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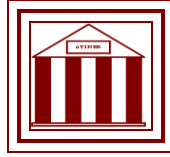
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Architecture of Electronic Revolution

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An Introduction to
ATINER's Conference Paper Series

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Abstract

Scientific and technological developments in the 20th century have become inseperable parts of every field and moment in life. These developments have a strong influence on the last century's and today's architecture.

The alteration that emerged after the 19th century Industrial Revolution hadn't understood sufficiently yet, in 1960's the second Industrial Revolution was made happened by the rapidly growing technology. This revolution is based on silicon chips. Due to chips and microchips computers become widespread and portable.

Computer technology has influenced architecture considerably. In 1980's personal computers became widespread and computer usage became very important in architecture. So computer-aided design and drawing programmes were developed by the big software companies.

The Electronic Revolution and computers are not only a technological changing, but also shows an alteration of our tecnological senses. This changing is as important as the ones that happened in the beginning of Renaissance and just before the first Industrial Revolution. These alterations have both changed the architectural design methods and men's view of design and production and even the understanding of the world.

It is apparent that the computer changes the structure of knowledge radically. So the architectural thought has changed by the terms like speed, machine, mobility, …etc. In this research, the alteration in architecture has made by Electronic Revolution since 1960's is analysed.

Keywords:

Corresponding Author:

Introduction

Today's architectural process points out important changes. These changes can be likened to the effect of development of perspective and invention of printing press in Renaissance on architecture. It can be said that printing press and perspective were placed with Electronic Revolution, in other words computer and internet. More importantly, architecture responses these changes more quickly than Renaissance period.

Electronic Revolution started with the invention of chip in 1954 and then microchips were developed in 1959 and microprocessors and personal computers were developed in 1971. The effects of these developments found its place in communication, transportation and space technologies quickly. Its reflections in architecture could only be possible with the development of personal computers and related software in 80's and its becoming widespread in 90's. The spirit of digital technology created by Electronic Revolution influenced the world of architecture rather than its products and found its place in the world of architecture conceptually. 1980's are the years when personal computers emerged and computer-aided design programs become accessible (Menges, 2010). Although these technological developments were not used until 1980's, they have created a new world, accelerated communication and brought out the term globalization. Together with the globalization, architecture gained transnational identity, therefore designs emerged through interaction of different cultures. This situation caused terms such as time, place and space to be redefined.

In 90's it is seen that the effect of electronic revolution on architecture improved and increased together with the development of personal computers, and computer programs becoming more accessible. Now it is possible to talk about a new kind of architecture. According to Mendes (2010) usage of computers in architecture can be classified in three groups such as "Digital form definition, computerized form finding, computational form definition".

Undoubtedly, another improvement brought by electronic revolution and computers is internet. Internet has a structure which accelerates alteration, propagates knowledge and changes the content with the virtual world it has created. The years when books are published and cheapened are revolutionary years in the history. Today internet has the similar effect. Communication theorist McLuhan says "Content changes with the change of instrument". In an environment where knowledge is such accessible and speed factor bursts into prominence, there would be revolution and content changes in architecture as in other fields.

In this study, the change of architecture is analyzed in parallel to specific important changes brought by electronic revolution.

In Parallel with the Electronic Revolution, Changing the Architecture 1960-1990

60's reflect disappointment created by modern world, the world of machinery on one hand while they are the years when modern architecture came to an end and postmodern architecture started in parallel. This beginning blesses the new spirit, the spirit of digital technology created by electronic revolution. Various architectural thoughts have emerged throughout this process.

The place of 1960's in architecture is therefore important and technological developments of this period led architectural quest of new era. Architects of this period adopted the responsibility of meeting the spirit of era, advanced technology of electronic revolution with architecture; similar to efforts of architects of modern period in meeting architecture with machines which are the spirit of era. The most important instrument of this would be computers which are the most important product of high technology.

The foundations of computer-aided design were laid with the first computer graphic system in the midst 1960's and advanced significantly in a short time compared to the history of humanity; such as fifty years. In 1960 sketchpad project was developed in MIT, in 1969 the first commercial solid modeling program was launched with the name of 'SynthiaVision' (Özlüdil, 2005). In 1976, the first design system was introduced with the name of AD-2000. In 1978, raster screen was used for the first time (Özlüdil, 2005). However computer did not address personal use in 60's-70's. In spite of this, the terms 'technology' and 'speed' which were brought together with computer directed the world of design. In this period, the world and dreams created by computer reflected on architecture, rather than the computer itself. The speed provided by electronic revolution to communication, transportation, cold war and space technologies began to be related and discussed in architecture with different methods. Cases of mass production, flexibility, consumption, mobility, incongruity considered by technology and speed began to be discussed in architecture and tried to be used in designs. This situation was corresponded in projects of Archigram, metabolism movement and Hi-Tech architecture.

Hi-tech architecture is the outstanding argument scene of this era. Quest for innovation started in buildings in the sense of material and construction technique and opportunities provided by advanced technology was utilized in the field of architecture. We can mention usage of machine simulation frequently in this era. However interpretation in architecture has changed like the changing machines of electronic revolution and structures of modern architecture which operate like machine were replaced with structures of postmodern architecture which seem like machine (machine aesthetics). Demountable, portable… etc. structures which seem like new machines of electronic revolution and its discussion was launched in architectural environment.
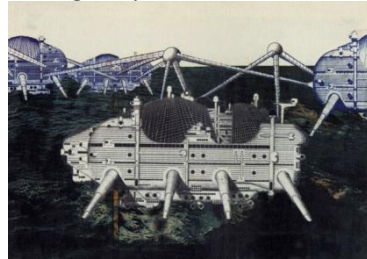
Figure 1. *Archigram – Walking City in 1964*

Figure 2. *Kisho Krukawa – Nakagin Capsule Tower in 1970*

Figure 3. *RenzoPiano – Centre Pompidou in 1971*

Pompidou Cultural Center which was designed in 1971 by Renzo Piano and Richard Rogers is one of the best examples of Hi-tech architecture. Charles Jencks (1997) defines this structure as "A celebration of technological systems".

As we arrive 1980's, there were more innovations in the field of digital design and production technology compared to previous years. In 1982, Autodesk which has a great share in the field of computer-aided design today was founded. First versions of Autocad began to be introduced into the market. The version of Autocad which has three-dimensional functions was introduced into the market in 1985 (Özlüdil, 2005). 1980's are the years when the foundations of three-dimensional design were laid.

In spite of these developments, computer was not used much in the area of architectural presentation in 1980's since high-technology computers of this era were not easily accessible and people rejected leaving traditional drawing methods. In this period, computers were rather used for analysis of design and environment, control of construction processes (Menges, 2010).

'90's

In 1990's technological developments started to change instruments thereby content of architecture. Digital design technology which started to improve rapidly in 1980's sustained its uptrend with an increasing momentum in 1990's. 3D Studio was introduced into market by Autodesk in 1990 and the version of Autocad which can operate in Windows media was introduced in 1993. Users of Archicad reached 40.000. Render technology started to be used in this period. In 1993, rendered image of product could be taken in new version of CATIA (Özlüdil, 2005).

As a result of improvement of render technology, observing buildings before they are constructed changed presentation and design processes. Observing three-dimensions of buildings simultaneously during design changes and accelerated design processes.

Deconstructivism which emerged towards the end of 1980's found a way to state itself better. Architects such as Zaha Hadid and Frank Gehry produced their designs in the sense of deconstructivism. Deconstructivism started to be discussed in the field of architecture towards the end of 80's. Harvey (1990) defines deconstructivism as the movement which started with interpretation of Martin Heidegger by Derrida in the end of 60's. Therefore, deconstructivism reflected on architecture 20 years later. The perception of new form which was brought by deconstructivism advanced further together with the improvement of technology and could be built in this way.

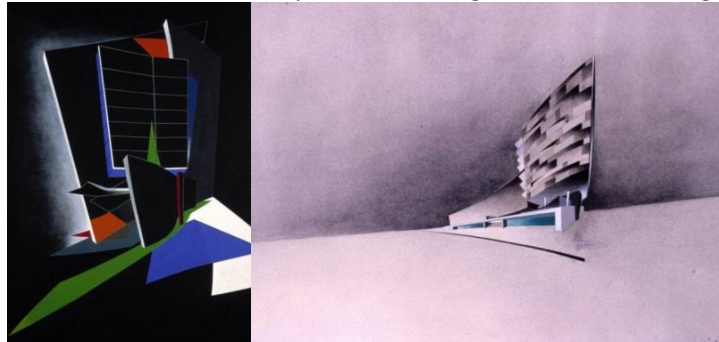**Figure 4-5.** *ZahaHadid – Azabu-JyubanBuilding and IBA Housing in 1986*

Figure 6. *ZahaHadid – 59 Eaton Place in 1981*

Although Zaha Hadid was one of the architects who could use computer-aided design technology of 2000's most effectively, she stated her design through hand drawing and collage method which are traditional methods in this period. Lebbeus Woods (2008) recalls his dialogue with Hadid:

'... Being one who drew, I asked her what brushes she used. Redsable? Without a comment, she showed me a cheap paint-trim 'brush' that can be bought at any corner hardware store – a wedge of grey foam on a stick. I still remember being shocked into silence. Years later, I came to understand her choice of tools as characteristic of her approach to architecture: wringing of the extraordinary out of the mundane.'

Guggenheim Museum which is one of the most ostentatious examples of deconstructivisim in 90's and designed by Frank Gehry has an important place about usage of digital design and production technologies in architecture. The building was modeled with real 3D and titanium pieces which make the façade was produced in factory with computer. The structure can be accepted as the start of a new era (Sorguç, 2010).

Jodidio (1997) explains the importance of computer in Gehry's design as such:

"... Here a sophisticated computer program known as CATIA, used by the French plane manufacturer Dessault to design the curves of fighter planes, has been harnessed to permit the creation of unusually elaborate shapes. Because of the flexibility of the computer-aided design process, both working models and final production drawings can be matched to a manufacturing process that makes it possible to control costs while creating unique forms. Despite his artistic temperament, Gehry's importance lies here in his capacity to make technology do his bidding while solving the practical problems of construction."

Figure 7. *Frank Gehry –Schnabel House in 1989*

Figure 8. *Frank Gehry – Guggenheim Museum in 1997*

Although Gehry is such addicted to computer in the entire construction process, in an interview dated 1995 he asserts that he works with sketch in design process and hates all images of computer. Gehry stated that he sued computer in order to persuade customer and build up inclined planes and insisted that he did not like computer. However his negative thoughts about computer-aided design would change in 2000's as he stated as such in an interview[1]:

> *"Thanks to CATIA's, cost and time-consuming actions like for example approval of the electricity project can be solved online. Additionally different kind of orders associated with organization and supplies of material can be developed."*

In this way, the effect of technology on form design and construction stage was accepted personally by Gehry.

Figure 9. *Zaha Hadid – Lois & Richard Rosenthal Center in 1997*

Figure 10. *Zaha Hadid – Vitra Fire Station in 1990*

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[1]Available at http://news.arcilook.com/news/key-role-of-catia-for-architecture-creations-of-frank-gehry/ [1 May 2013]

Figure 11. *Coop Himmelblau – Academy of Fine Arts in 1992*

Towards the end of 80's, discources of Hi-Tech architecture were replaced by ecological concerns gradually and by Eco-Tech in 90's. Computer technologies have great share in the design and construction of these buildings which have ecological priority and minimize energy consumption… etc. Norman Foster is one of the pioneers of this attitude. It is seen that he uses dynamic cover coats and forms. It is clear that this case results from the fact that designer is influenced by the new world created by advanced technology.
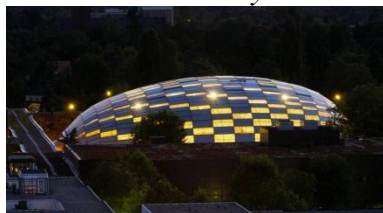
Figure 12. *Norman Foster – Sainsbury Centre for Visual Arts in 1974*

Figure 13. *Norman Foster – City Hall in 1998*

Figure 14. *Norman Foster – Free University in 1997*

2000 - …

Render technology advanced considerably as of 2000's and began a presentation technique which is being used by architects frequently. In this way, it can be observed how the building is seen in real, how it would receive light, what kind of an internal design it would have, its relation with environment and problems that may be confronted during construction.

In this period in which intensive technological developments are experienced, architecture was also influenced by these developments. 3 dimensional design programs becoming more accessible and practical, computers gaining acceleration and providing opportunity for these designs caused form to change. There are no geometric acceptances in digital technology. Therefore this situation reflected to architectural forms as well. Philip Jodidio foresaw in his book (1997) that;

'Concentrating on Europe, the United States and Japan, this survey has attempted to demonstrate that a number of factors have given rise to new forms in architecture in the past ten years. Naturally, the factors that influence architecture, from the economy to the spreading use of computer-aided design, are numerous. Some of these factors, such as the computer, are so powerful that they will continue to transform the shapes and function of architecture at an accelerating pace in the years to come.'

As Jodidio said, technology has significant influence on the forms of architecture today.

Zaha Hadid and Coop Himmelbau who interpreted deconstructivism over basic geometry in 90's makes designs by using rather flexible forms in 2000'. However it would not be possible to relate distortion in forms with deconstructivism.

Figure 15. *Zaha Hadid – Heydar Aliyev Centre in 2007*

Figure 16. *Coop Himmelblau – Martin Luther Church in 2008*

Figure 17. *B+U – Taipei Performing Arts Centre 2010*

Jodidio (1997) tells the effect of technology on architectural forms from Nancy Solomon as such:

> *"CAD/CAM means more than the fabrication of repetitive elements. In the field of architecture, where each final product is unique, CAM also facilitates a more complex, dynamic process in which sophisticated three-dimensional computer models of projects are made available to contractors and their subcontractors as informational tools to clarify fabrication, whether by traditional or robotic techniques. With such software, the architect can document complex, irregular shapes and generate more detailed construction documents for the fabricator. As a result, the practitioner not only broadens creative opportunities, but also streamlines the construction process while maintaining stronger control over design."*

In recent years, development of computer technology and software has broken new grounds in architecture. Development of digital design technologies brought a type of design which is called parametricism. Patrik Schumacher (2009) describes parametric design as a new avant-garde style of architecture. *And added that parametricism was evidenced at all scales from architecture to interior design to large urban design. He also described Kartal Pendik Masterplan Design, designed by him and Zaha Hadid, as a parametric design. A city includes "coherently differentiated city scapes" (Schumaher, 2009) and different heights and widths. So these circumstances, the order of a city* can be designed as a rhytmic flow. *These variations of a city can be designed by the means of parametric design.*
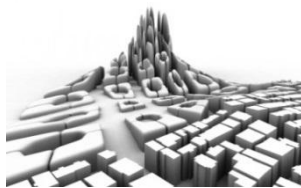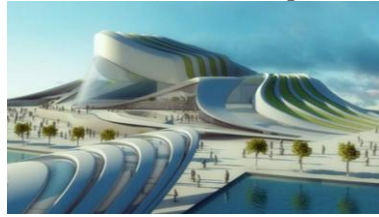
Figure 18. *Zaha Hadid – Kartal Pendik Masterplan in 2006*

Figure 19. *Coop Himmelblau – Pavilion 21 Mini Opera Space in 2008*

Figure 20. *Diana Quintero De Saul – Busan Opera House 2012*

Coop Himmelblau also used parametric design method in Pavilion 21 Mini Opera Space. Two songs were used to form the building. That songs' frequency sections were analysed by computer and translated into the form. The pyramidal order was shaped by means of parametric scripting.

In this design method, an abstract situation creates a design with computer generated 3D model.

An intensive technologic consumption era started in 2000's. mobile devices become widespread, therefore it has become possible to experience technology in any field. Internet become available everywhere, the speed of communication increased. With the improvement of communication media, people can be informed of any event which occurs anywhere in the world instantly.

In this period technology transforms rapidly, new versions of computer programs are introduced more frequently and advanced versions of devices are introduced into the market before the previous version is consumed. Although architecture is not consumed as fast as technology, it has become and object of consumption and surrendered more to the novel one. This rapid propagation and sharing environment provided by internet has some negative aspects much as positive ones. Architectural product has become marketable product presented to market. When there is a marketable product, package of product in other words new presentation techniques of computer technology have gained importance and even got ahead content most of the time. While architects can access qualified information and architecture easily and in real-time, on the other hand this situation may also result in easily consumed fashionable forms and popular architecture. Efforts for keeping pace with speed and showing up in the market transform architecture into rather complex organism which involves-requires fields other than architecture. Just like printing press, internet provides important changes to architecture as well.

Things provided by advanced technology influence architecture as well as our life deeply. We can discuss not only replacement of pencil and paper with computer but also change of design processes, forms, content, architectural performance… etc. The relationship between technologic developments and architecture can be seen more clearly in the graphic below.

TIMELINE of ARCHITECTURE and TECHNOLOGY
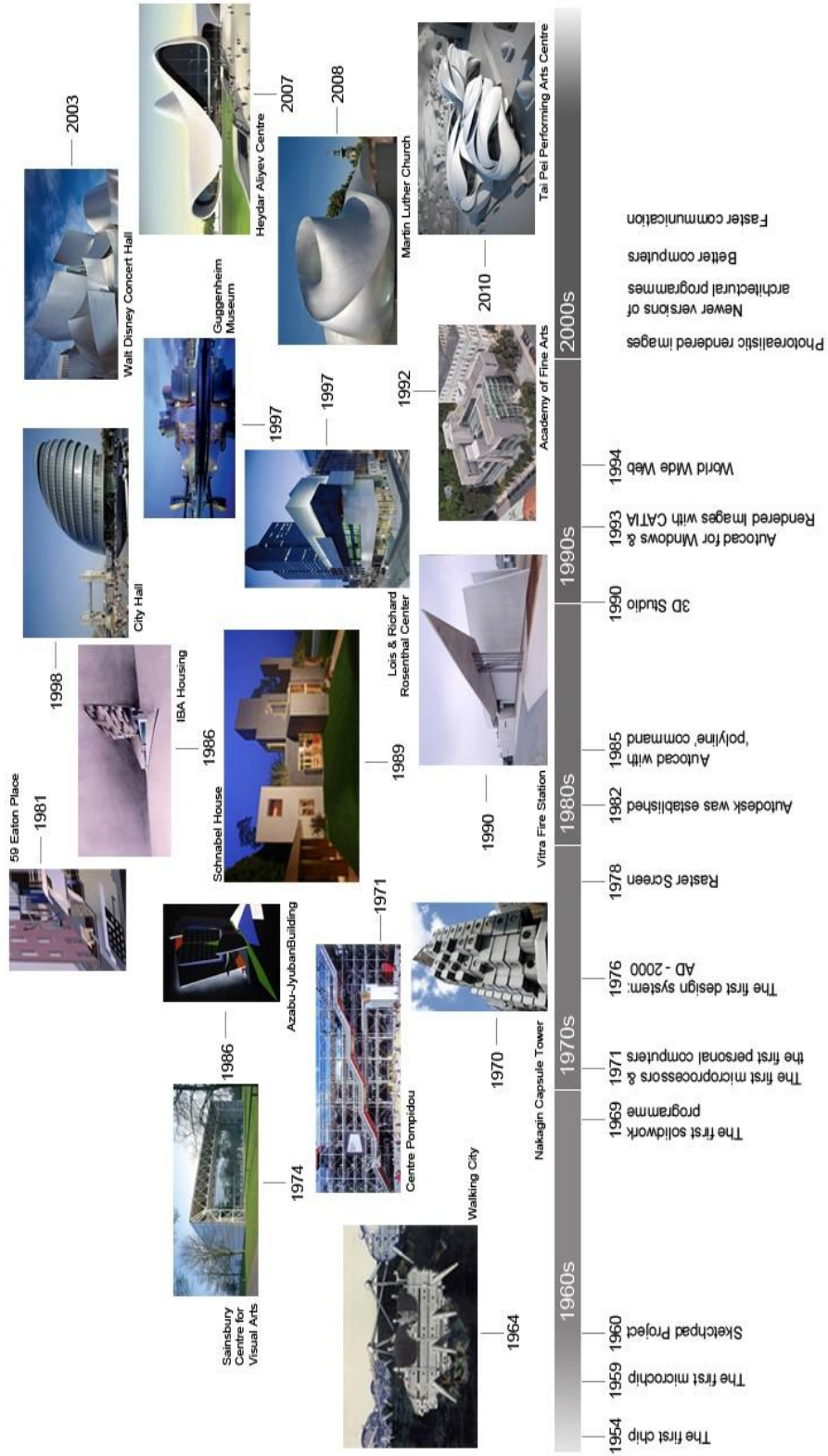
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Figure 1. Available at
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Figure 2. *Available at*
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Figure 6. *Available at*
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Figure 7. *Available at*
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de-saul/ [10 May 2013]