ACTUALIZATION OF THE VIRTUAL: NEW CONSIDERATIONS OF SPACE AND TIME IN ARCHITECTURE

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ABSTRACT

ACTUALIZATION OF THE VIRTUAL:
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This thesis explores the interaction between virtual and actual realms in architecture through digital design process and developing environment qualities thereby. The focus will be on the projects that are designed in digital medium to be generated in physical environment. By examining the design attitude of selected four projects in this context, this thesis claims that the two realms of virtual and actual are interdependent. The framework of the study is based on Gilles Deleuze's definitions of "actualization of the virtual", and "realization of the possible". In this study, besides its connotations of digital technology, the concept of virtual is highlighted with its meaning of "potential". The philosophical discourse on virtual and actual proves that the relation between these two realms has a potential to generate new conceptual fields.

According to this study, for architecture "actualization of the virtual", cultivates the "unforeseen relations and new connections" in terms of new understandings of space and time. This study introduces the conceptual pairs of form-unform, autoplastic-alloplastic space and linear-nonlinear time to develop discussions on the concerned process.

The aim is to explore new space and time considerations both in the design process and in the physical architectural environment generated by this process. The emphasis will be on how responsive and interactive environments speculate the established conceptions of space and time in-between virtual and actual realms. This thesis claims that the architectural projects between virtual and actual are subject to break the traditional understandings of space and time.

Keywords: virtual-actual, space-time, form-unform, autoplastic-alloplastic space, linear-nonlinear time

ÖZ

SANALIN GERÇEKLEŞTİRİLMESİ:
MİMARLIKTA
YENİ MEKAN VE ZAMAN ANLAYIŞLARI

Küçükbaşlar, Burcu
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Bu tez mimarlıkta sanal ve gerçek arasındaki etkileşimi, dijital tasarım sürecinde ve bu bağlamda gelişmekte olan çevresel kalitelerde incelemektedir. Araştırma, dijital ortamda tasarlanarak fiziksel çevrede üretilen projeler üzerine odaklanmaktadır. Bu kapsamda seçilen dört projenin tasarım yaklaşımlarını inceleyerek, bu tez, sanal ve gerçeğin birbirine bağımlı olduğunu ileri sürmektedir. Çalışmanın çerçevesi Gilles Deleuze'ün "olanaklının gerçekleştirilmesi" ve "sanalın gerçek olması" tanımlarına temellenmektedir. Bu çalışmada sanal kavramı, dijital teknolojilerle çağrışımlarının yanı sıra, içerdiği "potansiyel" anlamıyla öne çıkarılmıştır. Zira sanal ve gerçek kavramlarını tartışan felsefi söylem, bu iki kavram arasındaki ilişkinin yeni anlayışlar yaratacak bir potansiyele sahip olduğunu doğrulamaktadır.

Bu çalışmaya göre, "sanalın gerçek olması" mimarlık için yeni mekan ve zaman kavramaları anlamında "beklenmedik ilişkiler ve yeni bağlantılar" üretmektedir. Bu çalışma, bahsedilen mimari süreçle ilgili tartışmaları yürütmek için form-formsuz, otoplastik-aloplastik mekan ve doğrusal-doğrusal olmayan zaman olarak tanıtılan kavram çiftleri ortaya koymaktadır.

Bu sorgulamanın amacı yeni mekan ve zaman anlayışlarını hem tasarım sürecinde hem de bu sürecin etkinleştirdiği mimari ortamda incelemektir. Vurgu, cevap verebilen ve etkileşimli mimari çevrelerin sanal ve gerçek dünyalar arasındaki yerleşik mekan ve zaman anlayışlarını nasıl yerinden sarstığı üzerinedir. Bu tez, sanal ve gerçek arasındaki mimari sürecin geleneksel mekan ve zaman anlayışlarını sorguladığına dikkat çekmektedir.

Anahtar Kelimeler: sanal-gerçek, mekan-zaman, otoplastik-aloplastik mekan, doğrusal-doğrusal olmayan zaman

To My Parents

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CHAPTER 1

INTRODUCTION

The very difference between virtual and actual and their opposing but complementary and inevitable relation with each other in architecture constitute the major area of inquiry for this thesis. When architectural design is concerned, this inspiring relation proves itself as an arena that requires a questioning mind and a will for understanding and revelation.

In this thesis, the experimental and questioning design attitude in digital medium will be focused and clarified as a situation between the virtual and the actual. The relation between virtual and actual will be elaborated through an evaluation of the four different projects –will be mentioned below- that are designed in digital medium to be generated in physical environment.

The exploration of virtual and actual in Gilles Deleuze's philosophy opens new perspectives on how to question the architectural design and its realization process. Thus, the framework of this study will be based on the distinction, made by Gilles Deleuze, between the "realization of the possible" and "actualization of the virtual"[1]. The argumentative structure of the framework will be explored for a further comprehension. The content of the discussions will be including an inquiry on architectural design and realization processes as the actualization of virtuality. The different positions on this issue in architecture will be discussed in reference to John Rajchman, Elizabeth Grosz, Michael Speaks and Brian Massumi.

In this respect, the use of digital technologies in architectural design and its effect on the conventional understanding of architectural space and time in physical reality is the main concern of this inquiry. The articulation of the virtual realm with architectural design not only transformed the conventional design process, but also

[1] Gilles Deleuze, Difference and Repetition, translated by Paul Patton, New York: Columbia University Press, pp. 191-201

triggered the architects to re-think the establishment of the architectural product. In the digital era, architects develop a design within the virtual spaces of computer. While some projects designed in virtual medium are to be realized within this medium, some projects are to be built in their tangible forms. The most significant outcome of such a process is that the architectural product itself is re-conceptualized. Contrary to the conventional approach of a static form, determined relations within space and a linear understanding of time, the built environments are now implying interactive relations in physical space, which raise new conceptions of space and time through indeterminate and non-linear experiences.

Developing a project in the virtual space of computer, architects construct "unforeseen relations" and compose "new connections"[2]. By designing the interactive relation between the subject and the architectural object, the architect constructs the relations that will be activated in the physical environment. In that process, architects do not design a static object in a conventional manner, but design the parameters of change in space and time. Such an architectural process proposes new understandings of space and time by being actualized in physical realm instead of being realized in the virtual medium.

This study intends to develop insights into this process, through an understanding of Deleuze's terms "actualization of the virtual" and "realization of possible". Thus, this thesis approaches to the concerned process as a situation in-between virtual and actual realm.

The reason for underlining this architectural process as an in-between situation is that virtual and actual realms have been usually accepted as distinct conceptions. However, some contemporary architectural processes deal with "the possibility of allowing the physical and virtual domains to merge, of integrating them."[3] As Ole

[2] John Rajchman, "The Virtual House", Constructions, Cambridge, Massachusetts, London: The MIT Press, 1997, p.115

[3] Ole Boulman, "Building Terminal", in Archilab: Radical Experiments in Global Architecture, Frederic Migayrou and Marie-Ange Brayer Ed., London: Thames and Hudson, 2001, p.15

Boulman notes, architectural potential of the digital world should be considered as "a task to be charted not in spite of, not instead of, not even alongside, but in the physical world."[4]

Related with this claim, theorist Stephen Perrella's note is significant. He states that "virtual technologies produce new, heterogeneous interactive realms of human experience that bridge the real and the virtual, a relationship conventionally regarded as opposite and disconnected."[5] In Hybrid Spaces, Peter Zellner introduces Perrella's argument on this subject as follows:

> Instead of simply adding another "dimension" to our three-dimensional world, Perrella contends that the virtual has folded itself into the world, contaminating our consciousness, physical experiences and colonizing our unconscious imagination. The virtual dimension, like a renegade mutagen, has insinuated itself into the physical systems of organization that define our most basic and traditional conception of space and time.[6]

This point of view is also evident in Zeynep Mennan's interpretation by which she suggests "a certain paradigm shift in the digital discourse for architecture."[7] Mennan notes that: "It (the new discourse) diverges from first generation digital discourse by a re-materialization discourse contrary to an increased formalization and disintegration in the digital language. A transformation in perceptive and cognitive structures can only be comprehended and achieved in the field of the visible, material and the physical."[8]

At present, contemporary design processes have been expanding the architectural discourse into the concept of virtual and its connotations. As long as the digital

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[4] Ole Boulman, "Building Terminal", in Archilab: Radical Experiments in Global Architecture, Frederic Migayrou and Marie-Ange Brayer Ed., London: Thames and Hudson, 2001, p.15

[5] Stephen Perrella, "Hypersurface Systems", in Hybid Space: New Forms in Digital Architecture, London: Thames&Hudson, 1999, p.46

[6] Ibid.

[7] Zeynep Mennan, "Non Standard Architectures – Standard Olmayan Mimarlıklar", in Arredomento Mimarlık, 2004/02, p.61 (Trans. by author)

[8] Ibid.

design technologies are used to develop new ways of thinking in architecture, diverse approaches emerge about the interpretation of the virtual in architectural practice. This study explores potential applications of contemporary processes in physical reality, which are claimed to open new horizons for architecture.

To illuminate the so-forth mentioned argument of this study the following projects will be explored: Aegis Hyposurface by dECOi, Trans-ports Muscle by ONL, Fresh H^2O Expo by NOX and Digital House by Hariri&Hariri. These projects selected in the scope of this research, primarily exemplify the concerned design attitude, which in the built form question the experiences in the space and time continuum. There may be other projects, which can be included within this scope. However, this thesis has limited the examples mainly with four projects, to exemplify the fundamental concerns of the framework in a more elaborate manner.

On the other hand, a further survey into Deleuze's formulation on virtual and actual raises new conceptual fields for the mentioned architectural design process. In this point of view, virtual does not only connote the computational process, which is usually connected with terms such as "cyberspace"[9] or the digital design environment. Rather, the relation between virtual and actual has a creative and innovative impact, which is one of the significant aspects of the mentioned architectural process according to this study.

So, in basing the framework of this study on the distinction, between the "realization of the possible" and "actualization of the virtual", two objectives are considered. First objective is to introduce the architectural process between virtual and actual as not only a by-product of digital technology, but also a creative process, which generates new relations and connections by activating the potentials

[9] "Cyberspace: Computer-science concept of a place within the collective memories and interconnecting Networks of computers that is filled with virtual 'stuff' and populated by people with virtual bodies. Distinguished from 'virtual reality,' which is an immersive virtual physical environment with user interfaces." See the "Glossary", in Hybrid Spaces: New Forms in Digital Architecture, London: Thames&Hudson, 1999, p. 189

of virtuality. Second objective is to highlight the innovative aspects of this process in terms of breaking the traditional ways of thinking of space, time and architecture.

Evaluation of the architectural process from the mentioned framework proves that the concerned process is a field inherently open to new discussions for architecture. This study explores the emergence of conceptual fields in two areas: first one is that of design process, and second one is the environment of materialized physical product.

It is the issue of the third chapter to investigate the integration of digital technologies into architectural design. Primarily, generation of architectural design by digital tools defines a detachment from the conventional design process. Rather as a tool for existing approaches to design, computational design is considered as a field accelerating another mode of architectural thinking. As Bernard Tschumi declares "by the unprecedented integration of computer tools in design studios, digital technology was conceptualized as a mode of thinking about architecture, rather than a simple drafting machine."[10]

In the third chapter, it is claimed that digital technologies have potential qualities for the re-consideration of conventional understandings of space and time. In this respect, the possibilities of the digital medium will be introduced in the frame of the innovations that transformed the design process from a static organization of spatial qualities to a continuum of a dynamic approach to design and the final product. This architectural process does not depend on a formalist and tectonic approach. Rather, the common point of approach is to design the final product as a process in physical realm.

These qualities enable the design-object as a time-based, movement-based, and interactive process, capable of transforming itself in the physical environment. In

[10] Bernard Tschumi, "Introduction", in INDEX Architecture, Bernard Tschumi and Matthew Berman Ed., Cambridge, London: The MIT Press, 2003, p. 66

this respect, Lars Spuybroek's definition on his architectural point of view exemplifies the discourse beyond the mentioned process. Spuybroek notes that:

> This architecture does not wait for the real, it does not passively wait for things to come, for life to happen, it is itself part of it, it is active, it charges the present, it electrifies the now, multiplies the now with motor geometry, motorizes the real with rubbery, plastic, responsive interaction. We inhabit time more than space; we have to build houses in time more than in space.[11]

The third chapter claims that a change in the space and time considerations can be revealed in relation with the incorporation of the potentials inherent in the digital medium. According to this inquiry, the most significant innovation provided by digital technologies is the introduction of "computational thinking" in architectural design. This is evident in the renewed conception of time. In the digital medium, time may become a computational entity in the conceptual level of design. By the visible and calculable notion of time in digital process, concepts related with time and movement -that can hardly be related with architectural design process before- are considered within the process, and even question the fundamental assumptions about space, time and architectural design.

The effect of time in digital design process is highlighted in the third chapter. The discussion on this issue is developed by two computational processes in design: form generation process and parametric design. These two processes are re-considered in the scope of the framework between "actualization of the virtual" and "realization of the possible". From this point of view, these processes initiate the discussions on form and material. Thus, the conceptual pair of form-unform will be introduced as the discursive tool to understand that design process further.

On the other hand, the fourth chapter introduces how the understandings of space and time change. It is possible to mention a change in space and time considerations for architecture. Digital tools enable to manage both the quantities of space and time at the conceptual level of the design process. Thus, the changing

[11] Lars Spuybroek, "The Structure of Experience", in Anymore, Cynthia Davidson Ed., New York: The MIT Press, 2000, pp. 166-172

understandings of space and time in the design process can be marked as a shift from the conventional concern of space and time as abstract and *a priori* entities.

This shift in space-time understanding is revealed by the re-constitution of movement in the digital medium, where movement gains a transformative role on the generation process of form. Movement does not only emerge as a tool for representational animations on the computer screen. It is possible to design movement-based processions by the digital medium and realize them in the physical environment.

In this respect, generation of architectural form through movement is one of the topics to be considered under that concern. Movement can be considered as the primary constituent in such an approach to design. The most important shift introduced by the selected projects designed within the mentioned process is that, they actualize the virtual by translating the virtual movement to actual movement.

In the fifth and last chapter, the design approaches of the selected projects are discussed in detail. This chapter underlines the possible speculations on space and time that these projects provide. By being responsive and interactive environments, the built forms of these projects imply unusual experiences in space and time. Also, the four projects have diverging points and participated notions that will be elaborated. However, while these projects are introduced, it is observed that they speculate the very fundamental assumptions about the linearity of time and determinacy of space. Conceptual pairs of autoplastic-alloplastic space and linear-nonlinear time are discussed in this chapter, as the new relations that are introduced by the concerned process.

CHAPTER 2

VIRTUAL AND ACTUAL: "REALIZATION OF THE POSSIBLE" AND "ACTUALIZATION OF THE VIRTUAL"

French philosopher Gilles Deleuze introduces a distinction between "realization of the possible and actualization of the virtual"[12]. For this thesis the concepts of virtual and actual are elaborated in light of this distinction.

To begin with, John Rajchman states that the relation between virtual and actual is an interdependent one. He mentions that "the word virtual comes from 'virtus', meaning potential or force, and often comes coupled with the actual, meaning that through which the potential or force becomes at once visible and effective."[13] "Etymologically, virtual means full of virtue, 'virtue' being taken here as the capacity to act." [14]

In his book "Constructions", Rajchman notes that the "virtual" does not resemble, represent or symbolize anything, which is pre-existent. The "actual" on the contrary, is "the one which manifests and effectuates the virtual, but it never completely shows or activates all that virtual implies. Something always remains."[15]

The actual and the virtual have different natures that need and complete each other. Thus, the potentials inherent in the idea of the virtual are meaningful in the possibility of its actualization. Parallel to Rajchman's argument, Elizabeth Grosz's note on virtual and actual points out that this interdependent relation is one of

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[12] Gilles Deleuze, Difference and Repetition, translated by Paul Patton, New York: Columbia University Press, pp. 191-201

[13] John Rajchman, "The Virtual House", Constructions, Cambridge, Massachusetts, London: The MIT Press, 1997, p.115

[14] http://christianhubert.com/hypertext/, (Accessed on 10.01.2006)

[15] John Rajchman, "The Virtual House", Constructions, Cambridge, Massachusetts, London: The MIT Press, 1997, p.115

relativity and differentiation: "The virtual is not a pure, self-sufficient realm with its own fixed features and characteristics. Rather, it is a relative or differential concept whose status as virtual requires an actual relative to which its virtuality can be marked as such."[16]

After introducing "actualization of the virtual" as a relation, which is based on relativity and differentiation, it would be better to emphasize in what ways "actualization of the virtual" is considered as distinct to "realization of the possible". It should be noted that, for this subject, Gilles Deleuze builds his ideas upon the philosophy of another French philosopher Henri Bergson "who, at the turn of the century, wrote a series of texts where he criticized the inability of the science of his time to think the new, the truly novel."[17] Manuel De Landa informs us about Bergson's starting point:

> The first obstacle was, according to Bergson, a mechanical and linear view of causality and the rigid determinism that it implied. Clearly, if all the future is already given in the past, if the future is merely that modality of time where previously determined possibilities become realized, then true innovation is impossible. To avoid this mistake, he thought, we must struggle to model the future as truly open ended, and the past and the present as pregnant not only with possibilities which become real, but with virtualities which become actual. [18]

Bergson's argument between real and the possible is developed by Deleuze. It is important to note that in Deleuze's distinction, while virtuality and actuality are stated as having an interdependent relation; possibility and reality are claimed as opposed to each other.[19] The notions of realization and the possibility are considered as depending on two rules: that of resemblance and limitation. "Bergson

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[16] Elizabeth Grosz, "Cyberspace, Virtuality, and the Real: Some Architectural Reflections", Architecture from the Outside: Essays on Virtual and Real Space, Cambridge, Massachusetts: the MIT Press, 2001, p. 76

[17] Manuel De Landa, "Deleuze and the Open-ended Becoming of the World", 01.10.1999, http://essays.powerfoundation.org/dobw.pdf (Accessed on 10.01.2006)

[18] Ibid.

[19] For a broader exploration into the subjects of virtuality, actualization, reality and possibility, see Master Thesis "Virtual Realities and Real Virtualities" submitted to the Department of Graphic Design and the Institute of Fine Arts of Bilkent University, by Orkan Telhan in May, 2002.

affirms the virtual-actual couple over the possible-real in order to emphasize the creative force of 'being' and to highlight that being is not merely the reduction of possible worlds to a single real world, but rather than being is always an act of creation and unforeseeable novelty." [20]

In "Bergsonism", Deleuze states that "from the view of the concept, there is no difference between the possible and the real"[21]. Also, the resemblance between the possible and the real is due to a limitation: when a possible is realized, other possibilities are neglected.

On the other hand, "For in order to be actualized, the virtual cannot proceed by elimination or limitation (of its capacity), but must create its own (creative) line of actualizations in positive acts."[22] Deleuze also writes that: "Actualization breaks with resemblance as a process no less than it does with identity as a principle. In this sense, actualization or differentiation is always a genuine creation."[23] Supplementary to this, Manuel De Landa notes that:

> The distinction between the possible and the real assumes a set of predefined forms (or essences) which acquire physical reality as material forms that resemble them. From the morphogenetic point of view, realizing a possibility does not add anything to a predefined form, except reality. The distinction between the virtual and the actual, on the other hand, does not involve resemblance of any kind and far from constituting the essential identity of a form, intensive processes subvert identity, since now forms as different as spheres and cubes emerge from the same topological point.[24]

[20] http://christianhubert.com/hypertext/, (Accessed on 10.01.2006)

[21] Gilles Deleuze, Bergsonism, Trans. by Hugh Tomlinson and Barbara Habberjam, New York: Zone Books, 1997, p.97

[22] Ibid.

[23] Gilles Deleuze, Difference and Repetition, translated by Paul Patton, New York: Columbia University Press, p. 212

[24] Manuel De Landa, "Deleuze and the Open-ended Becoming of the World", 01.10.1999, http://essays.powerfoundation.org/dobw.pdf (Accessed on 10.01.2006)

The notion of creativity and innovation is thus, opposed to limitation and resemblance. While the "realization of possible" operates by the principles of limitation and resemblance, the "actualization of the virtual" offers creation. Deleuze's distinction highlights the actualization process as "lines of differentiation":

> For what coexisted within the virtual ceases to coexist in the actual and is distributed in lines or parts that cannot be summed up, each one retaining the whole, except from a certain perspective, from a certain point of view. These lines of differentiation are therefore truly creative: They only actualize by inventing, they create in these conditions the physical, vital or physical representative of the ontological level that they embody.[25]

On the other hand, Michael Speaks mentions Deleuze's view as a "provocative distinction between the realization of the possible and actualization of the virtual."[26] It is significant that, actualization of the virtual implies "difference" that provides revelation of the potential inherent in the idea of virtual. Thus for the creation of the "new", "difference" emerges as the key concept. In Deleuze's words: "It is difference that is primary in the process of actualization- the difference between the virtual from which we begin and the actual which we arrive."[27]

For Deleuze, difference has a positive meaning; difference provides new ways of thinking or "lines of flight" capable of cutting across disciplines and opening new possibilities. Therefore, "difference for Deleuze is expressed as diffuse and dispersed leaks from outside the perimeters of traditional thought; it can erupt inward, propagate, and transform the entire process of thinking."[28] The creative

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[25] Gilles Deleuze, Bergsonism, Trans. by Hugh Tomlinson and Barbara Habberjam, New York: Zone Books, 1997, p.101

[26] Michael Speaks, "Folding Towards a New Architecture", in Earth Moves: The Furnishing of Territories(Terre Meuble. English), Bernard Cache, Trans. by Anne Boyman, Michael Speaks Ed., Cambridge, Massachusetts, London: The MIT Press, 1995, p. xiv

[27] Gilles Deleuze, Bergsonism, Trans. by Hugh Tomlinson and Barbara Habberjam, New York: Zone Books, 1991, 97.

[28] Timothy Lenoir and Casey Alt, "Flow, Process, Fold", in Science, Metaphor and Architecture, Antoine Picon and Allesandre Ponte Eds., Princeton: Princeton University Press, 2002 http://www.stanford.edu/dept/HPST/TimLenoir/Publications/Lenoir_FlowProcessFold.pdf, (Accessed on 10.01.2006)

aspect of actualization process, thus, implies a break in the accepted considerations. It is important for this thesis to signify that this process is not considered as a response with better solutions, but as an accelerator to rethinking the established assumptions.

Brian Massumi discusses the same issue most notably in "Sensing the Virtual, Building the Insensible"[29]. Parallel to the mentioned arguments, Massumi claims that "Deleuze and Guattari (following Bergson) suggest that virtual is the mode of reality implicated in the emergence of new potentials."[30] Interpreting the concept of difference, Massumi approaches the 'virtual' as it is a reality of change; and, he adds that:

> If the virtual is change as such, than in any actually given circumstance it can only figure as a mode of abstraction, for what is concretely given is what is – which is not what it will be when it changes. The potential of a situation exceeds its actuality. Circumstances self-abstract to the precise extent to which they evolve. This means that the virtual is not contained in any actual form assumed by things or states of things. It runs in the transitions from one from another. [31]

In light of these suggestions, then, what does the mentioned relation of virtual and actual imply to architecture; and, how can we elaborate the potentials of virtual in architectural terms? To illustrate the potentials of virtual, Rajchman introduces his argument on "virtual house". He states that virtual house is "the one which, through its plan, space, construction, and intelligence, generates the most new connections, the one so arranged or disposed as to permit the greatest power for unforeseen relations."[32] Rajchman also adds that, "it is the one that most catches us by surprise

[29] Brian Massumi, "Sensing the Virtual, Building the Insensible", in Hypersurface Architecture, AD-Architectural Design, Maggie Toy Ed., profile no: 133, London: John Wiley&Sons, 1998, p.16

[30] Ibid.

[31] Ibid.

[32] John Rajchman, "The Virtual House", Constructions, Cambridge, Massachusetts, London: The MIT Press, 1997, p.115

in our manners of thinking and being… In fact, the virtual looks like nothing we already know or can see."[33]

It is important to note that in the following points underlined in the text "virtual house", Rajchman reveals that this suggestion on virtual house neither points out the so-called "smart house" nor the applications of "intelligent architecture". In fact, the unforeseen relations or the most new connections call for a questioning design attitude where even the fundamental assumptions are speculated and transformed. Also, Elizabeth Grosz introduces the idea of virtual as "providing a series of questions to both architecture and philosophy which may change quite fundamental assumptions they make about space, time, movement, futurity and becoming."[34]

2.1 The Idea of Virtuality in Architectural Realm

Michael Speaks argues that by this distinction Deleuze "has also given a way to determine its usefulness for architecture"[35]. In respect to the mentioned framework, this part of the study aims to introduce some significant insights in architecture to the idea of virtuality. The previously mentioned architectural process of "actualization of the virtual" proposes creation by difference; and, by this way, it does not offer repetition and resemblance.

In this part of the study, different fields of discussions on virtuality are explored. First argument on virtuality clarifies the use of virtual in Deleuze's sense, which does not exactly refer to the virtual spaces of computer. Second topic demarcates the notion of virtuality from its common used connotation of 'simulation' which is

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[33] John Rajchman, "The Virtual House", Constructions, Cambridge, Massachusetts, London: The MIT Press, 1997, p.115

[34] Elizabeth Grosz, "The Future of Space: Toward an Architecture of Invention", Architecture from the Outside: Essays on Virtual and Real Space, Cambridge, Massachusetts: the MIT Press, 2001, p. 109

[35] Michael Speaks, "Folding Towards a New Architecture", in (Terre Meuble. English) Earth Moves: The Furnishing of Territories, Bernard Cache, translated by Anne Boyman, Michael Speaks Ed., Cambridge, Massachusetts, London: The MIT Press, 1995, p. xiv

proposed as "substitute reality" by Greg Lynn.[36] Also, another crucial debate highlights the different meanings of the terms "virtuality" and "virtual reality" for architecture. Hence, the multiple interpretations on virtual enrich architectural field for constituting new connections derived from its articulation in design and theory.

While actualization of the virtual is considered as referring to a specific architectural process in this study, Elizabeth Grosz mentions the difference between "the two notions of virtual, one developed in contemporary cybernetics and the other in Deleuze's work"; and she adds that "they are not reducible to each"[37]. Grosz notes that, according to Deleuze "the virtual spaces of the computers are not the spaces of virtual, but the phantasmatic projections of real space."[38] In this regard, virtual acquires a meaning not limited with the virtual spaces of the computer. Introduced by Grosz as the "phantasmatic projections of the real space", virtual spaces of the computer can be considered as a tool to reach beyond the given circumstances in the physical real space. Thus, it is an important point for this thesis that the virtual spaces of computer emerge as the inevitable medium to articulate the virtual; but, the term virtual for Deleuze does not directly refer to the one in virtual spaces of computer. "If techno-usage stresses the dematerialized, computational capacities of the virtual, the philosophical tradition that passes through Bergson and Deleuze stresses the latent potentialities of the virtual."[39]

However, in reference to Greg Lynn, the idea of virtual in architecture is usually identified with digital design environment. Lynn offers that: "The term virtual has recently been so debased that it often simply refers to the digital space of computer-aided design."[40] As Greg Lynn emphasizes, in architecture the potentials of virtual are considered along with the possibilities of digital design environment. In other

[36] Greg Lynn, Animate Form, New York: Princeton Architectural Press, 1999, p. 38

[37] Ibid.

[38] Elizabeth Grosz, "Introduction", Architecture from the Outside: Essays on Virtual and Real Space, Cambridge, Massachusetts: the MIT Press, 2001, p. xx

[39] http://christianhubert.com/hypertext/, (Accessed on 10.01.2006)

[40] Greg Lynn, Animate Form, New York: Princeton Architectural Press, 1999, p. 38

words, “virtuality is a constitutive feature of experience that the digital means allows to explore further.”[41] Thus, the potentials of virtuality should not be confused with the visual substitute of a reality, or simulation. Greg Lynn’s suggestion eliminates the confusion between virtuality and simulation, and highlights the meaning of virtual in correspondence with Deleuze’s statements on the concepts of virtual and actual. Lynn suggests that:

> It (virtual) is often used interchange-ably with the term simulation. Simulation, unlike virtuality, is not intended as a diagram for a future possible concrete assemblage but is instead a visual substitute. "Virtual reality" might describe architectural design but as it is used to describe a simulated environment it would be better replaced by "simulated reality" or "substitute reality." Thus, use of the term virtual here refers to an abstract scheme that has the possibility of becoming actualized, often in a variety of possible configurations.[42]

Considering the disparity of virtual and “substitute reality” or “simulated reality”, it can be claimed that the virtual medium for architecture does not merely correspond to a representational device that substitutes the reality. Instead, the virtual should be understood as capable to the implications of new configurations of space and time.

This contradiction can also be emphasized between the two common uses of the term virtual: one is virtual reality, and other is virtuality. Virtual reality is a term usually used to define “an immersive virtual physical environment with user interfaces.”[43] On the other hand, Elizabeth Grosz asks a question in ‘Architecture from the Outside’, that entails a demarcation between virtual reality and virtuality. Grosz poses the question as: “What does the idea of virtuality rather than virtual reality, offer to architecture?”[44] It will be worth to note that “In common contemporary usage, virtual reality is a particular way of experiencing cyberspace,

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[41] Giovanna Borradori, “Virtuality, Philosophy, Architecture”, http://faculty.vassar.edu/giborrad/new_page_7.htm, (Accessed on 10.01.2006)

[42] Greg Lynn, Animate Form, New York: Princeton Architectural Press, 1999, p. 38

[43] Peter Zellner, “Glossary”, in Hybrid Spaces: New Forms in Digital Architecture, London: Thames&Hudson, 1999, p. 189

[44] Elizabeth Grosz, “Cyberspace, Virtuality, and the Real: Some Architectural Reflections”, Architecture from the Outside: Essays on Virtual and Real Space, Cambridge, Massachusetts: the MIT Press, 2001, p. 89

currently associated with the prosthetic goggles and glove which maximizes the sense of *being there* bodily." [45] On the other hand, by stressing on virtuality, Grosz argues that virtuality offers:

> …the idea of an indeterminate, un-specifiable future, open-endedness, the preeminence of futurity over the present and the past the promise not of simulation (which is a repetition, representation, or re-production of a real or an original –a copy with its own particular joys and aesthetic delights), but of (temporal) displacement, not simply deferral but endless openness. [46]

In this statement while simulation is used as synonymous with repetition, representation and re-production it again reminds us the previously mentioned aspects of "realization of the possible". Whereas virtuality for architecture is defined as offering an endless openness; and, this expression strengthens the argument signified with "actualization of the virtual".

To turn back to virtual reality, another point of view from architect Kas Oosterhuis expands the discussions into another field. Oosterhuis suggests that "Virtual reality is in all respects more real than so-called reality."[47] Regarding virtual reality as a reality of digital medium, he underlines a new mode of reality, which he calls "hyper-real". He notes that:

> Virtual reality, including all software ever written for any platform, is hyper-real; simply because we know the stuff where it is made of. We know every bit and byte. In the Digital Revolution reality has been re-written from ground zero[48]

As a consequence, we can grasp the idea of virtuality in architecture in two ways, where one highlights "a technological innovation" as exemplified with the so-called

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[45] http://christianhubert.com/hypertext/, *(*Accessed on 10.01.2006)

[46] Elizabeth Grosz, "Cyberspace, Virtuality, and the Real: Some Architectural Reflections", Architecture from the Outside: Essays on Virtual and Real Space, Cambridge, Massachusetts: the MIT Press, 2001, p. 89

[47] Kas Oosterhuis, "Game, Set and Match", 03/2001, http://www.oosterhuis.nl/quickstart/index.php?id=45, (Accessed on 15.01.06)

[48] Ibid.

smart houses, the other implies "an entirely new way of seeing, inhabiting and designing spaces."[49]

As a result of the discussions on virtuality, for this thesis, virtuality is argued as "an underlying figure that constructs new concepts and releases further meanings from existing articulations."[50] Actualization of the virtual does not propose a method, or a model of logic. Rather, virtuality is considered "as an unforeseen force for extending the relation happening in between the concepts, and to open a path to perceive what was not foreseen, and to sense what was indiscernible at the moment of thinking." [51]

In Grosz's words: "Is it possible to see space in quite other terms, terms that render more explicit unspoken conditions, so that it can be represented and inhabited in different ways?"[52] Or, the question may be coupled with a following question by Rajchman: "What is this idea of virtual as multiple potentials for new connections or unforeseen relations?"[53]

These questions reflect the approach of this thesis for investigating the architectural process of "actualization of the virtual". The revelation of the concepts of virtual and actual constitutes a framework to interpret the architectural contribution to new space and time conceptions. The following part of the study states how this framework operates with the mentioned architectural design process.

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[49] Elizabeth Grosz, "Cyberspace, Virtuality, and the Real: Some Architectural Reflections", Architecture from the Outside: Essays on Virtual and Real Space, Cambridge, Massachusetts: the MIT Press, 2001, p. 88-89

[50] Giovanna Borradori, "Virtuality, Philosophy, Architecture", http://faculty.vassar.edu/giborrad/new_page_7.htm, (Accessed on 10.01.2006)

[51] Ibid.

[52] Elizabeth Grosz, "Cyberspace, Virtuality, and the Real: Some Architectural Reflections", Architecture from the Outside: Essays on Virtual and Real Space, Cambridge, Massachusetts: the MIT Press, 2001, p. 88-89

[53] John Rajchman, "The Virtual House", Constructions, Cambridge, Massachusetts, London: The MIT Press, 1997, p.115

2.2 The Introduction of New Conceptual Fields

This study questions the architectural relation between "realization of the possible" and "actualization of virtual" in terms of innovating new space and time considerations. In the fifth chapter, this inquiry will be realized in detail through the exploration of the projects Aegis Hyposurface, Transports Muscle, Digital House and Fresh H2O Expo. However, before, it would be necessary to explain how the framework of the study directs the discussions on these projects to new conceptual fields.

The architectural qualities exhibited by the selected project such as Aegis Hyposurface, literally actualize the virtual in an architectural process. These projects are designed within the virtual spaces of the computer and are actualized in the physical environment. Actualization of the virtual, thinking architectural, is the process, which for the final product offers us what does not resemble anything we have seen, or experienced before. As John Rajchman notes: "Unlike the possible, whose realization always leaves us the same, the virtual is something we must always experiment and work with in order to see."[54] Thus, an experimental approach is the basic value of that process. Before it is actualized, we cannot predict what will happen. Again for Aegis Hyposurface, while its digital configuration is made and may be represented in digital medium, the transformation of the surface requires to be activated by the changing circumstances in the environment. It is not actualized unless it is activated. It is possible to claim that, these projects share an experimental thinking on the existing considerations of physical realm. In light of this distinction it is possible to discriminate this attitude from other examples of digital architecture.

By actualization of the virtual these concerned projects are claimed to construct unforeseen relations. They actualize the potentials inherent in the idea of virtual. By being actualized; they give rise to new considerations. Therefore, they create new

[54] John Rajchman, "The Virtual House", Constructions, Cambridge, Massachusetts, London: The MIT Press, 1997, p.117

spaces, construct new space-time relations; and, they compose new considerations of movement. In this regard it would not be irrelevant to claim that, as they actualize the virtual, they do not only deliver a virtual process into a material form, but they raise unforeseen relations and new connections in the physical environment.

This thesis, tries to reveal some conceptual relations that these projects inaugurate. These are conceptual pairs, not including a cause and effect relation, or describing differing qualities of two environments of virtual and actual. They are utilized to underline the conceptual background that these projects can be speculated. These conceptual pairs are: form-unform, autoplastic-alloplastic space, and linear-nonlinear time.

According to this thesis the discussions on form and material are mostly derived from the inherent qualities of the digital design environment, and its articulation in the design process by form generation or parametric design strategies. The realization of a virtual design through these processes sometimes emerges as a process with continuous flow in the physical environment. But, sometimes the process needs to be reduced to a static form. Brian Massumi's note is significant to understand how the concept of virtual is related with discussions of form and unform. He suggests that:

> Architecture has always involved, as an integral part of its creative process, the production of abstract spaces from which concrete forms can be drawn. The challenge that the virtual poses for architecture lies more its 'unform' nature than its abstractness. [55]

Therefore, the "unform" nature of virtual should not be considered as abstractness. Preceding this quotation, Massumi raises a remarkable question: "How can the run of unform be integrated into a process whose end is still-standing form?" [56]

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[55] Brian Massumi, "Sensing the Virtual, Building the Insensible", in Hypersurface Architecture, AD-Architectural Design, Maggie Toy Ed., profile no: 133, London: John Wiley&Sons, 1998, p.16

[56] Ibid.

To answer this question the concept of form should be explored. Besides its definitions in architectural discourse, French philosopher Henri Bergson's point of view provides a different perspective to the subject. Bergson's understanding of form is based on its relation with movement and flow. In his discussions on form Bergson claims that:

> ...there is no form, since form is immobile and the reality is movement. What is real is the continual change of form: form is only a snapshot view of a transition. Therefore, here, again, our perception manages to solidify into images the fluid continuity of the real.[57]

Such an understanding of form is also evident in the logic of form generation process in digital design environment. Form is considered not as a static unit, but as represented in an instance in its generic process.

On the other hand, the concepts of "autoplastic space" and "alloplastic space" are terms taken from Mark Goulthorpe's texts "From Autoplastic to Alloplastic Tendency: Notes on Technological Latency" and "Hyposurface: from Autoplastic to Alloplastic Space". These contradictive concepts are borrowed from psychology and are introduced by Sandor Ferenczi who suggests a move from "autoplastic" to "alloplastic" condition with a reconsideration of Sigmund Freud's analyses of "trauma". Goulthorpe uses these terms, initially, to define the design attitude in Aegis Hyposurface. In basic terms, autoplastic space to alloplastic space, defines the state between determinacy and indeterminacy. In Goulthorpe's terms: "'Autoplastic' being a determinate, fixed environment - one 'designs', auto-dictates - and 'alloplastic' an indeterminate, open description, a reciprocal relation between environment and self." [58]

On the other hand, "the linearity of time" in a conventional understanding is replaced by the non-linear systems where the interrelation between subject and the

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[57] Henri Bergson, Creative Evolution, Trans. by Arthur Mitchell, Mineola, New York: Dover, 1998, p. 318-319

[58] Mark Goulthorpe, "Hyposurface: from Autoplastic to Alloplastic Space", http://www.generativeart.com/99/2999.htm, (Accessed on 05.11.05)

architectural object propose unpredictable change. This shift is introduced by Marko Jobst in reference to Henri Bergson's suggestions on two aspects of time where one is linear and the other is non-linear:

> In the case of the first, time is seen to be quantitative and as such subordinated to space through a linear, uniformly charted-out diagram. It is the model which positions the present between the past that it is constantly passing into, and future, that continually replaces it. The scale is uniform, leading in a linear manner away from the point of present in both directions. The second model, developed on Bergson's theses, represents a qualitative understanding, in which time is taken to be a force, non-linear and non-homogenous, forming a complex relationship with movement. The second model will be explained in more detail, since it contains a number of unorthodox propositions. Time, as conceived through this model, stands for force crucial for the process of thinking. It 'does not present, much less represent thought,' but rather 'provokes' thought, or 'forces' the thinking.[59]

On the other hand, Gregory More introduces nonlinear systems "as providing a differing reading of time via their interior mechanics."[60] The incorporation of non-linear time instead of the flow of linear time is considered as suggestive of a latent potential in architectural design -particularly speaking for animation- in terms of the generation of a new attitude towards the consideration of space and time.

Contemporary design processes are considered as subject to discussions of form-unform while the activated material form proposes discussions of autoplastic-alloplastic space and linear-nonlinear time. So, the discussions on form-unform are suggested as derived from the design process. However, discussions on autoplastic-alloplastic space and linear-nonlinear time emerge as the questions into space and time considerations in the built forms of these processes.

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[59] Marko Jobst, "Constructing Deleuze", taken from a transcript of a lecture at the University of Greenwich School of Architecture and Construction as part of their Open Lecture Series on 25 February 2005, www.haeccityinc.com, (Accessed on 20.12.2005)

[60] Gregory More, "Nonlinear Animation: Time Matters and the Aionic Memoria Project", in A+A architecturanimation, Fredy Massad and Alicia Guarrero Yaste Eds., Spain: Col.legi D'Arquitectes de Catalunya, 2003, p. 372

CHAPTER 3

DIGITAL DESIGN PROCESS: BEING IN-BETWEEN VIRTUAL AND ACTUAL

Digital medium provides a change in conventional design attitudes by setting its own rules into the process. In other words, by the integration of digital medium, design process is under transformation. This chapter introduces digital design process, explores its intrinsic qualities and elaborates the possibilities offered by digital design environment to architectural design. The aim is to mark the difference of digital medium as a design environment and its potential to produce new understandings of space and time. Before getting into discussion, it would be important to mention how digital design process can be explored through the framework of the study.

For architecture, two main positions can describe the role of digital design for such discussions derived from the nature of virtual and actual. First, in architectural discourse the concept of virtual is already been considered as connected with digital technologies. Although virtuality is not only reduced to a concern of digital technology, for architecture, digital technologies can be suggested as the inevitable tools to operate with the virtual reality. The design process in digital medium is not made up of physical tools; rather the process continues by the digital configurations. Also, the digital design medium is a virtual environment for design, where physically unexisting forces and their interrelations can develop the design. In this regard, the concept of virtuality for architecture can be considered as intermingled with digital design process.

Secondly, the different nature of digital medium has triggered new discussions for architectural design. The most significant goal of digital design for architecture can be claimed as the integration of time as a design parameter. The concept of time becomes the main transformative effect for the development of a process-based design. So, the incorporation of time in architectural design is also inevitable for a

continuous process between virtual and actual. It can be claimed that as the time integrates into architectural design by digital technologies, both the design process and the activated built form of design in physical environment gain potentials to provocative discussions.

For the reasons that are mentioned above, digital design is explored in two ways. Including an additional general inquiry into the current condition of digital design, first part of this chapter explores the different nature of digital medium. In the second part of this chapter, the effect of time in digital design process is highlighted. For this reason two specific design processes are introduced. These are form generation and parametric design processes. By focusing on their realization in physical medium, these two processes will be discussed through an understanding of "realization of the possible" and "actualization of the virtual".

3.1. An Overview: Digital Environment and Architectural Design

For a few decades, digital technologies have been effective on the transformation of conventional design processes. Besides being a tool for drafting and representation, computational processes expand the boundaries of architectural thinking. With the introduction of digital technologies, architecture is being discussed along terms like "computational architecture", "digital architecture", "liquid architecture", "performative architecture" or "hypersurface architecture". Besides these, there are a variety of terms used in contemporary discourse. The general investigations on these definitions:

> …pose the end of architecture as a tectonic discipline, related to a determined expression on the process of assembling parts of construction and materials, given that in this new situation it seems rather the object is determined by the design of a shell, or a skin that is capable of transforming itself according to the circumstances.[61]

[61] Paolo Sustersic, "The Architecture of Virtual Reality: Towards an Aesthetics of the Information Society", in A+A architecturanimation, Fredy Massad and Alicia Guarrero Yaste Eds., Spain: Col.legi D'Arquitectes de Catalunya, 2003, p. 414

In respect to the quotation above, the physical translation of this process may be introduced as a shell, a surface or a skin, as well as an interactive cave or screens, which is designed within the qualities of digital medium.

Particularly speaking for the early decades of computer aided design, it can be claimed that architects searched for solutions to their design problems by the use of computers. It can be claimed that the common tendency in the use of digital tools, up to now, has been on its efficiency in design process, on its advanced representation qualities and on its capable techniques in construction methods.

The transformation of the design process by the introduction of digital tools is an issue of recent decades. As Yahuda E. Kalay states: "The majority of computer-aided design research over the past fifty years has been directed toward developing computational systems that provide varying levels of assistance to human designers by taking care of smaller or larger parts of the design process."[62]

A project designed in digital medium is developed and visualized with every detail including all the data that the architect imagines in the conceptual level of design. As Mikro Galli and Claudia Mühloff state:

> Computer technology offers an easy method for managing large quantities of data which can be modified infinitely. However, the most important possibility offered is that of defining relationships between the data, structuring them, making them interdependent, in a way that is convenient for their intended use.[63]

Computer aided architectural design has a history of a few decades. According to David Kurmann, the developments in computer-aided design can be analyzed in four main generations. In "Bits and Spaces", Kurmann introduces these four generations of computer tools used in architectural design.

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[62] Yahuda E. Kalay. "Preface", in Architecture's New Media: Principles, Theories and Methods of Computer-Aided Design. Cambridge, London: The MIT Press, 2004, p.xvi

[63] Mikro Galli, Claudia Mühloff, "Structuring Data", in A+A architecturanimation, Fredy Massad and Alicia Guarrero Yaste Eds., Spain: Col.legi D'Arquitectes de Catalunya, 2003, p. 202

The first generation of computers defines the ones capable of developing three-dimensional images by the use of Sketchpad in 1965. As William J. Mitchell states, "by the early 1970s, computer aided architectural design systems were beginning to penetrate everyday architectural practice."[64] In 80's the second generation emerged whose goal was the efficiency in design. Kurmann claims that these two phases were "based on a two-dimensional representation of designs and the use of layers to print plans on paper".[65] He traces the third generation in the true migration into the third dimension. It can be defined as the beginning of the development of virtual reality as a design medium. Finally, Kurmann adds that:

> After being confronted with virtually realistic, interactive three-dimensional spaces in computer games, designers envisioned similar possibilities for designing. Parallel to this development, new goals for design were defined.[66]

On the other hand, Ben Van Berkel emphasizes the computational techniques in four dominant approaches.[67] The first is about the potentials of virtual. The new techniques are considered as a way to realize this potential of virtual reality. This approach corresponds to the attitude, which is articulated in this thesis through the selected projects. The second one "centers on the intensification of the connectivity between the partners in the architectural process, less decreasing boundaries between process and production."[68] According to Berkel, the third one revolves around the objective, pragmatic properties of techniques:

> If any form is possible and all are equally functional in an economic sense, the pragmatic, standardized language of Modernism has lost its imperative. A simple, self-evident reasoning no longer justifies any specific form…. As the evolution of the chosen parameters is traced over time, the project emerges as

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[64] William J. Mitchell, "Foreword", in Architecture's New Media: Principles, Theories and Methods of Computer-Aided Design. Cambridge, London: The MIT Press, 2004, p.x

[65] David Kurmann, "Design in Space and Time", in Bits and Spaces: Architecture and Computing for Physical, Virtual, Hybrid Realms; 33 Projects by Architecture and CAAD, Maia Engeli Ed., Basel, Boston, Berlin: Birkhauser, 2001, pp.9-10

[66] Ibid.

[67] Ben Van Berkel, Caroline Bos, Move: Part 2: Techniques. Network spin, Amsterdam: UN Studio & Goose Press, 1999, p. 166

[68] Ibid.

> if of its own accord. In reality, the number of parameters is always too large for this to happen. The techniques are used as a direct and transparent medium to uncover the neutral values forming the basis of the project.[69]

The fourth is introduced as parameter design. Berkel notes that:

> …parameter design is primarily a static summing up. Only when the data begin to interact, do the elements of time and movement enter the process. At that point, the fourth important adaptation of new media techniques enters the equation: animation...Animation as a technique could not have been developed without virtual architecture and parameter-based strategies; in a way animation hybridizes the two and optimizes potentials inherent in both.[70]

The four topics introduced by Berkel constitute a possible point of view on the use of computational techniques in architectural design. Involving significant clues on each topic, Berkel also points out the different fields of research taking place in digital design. As well as new technologies are invented, and new ways of dealing with these techniques are discovered, the number and the content of these mentioned topics can be varied and multiplied.

3.1.1 Digital Environment as a Different Nature

Greg Lynn suggests that in conventional means, "the abstract space of design is conceived as an ideal neutral space of Cartesian coordinates."[71] In the conventional design process, realized mostly on paper, lines precede the design process. By lines sketches, plans, sections or elevations are developed and constituted.

However, contrary to that, the digital design process proceeding within the limits of a coordinate system begins with a single point in the three dimensional space of digital medium. Ben van Berkel suggests that beginning with a point in the three-dimensional space changes conventional assumptions about the process of design:

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[69] Ben Van Berkel, Caroline Bos, Move: Part 2: Techniques. Network spin, Amsterdam: UN Studio & Goose Press, 1999, p. 166

[70] Ibid.

[71] Greg Lynn, Animate Form, New York: Princeton Architectural Press, 1999, p. 18

"The architectural drawing, a scaled-down, two-dimensional representation of an aspect of a building, is obsolete. A project is built up in three dimensions and with its real measurements in the infinite mediation space."[72] In this regard, by the intrinsic qualities of digital medium, the design imagery of the architect is not constituted upon planes made up of lines, but develops with points in the three-dimensional space.

> Now, after the development stage, the traditional project executed on the basis of plans, sections, and elevations is replaced by computer controlled three dimensional modeling that guides both the ideation of the object and the production of its parts.[73]

The importance of the change of the design process beginning with a point rather than a plane, is that the existence of point in the infinite three-dimensional space of digital environment. A point's existence in the digital medium is enabled by the digital format. The point is, thus, being a singular unit is capable of changing place through set parameters. This quality of digital medium can be interpreted as providing a freedom about the generation of variable forms. Thus, in digital environment, form generation is due to a process, which is realized by a dynamic and interactive organization between the architect and the computerized medium of design.

Second basic difference of digital design is, its dynamic and interactive organization capability, which is of more advantage than the static one in the conventional design methods. Computation and digital technologies have given rise to new tendencies, which affect the design process. Thus, there occurred a shift in the classical models of pure static, timeless form and structure. One of the most important contributions of digital medium seems to be its opportunity to incorporate advanced systems of dynamic organizations. For example, the work of dECOi, Aegis Hyposurface, has a mutating form, which is generated within the

[72] Ben Van Berkel, Caroline Bos, Move: Part 2: Techniques. Network spin, Amsterdam: UN Studio & Goose Press, 1999, p. 163

[73] Paolo Sustersic, "The Architecture of Virtual Reality: Towards an Aesthetics of the Information Society", in A+A architecturanimation, Fredy Massad and Alicia Guarrero Yaste Eds., Spain: Col.legi D'Arquitectes de Catalunya, 2003, p. 406

digital medium by combining its structural, responsive qualities in single dynamic expression.

Also, dynamism in the process articulates the design medium as an 'active space'. Greg Lynn suggests that: "An object defined as a vector whose trajectory is relative to other objects, forces, fields and flows, defines form within an active space of force and motion" [74]. Greg Lynn defines a shift from the passive space of static coordinates to an active space of interactions. Lynn states that:

> Architectural form is conventionally conceived in a dimensional space of idealized stasis, defined by Cartesian fixed-point coordinates. An object defined as a vector whose trajectory is relative to other objects, forces, fields and flows, defines form within an active space of force and motion. [75]

The introduction of dynamic organization leads the articulation of time into architectural design process. By dynamic organization related with the notions of space and time the idea of movement is established. It should be claimed that, by the incorporation of time in the design process, the idea of movement is dealt in a different way than the conventional approaches in architecture.

Two basic characteristics of digital design environment that are hitherto explored can be used to understand the re-defined conception of design in the digital era. Kas Oosterhuis observes the changing aspects of design process in the following paraphrase:

> Traditional vernacular building is accomplished by executing the process. There are no intermediate phases like a set of drawings, working drawings, drawings of details. The communication is direct from person to person. In modern computing lingo: through a peer to peer wireless sensor network. Peer-to-peer since people connect directly to their own kind; wireless since they are not physically connected; sensor network since they immediately absorb, process and propagate information. People put their minds together, discuss and take action. Exact measurements and other relevant numeric details are decided along the process of building. The end result is

[74] Greg Lynn, Animate Form, New York: Princeton Architectural Press, 1999, p. 18

[75] Ibid.

> unpredictable in detail, but is performed according to an agreed upon set of simple rules.[76]

For contemporary architecture, computational generative practices are replacing established assumptions about design imagery. As well as new possibilities of architectonics, the conventional mainstream of architectural process is transformed and multiplied. Significantly, digitally driven processes characterized by dynamic and open-ended organizations enable continuity between design process and its realization.

Within the last few years digital technologies are being used in building design and construction practices along with the advances in computer-aided design (CAD) and computer-aided manufacturing (CAM) technologies. It is possible to introduce "a new digital continuum"[77] where a direct link emerges between the design process and the final product. Branko Kolarevic claims that: "The consequences could be profound, as new digitally-driven processes of design, fabrication and construction are increasingly challenging the historic relationship between architecture and its means of production." [78]

Related with this subject, the recent exhibition "Non-standard Architectures"[79] introduces a homogeneous connection between digital tools, design methods and production tools. This homogeneous connection is realized by the continuous

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[76] Kas Oostherhuis, "A New Kind of Building", taken from a transcript of a lecture originally titled 'Programming the Point Cloud' presented by Oosterhuis at the Royal Colloge of Art, Kensigton Gore, London, as part of the Architecture & Interior lecture series at the RCA on 15 March 2005. www.haeccityinc.com, (Accessed on 20.12.2005)

[77] Branko Kolarevic, "Digital Praxis: From Digital to Material", ERA 21, no: 4, vol. 2005, http://www.erag.cz/era21/index.asp?page_id=99, (Accesed on 10.01.06)

[78] Ibid.

[79] "Architectures Non Standard", Centre George Pompidou, Paris. December 10, 2004 – March 1, 2005.

The name "Non-Standard Architectures Exhibition" directly refers to a mathematical analysis, which encloses the architectures that do not exist towards Euclidean Geometry, but are based on a 'new' mathematical infrastructure like topology and vector geometry used in digital medium. Additionally, the name has assigned a secondary meaning as 'not being standard' by the curators examining modern concepts such as standardization, norm and typology. See, Zeynep Mennan, "Non Standard Architectures – Standard Olmayan Mimarlıklar", in Arredomento Mimarlık, 2004/02, p.61 (Trans. by author)

process beginning with the ideation of the architectural form and ending with its production.

The direct transaction of the project and its production process entails the requirement of a parametric design which is "a common language spoken by both the machines of the designer and of the producer."[80]

Oostherhuis notes that: "Parametric design is absolute compulsatory for the file to factory process of making the architectural bodies. One must directly connect the 3d model of the design to the production techniques in the factory."[81] He defines the consequences of parametric design related with industrial production process of "mass-customization":

> One parametric detail fits all. One building, one detail. One work of art, one detail: But always parametric. Each element is unique, but each element undergoes the same procedure. We are fully immersed now in the industrial production process of mass-customization.[82]

Kas Oostherhuis informs us about the use of parametric design in architecture by introducing what is achieved by their use. Oostherhuis deals with parametric design in terms of "design of the behavior, the rules of the game, the states of mind of the buildings and the environments, directly connected to physical places."[83] He states that: "The design work in both reality and enhanced reality heavily relies on the parametric basis. If not built parametrically one can not play with the parameters, and one is not able to interfere with it, to communicate with the 3D model and the project database, neither in the design process nor in the life-cycle of the environment."[84] In this regard, the dynamic organization is required to be computable and, thus, parametric for enabling change as well as interactivity.

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[80] Kas Oosterhuis, "Swarm Architecture", Hyperbodies, September, 2003, http://www.oosterhuis.nl/quickstart/index.php?id=45, (Accessed on 15.01.06)

[81] Ibid.

[82] Ibid.

[83] Ibid.

[84] Ibid.

> Working with parametric models creates the communication space for the stakeholders in the building process to discuss the qualities of the proposed environments. It opens up the design process for collaborative engineering. It also opens up the design process for a possible and meaningful interaction with the clients and the users.[85]

During such a process, architect does not usually consider a static model of the form, but there are numerous decisions to make through the design process. Through the changing parameters, the generation process continues and literally changes the form into a new one. This is a "generic process" where the form evolves, mutates like an organism that develops upon parameters. Greg Lynn emphasizes the generic process related with "temporal morphologies" and "experiential effect of time on form".[86] Hence, form is generated through a process of evolution or growth. This suggestion about form in generic process offers a dynamic condition rather than a static set. Parametric design can be introduced as the basis for a dynamic organization of architectural form.

> The shapes that are formed in computer-aided design are the result of decisions made using parameters. Numerical data which describe characteristics of the virtual design environment -such as temperature, gravity, and other forces- have an impact on the forms which result. For example, dynamic modeling systems are based on the interaction of multiple parameter statements calculated sequentially rather than in an instant.[87]

3.2 Time in Digital Design: Form Generation Process and Parametric Design

The introduction of digital design into architecture has transformed the conventional assumptions of architectural design processes and production. For this thesis, the significance of this change is identified with the possibility of incorporating time into the design process. Another research into the changing

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[85] Kas Oosterhuis, "Swarm Architecture", Hyperbodies, September, 2003, http://www.oosterhuis.nl/quickstart/index.php?id=45, (Accessed on 15.01.06)

[86] Greg Lynn, "Biotime", in ANYTIME, Cynthia C. Davidson Ed., Anyone Corporation, New York: The MIT Press, 1999, p.266

[87] Greg Lynn, Animate Form, New York: Princeton Architectural Press, 1999, p. 25

meaning of the concept of time for architecture is elaborated in the fourth chapter, where the intend is to reveal the changing effects of time in terms of introducing two shifts from the existing assumptions in architectural thinking. However, before, this chapter aims to find out what the concept of time refers to architecture in the Digital Era. In this regard, three basic questions lead this inquiry: (1) How can time be defined in digital medium?, (2) How does time affect the architectural thinking during the process? and, (3) What are the leading uses of time-based strategies in the digital design?

For this thesis the incorporation of time through design is observed both in the design process and the constitution of the final product. By the calculable notion of time in digital medium, this thesis elaborates two emerging design approaches. One is about the form generation processes where the design of a form is conceived as a dynamic process. Evaluation of a form is enabled in the digital medium and the phases of its change may be conveyed to physical models by rapid prototyping technologies. This production process itself implies a generative potential for architecture.

On the other hand, the second mentioned design approach, enabled by the incorporation of time, involves a continuum between the process and the final product. Time has an inevitable role in projects such as Aegis Hyposurface or Trans-ports Muscle project, not only during the design process, but also in establishing the relations of the built form. Such a process constitutes design not as the design of a determined form. Or, it is not a search for an instance in a form evolution process. Rather, by setting the parameters of change, it is the design of the relations between the architectural object and its surrounding environment.

Digital design environment makes time the inevitable unit of such generic projects both in design phase and in materialized reality. Such an understanding proposes the seamless digital continuum between design process and its production phase. Thus, the modes of architectural thinking expand. Besides considering design

process and its realization phase as distinct realms, process-based and time-based designs are the consequences of this digital continuum.

For this thesis, the integration of the concept of time into architectural design is considered as having the major effect in merging the process to its realization phase. Related with the framework of this study, two different uses of time in digital architecture are offered as form generation processes and parametric design strategies.

3.2.1 Form Generation Process: "Realization of the Possible"

> The great freedom of experimentation in the field of form generating processes is one of the most relevant aspects of the panorama at the start of the 21st century. It is a case of investigations opening out in many directions, and defining the new aesthetics of the information society.[88]

For architecture, digital medium becomes inherently convenient to generating forms through animation capabilities. In this design process, architect is not obliged to decide for the best one solution to a specific form that fits the requirement of the spatial needs. In other words, animation display proposes a process of evolving form rather than arriving to a single shape. This process develops many possibilities of form by evolving or mutating the given shape in terms of set rules through time.

However, for the realization of such a process, the animation display should be frozen or, in other words a single or a number of static frames should be chosen. In this respect, it can be claimed that the ending of the form generation process needs to face with the stopping-problem. The design process generated in digital medium may constitute a single or a series of animated representations. Whereas some of these architectural animations only serve as a final representation of the project, some of them guide through the design process in a more conceptual way.

[88] Paolo Sustersic, "The Architecture of Virtual Reality: Towards an Aesthetics of the Information Society", in A+A architecturanimation, Fredy Massad and Alicia Guarrero Yaste Eds., Spain: Col.legi D'Arquitectes de Catalunya, 2003, p. 412

For example, The Mobius House project by UN Studio, designed by Ben Van Berkel can be considered as an example of the digital animation regarded as the conceptual guide during the process. The animate process exists in digital medium, it is not designed to be built or activated in physical means. An animate model of the house is generated in digital medium according to a series of diagram that "…acquire a time-space dimension, which leads to the implementation of the Mobius band."[89] However, the mathematically model of the Mobius is not literally transferred to the building, but it guides the design by being conceptualized and thematized.

In some digital generated projects, animation exists in digital medium; while it is an endless process, it has to be stopped for being represented as two-dimensional images, or by production of three-dimensional models upon a freeze frame. The final product is a representation of the sequential parts from the generic process achieved by the evolution of a form in the digital medium. This process can be exemplified with Embryologic House project by Greg Lynn. Form evolves and it is in motion, but it has to be stopped at any instance to be realized in physical medium, to be represented as a two dimensional image or a three dimensional model.

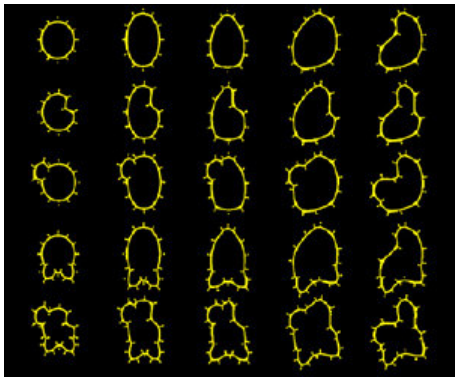

Fig. 1: Embryologic House

As in the example, in its realization phase, the form generation process may need to be replaced with some frozen and static instances from the animation display. So,

[89] Ben Van Berkel and Caroline Bos, Move: Part 2-Techniques, Network, Spin, Amsterdam: UN Studio&Goose Press, 1999, p.43

by evolving the form in time, possibilities of a form are acquired. As long as one instance of the form generation process is selected to be realized, others are naturally neglected.

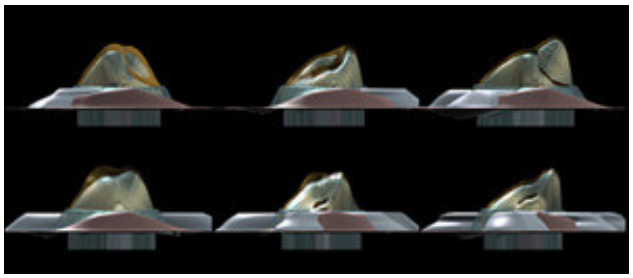

Fig. 2: Embryologic House

Reminding the framework of the study, form generation processes in digital architecture can be identified with the 'realization of the possible'. By the incorporation of time in the architectural process, infinite numbers of a form can be handled. However, realizing one of the possible forms is always subject to limitation as long as the chosen form is just one of the other possibilities, and the other ones needs to be eliminated. On the other hand, 'realization of the possible' is also used by Gilles Deleuze to offer resemblance with the other possibilities. Again for form generation process, as long as the form evolves in time and changes through time; actually, the essence of the form does not change. All the possibilities of a form resembles to each other, as they are all the by-products of the same configuration. They are the instances of a continuing evolution process depending on one digital coding.

Then, form generation processes mainly intend to search for the possibilities of a form. If the project leads to its realization in physical means, the process stops; in other words, there occurs the need to select some static forms from its evolved possibilities. For this thesis, such a process of time-based search in form results in form-unform discussions.

While a form generation process regards the design of form different from a conventional formal approach, the architect is responsible to decide the

environment that the form will evolve. The design environment for the form generation process is made up of forces that act on the predicted changes on form. So, in such a process it is impossible to mention a strict hierarchy on the development of the properties of a form. However, the architect is the one who constructs the forces affecting the process through time.

On the other hand, another perspective can be developed by revealing the relation of form and virtuality. The notion of form can be observed as it is subject to a re-definition through its articulation within virtual technologies. Related with this suggestion, Mark Goulthorpe poses a crucial question on the expression of form through virtual technologies. He states that:

> For the shift from an industrial society to a society of mass communication, which is the essential transformation taking place in the present, seems to be a subliminal and almost inexpressive technological transition - is 'formless', in a sense - which begs the question of how it may be expressed in form.[90]

The transition from the virtual environment to built environment is in a way the translation of the unform nature of virtual to the form of the final product. "Virtuality can not be seen in the form that emerges from it. The virtual gives form, but itself has none (being the unform of transition). The virtual is imperceptible. It is insensible. A building is anything but that. A building is most concrete."[91] While virtual is concerned with related concepts such as unform, insensible and imperceptible -for instance- in Aegis Hyposurface, the assigned virtual movement in the design process has a form preceding its translation to the physical built environment.

[90] Mark Goulthorpe, "From Autoplastic to Alloplastic Tendency: Notes on Technological Latency", in Anymore, Cynthia Davidson Eds., ANY Corporation, Cambridge: MIT Press, 2000. p.206

[91] Brian Massumi, "Sensing the Virtual, Building the Insensible", in Hypersurface Architecture, Maggie Toy Ed., AD-Architectural Design, Profile no:133, 1998, p.20

3.2.2 Parametric Design: "Actualization of the Virtual"

Besides the form generation process, another effect of time in digital design raises with the parametric design strategies. In general terms, parametric design in this thesis is conceived as a strategy for setting the rules of the "behaviors" of a system. As well as for the design process, the responsible and interactive designs may carry their design properties to the physical modes. The effect of time does not only offer the changes on form through time, but time is regarded as the primary and inevitable entity that the behaviors of the system are realized through it. So, while in the form generation process time is the effect that can be observed in the changing qualities of form, in parametric design time affects the continuum from process to the built form as the behaviors of a system.

The projects mainly explored in this study Aegis Hyposurface, Trans-ports Muscle, Fresh H^2O Expo and Digital House incorporate time in their design proposals as a fact not only valid for the design process but also as the determinate dimension in their built form. For Aegis Hyposurface, Transports Muscle and Fresh H2O Expo projects the effect of time can be observed as the changes of the form in the built form. However, for Digital House the responses of the built form are not observed as material change. The interactive relation between the subject and the house is provided by screens, which are interfaces that the responses are observed. For both material and immaterial changes in the physical forms, for these projects, it can be claimed that time is the inevitable entity for their actualization.

Parametric design process differs from the formal organizations that the architect decides for the single, static final spatial organization. In this process, the major concern for design is the parameters that are used to define the predicted changes through time. A project whose behaviors or responses are designed through time cannot be activated unless it is actualized in physical environment. In this respect, again following the distinction of Gilles Deleuze between "realization of the possible" and "actualization of the virtual", this design attitude can be considered in parallel to an actualized virtuality. In this process the definition of the parameters

that direct the predicted responses in the built form are virtual unless they are activated.

CHAPTER 4

A SHIFT IN THE SPACE-TIME CONSIDERATIONS BY THE INTRODUCTION OF VIRTUAL REALM

The introduction of the virtual realm into architectural design processes has broadened the conceptual articulations of space and time. The architectural process between virtual and actual opens new horizons to new conceptions of space and time. The creative aspects of this process are due to new connections between space, time and architectural object.

This chapter discusses the changes in the space and time considerations which are argued towards two main topics. In the first part, conventional understandings of space and time are grasped by focusing on how movement is related to architectural design and thinking. It is highlighted that, conventionally, time and space are seen as abstract entities which are "homogeneous and absolute given"[92]. The mainstream introduces architecture as "an art of space"; so, time and movement are not integrated into the parameters of architectural design. Whereas, the historical concern of movement for architecture can be read as solely an after-process that can only be achieved by the visitor in the built space.

The second topic will focus on the conception of movement in respect to the shift from representation of movement. The pictorial arts of the recent century and representative animation illustrate movement over static frames; and so, for architecture time is regarded in analogy with its use in cinematic modulation. For architecture, animation practices maintaining the cinematic modulation of time is defined as "the backbone of contemporary animation"[93] which are introduced by Greg Lynn as anticipating a process where "the multiplication and sequencing of

[92] Ben Van Berkel, Caroline Bos, Move: Part 3. Radiant. Synthetic, Amsterdam: UN Studio & Goose Press, 1999, p. 16

[93] Gregory More, "Nonlinear Animation: Time Matters and the Aionic Memoria Project", in A+A architecturanimation, Fredy Massad and Alicia Guarrero Yaste Eds., Spain: Col.legi D'Arquitectes de Catalunya, 2003, p. 368

static snap-shots simulates movement."[94] In this part, Henri Bergson's critics to cinematography takes place for providing a point of view to the distinction between illusion of movement and re-constitution of movement.

On the other hand, the concerned architectural process in-between virtual and actual, foresees notions of time and movement in the conceptual level of the design process. In this process, form is generated as a dynamic and evolving object. Or, time acts as the parameter for the constitution of the relations between architectural object and its surrounding circumstances.

Elizabeth Grosz suggests that "until the dimension of time or duration has an impact on the ways in which architecture is theorized and practiced, the utopic, with its dual impossibility and necessity, will remain outside architecture's reach"[95] Grosz introduces her essays collected in 'Architecture from the Outside' as they "propose experiments, conceptual or philosophical experiments to render space and building more mobile, dynamic, and active, more as force, than they have previously understood."[96] The shift of considering space for architecture can be introduced as the one from the passive space to an active space.

Also, Grosz notes that the book asks the question "How can we understand space differently, in order to organize, inhabit, and structure our living arrangements differently?"[97] ; and, significantly, she claims that the first direction it proposes is "in the direction of time, duration, or temporal flow, which is usually conceptualized as the other, the outside, or the counterpart of the space."[98] One of the most important proposals of Grosz about the future of architecture is "that the

[94] Greg Lynn, Animate Form, New York: Princeton Architectural Press, 1999, p. 9

[95] Peter Eisenman, "Foreword", in Architecture from the Outside: Essays on Virtual and Real Space, Cambridge, Massachusetts: the MIT Press, 2001, p. xiii

[96] Elizabeth Grosz, "Introduction", Architecture from the Outside: Essays on Virtual and Real Space, Cambridge, Massachusetts: the MIT Press, 2001, p. xviii

[97] Ibid, p. xix

[98] Ibid

question of time, change and emergence become more integral to the processes of design and construction."[99] This argument is crucial for it supports the argument of this thesis.

With a parallel point of view, Ben van Berkel and Caroline Bos state that architecture, today, deals with the new understandings of time and space. They note that: "Some of the most liberating effects that architecture can achieve today are to spring from new understandings of time and space."[100] Then, the most significant liberating effects in architecture are derived from the substitution of classical architectural metaphors of stasis and equilibrium by the emergence of architectural processes which enable a literally and conceptually animated object or a responsive and interactive design-object.

Architects in light of the achievements beginning from the integration of digital tools into the design incorporate time in the conceptual level of the design; so, time is not anymore a distinct, *a priori* and abstract element for design. In architectural discourse, Sigfried Giedion has been an important figure for his leading the discussions on space and time in architecture most notably in his book "Space, Time and Architecture: The Growth of a New Tradition"[101]. However, in light of the contemporary processes through virtual technologies, Peter Eisenman re-interprets the suggestions of Giedion about the conception of time in architecture. Eisenman notes that:

> ...Giedion's reflection of the 'so-called' fourth dimension of space while seemingly canonical in 1940, today seems rather naive in light of the advancements in virtual space and time. Transparency has proved to be a literal one-linear and architecture has moved to even more refined ideas of space and time. Indeed, there is a sense in which the idea of space-time continuum has been pulled apart. Time is no longer necessarily delimited by

[99] Elizabeth Grosz, "Introduction", Architecture from the Outside: Essays on Virtual and Real Space, Cambridge, Massachusetts: the MIT Press, 2001, p. xix

[100] Ben Van Berkel, Caroline Bos, Move: Part 3. Radiant. Synthetic, Amsterdam: UN Studio & Goose Press, 1999, p. 16

[101] Sigfried Giedion, Space, Time and Architecture: The Growth of a New Tradition. Cambridge: Harvard University Press, 1954.

> space; in fact, time may inhabit space in ways that have never before been conceptualized in architecture. For example, while the virtual space-time of the internet is not possible in architecture, it exists as a conceptual possibility.[102]

Digital design processes may include time-based, interactive and dynamic organizations with the engagement of the topics of motion, evolution, transformation, hybridization and mutation. The renewed complexity of time engaged to architectural animation can be observed as non-linear and is differed from the linear understanding of time as treated as an applied – a fourth – dimension in architectural animation. Gregory More examines the non-linear systems, "to present an alternative reading of time in architectural representation, form, and technology: a contrast to cinematic modulation, which seems to be the backbone of contemporary time-based architectural design."[103]

On the other hand, it is important to note Gregory More's arguments on the concept of time in architecture. More states that: "The cinematic modulation of time diminished our understanding of durations in creative processes."[104] He adds that: "Time in creative scenarios is complex: the duration of motion-captured data in the moving image industry, or the triggered movement of physical form in the Aegis Hyposurface. These examples are systems that are predicated to change."[105]

The interactive, responsive active structure of the Trans-ports can be considered as an example of a new form of building that is designed on the attempt of a real time motion experience in architectural space. This kind of a motion experience is realized in a built structure that is not only performed by the visitor, but the

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[102] Peter Eisenmann, "Time Warps: The Monument", in ANYTIME, Cynthia C. Davidson Ed., Anyone Corporation, New York: The MIT Press, 1999, p.252

[103] Gregory More, "Animated Techniques: Time and the Technological Acquiescence of Animation", in Architecture + Animation. Bob Fear Ed., AD-Architectural Design, Vol. 71, no:2, London: John Wiley & Sons, April 2001, p.22

[104] Gregory More, "Nonlinear Animation: Time Matters and the Aionic Memoria Project", in A+A architecturanimation, Fredy Massad and Alicia Guarrero Yaste Eds., Spain: Col.legi D'Arquitectes de Catalunya, 2003, p. 376

[105] Ibid.

programmable body of the structure itself. The surrounding environment responds by effects such as sound, color or etc., by literally changing shape.

This shift is also derived from the integration of computers to design process, by offering animation as a design tool. Architects have the chance to articulate movement as an initial given in the design process. Therefore, "the discipline of architecture within the last decades has increasingly explored issues of animation and movement."[106]; whether it is defined as animation or digital architecture or liquid architecture, what lies under these emerging attitudes is that the changing understandings of space and time, introduced as a paradigm shift in this study.

4.1 Conventional Considerations of Space, Time and Movement in Architecture

> Space is not a ground on which real motion is posited; rather it is real motion that deposits space beneath itself[107]

An insight into the traditional consideration of movement in architecture implies the shift to new space and time understandings. As, Christian Hubert states, "time makes the conceptions of both change and motion possible."[108] Architects, throughout the history, considered the idea of movement as the travel of the moving eye in space, as a fact to be conceived in the built environment, which occurs between the visitor and the architectural object. Greg Lynn discusses the conventional concern of movement for architecture: "Historically in architecture, form is static; dynamism and motion can be animated only by visitor or the occupant."[109] Also, in Anytime, Peter Eisenman underlines the same subject:

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[106] Gregory More, "Nonlinear Animation: Time Matters and the Aionic Memoria Project", in A+A architecturanimation, Fredy Massad and Alicia Guarrero Yaste Eds., Spain: Col.legi D'Arquitectes de Catalunya, 2003, p. 368

[107] Henri Bergson, Matter and Memory, translated by Nancy M. Paul and W. Scott Palmer. New York: ZoneBooks, 1991. p.217

[108] http://christianhubert.com/hypertext/, (Accessed on 10.01.2006)

[109] Greg Lynn, "Biotime", in ANYTIME, Cynthia C. Davidson Ed., Anyone Corporation, New York: The MIT Press, 1999, p.266

"Historically, the subject came to be understood the object of architecture through an experience of it in time. The more the subject moved in and around architecture, the more the subject understood the object." [110] Lynn also notes that: "Form is static and the sequence or promenade of a visitor adds motion to form in order to render it dynamic."[111]

In a conventional manner the predicted experience of the visitor or the occupant in the physical space has been conceived as the only aspect of movement that architects are involved. In this respect, architecture in its practice and conceptual level is regarded in relation with "static, fixed, ideal and inert" [112]. The idea of static can label the forms that are built, but more importantly the consideration of design is based on models of stasis and equilibrium. According to Greg Lynn the idea of movement has been a problematic for architects because "they have maintained an ethics of static in their discipline."[113] Lynn adds that: "Because of its dedication to permanence, architecture is one of the last modes of thought based on the inert."[114]

It can be suggested that the historical concern of movement for architecture is a consequence derived from the distinct understandings of space and time. As Ben van Berkel suggests "Until recently, time and space as architectural elements were conceived as stable and transcendent categories." [115] This distinction is remarkable in Hegel's classification of arts which is discussed by Hubert Damisch in 'Anytime'.[116] In that classification, architecture takes place as an art of space

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[110] Peter Eisenmann, "Time Warps: The Monument", in ANYTIME, Cynthia C. Davidson Ed., Anyone Corporation, New York: The MIT Press, 1999, p.250

[111] Greg Lynn, "Biotime", in ANYTIME, Cynthia C. Davidson Ed., Anyone Corporation, New York: The MIT Press, 1999, p.266

[112] Greg Lynn, Animate Form, New York: Princeton Architectural Press, 1999, p. 9

[113] Ibid.

[114] Ibid.

[115] Ben Van Berkel, Caroline Bos, Move: Part 3. Radiant. Synthetic, Amsterdam: UN Studio & Goose Press, 1999, p. 16

[116] Hubert Damisch, "Three minus two, two plus one: Architecture and the Fabric of Time", in ANYTIME, Cynthia C. Davidson Ed., Anyone Corporation, New York: The MIT Press, 1999, p.85

beyond sculpture and painting, whereas the arts of time are defined as music and poetry. By revealing the historical understanding of architecture, Damisch points out a strict opposition between time and space, which regards space as related with static and, on the contrary, time related with dynamic.[117] Damisch also adds that: "What photography and moreover film reveal is that architecture cannot be considered only as an art of space; room to be made, in its practice as well as concepts, for time and movement."[118]

The further statements will be helpful for revealing the conventional concerns about the distinct notions of space and time. Ben van Berkel notes that:

> The notion of universal and generic space conveys a significant emptiness, unaltered throughout history. In that vision, space is the uniform notion in between things; while the things are all different, the nothing is always the same, transcending the banality of matter. This ultimate space cannot be further abstracted.[119]

Therefore, according to Berkel, in a conventional manner, space is conceived as an ultimate entity; then, what were the ways it is maintained in design conception? Related with this subject, Bernard Tschumi claims that: "Architecturally to define space (to make space distinct) literally means 'to determine boundaries'."[120] The following suggestion of Tschumi sheds light on the historical notion of space:

> Space had rarely been discussed by architects before the beginning of the twentieth century. … From the Greek "power of interacting volumes", to the Roman "hollowed-out interior space", from the modern "interaction between inner and outer space" to the concept of "transparency", historians and theorist referred to space as a three- dimensional lump of matter. … Giedion related Einstein's theory of relativity to cubist painting, and cubist planes were translated into architecture in Le Corbusier's Villa Stein at Garches. Despite

[117] Hubert Damisch, "Three minus two, two plus one: Architecture and the Fabric of Time", in ANYTIME, Cynthia C. Davidson Ed., Anyone Corporation, New York: The MIT Press, 1999, p.85

[118] Ibid.

[119] Ben Van Berkel, Caroline Bos, Move: Part 3. Radiant. Synthetic, Amsterdam: UN Studio & Goose Press, 1999, p. 16

[120] Bernard Tschumi, Architecture and Disjunction. Cambridge, Massachusetts, London: The MIT Press, 1996, pp.30-31

> these space time concepts, the notion of space remained that of a simplistic and amorphous matter to be defined by its physical boundaries.[121]

Hitherto it is introduced that space and time are seen as homogenous entities. Space in its uniform condition is defined by architects over its physical boundaries and remained as an amorphous matter. Berkel points out that the concept of time has also been thought as an *a priori* entity like space:

> Time is not understood as something that is produced in various ways, but, like space, it is simply there; infinite, its beginning and ending undefined. All time seems to do is speed up or slow down, generating effects such as transience and the negative horizon. But time and space are no longer seen as homogeneous.[122]

What Berkel points out with this suggestion is that the understanding of time as an a priori condition shifts to an understanding that time can be produced –here, the production of time may be understood as referring to the *durée* of objects generated in digital medium, which are assigned their own duration by evolving and transforming-. This shift can be thought as dependent on the changing design tools for architecture, by the availability of computation of time in digital medium. With a similar position to that debate, in an interview published in "The Virtual Dimension", Andreas Ruby develops a discussion with Paul Virilio.[123] Ruby proposes a general introduction of time by stating that it appears to be one of the hidden issues in history of architecture; and, he notes that: "Architectural design seems to focus more on the three dimensions of built space than the temporal dimension that merges as we start to use that space –which is probably due to the traditional design tools of architecture."[124] As an answer, Paul Virilo states that:

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[121] Bernard Tschumi, Architecture and Disjunction. Cambridge, Massachusetts, London: The MIT Press, 1996, pp.30-31

[122] Ben Van Berkel, Caroline Bos, Move: Part 3. Radiant. Synthetic, Amsterdam: UN Studio & Goose Press, 1999, p. 16

[123] Andreas Ruby, "Architecture in the Age of Its Virtual Dissapearance", an interview with Paul Virilo by Andreas Ruby, Paris, 15 October 1993, in The Virtual Dimension: Architecture, Rerpresentation, and Crash Culture, John Beckman Ed., New York: Princeton Architectural Press, 1998, p. 183

[124] Ibid.

> There is a dynamics of space, or of the space-time experience by the individual. And this dynamics escapes from the ordinary graphic representations of space such as plan, section, and elevation. But one needs to integrate time and movement as spatial parameters into the design of architecture.[125]

Therefore, historically, architecture is considered as dealing within the spatial design of space, where time is seen as an independent element from the design process. The only aspect of movement conventionally refers to the conception of movement as a dimension emerging with the use of the architectural space.

4.2 The Shift from the Representation of Movement

> Repeatedly, throughout the history, architects have attempted the representation of dynamic phenomena in an essentially static and permanent medium, resorting to configurations that express the movement detained in one of its instants, incorporating devices that allow the onlookers to reconstruct a dynamic sensation through form, the generation of trajectories, a breaking away from the limits of the object or the generation of other phenomena that act on perception.[126]

Contrary to the traditional assumptions, for architecture, movement is not anymore conceived as only related with the experience of the visitor in the built environment. Rather, movement refers to a dynamic organization both in design process of architectural form and its extension into physical environment. This new attitude in architectural design articulates movement connected with terms such as transformation, mutation and evolution as dynamic possibilities of form and information flows through the built form. For movement, while its articulation is considered as distinct from a representational value, it, rather gains a transformative role in the re-consideration of space and time with the generation of form in the digital design process. This part of the discussions includes the exploration of a

[125] Paul Virilio, "Architecture in the Age of Its Virtual Disappearance", an interview with Paul Virilo by Andreas Ruby, Paris, 15 October 1993, in The Virtual Dimension: Architecture, Rerpresentation, and Crash Culture, John Beckman Ed., New York: Princeton Architectural Press, 1998, p. 183

[126] Paolo Sustersic, "The Architecture of Virtual Reality: Towards an Aesthetics of the Information Society", in A+A architecturanimation, Fredy Massad and Alicia Guarrero Yaste Eds., Spain: Col.legi D'Arquitectes de Catalunya, 2003, p. 414

shift from the representation of movement to its articulation in the design process at a conceptual level. It can be claimed that the paradigm shift in space and time considerations which is introduced as a consequence of digital technologies also can be handled by observing the remarkable attempts achieved in the beginning decades of the twentieth century.

To begin with, in the scope of the changing conception of movement in architectural design, Anne Boyman defines "a basic shift from the problematic of representation, central to the pictorial arts since the last century, to a problematic of space and time."[127] What Boyman refers here as the problematic of representation in the last century, reminds us the studies on motion; alongside avant-garde arts of cubism and futurism, photography and cinematography. Hubert Damisch's note is remarkable to distinguish the notion of movement articulated by concerned studies. Damisch states that: "As far as movement was concerned…painting succeeded in evoking, representing or 'expressing' it in a more or less illusionistic way but did not succeed in actually producing or even 'imitating' it." [128]

French physician, photographer and inventor Etienne Jules Marey's studies on movement and its representation can be pointed out as the very early examples on the expression of movement. Marey used photography in his studies of movement. "He was the inventor of the "chronophotograph" (1888) from which modern cinematography was developed."[129] He developed works with 'chronophotographs' which can be defined as "multiple exposures on single glass plates and on strips of film that passed automatically through a camera of his own design"[130] Marey's

[127] Anne Boyman, "Translator's Preface" in (Terre Meuble. English) Earth Moves: The Furnishing of Territories, Bernard Cache, translated by Anne Boyman, Michael Speaks Ed., Cambridge, Massachusetts, London: The MIT Press, 1995, p. ix

[128] Hubert Damisch, "Three minus two, two plus one: Architecture and the Fabric of Time", in ANYTIME, Cynthia C. Davidson Ed., Anyone Corporation, New York: The MIT Press, 1999, p.87

[129] Robert Leggat, "A History of Photography", http://www.acmi.net.au/AIC/MAREY_BIO.html, (Accessed on 12.11.05)

[130] http://www.acmi.net.au/AIC/MAREY_BIO.html, (Accessed on 12.11.05)

quoted statement about his mentioned works is remarkable as he describes his attitude on the expression of time and movement. He notes that:

> In this method of photographic analysis the two elements of movement, time and space, cannot both be estimated in a perfect manner. Knowledge of positions the body occupies in space presumes that complete and distinct images are possessed; yet to have such images, a relatively long temporal interval must be had between two successive photographs. But if it is the notion of time one desires to bring to perfection, the only way of doing so is to greatly augment the frequency of images, and this forces each of them to be reduced to lines.[131]

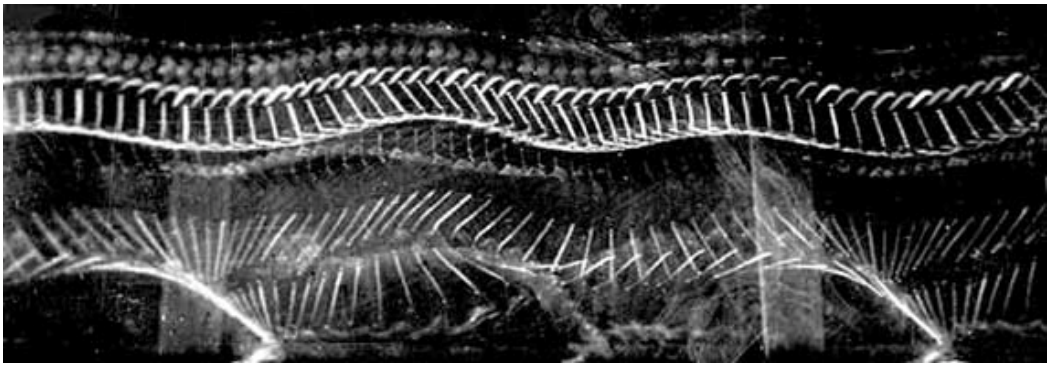

Fig. 3: "Man Running" by Etienne Jules-Marey

For a brief observation to the representations of movement in the pictorial arts, it would worth to note Sigfried Giedion's well known suggestions about cubism and futurism. Significantly, in 'Space, Time and Architecture', Giedion had introduced cubism as "the research into space"[132], and futurism as "the research into movement"[133]. In Modern works of art, simultaneity has been a leading concept to represent. Most notably cubist painting and the emerging arts of photography and cinema dealt with representative studies on motion.

[131] http://www.acmi.net.au/AIC/MAREY_BIO.html, (Accessed on 12.11.05)

[132] Sigfried Giedion, Space, Time and Architecture: The Growth of a New Tradition, Cambridge: Harvard University Pres, 1954, p. 430

[133] Ibid.

Fig. 4: "Nude Descending a Staircase" by Marcel Duchamp

In architecture the most notable reflection between cubism and architecture is cited with Sigfried Giedion and explored by several theorists. A suggestion on the relation of architecture and cubism can be taken from Beatriz Colomina. In her text "Where Are We?" published in "Architecture and Cubism", Colomina writes on Le Corbuiser's Villa Savoye; and, claims that:

> The house, in a certain sense, is immaterial. That is, the house is not a simply constructed material object from which certain views can be possible. The house is no more than a series of views choreographed for the visitor, the way a film-maker affects the *montage* of a film. And if Le Corbusier is a cinematographer, his 'films' dislocate the viewer.[134]

Architecture's relation with themes of movement and motion had been constituted with cubist approach in painting, and debated in analogy to cinema. However, another motion-picture analogy is introduced with the engagement of animation in architectural thought.

[134] Beatriz Colomina, ''Where Are We?'', in Architecture and Cubism, Eve Blau and Nancy J. Troy Ed., Cambridge, Massachusetts and London: MIT Press, 1997, p. 155

At that point, it is necessary to explain in what sense the term animation will be used in the following parts. The emergence of animation was as an art form in the first decades of the twentieth century. Animation has raised the questions on time and movement in the media of artistic creation and design. The first experimental studies on animation dealt with cinematic apparatus as long as the cinematic techniques enabled opportunities of different methods. Animation is a term that connotes different uses achieved in different media. For its understanding in architecture Greg Lynn offers that: "Animation is a term that differs from, but is often confused with, motion. While motion implies movement and action, animation implies the evolution of a form and its shaping forces; it suggests animalism, animism, growth, actuation, vitality and virtuality."[135] While the most common consideration defines animation as a representation tool closed to the generation of cinema, animation also used to define an architectural design generation process. Mark Burry's suggestion will be useful to describe the use of animation in architecture. Burry notes that:

> …there are at least two opportunities for animation to be used as part of the development and representation of ideas: firstly as architecture considered and represented through animated treatment of 'real buildings'; and secondly at a conceptual level where animation is used as a device in architectural design, most usually as part of an iterative design generation or as an evaluation procedure.[136]

For the first sense, it can be claimed that in this context, movement is concerned in architecture not as an after process with its historical understanding, but usually highlights a representational value as it is considered with motion-picture analogy. Animation in architectural presentation and representation practices are held in a cinematic modulation of time understanding, which handles movement as linear and flowing alike provided by cinematographic apparatus. The cinematic model has been the main method for discussing motion through static frames by which architects dealt with the themes of motion and dynamics. Lynn emphasizes that:

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[135] Greg Lynn, Animate Form, New York: Princeton Architectural Press, 1999, p. 9

[136] Mark Burry, "Beyond Animation" in Architecture + Animation, Bob Fear Ed., AD-Architectural Design, Vol. 71, no:2, London: John Wiley & Sons, April 2001, p.7

> The dominant mode for discussing motion in architecture has been the cinematic model, where the multiplication and sequencing of static snap-shots simulates movement. The problem with the motion-picture analogy is that architecture occupies the role of the static frame through which motion progresses. Force and motion are eliminated from form only to be reintroduced, after the fact of design, through concepts and techniques of optical procession.[137]

Reminding us the criticism of Henri Bergson to cinema -for it deals with the illusion of movement- Greg Lynn supports this argument for the use of animation in architecture. It would be illuminating to observe Henri Bergson's claims on movement in cinema, to comprehend the notions of movement, and the articulation of animation in architecture:

> Bergson's critique of the cinema is based, then, upon the indivisibility of motion. For the cinema, as for physics, motion cannot be projected unless there is real movement somewhere. The illusion is dependent upon this irreducible reality. At the same time, he warns of the usual dangers that inhere in all such re-creations. No matter how effective the illusion of movement it creates, the snapshots cinema animates remain immobile 'views'. He remains adamant that from movement one can pass to immobility, but not vice versa.[138]

Therefore, the suggestions from Bergson introduce a reaction towards the representation of movement considered with cinema, which insists that movement can not be generated by its representation over static frames. The underlying paradigm of this critic is considered as the indivisibility of movement. Bergson's suggestions on the nature of movement and cinema are also supplementary to the mentioned critic: "We can never understand reality-as-mobility through cinematographic analysis, since 'rests placed beside rests will never be equivalent to a movement."[139] Also, it will be helpful to note Hubert Damisch's related statement:

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[137] Greg Lynn, Animate Form, New York: Princeton Architectural Press, 1999, p. 11

[138] Paul Douglass, "Bergson and Cinema: Friends or Foes?" in The New Bergson, John Mullarky Ed., Manchester, New York: Mancheseter University Press, 1999, p.211

[139] Henri Bergson, Creative Evolution, Trans. by Arthur Mitchell, Mineola, New York: Dover, 1998, p. 329

> For movement, as Gilles Deleuze later puts it, does not only takes place in space, as something that occurs between objects; it expresses duration, in the Bergsoninan sense, as something that, in opposition to time, cannot be divided into parts.[140]

Therefore, hitherto, the representation of movement is elaborated with the examples from pictorial arts of cubism, with works from Etienne Jules Marey; then, cinema and animation with its applications in architecture with the motion-picture analogy is mentioned. To turn back to Anne Boyman's introduction, mentioned in the beginning of this part, it should be noted that the shift from the representational aspect of movement is defined as directed to a new dynamic conception in design. This shift forces architecture to acquire "a singular new role, quite different from the traditional notion of a closed system or architectonic" [141]; and a new question arises: "how to show or create the kind of movement that is prior to the representation of stable objects, and so introduce a new dynamic conception of both image and architecture."[142]

[140] Hubert Damisch, "Three minus two, two plus one: Architecture and the Fabric of Time", in ANYTIME, Cynthia C. Davidson Ed., Anyone Corporation, New York: The MIT Press, 1999, p.87

[141] Anne Boyman, "Translator's Preface" in (Terre Meuble. English) Earth Moves: The Furnishing of Territories, Bernard Cache, translated by Anne Boyman, Michael Speaks Ed., Cambridge, Massachusetts, London: The MIT Press, 1995, p. ix

[142] Ibid.

CHAPTER 5

'UNFORESEEN RELATIONS': A SURVEY IN ARCHITECTURE

This chapter discusses the 'new connections' and 'unforeseen relations' constituted by the architectural projects, which are highlighted as the examples of actualized virtuality. In the third chapter of this thesis, digital design process is discussed in terms of its latent potentials that lead to discussions on form-unform in the design process. The previous chapter on space and time observes a shift from the conventional considerations of space, time, movement and their conception in architecture. This chapter states that, the concerned shifts on space and time considerations in architecture can be revealed by some projects, which imply interactive and responsible characteristics in constructed physical environment.

Before introducing the projects in detail, the reason for their selection needs to be clarified. While others can be considered within this scope, this thesis supports its argument by mainly exploring four architectural projects: Aegis Hyposurface of dECOi, Transports Muscle by ONL, Fresh H20 Expo by NOX and Digital House by Hariri&Hariri. They bridge the virtual and the actual realms; and, their existence in physical environment implies the process of 'actualization of the virtual'.

Derived from the nature of 'actualization of the virtual' process, the actual modes of the mentioned projects speculate the very fundamental assumptions on space and time. Their built forms imply "reciprocal transformation"[143] which can only be realized when they are activated. So, by being actualized, these projects constitute unforeseen relations and generate the most new connections. In other words, they speculate the fundamental assumptions of space and time by directing the subject into unusual experiences of architectural space. Depending on these claims, for this thesis, the actualized models of designs in physical reality are subject to speculate

[143] Mark Goulthorpe, "Hyposurface: from Autoplastic to Alloplastic Space", http://www.generativeart.com/99/2999.htm, 05.11.05

the determinacy of space and linearity of time. These two argumentative fields will be discussed by conceptual pairs of autoplastic-alloplastic space and linear-nonlinear time. As the projects will be further explored, the qualities exhibited in the constructed spaces will be related with these conceptual pairs.

5. 1 Introduction of the Projects

5.1.1 Aegis Hyposurface

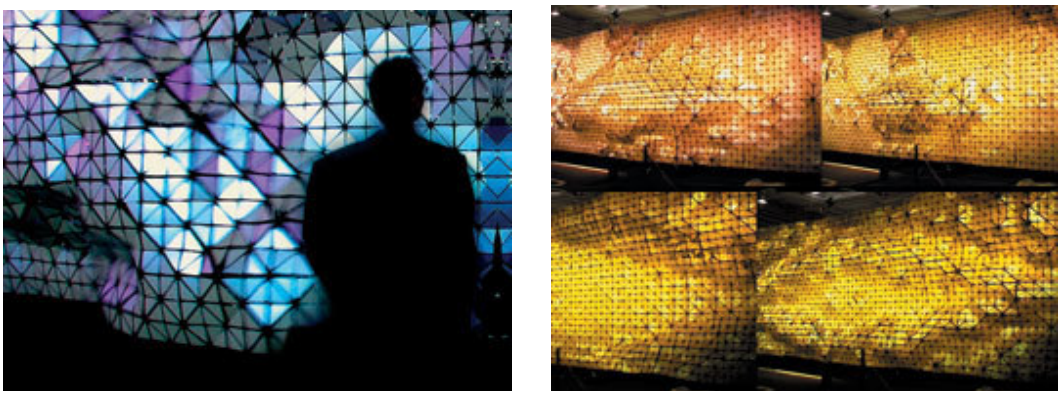


Fig. 5, 6: Aegis Hyposurface by DECOI

Aegis Hyposurface is developed by dECOi for a competition of an interactive art-work in the foyer of Birmingham Hippodrome Theater in 2001.[144] This project continues to be under research at MIT's Media Lab. Mark Goulthorpe as the principle designer, developed this project with a large multi-disciplinary team of architects, engineers, mathematicians and computer programmers.

Fig. 7: Aegis Hyposurface

[144] http://www.sial.rmit.edu.au/Projects/Aegis_Hyposurface.php, (Accessed on 02.10.05)

Aegis Hyposurface is an interactive surface which responses to the changes in the surrounding environment by physical deformation. Mathematically generated patterns or sequences are registered by the surface and are translated to responses. "It deforms physically according to stimuli captured from the environment, which may be selectively deployed as active or passive sensors."[145] Mark Goulthorpe defines the operation principle of the Hyposurface in detail. He notes that:

> It (Aegis Hyposurface) will be linked to the base electrical services of the building which are to be operated using a coordinated bus system, such that all electrical activity can feed into its operational matrix. But additional input from receptors of noise, temperature and movement will be sampled by a program control monitor which will select a number of base mathematical descriptions, each parametrically variable in terms of speed, amplitude, direction, etc. The elastic surface will then be driven by a bed of about 3,000 pneumatic pistons, which offer a displacement performance of some 600mm 2-3 times per second.[146]

This metallic and facetted surface is introduced by Goulthorpe as "a surface of potential" [147]. The changes in the stimuli captured by the sensors are conveyed to the structure of the surface. Through the sensors, the change in the sound and the movement of the people turn to real-time responses activated by the surface.

> It is therefore a translation surface, a sort of synaesthetic transfer device, a surface-effect as cross-wiring of the senses. It plays the field of art as it alternates between foreground and background states, an emergent decora(c)tion which then vanishes-as-trace.[148]

[145] Mark Goulthorpe, "Hyposurface: from Autoplastic to Alloplastic Space", http://www.generativeart.com/99/2999.htm, (Accessed on 05.11.05)

[146] Ibid.

[147] Ibid.

[148] Ibid.

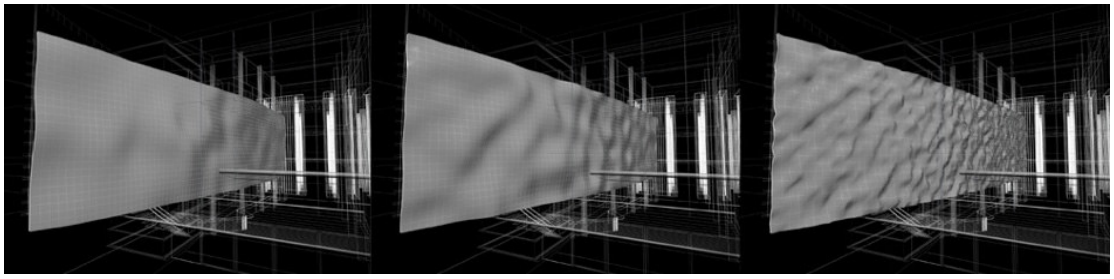


Fig. 8: Aegis Hyposurface

Aegis Hyposurface is an interactive surface which responses to the changes in the surrounding environment. It is activated by the user input, sound, video source and pre-configured effects. "This interactive, dynamically reconfigurable three-dimensional screen reacts in real time to surrounding motion and sound, transforming Hyposurface's complex topography and color."[149]

Aegis Hyposurface can be considered as a crucial example that merges the virtual and the actual realms by realizing an interactive and responsive process between the surrounding environment and the design-object. The movements of the visitors in the environment are responded by the deformation and the changing color of the surface. This project is defined by its principle designer Mark Goulthorpe as being developed on the speculation of alloplastic space, a term which will be further explored in this inquiry. Also, Aegis Hyposurface provides a non-linear conception of time by the unpredictable changes it is pre-configured by set parameters in its design process.

5.1.2 Transports Muscle

Trans-ports Muscle is a project developed by Prof. Kas Oostherhuis of ONL. As an interactive and 'programmable body', Trans-ports is an installation first developed for the Architecture Biennale in Venice in 2000, and exhibited as Trans-ports Muscle in 'Non Standard Architectures' exhibition at Centre Pompidou in Paris in 2004. Also, this project is still a continuous research by the Hyperbody Research

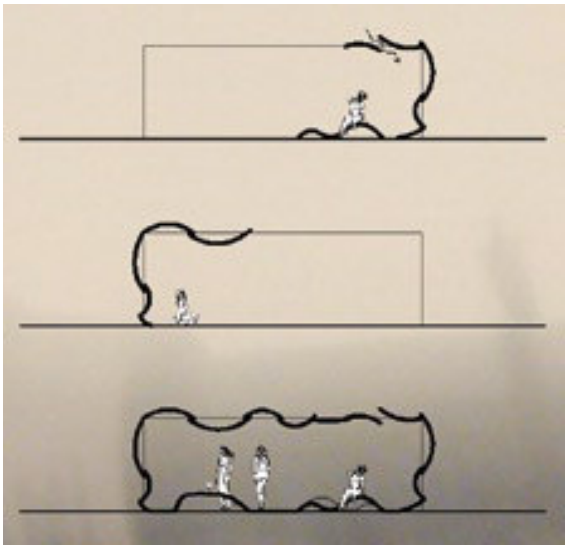
[149] http://archerecord.construction.com/projects/portfolio/archives/0412_10_decoi.asp, (Accessed on 02.10.05)

group named 'Trans-ports Muscle Reconfigured', which is based on the development of the material qualities of its 'active structure'.

Fig. 9, 10: Trans-ports Muscle by Kas Oosterhuis/ONL

Transports' structure is composed of a constructive mesh that is, to a large extent, made of hydraulic cylinders. The action in the structure is transferred to that structure by pulses, which are sent to the cylinders to extend or shrink. In this way, the work principle of the structure connotes muscles. "All fibers cooperate to perform the new configuration. Then the whole dynamic space frame construction must reposition its joints by lengthening or shortening the hydraulic members: The whole construction becomes active, like a muscular bundle."[150]

[150] http://archerecord.construction.com/projects/portfolio/archives/0412_10_decoi.asp, (Accessed on 02.10.05)



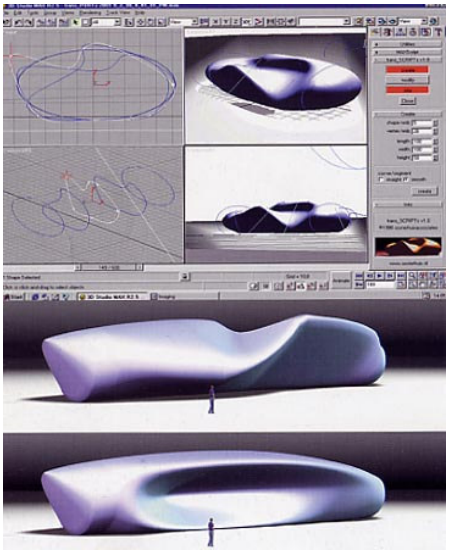


Fig. 11, 12: Transports Muscle Reconfigured

Transports Muscle project enables "a multi-player interactive game" that is achieved between the visitors and the fully programmable structure of the Transports in the real time. The principal designer of the Transports Kas Oosterhuis states that this project is "the first example of a fully programmable building."[151] Programmable buildings can be defined as the ones having a potential to be reconfigured without the need of displacement. The programmable structure of Transports is provided by industrial muscles, which allow changing shape.

> Orchestrated motions of the individual muscles change the length, the height, the width and thus the overall shape of the MUSCLE prototype by varying the pressure pumped into the 72 swarming muscles. The balanced pressure-tension combination bends and tapers in all directions. The public connects to the MUSCLE by sensors, and by input through sliders on the computer screen. The sensors are attached to the reference points of the construction. Coming closer to the sensors triggers a reaction of the MUSCLE as a whole.[152]

[151] Kas Oostherhuis, "Trans-ports Muscle", Hyperbodies, September, 2003, http://www.oosterhuis.nl/quickstart/index.php?id=45, (Accessed on 15.01.06)

[152] Kas Oostherhuis, "Muscle Reconfigured", http://www.oosterhuis.nl/quickstart/index.php?id=45, (Accessed on 15.01.06)

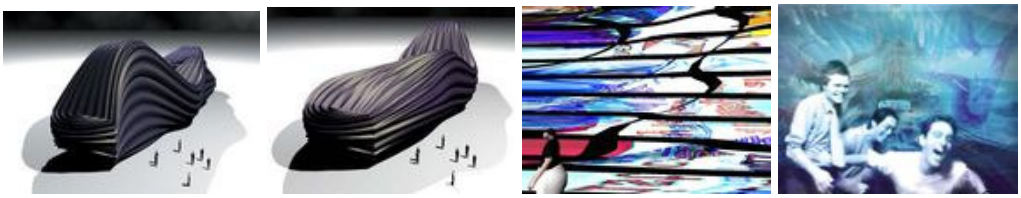


Fig. 13, 14, 15, 16: Trans-ports Muscle by Kas Oosterhuis/ONL

The visitors whose actions direct the changes in the environment activate the interactive cave of Transports. The installed sensors in the structure convey the information to a running game on three computers, which are connected to the projectors.

> Each projector is a camera viewpoint registering 120 degrees of the virtual world. The signals coming from the sensors are similar input as the keyboard strokes when playing a computer game. Each signal means a certain action in the game, and since in the Trans-ports installation 16 signals act simultaneously, it works like a multi-player game environment. Some of the actors change the geometry of the environment, others insert particles (rain, bees, ghost images), some add sound samples, others create fog effects in the worlds. The visitors are in real time recreating the environment where they are themselves part of.[153]

Oosterhuis defines Transports, as "a building devoted to new technologies."[154] The intensity of the communication flows determines the continuous transformation of its structure. Sharing similar properties with dECOi's Aegis Hyposurface, Trans-ports is not a surface but an interactive cave, which is designed as "an active structure" that can change shape and content in real time. Transports is also one of the few projects that bridges the animate-inanimate disparity by continuing its motion-based properties in its design process to its built form.

The interactive, responsive active structure of the Trans-ports can be considered as an example of a new form of building that is designed on the attempt of a real time motion experience in architectural space. This kind of a motion experience is

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[153] Kas Oostherhuis, "Trans-ports Muscle", Hyperbodies, September, 2003, http://www.oosterhuis.nl/quickstart/index.php?id=45, (Accessed on 15.01.06)

[154] Kas Oosterhuis, "Oosterhuis Associates-Trans_Ports 2001", in Archilab: Radical Experiments in Global Architecture, Frederic Migayrou and Marie-Ange Brayer Ed., London: Thames and Hudson, 2001, p. 350

realized in a built structure that is not only performed by the visitor, but the programmable body of the structure itself.

5.1.3 Fresh H2O Expo

Designed by NOX - Lars Spuybroek, FreshH^2O Expo (1993-1997) is a water pavilion and interactive installation created for WaterLand Neeltje Jans. It is located in Zeeland, in the southwest of the Netherlands. Fresh H2O Expo enables the visitor to interact with the fabric and multimedia systems that define the spaces; and, the built form itself directs the physical experience in an unusual way.


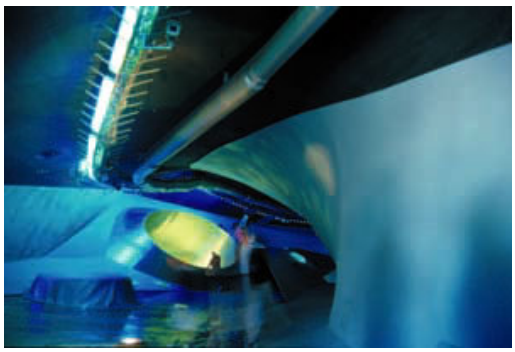

Fig. 17, 18: Fresh H2O Expo

Experiencing the Fresh H20 Expo, the visitors are responded by variable changes in the environment. The environment continuously transforms according to the movements and actions of the visitors. There are not separate elements of walls, floors and ceilings. The form changes by the fluid deformation of a unique skin. The structure involves seventeen sensors connected to a 65-meter-long raw of blue lamps attached to a sound system. "The deformation of the object extends to the constant metamorphosis of the environment, which responds interactively to visitors through a variety of sensors that register the constant reshaping of the human body." [155]

Installed in the structure, there are light sensors for crowds, pulling sensors for groups and touch sensors by individuals. Each group is connected to a projector that

[155] Lars Spuybroek, "FreshH^2O eXPO" in The Virtual Dimension: Technology, Representation and Crash Culture, John Beckmann Ed.. New York: Princeton,1998, pp. 264-265

shows a frame which translates every action into real-time movement of virtual water. The light sensors are responding as a wave going through the projected wire frames. On the other hand, the touch sensors create ripples and the pulling sensors are connected to the wire frame projection where a sphere can be topologically manipulated. Spuybroek notes that:

> Next to non-interactive events –ice, spraying mist, rain and an enormous well- there are seventeen sensors connecting different visitor actions to fluidity. Light sensors for crowds, touch sensors for individuals, and pulling sensors for group create, respectively, waves, ripples, and blobs in real-time projections and sound manipulations.[156]

5.1.4 Digital House

Digital House by Gisue Hariri and Mojgan Hariri is designed for House Beautiful's Houses for the 'Next Millennium' feature in 1988, and is one of the 26 projects exhibited in 'The Un-Private House' exhibition, which took place at The Museum of Modern Art between July 1 and October 5, 1999**.** The selected projects reflect the recent studies on private house, which are formed in response to evolving architectural theory and changing ways of living.

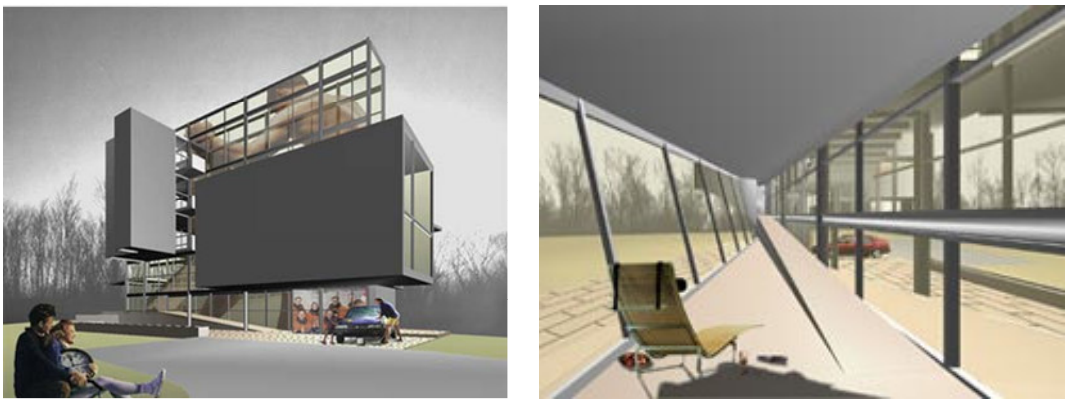

Fig.19, 20: Digital House, Computer Generated Image

The Digital House is an intentionally permeable structure able to constantly receive and transmit images, sound, text and data. The underlying framework of this house

[156] Lars Spuybroek, "FreshH^{2}O eXPO" in The Virtual Dimension: Technology, Representation and Crash Culture, John Beckmann Ed.. New York: Princeton,1998, pp. 264-265

is a structural core that serves as its infrastructure. Various prefabricated volumes 'plug in' to the frame and can be used as bedrooms, kitchen, and the like. The surfaces of the frame-like core are what the architects call 'smart skins', and are capable of receiving and transmitting digital information. The devised glass skins are proposed to be made up of liquid crystal blocks that "perform various functions to enhance daily living."[157]

> Images and information providing advice on food preparation appear over the kitchen counter, while digital guests appear in the living room for a virtual visit. Bedrooms are equipped with recording devices that allow sleepers to record and replay their dreams. More than just an environment characterized by the discreet pervasive presence of computers, the Digital House's surfaces and devices are interactive in themselves. [158]

Fig. 21: Digital House, Computer Generated Image

For example, in the kitchen, a virtual chef assists with the preparation of a meal. Or, in the working areas "the smart skin" serves as a digital drafting board for an architect. Rather than using isolated devices such as telephones or televisions, information can now be transmitted through the structure itself, creating smart environments that are characterized by what has been called "ubiquitous computing"[160]. All bedrooms are equipped by Dream-recording device, so one could review one's dreams on the liquid wall of the room at any time. The work

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157 http://www.moma.org/about_moma/press/1999/un_private_6_30_99.html, (Accessed on 05.01.05)

158 Ibid.

160 http://www.moma.org/exhibitions/1999/un-privatehouse/project_05.html, (Accessed on 05.01.05)

spaces have liquid drafting walls instead of the individual computer screens, and the children's work/class rooms are connected to the schools around the globe.[161]

Architects note that for the Digital House they propose for the use of digital technology as a building block of next millennium.[162] "Rooms and buildings will henceforth be seen as sites where bits meet the body-where digital information is translated into visual, auditory, tactile, or otherwise perceptible form, and, conversely, where bodily actions are sensed and converted into digital information… In the end, buildings will become computer interfaces and computer interfaces will become buildings."[163]

5.2 The Discursive Fields: Autoplastic-Alloplastic Space and Linear-Nonlinear Time

Designed to be built in physical environment, all of these projects are considered as implying a process between virtual and actual realms. As well as the consequences of this process will be further elaborated; first, their being "a process" needs to be examined. These projects can be considered as by-products of a process-based approach. Their built forms continue to be in process whose rules are set in the design process, while some are open to re-configuration. Their existence in physical environment is not a static and uniform condition; rather, they imply processes, which need to be activated in the physical environment.

The discussions can be developed in the light of the suggestions of Stan Allen who interprets the process-based architecture in a different point of view. Allen claims

[161] http://www.haririandhariri.com, (Accessed on 05.01.05)

[162] http://www.moma.org/exhibitions/1999/un-privatehouse/project_05.html, (Accessed on 05.01.05)

[163] William j. Mitchell, "Programmable Places", Space, Place and the Infobahn: City of Bits, http://mitpress2.mit.edu/e-books/City_of_Bits/Recombinant_Architecture/ProgrammablePlaces.html, (Accesed on 02.09.05)

that “A process-based architecture is trivial unless it produces new effects into the world; all it can do is point back to the author.”[164]

Digital design processes may include time-based, interactive and dynamic organizations such as animation practices, which are developed under the topics of motion, evolution, transformation, hybridization and mutation. The design process generated in digital medium may constitute one or a series of animated representations.

On the other hand, the mentioned projects imply properties transferring their animate design process directly the built structure. For instance, Aegis Hyposurface has not been built upon the freeze frame of any instance in its animated design process; rather, it continues to evaluate, to transform when it is built. More states that Aegis Hyposurface is a project “that bridges the animate/inanimate disparity by being a physically built and animate surface that information is conveyed through it.”[165] In other words, motion is experienced in physical space and time continuum. Through its motion based design process Aegis Hyposuface can be claimed as it produced new effects into the world by enabling the real experience of motion.

In this regard, the mentioned projects can also be observed as the physical outcome of a dynamic organization generated by motion in digital design process. The digital process does not stop by their production in physical reality. For example, for Aegis Hyposurface, the leading concepts in its design process extents to its material reality from virtual reality. In this project, an interactive and time-based design process is not only limited by the computer screen, but it has been transferred to a surface built in physical world so it provides an unusual type of space and time consideration by the participation of the visitor.

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[164] Stan Allen, “Process”, in INDEX Architecture, Bernard Tschumi and Matthew Berman Eds., Cambridge, London: The MIT Press, 2003, p.197

[165] Gregory More, “Nonlinear Animation: Time Matters and the Aionic Memoria Project”, in A+A architecturanimation, Fredy Massad and Alicia Guarrero Yaste Eds., Spain: Col.legi D’Arquitectes de Catalunya, 2003, p. 372

On the other hand, depending on the pre-configured relations between architectural object and its surrounding environment, the continuing process in their built form may imply different responses. The activated effects in their built form can be considered as responses, which may both be material or immaterial.

To begin with, for Aegis Hyposurface and Transports Muscle, the interaction between the visitor and the architectural object results by physical deformation. In these projects the deformation of the structure is the response to the changes in the environment. However, in Digital House the screens act like interfaces that the interactive relation is realized. The responses from the design-object are as information flows that emerge according to the actions of the occupant. On the other hand, Fresh H^20 Expo can be considered as reacting in a more complicated and hybrid way. While the movements of the visitors are responded by the fluid deformation of the structure, various sensors react with interactive electronics. In this project, interactive and in-interactive sensors provide the unexpected changes in the architectural space.
On the other hand, a general concern on these projects observes that all of them imply an indeterminate experience of space. The speculated indeterminacy is the result of the un-expected reactions configured by the design-object. So, instead of the active subject and a passive and static space, the interactive relation between each other constitutes a more complicated experience. It may be claimed that as the design-object is activated by the user actions, they together form "a unique organism".

This situation can be analyzed in two perspectives: From the point of the one who experiences the design-object, and the architect whose role has been changed in designing such a process.

To begin with the experiences, we can consider two new conceptions different form the usual ones. First is the indeterminacy of the process which this thesis has specified by discussing the 'autoplastic and alloplastic space'. As introduced before in the second chapter, these conceptual pairs define the two types of experiences of

space. While in autoplastic space the experience is controlled and determined, the alloplastic space allows -at least- a two-sided control on the physical space.

The etymologic roots of these terms give clues about their meanings. The word "alloplastic" is composed of the words "allo" –originally "*allos*" in Greek means "other"- and plastic. In this respect, the meaning of 'other' can be interpreted as marking another effect to the plastic of space from an outsider. The response of the design-object is activated by the user input, so, the subject in this relationship constitutes the "other" determinate effects into this unique organism.

'Autoplastic' and 'alloplastic' are terms that Goulthorpe has borrowed from psychology. In his studies of trauma, Sandor Ferenczi introduces that: "In autoplastic environment as the one where the subject is challenged by a highly determining context and is forced to auto-adapt in the face of such resistance which can lead to neuroses of trauma."[166] On the contrary, "alloplastic environment is which including a possibility of a "reciprocal transformation' in which both subject and environment negotiates interactively."[167]

So, alloplastic space can be considered as suggesting a more flexible and changeable environment based on the interactive relation between the subject and physical space. Also, based on the definitions of Ferenczi, while autoplastic environment forces the subject to auto-adapt, in an alloplastic environment the adaptation can also be challenged by the physical space.

Aegis Hyposurface project designed by Mark Goulthorpe marks the transition from autoplastic (determinate) to alloplastic (interactive, indeterminate) space, by proposing a new species of reciprocal architecture. Goulthorpe notes that Aegis

[166] Mark Goulthorpe, "Hyposurface: from Autoplastic to Alloplastic Space", http://www.generativeart.com/99/2999.htm, (Accessed on 05.11.05)

[167] Ibid.

Hyposurface "has developed as a speculation on the alloplastic condition …, and as a vehicle for foregrounding current operative design strategies."[168]

Another significant transition that the Hyposurface points out is that of between determinacy to indeterminacy. It is possible to observe this conceptual contradiction both in the design process and its extension to real time experiences in physical world. For the design process, Mark Goulthorpe notes that:

> In our creative process we're here in a mode of plastic reciprocity: we're setting parameters which release forms which we then interrogate technically, aesthetically, etc. Such back and forth process condenses a compelling final form as a sort of trapping of such indeterminacy, and which itself, in a quite subtle way, becomes alloplastic in its responsiveness, in its capacity to modify to environmental stimuli.[169]

The selection of the prefix hypo- rather than hyper- is also related with the speculation of "alloplastic space", and so the "trauma". Mark Goulthorpe defines the reason for choosing the prefix hypo- rather than hyper- as follows:

> Trauma…is not marked by an over-fullness or excess of significance, but by an absence of conceptual registration. This suggests that the prefix hypo-, which is characterized by deficiency and lack, by a subliminal incapacity, might be more appropriate in considering the effect of such numerically generated surfaces than hyper-, which denotes excess or extremity.[170]

Mark Goulthorpe's suggestions about the design process also imply the speculation of alloplastic space in the design of Aegis Hyposurface. Goulthorpe notes that:

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[168] Mark Goulthorpe, "Hyposurface: from Autoplastic to Alloplastic Space", http://www.generativeart.com/99/2999.htm, (Accessed on 05.11.05)

[169] Ibid.

[170] Mark Goulthorpe, "Aegis Hyposurface – Autoplastic to Alloplastic", in Hypersurface Architecture II, Stephen Perrella Ed., Architectural Design Profile 141. London: Academy Editions, 1999, p. 60

In the same article, Goulthorpe also introduces the meanings of the two prefixes of hyper- and hypo- taken from Longman's English Larousse:
hyper-: excessive, overmuch, above, from Greek huper-, over, beyond eg. hyperbole – a figure of speech which greatly exaggerates the truth hypercritical – too critical, esp. of trivial faults.
hypo-: below, under, deficient, from Greek hupo-, hup- under eg. hypocritical – of characterized by hypocrisy a pretense of false virtue, benevolence.

> In effect we didn't define the form as a figure in space, but left it as a movement hanging in space – a reversal of gestural instinct: a sort of Asiatic sense. There's an elegance to this besides the flowing form, a curious new aesthetic act: not to design an object, but to devise the possibility of an object: it's not an architecture so much as the possibility of an architecture. For us it was like watching determinacy evaporate. [171]

This project is a crucial example for its complex relations between the virtual space and real space, occurring as a time-based and interactive surface. Gregory More introduces Aegis Hyposurface as a time-based and interactive surface. More emphasizes that the update of the information of the surface is programmed in a similar frame based manner as cinema, while the material properties of the surface ensures a fluid visual continuum. In a similar way, the principal designer of the project Mark Goulthorpe discusses the complex system of the Hyposurface as such an engineered mechanism reliant on the collaboration of software, electronics and mechanical parts.[172]

On the other hand, Trans-ports Muscle and Muscle Re-configured projects also imply an example of "reciprocal transformation" between the environment and the subject. The suggestions on alloplastic environment can be considered as involved by the other three projects. While the effects in the built environment differ according to the set and re-configured parameters, the conception of indeterminism can be interpreted as opening a way for discussing their suggesting alloplastic conceptions.

Gregory More, whose research area is based on animation and time-based design media, has worked for dECOi and with Mark Burry. More introduces the Aegis Hyposurface in his text "Nonlinear Animation" published in Architecture-

[171] Mark Goulthorpe, "Hyposurface: from Autoplastic to Alloplastic Space", http://www.generativeart.com/99/2999.htm, (Accesed on 05.11.05)

[172] Mark Goulthorpe, "From Autoplastic to Alloplastic Tendency: Notes on Technological Latency", in Anymore, Cynthia Davidson Eds., ANY Corporation, Cambridge: MIT Press, 2000. p.206

Animation, as one of the "…very few projects when physically built, continues exhibiting the animate qualities of their design imagery."[173]

The experience of responses in these projects can be explored by emphasizing the "nonlinear time" concept that it is reliant on. The renewed complexity of time engaged to architectural animation is non-linear and is differed from the linear understanding of time as treated as an applied – a fourth – dimension in architectural animation. Gregory More states that:

> With the architectural engagement of animation software we have witnessed the development of concepts incorporating time inherently tied to cinematic models of thought. Change in architectural form becomes defined relative to frames of animation with time treated as an applied dimension that is readily removed for the procurement of physical form: the freeze frame. When associative technologies or non linear techniques replace mechanisms of the cinematic apparatus then time has a renewed complexity. Within these technologies time can be considered to be varying as opposed to flowing. This alternative reading of time which disturbs the flow of cinematic modulation is suggestive of a 'nonlinear' approach to architectural assemblies, or an architecture of nonlinear animation.[174]

A linear sense of time can be introduced "as a series of punctual *nows*, some of which are no-more and some of which are not-yet."[175] On the other hand, nonlinearity implies a situation "where the result is not proportional to the cause. Various choices are possible at any time." [176] A nonlinear system is not the sum of their parts. Instead, "The parts of linear systems can be analyzed in isolation and can be combined to understand the system as a whole." [177] For nonlinear systems it can be claimed that: "The key feature of non-linear systems is that their primary behaviours of interest are properties of the 'interactions between parts' rather than

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[173] Gregory More, "Nonlinear Animation: Time Matters and the Aionic Memoria Project", in A+A architecturanimation, Fredy Massad and Alicia Guarrero Yaste Eds., Spain: Col.legi D'Arquitectes de Catalunya, 2003, p. 372

[174] Ibid, p. 366

[175] Giovanna Borradori, "Virtuality, Philosophy, Architecture", http://faculty.vassar.edu/giborrad/new_page_7.htm, (Accessed on 10.01.2006)

[176] http://christianhubert.com/hypertext/, (Accessed on 10.01.2006)

[177] Ibid.

being properties of the parts themselves, and these interactions necessarily disappear when the parts are studied independently." [178]

> Producing a geometric form from a differential equation is problematic without a differential approach to series and repetition. There are two kinds of series: a discrete or repetitive series and a continuous or iterative series. In a continuous or iterative series, the difference between each object in the sequence is critical and individual to each repetition. lf the difference is the product of three or more variables, and if those three variables are unrelated, then the change between each iteration will be nonlinear in its structure and it will therefore be difficult to predict with absolute precision.[179]

The generation of responsive, interactive spaces that the architectural form is mutable, dynamic and evolving does not only an aid to respond the needs of the occupant or the visitor. In other words the intelligent architecture -or more specifically smart houses- are generated by some determinant purposes that will act due to some requirements, such as security needs or any other efficiency in the built environment. The observed projects in this chapter can be observed as much more reliant on an experimental search of architects, which focuses on the unordinary considerations of space and time experiences.

[178] http://christianhubert.com/hypertext/, (Accessed on 10.01.2006)

[179] Greg Lynn, Animate Form, New York: Princeton Architectural Press, 1999, p. 33

CHAPTER 6

CONCLUSION

The tension in the relation between virtual and actual inherently gives birth to the emergence of new concepts. For architecture, the potential of this relation is evident in new considerations of space and time. This thesis has elaborated the architectural design process in digital environment and its realization in physical environment as merging virtual and actual realms, and raising new understandings of space and time.

This thesis has interpreted the concept of virtual in reference to Gilles Deleuze's philosophy. Besides its connotations with digital technologies, the concept of virtual is highlighted with its meaning of "potential".

Actualization of the virtual always offers novelty and creation. From the point of Deleuze, the difference involved by this process is seen as the constituent for the generation of new concepts. Thus, differing from "realization of the possible", "actualization of the virtual" implies a truly creative process. When virtual is actualized, unspoken relations will be revealed, and new conceptual fields will be opened up.

The field of architecture has conventionally focused on the spatial organizations of space. For architectural design, the concept of time is historically regarded as an abstract and a priori entity whose effect is considered to begin after the realization of design in the physical environment. However, the articulation of virtual and actual as an architectural process has potentials to break the traditional assumptions about architectural space and time. For such a process, space is not anymore conceived as a static entity for design. The constitution of space in the conceptual level of design cannot further be considered without its relation with time. Thinking architecturally "actualization of the virtual" necessarily suggests a process. Thus,

instead of distinct conceptions of space and time, the design emerges as process-based, so offers the consideration of space-time continuum. The primary contribution of that process can be suggested as to open discussions on the renewed conception of time for architectural design.

The exploration of the selected projects has shown that their design process involve the concept of time at the conceptual level of design. By the concept of time becoming a computable design parameter in the digital design environment, its articulation has expanded architectural thinking into new models of design.

This study explored the latent potentials of digital environment by pointing out the proposals of the projects that exemplify the concerned process in architecture: Aegis Hyposurface, Transport Muscle, Digital House and Fresh H^2O Expo. Having been generated by virtual means, what is important about these projects for this study is their insight into the contribution of virtual realm to built environment. This study investigated these projects in the scope of their contribution to the emergence of a new understanding in space and time considerations.

Each of these projects has different qualities to be observed according to this study. The principal differentiation is exhibited by the mode of reciprocal transformation that takes place in the physical environment. For example, while Aegis Hyposurface, Transports Muscle and Fresh H^2O projects imply a physical deformation in their structure, Digital House interacts by the “smart skin” which is an LCD screen that conveys the information flows. In Digital House, the responses are given by the screens that act like interfaces, so, instead of a material one, only an immaterial interaction is exhibited in this project. The availability of different modes of responses proves that different forms of interaction are possible in order to provide the reciprocal transformation in the built environment.

In this study, the digital design process and spatial quality exemplified with the selected projects are tried to be understood through a reading of “actualization of the virtual”. The new relations they generate in the constructed environment are

considered as related with the “reciprocal transformation” of the design-object. The interactive and responsive built environments direct the user to unusual experiences. Unpredicted responses pre-configured by set parameters enable an indeterminate conception of space and a non-linear sense of time.

For this study, architectural concerns of the notions of space and time are introduced due to their consideration in the conceptual level of design, and their presupposed effects in the built form. Therefore, in the digital design process two processes are identified with the framework: form generation process with realization of the possible and, parametric design with actualization of the virtual. On the other hand, the discussions for the constructed environment have been developed in two ways: one is between autoplastic and alloplastic space, and the other between linear and nonlinear understandings of time.

The discursive fields introduced through the examination of the projects are stated with conceptual pairs with form-unform, autoplastic-alloplastic space and linear-nonlinear time. As well as other fields of discussions inaugurated, the framework suggested by this thesis can serve as a tool to interpret design approaches of other projects. As every project develops different ways for its realization in physical environment, the process of “actualization of the virtual” will give birth to new conceptual fields. This thesis claims that, with its every different couple of actual, the virtual has the potential to offer new discursive fields.

As a conclusion remark, this thesis has a claim that the examined digital design process and spatial qualities offered thereby have potentials to raise new discursive fields for architecture, which will in turn contribute to architectural discourse by speculating the very fundamental assumptions of space and time.

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