A5   THEORIES OF DESIGN AND ARCHITECTURE

THE IMPACT OF DIGITAL TECHNOLOGY ON THE LIBERATION OF ARCHITECTURAL
FORMAL LANGUAGE

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ABSTRACT

The latter few years has been marked by a revolution in digital technology which was reflected deeply in architecture in concepts and representation, causing a rapid progress in theories and offering a brand new formal language.

Where paradigms are shifting different formal themes are identified; a need to express resistance to gravity and earthbound forces, and scale which is represented in the colossal architectural elements cantilevering over improbable distances escaping gravity and vibrating with dynamic tension. Another starting point for form-making is to cease seeing architecture as sculpture in the landscape, as there became no barriers between the form and the ground and the boundaries between architecture and sculpture are contravened in different ways. A third approach for form making is cyberspace and the way digital technology is deeply affecting the way design is both conceptualized and put together where there are no limits to formal complexity and also there is the innovated use of materials. Being the core of architecture, form making affects all other pragmatic concerns that architecture has to address. The paper discusses the way architectural form-making is affected by the digital age in an attempt to evaluate the formal experimentation that occurred in the last decade.

KEYWORDS: Spatial form, Topological geometry, Abstraction, Materialization, Digital information.

الخلاصة :
تميزت السنوات القليلة الماضية بثورة في التكنولوجيا الرقمية انعكست بعمق على العمارة سواء في المفاهيم أو في الأساليب مما كان له أكبر الأثر في تطوير النظريات وتحرير لغة التشكيل في أكثر من إتجاه: ظهور الكتل المرنة الديناميكية المقاومة لقوى الجاذبية ، تغير العلاقة بين المبنى والطبيعة حيث تلاشت الحدود بينهما وظهور أشكال متراكبة غاية في التعقيد لم يكن من الممكن الوصول إليها قبل ذلك. وتتعرض الورقة البحثية لهذه الإنعكاسات على المفاهيم، المنتج المعماري والعلاقة بين الكتلة والفراغ سواء كفراغ داخلى وخارجى أو كاستمرارية للأسطح وكذلك المواد واسلوب استخدامها .

1. INTRODUCTION

In the end of the 20th century and the beginning of the 21st century, the applications of computer had already changed the design method, especially technology like the virtual reality, new techniques such as CAD (computer aided design), CAE (computer aided engineering), CAM (computer aided manufacture),

and CNC (computer numerical control) and Internet, spatial form has reached an entirely new level. Mastering computer techniques in design or production does not necessarily give way to great architecture. Architects are becoming increasingly skilful at producing complex forms and integrating digital design and production techniques into their design process - yet only projects that are sophisticated at the level of conception achieve merit. The most direct manner that architecture presents itself is by means of spatial form, therefore, when the process of architectural production undergoes change, and then changes in the form of architecture follow.

The paper discusses a variety of contemporary architectural concepts, tendencies and design objectives illustrated through different ideas and visions of architects thinking about how new media affected new age architectural forms in many ways: conceptualization of form, fabrication of form, redefining the form/space relationship and materialization of form.

2. CONCEPTUALIZATION OF FORM

Even though Architecture is becoming – in part – an experimental investigation of topological geometries (topological space, isomorphic surfaces and parametric design), there is more to defining form than superficial considerations.

This part focuses on the concepts designers used in order to be able to move beyond technique.

Through the computer, many famous architects, for instance Frank Gehry and Peter Eisenman, had designed various amazing spaces. Many of the architectural elements had been redefined, such as function, form, volume and space. This new type of architecture produced by the combination of new architectural efforts and digital technology is generally called digital architecture and is expressed through the design method, thinking pattern and spatial theory.

As pluralism was an unavoidable part of the modern and post-modern architecture, today, technological revolution has had a great impact in promoting heterogeneity. Even, influential architects are no longer a few pioneers but many equivalent (dissimilar) figures.

The three components besides pluralism or heterogeneity that remain dominant are **abstraction, minimalism and rationalism.**

2.1. ABSTRACTION

Abstraction was meant to remove away the signs of historicism attached to architecture, removing elements from their normal context and putting emphasis on space, light and material. While some contemporary architects like Denton Corker Marshall use abstraction as a compositional device [1], to produce sculptural forms, many architects appear to be increasingly interested in balancing the abstraction of their architecture by representational references giving their works a deep meaning. Seeking a balance between innovation and tradition, seeing their work as a continuation of the architecture and typologies that have evolved over time in their cultural context, in Japan buildings Hitoshi Abe refer to traditional Japanese approaches to space, scale, luminosity and material tactility, to him architecture is the medium that unites human will and the environment Abe quotes directly from the traditional architecture of country buildings in Japan but he uses dynamic flow of space, , the quotations of traditional architecture in this building are not the point of the work, but they serve mainly in generating a tension between stases and dynamism, the customary and experimental. In Ireland De Blacam+Meagher designed buildings of clear originality, which in their purposefully chosen evocative materials and forms. Are layered with implicit and sometimes explicit, representational references. Against the truly meaningful form that these designers produce –a meaning that is dense and complex which refers to place, climate and programme, materiality and, society and progress in architectural thought.

Fig1: Denton Corker Marshall uses abstraction to produce sculptural forms

Fig 2: Hitoshi Abe, Abstract thought and abstract form coexist.

2.2. MINIMALISM

Minimalism is considered both a design objective and an aesthetic. Today's minimalists, such as Giraudi+ Wettstein are interested in describing place and culture through their forms, they make an architecture of materials and light, they provide a sense of transparency, light, and connection . In Japan, although it was expected that the obsession with shape would eliminate all other concerns, minimalism can be seen in buildings which has few of the usual attributes, and is really no more than a series of different specific locations for the activities of the client.   There is almost no architecture in the usual sense of the word and yet it satisfies the timeless criteria of firmness, commodity and delight. Similarly, Kazuyo Sejima is usually minimal in architectural vocabulary but not Minimalist in architectural ideology. Her buildings have discipline and consistency, but also apparent randomness which she manages to design genuinely within the simple frame of each building. Sejima's works have minimal materiality. They are always geometrically pure and never as pieces of conceptual art rather than as constructed spaces [2]

Fig 3: Giraudi+ Wettstein, architecture stripped of its semantic signs
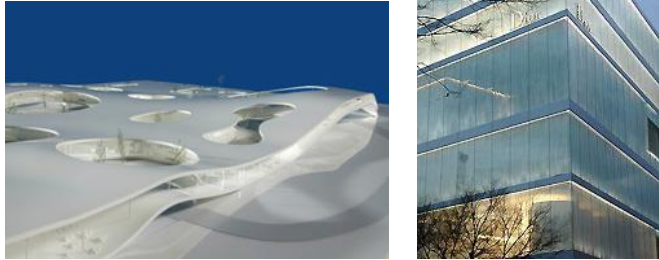
Fig 4: Kazuyo Sejima, the pure and minimal materiality

2.3. RATIONALISM

Rationalism provides a philosophy, a way of working and an expression of the programme, Engelen Moore's designs, although are prosecuted with brutality and harshness, yet the sense of lightness is not lost in the space. Engelen Moore even combines dual programmes, in a single space.

Ashton Raggatt Mc Dougal transforms the idea of the architectural promenade into a programmatic sequence that succeeds in making clear the typology and its different elements as well as cultural ideas of history, people and place, he has generated an architectural aesthetic based on an ideological /social consciousness.

Some architects use new formal languages that come out of cyberspace and fractal geometries as a way to express the programme.

Through this highly refined algorithmic process, both intuitive and logical form-making processes are necessary. A grid-like structure transforms gradually into a convoluted scheme with numerous

overlapping coils or folds revealing complex patterns. As the new architectural forms become complex, interconnected parameters change thus affecting the outcome. Algorithms offer a degree of rationality which allows the designer to become a free form maker.

Digital media is employed not as a representational tool for visualization, but as a generative tool for the derivation of form and its transformation –To justify itself architecture must Instead of giving us scenes we can recognise and be familiar with, architects can invent completely floating worlds undulating on seas of digital information promising liberation from the real world in which we are imprisoned by the banality of building.

Fig 5: Engelen Moore, rational and at the same time inventive

Fig 6: Ashton Raggatt Mc Dougal, transforms the idea of the architectural promenade into a programmatic sequence

A new realistic attitude towards quantities and numbers is shown in the work of MVRDV.

MVRDV's architecture evince and independent, open-minded attitude that is expressed not only on in the integration of the various aspects of the task; programme, interior , exterior and site, on a more abstract level, the way requirements are distilled into a programme of concepts and visions. The key concept in the eventual elaboration of their design ideas is space, on all its layering, associations, derivatives and manifestations, generated from dissimilar mathematical models and creating a sense of boundlessness both from without and within.

Phenomena take place on the basis of apparently disorganized patterns, but this supposed chaos has hidden logics which make it possible to define gravities-landscapes of data- in the midst of these interminable carpets of objects [3]. The interaction between design concept and manipulation of objects, enabled by computer software and hardware, along with multidimensional and virtual digital environment, leads the minds of designers into a three dimensional or even four dimensional spaces for design concepts.
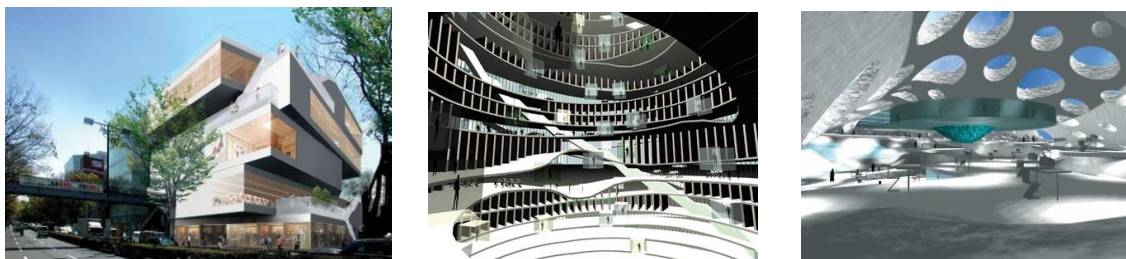
Fig7: MVRDV 3 dimensional spatial fluidity that is felt both inside and outside.

3. FABRICATION OF FORM

Interpreting architecture as a dynamic process and aiming at going beyond the traditional spatial concepts, some new age architects use the computer developing and giving body to their artistic work. Criteria can be plotted as determinants; like circulation, patterns and topographical features; that can generate form. The architect Greg Lynn's architecture develops in strict correlation with the most sophisticated digital production systems used by the aerospace industry and computer animation to dynamically generate forms while the designer-director controls their changing and unpredictable development. Instead of static, fixed, and still, the themes of movement and dynamics of form in architecture are typically

addressed through pictorial views of static forms. Instead of being conceived and created based on models of stasis and equilibrium, the architectural product now is conceived through vital process of motion, transformation and alteration. Greg Lynn investigates the combination of deformable surfaces, external physical forces, and technological computer-aided processes based on computers and biological models of growth, development, and transformation using animation rather than conventional architectural design software. To him, surfaces can be described independent of any prescriptions arising out of fabrication techniques. In his search for systems that simulate the appearance of life, the special effects and animation industry is of fundamental importance for this type of investigation. The crossover from determinism to controlled indeterminacy is central to the development of this dynamic design method [4].


Fig8: Greg Lynn, dealing with the building as an investigation using digital techniques

4. REDEFINING THE SPACE/ FORM RELATIONSHIP

4.1. INTERIOR /EXTERIOR RELATIONSHIP: It is about the careful placing of buildings in their surroundings leaving its mark without being pompous or monumental. Dealing with nature as something we wish to consider and experience, defining internal and external forms, as in Nox's firm whose buildings unite seamlessly into their natural surroundings. No longer as an object in nature, architecture and landscape become one another.

Architect Winka Dubbeldam's work is continuous with the landscape from which it emerges. The basic structure of her projects consists of interweaving layers representing spatial, political, social, economic and cultural influences, the layers form a dynamic system which connect to each other in a complex system [5].
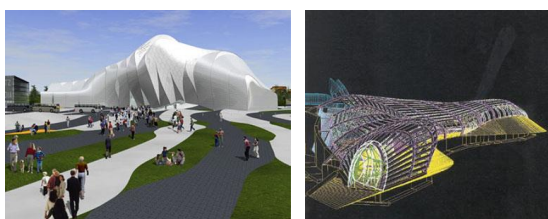
Fig9: Nox, electronic organisms   **Fig10: Winka Dubbeldam, integrity with landscape**

4.2. TOPOLOGICAL CONTINUITY: Present day digital architecture emphasizes dynamic surface with its three-dimensional curves, and the interior and exterior continuity of its topological spaces [6]. Just as the use of topological geometries that can be bent, twisted, deformed, and differentiated while maintaining their continuity is also essential. Sometimes projects take their primary form, and in many cases even their names, from topological geometries In the case of Ben Van Berkel's Mobius house and other designs, however the real interest in using these geometries can be drawn between them and broader cultural issues, the continuity and fluidity with which these forms are identified has stimulated thought and stirred the   ideas that has calcified around architectural thinking.

Fig 11: Dynamic continuity of forms

5. MATERIALIZATION OF FORM

In projects notable for artistic and technical innovation, contemporary designers are investigating the nature and potential of architectural surfaces. They are concerned not only with their visual and material qualities, but with the meanings they convey.

Some contemporary architects have constructed new spatial form materials as diverse as wood and cardboard tubes respectively. Their architecture unfolds out of the normative limits of these materials, to building multi-storey buildings out of wood and still meet fire regulation or constructing a permanent structure out of cardboard tubes that expands the possibilities for such a lightweight and disposable material. Sometimes it is about the materialisation of architecture exemplified in the way some architects like Artengo Pastrana give traditional materials a special character.

Fig12: Artengo Pastrana, gives concrete a special character


Fig13: Barkow Leibinger, Laser fabric

On the other hand, Barkow Leibinger and Lacaton&Vassal are concerned with the question of mass production. In the first instance techniques such as prototyping are explored as part of a reassessment of the relationship between the unique and the repetitive object. In the second case mass-produced elements such as corrugated plastic sheet are displaced and put to a different use from the norm, such as a full height addition to a private residence.

It is not practical to use the traditional concept of materials to study this kind of material-turned-information phenomena. By means of parametric settings, this information becomes a dynamic message, causing the information / material to change the texture and state of the structure itself. This can result in construction components manifesting different qualities and an adaptation of these components toward each other. This natural dynamic state causes the entire form to blend together.

In a digital environment, materials exist in an immaterial state. A designer can create new materials that do not exist in real environment. The wide use of imagery changes one's view of materials, and in a digital environment, all materials are changed into the form of information. Materials become parametric information input and this theme is reflected in the design process.
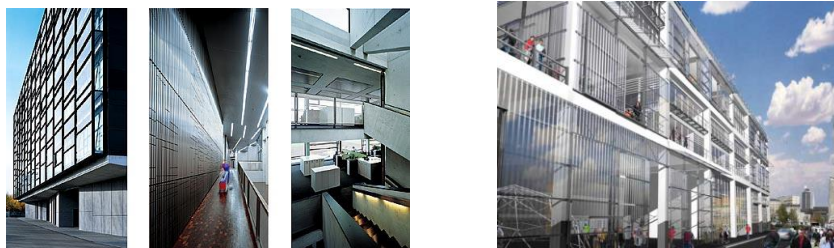
Fig14: Barkow Leibinger and Lacaton&Vassal, material put into a use different from the norm

6. CONCLUSION

The process of digital architecture production proves that computer technique is not just a tool for design, but is also a medium for inspiring thinking in the realm of design and a means of producing the logic behind even more complex forms.

If the digital technology influences the design thinking, design method and spatial theory, then it should be considered more than merely a new tool it might thus form a new age of digital architecture. It is not easy to predict the future of the digital architecture, although, it is still progressing with the full speed. There are still gaps between the architectural education, society culture, and digital architecture. The generation gap between the existing generation and the digital generation can be easily seen in the debate of architectural design process, presentation, space, volume, concept and aesthetics. The architectural education hardly puts any effort to keep up with the rapid change of the digital technology. Traditional architectural education is still based on the philosophical, social, historical and psychological theory.

in order to develop sophisticated architectural forms leveraging the latest digital techniques, the architect needs to become familiarized with both the systems theory and digital techniques that have the potential to yield an elegant form also an accompanying visual intelligence and refined aesthetic sensibility is required.

What we are seeing now is a transition from systems that are closed completely and defined by decisions, to systems that are open, non-defined and incomplete: from the world of necessity to a world of variables manipulated by the observer , from the single perspective to the multiple perspective, from hegemony to pluralism , from the text to the context, from locality to non-locality, from the totality to the particular, from objectivity to the relativity of the observer from autonomy to co-variation, from the dictatorship of subjectivity to the immanent world of technology [7].

Finally, digital architecture can be defined as a revolution that affects not only architectural form, but history, life style and general taste and causes other socio-cultural changes.

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