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THE EFFECTIVE TECHNOLOGICAL FIELDS IN DEVELOPMENT OF MODERN ARCHITECTURE

ABSTRACT

Technology has always played an important role in improving the quality of human biological space at various timescales. Indeed, alongside each architectural movement, technological changes in building materials can be seen. The evolution of technology, especially after the industrial life style and human revolution, requires serious reviews and investigations. It means, by its reading and investigation it is possible to grasp the correct understanding of modern architecture and apply them in the analysis of modern styles.

The acceleration of industrial evolutions after the invention of the steam engine caused widespread changes in all aspects of human life, especially in cities and architecture. As a result, changing in the way of lifestyle and human affiliation on industrial productions increased day by day, but the adaptation of architectural issues with these developments require passing of times. As a result, like the former, technology regains its position in the shaping of place in the architectural design. The main aim of this study is (1) the accurate evaluation of this trend, (2) the affection of architectural technology, especially, in contemporary times, and (3) its results in shaping and organizing locations.

Keywords: High-tech architecture, the quality of biological places, technology, globalization.

1. INTRODUCTION

The technology is recognized by architecture. It means architecture is created from the ventricle of technology. This aspect is true for not only in modern architecture but also in classical architecture and first man-made buildings too. The term “Tech” itself is the proof of correctness; because mentioned term originally comes from Greek. One of the main reasons for cutting modern architecure architecture from the neo-classic of the nineteenth century was getting the architecture away from its original. It means, in neo-classic the appearance of buildings was made in classical (Renaissance) form but in accordance with the new technology of that time. In the nineteenth century, Doric, Ionic, Corinthian shaped buildings with steady pillars were hard to find (Süyük Makakl, 2010).

These conditions were made modernist and worried architects upset because of time transformation and new technological features. As stated by Berlage “The apparent architecture is a lie” can be a proof for this claim, these type of claims can depict the sadness and anger of architects of that period. Furthermore, Berlage in the Stock exchange building revealed how can state the new technology in the proper language, where he exposed the steel trusses of the building to the public view.

2. THE RELATIONSHIP BETWEEN MODERN ARCHITECTURE AND TECHNOLOGY

In initial architects of modern architecture, especially in the first years, the long-standing and immortal link between architecture and technology is obvious. For example, in Domino house (1915), Le Corbusier was depicted that, the foundation of any architecture was associated with its structure. Mies

van der Rohe, always emphasized in his words in the technological classroom, which is stated obviously and beautifully in his works. With Mies's insistence, the name of Armour Institute converted to Illinois Institute of Technology .Also, he was the designer of philosophy for teaching, building and campus of mentioned university. As presented by Frank Lloyd Wright who recognized as orogenic architecture, the architecture should come from the maternal ventricle and not from the baseless desire of every vulgar dreamer (Asadi, 2004).

Therefore, modern architecture was born from its origin denotes technology. Accordingly, it's not true to state that architecture firstly has been changed, then it was developed, or due to advertisement of recent decades, the modern architecture has been cut from its historical root (Soltanzadeh, 2005). These type of dialogues are some incoherent and absurd statements from Charles Jencks, and he has found some disciples such as Vincent Scully who was not noticed the main aspect of modern architecture, the historical forms of old decades was what modern architecture rejected and it doesn't have relation with the technology of our time (Macdonald, 2001).

3. DIFFERENT MEANING OF TECHNOLOGY IN THE MODERN ARCHITECTURE OF EUROPE AND AMERICA

In order to see the effect of technology in modern architecture, the manifestation of modern architecture must be understood in Europe and on the other side of the Atlantic (USA). Although, there are many similarities between these two phenomena and also many changes and evolutions of modern architecture of the USA especially in forty and fifty decades of the twentieth century, but it should be noted that the architecure of USA have association with architects with European origin, by the way, as mentioned in this study, recognizing the roots of modern architecture in both continents makes human's mind more discerning and perspicacious (Jencks, 1995).

3.1. The Role of Technology in the Development and Redefinition of European Architecture

In Europe, the manifestation of modern architecture was the response of nineteenth-century obscurantism (old-fashioned). Architects of those periods regardless of new technological features and new construction materials were following old forms and concepts. Hence, in the study and investigation for the roots of modern architecture in Europe, most famous scholars are describing and analyzing about buildings like; crystal palace, world exhibitions, factories, warehouses and bridges, Why? Because, in such buildings, innovations of technology are have been depicted. In other words, new techniques of buildings are more effective than banal architecture (Salahedin, 2016). Many architects of that time were tending to follow old ways, most of them were similar to classical architecture, such as; Renaissance, Baroque and Rococo, and the construction approach was archaic and old. Thus, thick walls and pillars continued to carry the construction load. The opening relatively was small and slight, apertures were narrow and prudent, and spaces were spiral and dim. The building view was indiscriminately and without symptoms, it means, the kitchen, bedroom, stairs and other parts of the buildings from outside looks similar (Lyons, 2015).

Contrariwise, in the modern architecture of Europe and the USA, their own and particular qualities manifested. Firstly, the freedom of building from its load endurance in comparison with classical form. The buildings, which must be constructing quickly, such as; industrial buildings and world exhibitions and the bridges which are merely engineered become a pattern for architects. Therefore, architects and architectures opened their eyes for new technology and features, eventually, it turned into the modern architectures which are recognized nowadays. The buildings without pillars and thick walls and also with wide openings as well as continuous and bright spaces, these type of spaces can adapt themselves with future demands. The term "free plan" which have been introduced respectively by Le Corbusier and Mies van der Rohe et al. have been emphasized on the effect of technology on architecture. This belief of Le Corbusier on technology and it's an effect on architecture was progressed till he was stated "home is the living machine", but at a later time this phrase has been abused by his malicious enemies (Vellinga, 2006).

3.2. The Role of Technology in the Structure of Modern American Architecture

In the new continent (USA), modern architecture was reached the same conclusion as Europe, but with some different opinion in contrast with Europe. In the USA, neo-classical architecture was not rooted the same as Europeans, hence, modern architecture as the response cannot be assumed. Modern architecture in the USA was flourished from seeds which were planted in America. One of the architect scholars from France named Leon de Laborde, after watching American industrial objects which were made and designed simply has been represented that "an industrialized nation which is turning into an artistic nation". At the later time, this mentioned phrase in the book of Kuno Franke, the invited professor (1908) of Harvard University was taught. After two years, he published the book with the theme of praising Frank Lloyd Wright (Tzonis and Lefaiver, 1996).

Therefore, the modern architecture in the USA did not directly respond to the European rooted neo-classical architecture, but the specific conditions of this continent were its major motivations. Abundant resources and a shortage of skilled workers who could simulate or imitate the architectures and complex components of old European architectures were top factors which affected the architecture of this country. Thus, from the beginning, a kind of simplicity in American architecture was emerged, which later became an approach to works on the importance of modern architecture. But - especially as a discussion, it is interesting to note that behind this simplicity, the technology derived from the conditions of this country played a major role. For example, the invention of a pin in the USA as a simple technological tool for utilizing on trusses junction instead of tongue and groove (common of European carpenters) is recognizing as a tool which developed the building industry (Jodido, 1997).

In later years, this simple tool which has emerged due to the necessity of time conditions in the United States were followed by modern European architects. That's why what happened in the USA, caused Europe's attention. The reason for becoming famous of Frank Lloyd Wright in Europe before America was the specific qualities of American's architecture. Adolf Loos, the Austrian architect, who called decorations as the felony of architecture was fascinated by the work of Louis Sullivan (an American architect). So that, it can be understood the notice of European on the simplified and unaffected technology of America architectures (Venturi, 1980).

But the impact of technology on modern American architecture is not limited to a simple tool like a pin. The use of metal skeletons instead of thicker loader walls in skyscrapers of Chicago and also the invention of elevators of this city are the evidence for the important impact of technology on the modern American architecture and around the world. It should be noted that the relationship between America and Europe was based on a mutually supportive and bi-directional effect and also the technology was played the most important role in this connection. By the way, what's happening in Germany is also must be very important in this discussion (Charleson, 2014).

3.3. The Role of Modernism in Technology's Replace of Architecture

The famous Bauhaus School of Architecture in Germany with the headed of Voltaire Gropius was the first and only school of architecture in the world. On that time, Bauhaus School was the only school which accepted modern architecture. The teaching of art, architecture and urbanism which calls "industrial design" in this school was about modernism. Indeed, the efforts of Walter Gropius, Peter Behrens, Ludwig Mies van der Rohe, and the group of art and famous architectures of that period, were focusing on the emergence of reconciliation between art and technology (Schulz, 1988). In contrary to John Ruskin and William Morris, who considered technology as the enemy to the originality of art, those architects believed in technological innovations. They could see the transformations of the future obviously, it was a point which was proved by history nearly in one century later. It is interesting to be noted that, on those years until fourteenth decade of the twentieth century, the famous school of Bozar which was recognized as the exemplified school for the most reputable and important schools of the architecture in the world such as M.I.T and Illinois (both of the oldest architecture schools in the United States) were still in the rabbit's dream of neo-classicalism of 19th-century. But Bauhaus school did not last a long time and became the victim of the Nazi dictatorship. Eventually, the school with the head of Ludwig Mies van der Rohe was closed by the pressure of Gestapo police in 1938. The school by efforts of some professors and students was continued at the warehouse in Berlin. Walter Gropius had left school and then Germany a few years before that. Gropius firstly went to England and then to the United

States and eventually went to the school of architecture as the presidency. And at the new school, Gropius taught and advertised the principles of architecture school and what was he agreed upon the technology and art reconciliation (Jencks and Baird, 1970).

Mies van der Rohe after closing the Bauhaus school decided to go to the USA by Self-imposed. In the USA he established the architecture school of IIT (Illinois Institute of Technology) and then he decided to become the head of school. In the following, he managed the school with his best friend and colleague Hilbert Zimmer until the late sixties of the twentieth century .Mies van der Rohe was truly enchanted of technology, although he was a taciturn person the importance of technology was emphasized in many words of him. He believed that if there was one way to develop the architecture, it would be through technology (Emmitt, 2013).

Maybe some of the beliefs of Mies about the architecture originated from his German spirit. Basically, in this field, the Germans believe in constructing more. Until a few years ago (and perhaps till now), architects in Germany, before taking up theoretical lessons and architectural design, they had to learn construction and carpentry for a while in order to learn to construct from the beginning. This approach was not common in America, France and England (Süyük Makakl, 2010). Furthermore, in Germany, the term "architecture" was a very common word, but originally this word comes from Greece and it denoted to construction, but this word now is disappeared. As represented by Baukunst, this word means "making art". It shouldn't be forgotten, in some of Mies's work, the tendency to Statue and the forms with not cutting lines with 90 degree angel were very obvious. But finally, he tended to use orthogonal forms because of the technology of the times. In his period, construction was simple by orthogonal forms. In other words, by the usage of those forms, they could utilize technology better and more as the determining factor of architectural essence. Mies believed to orthogonal approach, and he has utilized it till the last years of his life. For validation, he was utilizing the term "build or to build" instead of using "design" in teaching at IIT (Schulz, 1988).

These words which stated were about the days of Mies's flourish in his architecting. On that time, Le Corbusier had left his first approach, such as; multi-storey buildings of India and Ronchamp of France. Mies was constructing buildings with 860 Lake Shore or Seagram and ITI borders, and he also showed his strongest tendency toward technology in architecture. He even utilized technological aspects as a diversity of work and architectural innovation. With these buildings, many architects noticed the originality of technology and it's the role in architecture, hence, they were constructing tens and hundreds of such building. But what Mies created with the full power of emphasizing on originality of technology and with his own words was build, as he considered build itself was an innovation and began (Vellinga, 2006). More importantly, the technology was not as advanced as today. The standards of technology for Mies were the same as the long-standing relationship between the beam and the pillar. He gave the most important role to them and he were exposed to the public with a great deal of sensitivity and elegance. Hence, the following features must be increase: exposed trusses on the roof, exposed space frames, wide openings, usage of glass in unprecedented dimensions, and other aspects which have open, continuous and transparent space or a space with the combination of indoor and outdoor. Humans were progressed extensively and unimaginably in the decades after the sixties in technology (Rinn, 2004).

4. TECHNOLOGY AND ARCHITECTURE OF NEW BUILDINGS

For application the advanced technology in architecture the famous structures must be noticed, including Munich Olympic building, Hajj terminal in Jeddah from Fazlur Rahman Khan, Bangladeshi structural engineer; due to his work, it is not clear to understand where the architecture begins and where the structure comes to the field and tens of such building. The works of Santiago Calatrava, from Latin America who is recognized as the architect of the present era are depicting the perfect composition of architecture and structure. He has utilized some technologies in his works which seemed inconceivable in the thirteen or fourteen years ago (Motallebi, 2005).

However, the works of Mies and the examples which are closer to nowadays and those mentioned in this article are the usages of technology and advanced technology in contemporary architecture. But the advancements in technology and its application in architecture have not been limited to the structural aspects, and it has entered to every field of the manufacturing industry which can be applied in

architecture. Perhaps one of the obvious examples of this field must be the Centre Georges Pompidou in France. This building utilized most of the technological powers not only in structures but also in industrial production fields. And also it was exposed to the public. According to a few critics, all of the utilized components in Pompidou building are visible apparently so it looks like a huge factory. As they continued, the view of Pompidou doesn't look like a cultural place. Judgment, in this case, maybe a little bit early, but with any results, the Pompidou reveals the relationship between technology and architecture (Vellinga, 2006).

5. THE ROLE OF NEW SCIENCES IN THE DEVELOPMENT OF TECHNOLOGY IN ARCHITECTURE

Technology not only facilitates the constructions in many cases but also provides opportunities in the lateral arenas which bring much inspiration to the future of architecture. The following are the results of the technology on the global scale:

- The age of science and technology is a common gift in cultures, civilizations and technique of constructing.
- Hesitation, doubt, and positive results
- The emergence of a phenomenon named among culture (exact culture) or two-way link
- The emergence of universal culture, consumerism, justifying the creation of the same architectural spaces
- The field of sociology, economics, architecture as global phenomena
- National resources, global demands - modern architecture, multinational or architecture for everyone
- The charm of life, today, the same cultural demands

An interpretation which contemporary human beings offer for the material relation between objects and phenomena is being identical. In this respect, human beings have become very close. And it is because of the dominance that science has acquired in its positivistic meaning today (Emmitt, 2013). Hence, it can be claimed that global culture has been formed in this field. According to this field, the structure of the educational system and educational content in different countries can be briefly mentioned. This field has been existed in a coordinated path, especially after World War II. If the developments in science and technology, as well as the making of new materials, are recognized as the factors for the domination in the movement of modernism at the beginning of the twentieth century, IT (information and technology) has been created the transformation and great challenges in the production and design of architectural spaces. Especially after the modernist movement, the classical and traditional structures of production and space compilation of architecture were transformed. IT can be introduced as a revolution at the beginning of the new millennium. The way to influencing of that is direct with the very complicated and less visible path which was impressed the dominant figure of contemporary architecture (Sandaker et al. 2011; Lyons, 2015).

By looking at architecting of the twentieth century and noticing to the avant-garde architecture as a wave, it can be understood that the beginning of the wave will be the modern movement, and the ups and downs of the wavelengths would be the next movements. By the way, it can't be denied the movement which started by modernism and the wave which appeared by modern movement at the field of architecture. These conditions have opened the way for subsequent ups and downs. With all bugs and dilemmas of modernism, they can be known as the main motive and stimulant of this wave. Furthermore, some of the complementary movements were helpful in continuing the flow. The real revolution in contrary to the claim of Venturi (Complexity and contradiction) is developing by modern man-made technology means computer. The bases of this revolution in architecture have affiliation with a series of developments in science, technology and theories which occurred from 1940 to 1970. Indeed, the star of these changes is the computer, a very special machine in contrast with other previous machines (Pallasmaa, 1988).

6. TECHNOLOGY AND THE CREATION OF NEW STYLES IN CONTEMPORARY ARCHITECTURE

By investigation the transforming of science, industry and technology, and by assuming the industrial revolution as a result of those transformations, it can be understood that the emergence of the steam engine, combustion engines, the emergence of a phenomenon including railway and all of the other transformations were changed the face of the city. These transformations caused new concept spaces in architectural history, involving: railway stations, factories and etc. in the following, the growth of economic, demographical, cultural and scientific fields were also established other new architectural spaces, such as universities, exhibitions, community halls, cinemas, and the other spaces. Some of such spaces have historical records like theatres, the growth and reappear of these spaces were caused extensive fundamental changes in the history of architecture. The most important spurt after this period (100 to 200 years) was the advent of electronic science and new material, this advent was caused to the emergence of a phenomenon called informatics technology and information as well as computer. This phenomena directly and indirectly not only supported and helped the creation and designing the architectural spaces but also helped to teach architecture as well as communication and fast data transferring (Macdonald, 2001).

The iron, steel, glass, concrete and structural computing science are recognized as the most important aspects for modernist architectures in production, creation and invention of new designs, these aspects were helping Mies for constructing glasshouse and Le Corbusier for Ronchamp chapel. An unmistakable computer is the most significant factor Frank Gehry in the Guggenheim museum of Bilbao and for Eizenman in most of his projects (Salahedin, 2016).

With considering to these concepts and interpretations, the formation of a new concept in the architecture of space and the tradition of space design in architecture have been challenged and transformed, or maybe they are forming into a new state. This issue is being globalized due to regional, local and traditional concepts. In fact, this culture is changing and shaping permanently. In order to adoption, understanding and optimal utilize for improving the formulation of space, culture and civilization, the investigating and knowing must be emphasized better. As represented by Canadian architecture Alberto Pérez-Gómez (1983), technology cannot be the determinative factor in the architectural framework. Therefore, the proof and pursuit of such things must be considered in vain. He also stated, this issue is a very painful and detrimental thing (Jodido, 1997).

7. MULTILATERALISM

Two contradictory forces, global axialism and regionalism are forming the architecture of global and urban landscape. Global axialism is speeding up and accelerating through foundations that are spreading around the world. Regionalism is also tried to deduction the pressures of globalization: in economical field, Europe by desiring to be unit, USA by forming NAFTA group, and Asia by forming APEC group are committing to a case. This issue also is establishing in other fields, including commercial, social, cultural and etc. Thus, by respecting to these important movements, they have had a slow but effective consequence on contemporary architecture. All of these movements, transformations, and challenges were caused to appear phenomena named multilateralism. From a while ago, multilateralism has been mentioned in the political and economic sciences. Undoubtedly, it must be one of the new qualities and very complex aspect, which is challenging in our time soul. Consequently, through all of the reviewed details on this article, it can be stated; the multilateralism is identical to the issue which is dominant for some years in architecture and contemporary architectural designing in space. In fact, the mentioned issue is paying more attention to side issues for designing contemporary architecture (Vellinga, 2006).

Table 1. The Accordance of Technology and Architectural Styles in the Historical Period (Original)

The Employed Technology in the Style	The Instance Constructed Building in that Historical Period	Historical Times
Trilithon technology and Dolmen rocks for Structural systems	Stonehenge	The Neolithic era
Using bitumen and fasteners to strengthen buildings	Ziggurats	The Sumerian and Mesopotamian civilization
Using the beam, column and lighting systems to create a height difference	Egyptian Pyramids, Karanja Temple	The Egyptian civilization
Using the beam, column and combination of them with the central courtyard	Megaron plans type	The Anatolia civilization
Using of Doric columns (male's fitting) Using of Unique Pillars (Women's fitting) Using Corinthian columns as golden proportion Applying geometry and mathematics to the formation of architectural space	Greek temples	The Greek civilization
Using the vaulted structures, arches and domes in the architectural places designing	Coliseum, Basilica	The roman civilization
A. The conversion of Roman Basilicas into Church, using the central plan for the formation and optimal Use of the Dome. **B.** Use of carrier and revetment walls to release the plan. **C.** using of narrow and stretched walls, using of arches to create large openings	**A.** The Byzantine era **B.** The Romanesque era **C.** The Gothic era	The Medieval
Using the structures of the loader and adding the revetment walls and increasing the space of the courtyard, using the dome and the connection of Turn a square plan into a circular dome with a philosopher	Mosques	Islamic architecture (Ottoman period)
Using stretched structures and exaggeration in the displaying of decorative elements	The Baroque architecture	The Renaissance
The development in the construction industry, surpassing of structures from the architectural community, the application of technology and new materials, the use of iron and metal in the construction of structures	Spinning factories, bridges and railway stations	The industrial revolution
A. Using of naked reinforced concrete in buildings, the application function form in the buildings designing **B.** Using a minimum size in designing, removal of decorations, the use of new naked materials in the buildings, the start of high-rise buildings, the transformation of metal structures, the release of plans **C.** The technology displaying as a designing symbol and the conversion of architectural designing into statues, the function of structures in the term of the symbol in buildings. **D.** The use of superior technology in the construction of buildings, the displaying of facilities and structures in the building facades.	**A.** The Functionalism era **B.** The Globalization and Minimalism **C.** The Brutalism and structuralism **D.** The High tech	The Modernism
A. The combing of technology and environment, using of technology capabilities for environmental solutions and sustainability in architecture and urbanization. **B.** Deforming the well-known structure with the use of new technologies, using new building materials in redefining the architectural space. **C.** The tension of architecture, complicated architectural structure, The definition of new structural systems and the combination of structural elements in shaping complex architectural forms **D.** Using new materials in the shaping of architectural forms, Redefining architectural spaces using the capabilities of modern technologies, Using fractal geometry and computer technology in architecture.	**A.** Eco-tech **B.** Deconstruction **C.** Folding **D.** Parametric architecture, HyperSpace, Surface	The Postmodernism

8. CONCLUSIONS

With respecting to analyze the evolution of technology over time, the technology always recognized as a function of the architectural process and is one of the main elements of the formation and development of the site. Apart from the short period in the neoclassic style of the postmodern period that the architecture is recognized as a kind of apparent body which imitates the architecture of the classical era, it was placed on the building like a shell. Furthermore, structure and architecture were two separate elements in other ears and styles, also, these two have always been used as complementary to each other. Indeed, technology has never been separated from the architecture and always it has been formed the soul and body.

Comparing various eras with the growth of human knowledge and technology has led to the promotion of architectural sites. In recent periods, especially after the environmental crises, climate changes, and global warming due to greenhouse gas emissions, the technology with architecture have been tried to solve these problems. In fact, Eco-tech has been the answer to this problem. Architecture after modernism, especially postmodernism, has been integrated with technology more than before, and more precisely, technology has transformed the shaping of architectural places. With regarding statements and the analysis, it can be claimed that technology is the spirit of architecture and in order to read architectural works and afford a place with optimal quality, searching, unison and connection with technology are significantly required.

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