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Drawing Tools Used from Past to Present in the Architectural Design Process[#]

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Abstract: Drawing tools used in the design process are continually changing as a result of developments in technology. Computer aided drawing tools offer new capabilities to users as an alternative to traditional drawing tools that have been used to this day. These new capabilities are of a nature significantly affecting the design process. This study examines the effective use of traditional and computer aided drawing tools in the landscape design process. In this respect the scope of the study includes design, design processes and drawing tools. Especially, under favour of rapid developments in information technology in the last 20 years, design process has become shorter, achieving a solution has become easier and there were presentations which have been produced in higher visual quality.

Keywords: *Design, design process, drawing tools, traditional drawing tools, computer aided drawing tool*

Introduction

Drawing tools play a significant role in solving problems in regards to design. The only way for a designer to reflect their ideas into a physical reality is through the use of drawing tools. With changes occurring in the field of technology and design the use of drawing tools have also changed and improve. While only the ***traditional drawing tools*** were used in the past, nowadays ***computer aided drawing tools*** are also being used. This has led to positive changes being observed towards finding a solution to the design problem. The development of drawing tools has eased effects such as accessing results, shortened drawing cycle, easier understanding of details, ease of archiving, and the ease of modelling which to this day is further advancing with computer-aided drawing tools. Drawing tools play a crucial role in solving the design problem; the only way to obtain physical reality of the ideas visualized by the designer is through the use of drawing tools. A change in technology and design field has resulted in the use of drawing tools to also change and evolve.

In the past, only ***traditional drawing tools*** were used, but nowadays, with the use of ***computer-aided drawing tools***, positive changes are shown in solving the design problem. The ease of access, shortening of the drawing process, easier recognition of details, ease of archiving and ease of modelling effects have been further advanced and become more and more common with advanced computer-aided drawing tools and reached the point where they are today.

Concept of Design

The word ‘design’ is used both in English and German but translated as 'conception' in French. Its definition is to imagine a plan, sketch or something similar, give it shape in the mind in order to produce it. Design is steps which prepare for the result obtained by an idea which has been put out in the form of a project or scheme. Art is the first sketch, picture, building or decoration feature summarized by a figure to bring out a work of art with the arrangement of elements and details (Beyazıt, 1994).

In design the greatest challenge is to take advantage of available information of the possible future. A successful result is attained in the degree of correctness of these possibilities (Cooper & Pres, 1995).

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The work done by the designer is the act of thinking and sharing the product by displaying it to other people and conveying the product to humanity results in the design made reaching the point desired. Design is when something considered as a problem emerges, imagining a concept in order to find solution to this problem (Cross, 2007).

Design process

Design is considered as a kind of problem solving act, the design process is common to all professions. Although the disciplines may change, the processes are always the same. Many departments in the faculties of architecture and fine arts use landscape design, industrial products design or fashion design, namely, space or object design aiming to solve problems no matter what the scale and all follows the same design process (Dağlı & Şahin, 2012; Erdoğdu, 2016; Gülgün et al., 2014).

According to Jones (1992) the design period definitions is a problem-solving effort directed at a specific goal. In case of uncertain situations not deciding to remove large errors, but to determine how to reach satisfaction and what was wanted previously by comparison being made and providing the most appropriate solution, obtaining the most convenient case out of the existing situation, a creative pursuit, resulting in new and useful status (Küçük, 2007).

In real life for an architect to begin with a design first requires the presence of an investor to or an employer. The investor who will invest, becomes more or less effective in the design of the architects by revealing their aims, financial possibilities or constraints, thoughts, demands, dreams, value judgments when necessary. The person to be satisfied with the design to be made is the employer who will approve the design. In architectural education there is no investor. This role is undertaken by the counselling faculty member. However, their investment is not to the architectural subject to be designed, but the students who will design it. (Onat, 2006).

According to Taşkıranoğlu (2003), in pre-industrial societies where traditional craft was predominant design and construction were not prevalent. Planning would not have been a part of the building prior to it being built. However, in modern industrial societies, doing and designing have become separate actions. Generally, the construction of an object does not begin until the end of the design. Nowadays, in the modern production process the designer plays a unifying role in every sense. Since the basic distinction is between design and construction work, at least one goal of the design process gains clarity. According to Bridges (2001) design it is a clear definition of what is to be done. (Taşkıranoğlu, 2003). Frederick (2007) defines the design process as something that often develops in the direction of a certain order and method, nonetheless it is not a mechanical process. The results are predetermined in mechanical processes; trying to produce something that has not existed previously in the creation process. Being creative in the real sense meaning that although they are responsible for directing the process, they do not know which direction it will go. Designers should not forget that 'the design process is not limited to the design problem' (Cross, 2007).

Designing process, as far as the psychological-mental process go is the whole transformation that takes place, it is also an education phase, it is a social communication and interaction process even when the implementation stages are taken into account. Social communication process contributes to knowledge and experience exchange; more importantly, a common architectural language, it contributes to the formation of professional ethics and culture. Student recognizes these processes and experiences of thinking together. Gökmen & Süer, 2003; Gülgün & Türkyılmaz, 2001).

Design Bielefeld and Khouli (2010) is complex, often conflicting, it is a nonlinear process. This is the basic feature of design, for both experienced architects as well as beginners in architecture. It is not known where the process will go, even if the details of the design problem are obvious. Design learning, requires knowledge of the contact and fulcrum points of any given design problem and the search for methods that allow the system of relations to be grasped. While architects later reconcile these factors with architecture, experience, spatial imagination and creativity. Every design leads to new questions that provides opportunity to acquire fresh information and create an appropriate result for the design problem. Design activity brings together everyone who deals with architecture is one of the most interesting aspects of business. There are also philosophers who divide the design process into different stages. Cooper and Press (1995) defined the design process as:

- Formulating the problem,
- Understanding the problem,

- Allowing conscious thoughts to be revealed,
- Creating the idea,
- Developing the testimonial, testing.

It is easy to see that the concept of 'knowledge' is also important besides the analytical point of view of probing. In almost all sub-stages, there are implications for the effective use of information in solving the design problem. They may need to be returned and redefined.

The designer goes on to the new situations in the solution, bringing out subconscious ideas and as a result the solution begins to form. Architectural design is in the group of physical design studies. Design studies related to landscaping / environmental regulation are also included in physical design studies. All of the physical design studies, which can show differences in purpose, content and scale, have a common design process (Özkan & Küçükerbaş, 1995). This process can be gathered in five stages.

Identification and limitation of subject-matter

According to Uzun (2004) determining the designs objectives, presenting the problems, researching their quantitative and qualitative properties, gathering wide range of information according to design are placed in order of step in the process.

Data collection

In terms of architectural design studies, data collection is everything the environment reflected without any comment yet, and that only the proper data are collected, work to determine the current situation (Gündüz, 1985; Yılmaz & Yılmaz, 2004).

Analysis and function diagram

Information containing basic ideas, where observations and experiments are made clearer at this stage and reduced to smaller units. Developing alternative solutions, analysis of available alternatives, material types, processing technique, expression power, function are analyzed and the synthesis of information and findings related to design goals is entered (Uzun, 2004).

Assessment

According to Özkan and Küçükerbaş (1995), collected and analyzed data according to the stage in which the desired activities are evaluated together in line with the design principles and the most appropriate solution is sought.

Synthesis

The result obtained is the final point reached by sifting many influences in the light of certain assumptions made by the designer (Özkan & Küçükerbaş, 1995).

Drawing Tools

Drawing tools to be used in the design process are a special case that varies according to the preference of the designer (Howard, 1993, Ketizmen, 2002). Items that can be defined as drawing tools, free hand drawing, model and computer-aided drawing. These tools, which have advantages and disadvantages, usually need to be designed combination all of the three (Ketizmen, 2002). Regarding this use, ***'The best approach is to identify and use the vehicle that will be required for each phase of the business'.*** There are no rules as to which rule will be used in each phase (Howard, 1993, Ketizmen, 2002). The only way the designer can show what they are imagining is by using drawing tools. For this reason, the designer must be able to use the drawing tools competently.

Traditional drawing tools

Drawings are divided into three main sections; concept diagrams, rough plan drawings. Drawing tools are made up of paper, pencil, ruler, ruler, T ruler, various drafts, plain and circular templates, mirrors, sketch paper, snake ruler, roll copy paper, presentation paper, curved ruler and cleaning sweeper. In order to use all of these tools a lot of attention and skill is required (Mitton, 2003).

Between 1400-1500 AD, during the early Renaissance period, the task of the builders was divided into various sections. These are the artistic architects who undertake the design and idea

phases, architects, practitioners, and designers. In the late Renaissance period, architects began to make architectural designs outside the construction area and created scale drawings (Figure 2). These drawings are made between the architect and other people involved in the construction, expressing the building and providing communicating. (Barrow, 2000; Küçük, 2007). The technique of expression with drawing is the main method of visualizing the design since the Renaissance period (Yıldırım at al., 2010). A drawing can be an object, a building, or any architectural element drawing, by using tone and colour (Figure1).

Drawings are divided into three main sections; concept diagrams, rough plan drawings and technical drawings. Drawing tools are made up of; pencil, paper pencil, paper, pencil, ruler, ruler, T ruler, various drafts, plain and circular templates, mirrors, sketch paper, snake ruler, roll copy paper, presentation paper, curved ruler, cleaning sweeper. In order to use all of these tools a lot of attention and skill is required (Mitton, 2003).

The technique of expression with drawing is the main method of visualizing the design since the Renaissance period (Yıldırım et al., 2010). 'Traditional Expression Techniques' made using traditional drawing tools (Yıldırım et al. (2010)) are explained as:

- Two dimensional drawings on paper
- Three dimensional drawings: perspectives
- Three dimensional models: model

Figure 1. Landscape architect who designs with traditional drawing tools (Özgün, 2011)

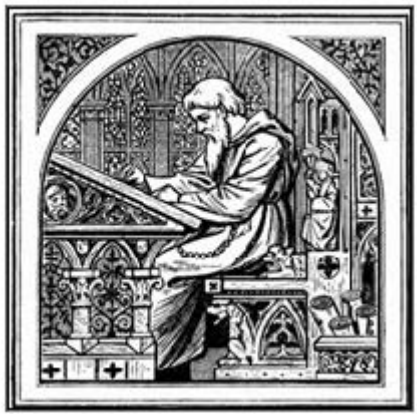

Figure 2. Architect drawing during Renaissance (Rönesans Hareketleri, 2011)

Computer-aided drawing tools

About 25 years ago, almost all drawings were made on paper with pencils. Small changes meant to erase, delete and redraw, whereas, major changes meant designing drawings from scratch. Computer-aided drawing tools changes all these operations from the base (The History of Cad, 2011). All these operations affect the speed of the designer in the designing process. The computer, which accelerates the drawing time of the students, also increases the time that has been separated for the design and allows the changes to be made on the drawing to be done easily (Figure 3). The 'Expression Techniques' made by using computer aided drawing tools (Yıldırım et al. 2010)

Explain as follows:

- 2D drawings,
- Drawings (plan, section, views),
- Three-dimensional models, modelling,
- Animation and photorealistic images.

The general structure of computer aided drawing tools are based on the interactive computer graphics system. In these systems for the user, the computer generates the data using the form and symbols according to the commands of the user, modify images and drafts, (Keskinel, 1985). The student is a designs or models by giving commands to the computer. With the influence of electronic technology in social and cultural fields, students experience their learning and learning in everyday life in new technological environments, they can change many facts on the screen by pressing a single key (Kurt, 2002). The processes carried out on the computer in the architectural profession can be realized in

three different ways (Özcan, 1994):

- Describing existing hand drawings in computer environment,
- Drawing a designed project,
- Designing from scratch directly on the computer screen.

The general purpose of architectural drawing program in computer environment, with the help of a functional algorithm, is to create a specific design and to provide the necessary support for these design-related processes. The classically created designs according to computer environment, results in the process being less sensitive, less detail, slower, and less technical. (Akın & Anadol, 1993). Computer technology can be seen as part of the art of twentieth century. It is thought that learning through technology can take its place in the world more effectively (Lasky, 1978; Ayaydın, 2010).

Historical development of computer-aided drawing tools accelerated in the mid-1940s when architects began to realize that even if things were difficult they started to change, speeding things up. Scientists and engineers, during wartime, have begun rumors stating electronic technologies will create profound changes in the character of the mental working environment (Mitchell, 1990).

In 1945, Vannevar Bush imagined a device that could provide information to people under the name Memex. With the 1950s, computers were beginning to enter into real business life, and in 1956, the computer-aided drawing we now of know including graphical input and three-dimensional object tools with multiple window indicators from different angles was identified as CAD (Computer Aided Design) workstation by Furtune magazine.

These machines are the basis for creative ideas to reach today (Mitchell, 1990).1950-CRT in MIT laboratories (cathode ray tube), simple images were produced using it as an interface (Mitchell, 1990). 1952-Numerical control concepts were developed on a three-axis milling machine in the MIT Servo mechanism laboratory (Küçük, 2007).Computer interactive graphics were first seen in 1963. (Hitomi, 1996). This system is based on the SkechPad system developed by Ivan E. Sutherland on the time-shared TX-2 computer in the MIT Lincoln Laboratory in the United States and is based on drawing with a light pen on a graphically interactive screen (Figure 4; Mitchell, 1990).

Figure 3. Landscape architecture using computer-aided drawing tools (Özgün, 2011)

Figure 4. In the first half of the 1950s a drawing with a light pen on the screen (TURKCADCAM, 2011)

In the 1960s, computer-aided design did not find as much use in architecture as it was in engineering. The reason for this is shown as high costs. Architectural firms were structurally small-scale, therefore prevented investments in this area (Güngör, 2003). Computer-aided drawing tools began to enter the architectural branch towards the end of the 1960s. In 1963, Timothy Johnson extended the SketchPad system in three ways. At the end of the decade, there were several CAD systems that could be used practically in architectural offices

Second generation CAD systems appeared in the 1970s. With the creation of these systems, 16-bit storage mini-computers had been introduced (Mitchell, 1990). Many conferences and publications were published in the 1970s. The spread of systems in all sectors took place in the mid-1980s. In the beginning of the 1980s, third generation computer aided design systems began to be used with 32-bit super-mini computers. The high-resolution grid system took the place of the image storage tube (Mitchell, 1990) in 1980 'Apollo workstation' was made and in 1982 'Suns'. In the same year, the 'Athena workstation' was set up at MIT to provide on-campus service. Work stations grew rapidly in

the 80's as prices went down and their performance increased (Kalay, 1999).

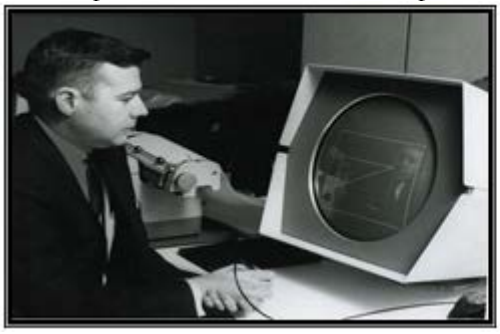

Figure 5. (Mitchell, 1990). PDP 1 model computerized CAD application at MIT (TURKCADCAM 2011)

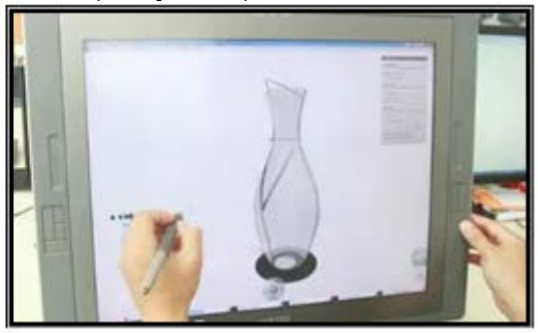

Figure 6. Drawing screen developed by Catia (Catia, 2011)

In the 1990s, the building sector was hit hard by computer and electronic communications. With the cooperation of internet and computer-aided design, the skills of computers have emerged in technical sense. Digital design information has started to be transmitted easily and quickly over the internet (Kalay, 1999). At the end of the 1990s, the daily use of personal computers with the very rapid development of computer technology had gained importance in Turkey has increased even more since. In this process, the problems and deficiencies experienced in the use of computer aided design versions, that can be used for all engineering fields and in the field of architecture ato be evaluated and compatible versions which allowed them to work together with other engineering software gained importance (Güngör, 2003).

Today, the computer is used for the creation, preservation, renewal and transmission of original drawings. The process of producing drawings by this method is called computer-aided drawing or computer aided design-drawing. These and similar terms can be used interchangeably " (Aydın, 2004). Today, the last point of computer-aided drawing tools is seen modelled on the screen. Although it is not yet used among university students, drawing on the screen and modelling the design on the screen will show itself in the architectural field in the future (Figure 6). These technologies will be easier to reach in the coming years.

Conclusion

Traditional and computer-aided drawing tools have different use alternatives in themselves. In the time frame we are in, both vehicles must be available for their own use. Both drawing tools have important features from their nature.

Architectural practices until today have been effected by the design environment and the technological development of design techniques. For hundreds of years, the design was carried out using T-scale and 45-30 degree views. The inadequacies resulting from the drawing-board-based process of transferring the design of complex forms to the third dimension limit the construction stages. As a natural consequence of this, it is known that the design of the buildings, and even the production processes, are dominated by the angles of 90 and 45 degrees.

Antonio Gaudi's unusual buildings, it is known that he worked with three dimensional models without using a drawing table (Utkutuğ, 2000). Computers where first use in the field of design as a tool, their priorities were aimed at providing the drawings with conventional drawing tools. However, computers go out of being drawing reapers, writing, voice, image and their different forms to express, it is an environment feature with the ability to perform transactions (Bermudez, 1999).

Today, the most common form of architects' utilization of computers in our country, computer-aided drawing. Computer support accelerates the drawing process and shortens the drawing time of the projects by 5% - 20%. The 'Expert Systems', which are expected to be increasingly preferred, create the possibility of building databases for use in the context of building type and construction system. Instead of redrawing the system, component and point details each time, systematic catalogs are prepared, cut-and-paste method are used which will speed up the design and drawing process (Loon, 2010).

Unlike traditional expression techniques, the most important advantage is that the models created in the computer can be observed in three dimensions and from the desired point. Digital expression

techniques enable the use of computer and internet technologies together with distance education (Yıldırım *et al*., 2010). The computer is not a magical box which will wipe out traditional techniques. It has to be considered with the experience of the hand. Technologically, what is expected is not to distract the person from producing art, but to make design methods more effective (Özcan, 1990).

Both students and professional landscape architects will use more computer-aided drawing tools in the coming years. For this reason, it is necessary to emphasize the use of computer aided drawing tools in the undergraduate education program and to provide necessary substructures for the studios. The use of computer aided design tools in the landscape architectural education process must be researched internationally, course schedules should be reconsidered and students should be encouraged to participate in computer-aided design practices, especially during internship periods (Kalaycı *et al.,* 2014; Demiroğlu *et al.,* 2014; Erdoğan *et al.,* 2014).

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