FROM HARD ARCHITECTURE TO SOFT ARCHITECTURE: ARCHITECTURE FORM IN THE 21ST CENTURY

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Abstract: The digital revolution is affecting not only the way we produce drawings, but also the way we think about architecture. Such expressionistic, neo-baroque forms would have been unthinkable without higher technology, which allows for customization at a massive scale. Three dimensional computation extends the architect's range, permitting a wealth of experimentation, any form seems possible, the architecture language, the vocabulary changed, and the way design thinking has various dimensions.

Within a short space of time the computer has become a widely accepted feature of architecture, both in the design process and in the everyday operation of buildings, and we are constantly aware that the computer's introductions into architecture will eventually have far-reaching consequences. After all, the current revolution is not just about the computer as a tool but about its role and effect on the form of architecture and thinking

This paper will discuss what form will architecture take in the next years? Will every future problem be anticipated, developing more efficient solutions? Will projects reflect meaningful architecture, for dynamic and contemplative environments and for aesthetic quality? And, how we will stand this unavoidable futurism?

1. Introduction

Since its creation, architects, artists, media designers and theorists have speculated about the ramifications of the computer. It is a theme that invites speculation, experiment and play - but that is not the only reason for the persistent questioning. Today we are aware that we cannot foresee al the implications of the technological revolution. We are aware that innovations and inventions need time to incubate, and that their effects on the

organization of society can be completely unexpected. The radicalization of modernity that has been triggered by the computer means that it has become increasingly difficult to fall back on traditions: more than ever. We must reflect on what the future will bring (Figures 1, 2 and 3).

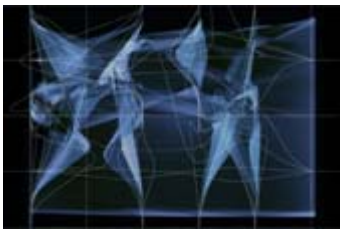

Figure 1. Computer model generation

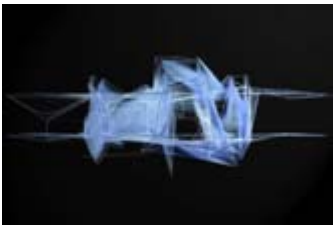

Figure 2. Model transformation

Figure 3. Model approaches

It presents a wide spectrum of approaches, from architects who incorporate the computers techniques into their working methods in a more efficient or exploratory way to practices that are based on the belief that the computer will dramatically change the nature of architecture, in terms of the design process, as well as on the levels of organization and experience. Digital architecture is not a movement - like many others that have been recently coined - but a way that helps us better understands and connects the many attempts to establish the computer's role in architecture, it makes us aware of the many opportunities that exist between and behind design approaches. Instead of trying to validate conventional architectural thinking in a different realm.

2. Evolutions and Transformations of new architecture

At the close of our century it is the information revolution that is metamorphosing architecture and urban design. Digital technologies are transforming the nature and intent of architectural thinking and creativity, (Figure 4), blurring the relationships between matter and data, between the real and the virtual and between the organic and the inorganic and leading us into an unstable territory from which rich innovative forms are emerging. It

is in this context that today's experimental architects are deploying novel "hard' (manufacturing and material) and "soft" (digital) technologies to engender an architecture of incorporation and conjunction, to test the radical generative and creative potential made possible through computer application (Figure 5).

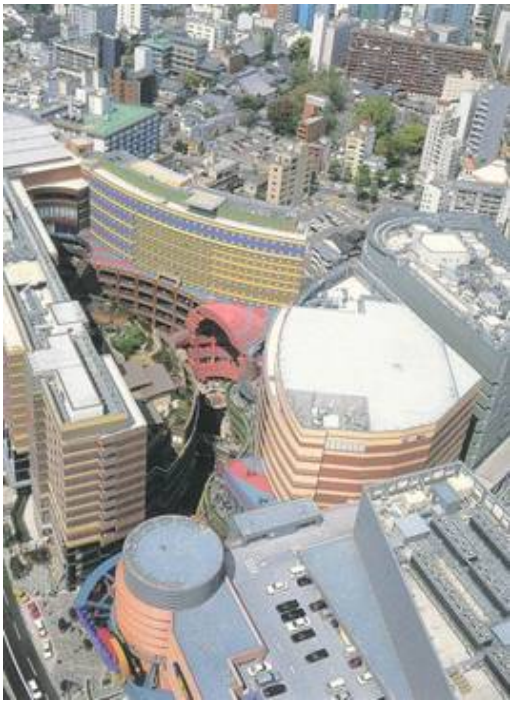

Figure 4. Digital technologies are transforming the nature and intent of architectural thinking and creativity

Figure 5. Reichstg Berlin-Norman Foster, 1999.

A new time-space vernacular is re-scripting the model of the city as cable and satellite connections span massive physical distances along a curved terrestrial geography, spatial description itself. Through visual and non-visual means of mobile cognition satellite-imaging, electron-scanning or heat-sensing -structures and buildings are being set free from a conventional linear viewpoint buildings can become less like icons of fixity and immobility and more like incursive fields of organized materialization.

Paradoxically, while architecture may at last free itself from the shackles of an over determined mode of visualization. The building user has become increasingly static, as human cognizance and transience reach around the planetary surface via telecommunications networks, we remain relatively fixed to our points of interface-our workstations, televisions and fax machines. The idea of place has therefore as instantaneous data exchange

replaces traditional means of mobility. Buildings can now be seen from anywhere at once with the aid of a digital cognition, and strangely we are able to perceive everything at once by not moving at all.

If the seminal avant-garde of the early twentieth century designed an architecture for the Machine Age, then the architects are now devising transformative, poetic and pragmatic responses to the technologies urban networks and post-mechanical processes of the Information Age. They are developing spatial routines and urban coding for a world that is at once unfixed and fixed, here-there and there-here, dislocated and located. Theirs is neither revolutionary nor utopian architecture but an architecture of evolution, contextualization and transmutation (Figure 6). Their researches are triggering a phase-shift in our perception and comprehension of space, materiality and time at the start of a new millennium.

Figure 6. Disney Concert Hall, Los Angeles, USA, Frank O. Gehry, 2003.

Within our lifetimes we are watching unprecedented deviators from the basic outline of the city. The boundaries between urban conditions, between private and public space, natural and urban space, are blurring, while whole families of urban and architectural types-1950s skyscrapers and 1960s malls- are becoming marginalized or superannuated, urban forms like featureless information factories, gated exurban estates, anonymous strip malls and hopelessly tangled parking-lot complexes are evolving within the topographies and ecologies of our wired cities (Figure 7). At the never-ending edges of town, urban forms germinate and grow almost instantaneously, appearing in the world as if overnight, fully formed by the forces of global capitalism.

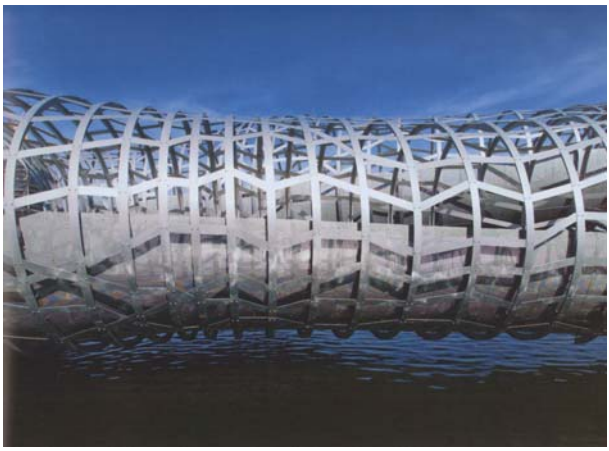

Figure 7: Webb Bridge, Melbourne, Astralia, Denton Corker Marshall, Robert Owen, 2003.

3. Virtual Versus the Real

The virtual is real but not actual, ideal but never abstract. Indeed, the two sides of this purported dialectic, the real-actual and the virtual-imaginary are not distinct halves but something akin to oscillating forces in a shifting field, existing not side by side but through and across each other. If we were to assign identities to the real-actual and the virtual-imaginary, we might say that they are at once singular and doubled. If they are entities at all, they share functions and space over coterminous territories, or overlapping regions of nor-exclusivity.

The twinning of the virtual and the real in architecture is not a phenomenon specific to our time or technologies (Figure 8). The notion of real spaces enriched by a virtual logic has existed since the seventeenth century, if not earlier. The puzzling forms of the garden maze, for instance, or the infinite reflections of the mirrored gallery, spaces in which vision and reasoning bend and warp according to a virtualized logic of reflection, simulation and distortion, were in many ways precursors of our intermingled electronic-virtual and material-real structures: the actual being recorded in a world network (data-maze) and the virtual as the points of interface (data-mirrors). If in the seventeenth century the real-virtual might have existed only in the mirrored halls and garden mazes of the privileged, todays intertwined real-virtual is more democratically shared across cities and social classes.

Figure 8. Reichstg Berlin-Norman Foster, 1999.

Time, perhaps once seen as an impediment to building, a source of delay and decay, has assumed a decidedly intimate role in an architecture that engages in a kinematical sculpting of space. Today, time and movement have been instrumentalized in architecture with the aid of powerful animation software's, which have enabled architects to develop dynamic, mutable and evolving design techniques and new spatial paradigms.

The use of animation software has inscribed duration and motion into static form rather than creating an architecture that is essentially the organization of stationary, insert forms, architects view spatial design as a highly plastic flexible art in which the building form itself continuously evolves through motion and transformation. With complex time sequences and simulations, forms are no longer defined by the simple parameters of scale, volume and dimension; multivalent and shifting external or invisible forces and inclinations can also affect forms (Figure 9). Employing software routines that track time-related factors, such as pedestrian and automotive movement, environmental elements such as wind and sun, urban conditions such as views or site density, these designers are producing buildings in which virtual and real media technologies are inextricably linked.

It suggests that mathematical models and generative procedures can be used to build models "derived from the particulars of the real world, from data and processes of the virtual world (Figure 10), or from numerous techniques of capturing the real and casting it into the virtual, motion-capture, for instance. Since time is a feature of the model, if the model is fed time-based data, the form becomes animate.

Figure 9. London City Hall-Norman Foster, 2002.

Figure 10. Fisher Center for the Performing Arts and Bard College, Annandale,USA, Frank O. Gehry, 2003.

4. Emergent Future Dimensions

A seamless virtual geography of informational interchange has replaced locale as an indicator of space and rearranged "natural" temporal sequences along the earth's surface The globalized liquid "soft architectures" of digital media from over, under and through the local, concrete and "hard architectures" of our contemporary cities, creating an indeterminate, "floating" environment, an interface between public and private, collective and subjective, symbolically rich and multidimensional world-space as an extraordinary context for architectural exploration.

Our international telecommunication networks have become characterized by agitated, irreversible super-corrections that operate outside conventional human understanding of time and space. We no longer communicate with friends, family or associates exclusively in a particular place; rather, we communicate both in the local context and across time zones and cultures. A seamless virtual geography of informational interchange has replaced locale as an indicator of space and rearranged "natural" temporal sequences along the earth's surface (Figure 11).

Figure 11. Guggenheim Museum, Bilboa, Spain, Frank O. Gehry, 1997.

Computerized design and manufacturing processes have brought about working practices that irrevocably affect the way buildings are assembled, function and behave. Little more than a decade ago, most offices reproduced their architectural drawings and schedules mechanically or by hand,

documents were then delivered to consultants for review and updates, before revisions were painstakingly added to working drawings by hand. Today three-dimensional CAD models can be relayed between workstations or offices executed in different time zones and endlessly revised without ever leaving the electronic sphere. As computer processing power increases exponentially and advanced manufacturing software's become more available and less expensive, both large corporate offices and one-person studios will reap the practical benefits of the electronic paradigm shift.

Perhaps the most spectacular (and publicized) example of the extent to which these new technologies are influencing architects' production and aesthetic practices is the captivating use of complex-curve-generation software, digitization devices and numeric command-machining in Frank Gehry's Guggenheim Museum in Bilbao (Figures 11and 12). Using CATIA, an aeronautic and automotive design and manufacturing software, Gehry was able to produce precise three-dimensional models for every facet of the titanium and stone surfaces, as well as the intricate structure of the interior curtain walls and stairways, before directly delivering the design details to Spanish subcontractors in CATIA format.

Figure 12. Guggenheim Museum, Bilboa, Spain, Frank O. Gehry, 1997.

Architecture need no longer be generated through the static conventions of plan, section and elevation. Instead, buildings can now be fully formed in three-dimensional modeling, profiting, prototyping and manufacturing software's, interfaces and hard-wares, thus collapsing the stages between conceptualization and fabrication, production and construction, numerical data formations and spatial experience.

Architecture is becoming like "firmware" the digital building of software space inscribed in the hardware's of construction. Soft complex-curved surfaces modeled in data-space will be transmuted to real space as bent or torqued variable panels, as sheets in steel, copper or plastics, or glass-fiber skins: massive involutes elements designed in data-space will become milled, routed or turned elements in wood or aluminum, or cut as molds for quick-setting resins, rubbers or metals. Bridging the boundaries between the real-technical and the virtual-technical, firmware will favor a far more malleable relationship between bits of space and matter.

Figure 13. Disney Concert Hall, Los Angeles, USA, Frank O. Gehry, 2003.

Figure 14. Kunsthaus Art Museum, Austria, Peter cook, Colin Fournier, 2003

As the French architect, technologist and theorist Bernard Cache has argued, architecture today should be understood as an electronic technical art." based less in the representation of ideal forms than in the scripting of machining codes and routines for numerically controlled (NC) routers, lasers and water jets. He suggested that the calculation of space, form and structure will usurp design altogether and eclipse the architect's previously deterministic role. The separation of entities corresponding to the productive division of elements is precisely what is being called into question. If there are any sacred cows to kill, it is not so much the strict geometry and standardization of components that industrial production has seemed to suggest, but the structures of thought itself, and in particular the linear and rationalizing tendencies that such divisions have championed."

The computer, then, will no longer be merely a production, engineering or facilitation tool under the command of the architect-user but a generating entity with its own virtual intelligence or "knowledge" of the design process: the computer will function as a partner (Figures 13 and 14).

Architecture is becoming a computational collaborative art based on the choreography of robotic manufacturing, while the architect, freed from the need to continuously invent a new is becoming more like a choreographer of space and material production (Figure 15).

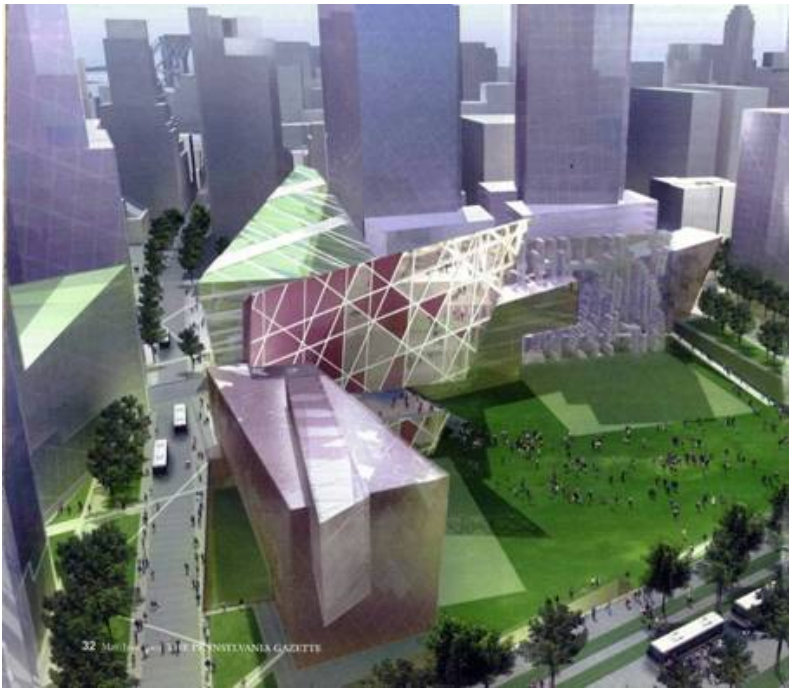

Figure 15. New York Gardens, New York, USA, Daniel Libeskind, 2004.

5. Conclusion

Architecture need no longer be generated through the static conventions of plan, section and elevation. Instead, buildings can now be fully formed in three-dimensional modeling, profiting, prototyping and manufacturing software's, interfaces and hard-wares, thus collapsing the stages between conceptualization and fabrication, production and construction, numerical data formations and spatial experience. The unique character of handwork and systemic mass production can now commingle in CADICAM mode of creation, which can produce series-manufactured, mathematically coherent but differentiated objects, as well as elaborate, precise and relatively cheap one-off components.

The shift in the twentieth-century image of architecture from the "hard" forms of industrial and military technologies (the biplane, the transoceanic streamliner and the automobile) to a more pliant investigation of broader techno-cultural conditions (the soft technologies of leisure and domesticity or the interface model of the computer) is an ongoing manifestation of the ethics of technology in the aesthetics of building, technology is ultimately society, and society cannot be understood or represented without its technological tools.

Nevertheless, the investigation and application of technology by architects must consider the ramifications of the potentially reckless and uncritical coercion of technology's powers into architecture. We must remain watchful of the machine's ruinous endgame played out as urban forms, spaces and relations. Recalling early modernism's utopian romance with machine form tells us much about the dangers of an addictive technology fix and the consequences of a technological overdose Indeed, there is something ominous that lies beneath modernity's play of sleek forms and pure surfaces under light. It was no accident that in the aftermath of the Second World War, Le Corbusier, once the champion of the engineer's aesthetic of cold, naked, polished steel, would reject the accelerated technologies of terrestrial movement and aerial flight, Witness to the spectacular violence brought into the world through the combined efforts of mid-century science and the war machine, Corbusier turned his architecture to the vernacular forms of the Maisons Jaoul (1952-56) and the sacred space of Ronchamp (1950-54).

Today, in a post-industrial age, we assume too easily that the more supple technologies of communication and computation are less threatening or less likely to drive us towards a total societal crash However pliant and mobile the technologies of the information age might seem real-time connectivity and interface may be only slightly more subtle in their potential for violence than their the brutal counterparts in the Machine Age.

With supercomputing speed estimated to achieve some twelve trillion calculations per second by 2005 and the sum of stored human knowledge to double every seventy three days in the year 2020, the heart of a highly technologized millennial architecture must lie in the critical relationship between technical speed and the architect's ethical concerns. Time and space may be at their most useful when not in use. Architecture may serve us best when it helps us to recognize the gaps, pauses and intervals or respite in an ever accelerating world. Sometimes speed limits us, and sometimes limits set us free.

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