also something that we have to play with, because, as Hugh Whitehead mentioned, the whole idea of parametric design is to create an editable design history that you can re-execute. So, Ali Rahim's comment about time being irreversible – I'm sorry, but that goes out the window. I have reversed time many times, because I go back, edit something, replay it.

Then, there is the idea of *intention* versus *indirection*. We heard about design intent where we actually draw something – but how about actually making a program that we set parameters for and then we look at the end result. We don't directly manipulate something; we manipulate the algorithm, and we look at the result, and sometimes that result produces accidental contributions. It doesn't matter what kind of computer program we produce; this program doesn't execute by itself in a machine in the dead of night when there is nobody around. We are aiding a design process and, therefore, we have to develop a cognitive model of design. There is no point in having some fantastic conditional statement with nested ifs going that deep if you can't understand it; the compiler can understand it. The question is how we present that logical possibility in a way that a designer, who also wants to be spontaneous, can combine that type of thinking into a design process.

BURRY: I think we do risk being in a little bit of a vacuum or a closed circuit, where we think it is appropriate to discuss whether we misappropriate or appropriate software that is designed for other people and whether that is clever or foolish. I think we do risk getting into situations where folk will chase the cause, having gotten the effect. I don't think these are the issues. I think the issues are actually how we expand our horizons and work with people who actually do know how to use the tools properly. I am not saying that we shouldn't mess around and break things – that is our instincts.

One of the things that I have appreciated most over the last few years working with Mark Goulthorpe, particularly working with the interactive wall, was working with a very deep and wide multi-disciplinary team. What is fundamentally missing is that we can't really communicate with other designers yet. You have other designers performing design activities that are entirely consistent with our own aims; they are just working in a different way.

What I see as an opportunity is the possibility of revising the whole academic environment. When you look at other designers, who aren't architects or interior designers, but are aeronautical designers, boat designers or graphic designers,

they are physically in other parts of the university; they aren't actually sharing time. When you look back at the history of how we actually do our education and practice, we find that the laboratories or the workshops associated with particular design activities are discreet, so that a printer using acid doesn't necessarily want to work with a die-maker in another workshop. But now we have all these tools, such as rapid prototyping, which are consistent across the disciplines. Yet I am not aware of anybody, apart from our own institution, trying to get all the designers, who are actually involved in the creative act of taking an idea through to an artifact, to share physical space and actually start sharing knowledge. So if you see somebody using a computational fluid dynamics (CFD) software, you are not tinkering with it yourself seeing if you can actually get some cool effects, but you can actually say: "this is what I want to do; this is what you do, can you help me do it?" I think that is the challenge and the opportunity for us.

MITCHELL (from audience): I think the issue of software is fundamental. I would argue that software is in fact a deeply conservative force. One tends to think of it as a liberating tool, but mostly it is anything but. The reason comes out of the dynamics of software development. Typically, almost all software begins with the observation of some existing practice, with maybe some incremental transformation of it in mind. Then, by the very act of producing software, you privilege those practices and you marginalize other practices simply by making the ones that you support with software much more efficient, much faster, much easier; so, you introduce this kind of distinction between the privileged practices and the marginalized practices. Then that is reinforced by another kind of dynamic with commercial software: the more software gets used, the more an organization that produces it has to devote its efforts to supporting its user base and the less it can afford to change. You get into a tremendously conservative situation. I think it is really crucial for architects to understand the ways out of that, otherwise you get trapped in this cycle of conservatism that I think is absolutely deadly. One way out of it is just to have a deep critical understanding of what you are appropriating and be prepared to rip it apart and transform it. The other way is to have a more open, modularized structure of software and less division between a closed system that embodies a system of practice and a much more free, open, programmable, and transformable environment. Such an approach enables one to be critical and break out of this cycle of conservatism. You do have to have some mathematical knowledge to do it, some fundamental knowledge of how computation works, but I don't' see any substitute for it. Otherwise I think one is trapped irrevocably in this cycle of conservatism that I think one can observe in a lot of work.

KOLAREVIC: I think Bill Mitchell is absolutely right on that theme. I too wish the Microsofts of CAD would take a more progressive role in casting the future for us in different terms.

AISH: I quite agree with Bill Mitchell too. My experience is very much influenced by my work in practice. I have been working with Hugh Whitehead, for example, and if I can paraphrase what he says and what I completely agree with, which is that so much CAD software is pushing a particular semantics of design that is most probably irrelevant except for extremely pragmatic buildings designed and constructed using conventional practice. But lurking underneath the semantics is a very powerful and general geometry toolkit. If only we can get down to that, and have some programming skills taught alongside of design skills, then you have that general toolkit and you can go and invent your own semantics and you are not constrained. In one sense, the final layer that you currently see is very conservative, but underneath is something very general and we must encourage the students and the practitioners to get down to that layer. To quote Hugh Whitehead again, one of his comments is "what we need is tools to design tools." It is not for the software developer to hard code in a special button on the menu to do some special stadium roof. You have to program that yourself and you need to have skills to do that.

FRANKEN: I want to return to the Utopia question and the 1960s question. I was born in the 1960s and so I am a child of the 1960s. When we started out, we were quite naïve. I think the same goes for Brendan MacFarlane and my generation – the generation of the 60s – that we thought what we did in software was somehow possible to do in reality. Over time, through projects, we lost some of this innocence and we gained professionality. Looking at it now, I rather prefer professionality. I am tired of software that is inadequate, so we started programming our own, out of necessity to get things done the way we want to have them done. We have to do it ourselves because the industry is not supplying the right software.

RAHIM: With regards to the future, what needs to occur – and I think specifically from the institutional realm – is inclusion. It is about having very different participants engage in a discussion much like this forum. But to evolve a working method that includes the future, I think we need to be more inclusive, from software engineers to politicians. By working with the people making the decisions, and working through some of these issues simultaneously, I think we can do that properly and actually participate in a discussion that does include all of these constituencies. We can then possibly reduce the gap of the feedback I mentioned in my presentation. It is a challenge that is not easy to overcome, because there are certain conditions that are redundant, in building codes, building designs, submissions, etc. There is no discussion between any of these entities. If there is a way of beginning to evolve certain relationships with all of these partnerships that are networked through a way of working, I think we are onto something that is incredibly relevant today. I am not sure if that is going to occur, but I think that to forge all the problematics I mentioned here, we have to posit a way of thinking through relationships that can manifest in something culturally relevant. I am not sure we are there yet.

WHITEHEAD (from audience): I would like to leave you with a question that was put to me the other day as I was walking into the office. Somebody stopped me and said: "Look, in exploring these new forms, are we doing it just because we can, or because it is a good idea?" I was quite shocked to be attacked by one of our own people. I had to come up with something quickly, but I didn't get any further than saying: "Well, actually I think the answer is both. We are exploring it because we want to find out if we can, and the reason why we are doing that is to find out if it is a good idea." Now, this poses a whole set of new questions, because to answer that we need better methods of evaluation. Obviously, when we look at new forms – and if we want to promote new forms as a good idea – we have to make the energy case. That is something we are now focusing on very strongly. If you make the energy case for new forms, you have to integrate all these wonderful, powerful analysis tools with your geometry controls. That is a question that I leave you with – how do we integrate analysis tools with our geometry controls?

BRUCE LINDSEY (from audience): I was thinking of a moment where the term user may be useful, and I would describe it as an *aesthetic addiction*. To turn perhaps what might be an observation into a question I would ask – why the differences aren't more dramatic between the projects?

KOLATAN: There is a kind of homogeneity that is a default condition of the kinds of software we use. One could say that it is because we still don't use the software in a sophisticated enough way. In other words, what seems to generate this homogeneity in computational architecture is in part the fact that shape and geometry are often too closely aligned. Geometry becomes genotypic as well as phenotypic destiny, as it were.

While topology is intrinsic to the software we use, it need not become extrinsic. In our own work we are extremely interested in problematizing this difference between form and shape. The *Housings* project, for example, is a case in point. A single genotype (the colonial house) produced a wide range of phenotypes. A way out of the extrinsic geometry dilemma can

potentially be found through the introduction of scalability. If geometric structure is thought of as scalable or fractal, shape does not have a fixed or singular relationship to geometry. In other words, if this structure operates at a micro- or nano-scale in relation to the identifying marks of individual shapes, it becomes invisible. This is not unlike the scalar relationship between a species and its cellular structure. I think it would be radically liberating in terms of the range of formal and spatial definitions to be mapped. Geometry can become backgrounded, deep and sublimated, rather than foregrounded and "in your face."

The question of the user is a good one because many other areas are already going into the business of mass customization, as mentioned earlier. There is going to be a great degree of user participation in the future – potentially in our profession too – in the way things are designed and produced. I think we need to provide a much greater flexibility in terms of the final formal, spatial organizational diagrams that we are working with. I don't think that is the case yet.

ULRICH FLEMMING (from audience): I would like to challenge the notion that you program only as a last resort in case the software vendors don't provide you the with right tools. I have been a programmer for more than 30 years and I enjoy it tremendously. I preach to my students that the program is a crafted artifact like many other crafted artifacts that can be crafted well (or less well). Given that, I would suggest that the only software worth using is one that you can program, that you can customize, such that it becomes an integral part of the tool you are using.

I wish architects would abandon this passive stance in which they simply accept what the software vendors offer them. They don't even make suggestions how to improve the software; they don't even know what suggestions to make, because they don't understand the software at the level at which you need to understand it if you want to make intelligent suggestions. And the best way to learn how software works is being able to program it.

I suggest that one should consider software that you can actually program as a positive aspect of practice and not as a means of last resort. You should be ready to program, and it is fun.

FRANKEN: For me, programming was not only a last resort, it was a question of beauty too. In programming it is a resourcefulness, i.e. how much code do I need to achieve something. It is like a mathematical formula. If it is good code, it looks beautiful.

KOLAREVIC: I want to refer to one of the comments that were made earlier by Bill Mitchell. We do not need to code in order to program. What Ali Rahim is doing is programming. A number of people who presented their design work at the symposium are actually programming, but not by doing hard coding.

I would like to conclude this discussion without any remarks that could hint at the possibility of an end, because I think we are at the beginning of an open-ended and exciting search for the future of our professions. So, I would like to leave this discourse inconclusive and open-ended. I hope that we will see numerous answers in the future to the issues of opportunities, possibilities, and challenges of designing and manufacturing architecture in the digital age.