THE IMPACT OF DIGITAL ARCHITECTURE ON FREEHAND SKETCHES THROUGH DESIGN PROCESS

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INTRODUCTION

The computer software has emerged to take the place of freehand sketches in the design process. This new thought has advocates and opposers similar to the industries and crafts when the machine has invaded its different sectors to take the place of handmade. Freehand sketches are one of the initial learning means in the architectural design subject and currently encounter major challenges due to the widespread use of computer software in the design process, “as a result” to the age of the digital revolution influencing all fields and the designation on the part of educational institutions of study materials concerning it within its courses. This subject has encouraged the architectural student to use it, and it has become more difficult with the successive and excessive development in these applications.

The digital revolution effects emerged clearly in the architectural design process as it reflected on the other scientific fields.

Recently, new methodologies have emerged in the field of architectural design that uses the computer as a design tool. It has set up a variety of digital skills and a new form of architectural design process. The required techniques to be used in digital design environments can be better understood and developed by students to create a new design ideas. It will enable students to provide new design possibilities.

Sketch is a tool for a range of designers, clients and the public and a key factor to understand the idea of a design project. Design is a creative process which brings an idea to reality. The question is whether freehand sketches still retains this important position in the face of development of the computer application. Others may ask: can the architect make design without the aid of freehand drawing?

A. Research Problem

This research attempts to display the theoretical features of the design stages affected by the digital revolution, whether negatively of positively, and the
extent of its output towards raising the designer's efficiency, especially under the invitation of reducing the role of freehand sketches. The problem of this research is about many questions:

- Have the widespread of computer application led to the inevitability of the designer's use of these applications the multiple design stages for expressing his different design ideas and leaving the freehand sketch?
- Have these applications become a restriction on the designer losing him the communication with his ideas in the sufficient quickness, especially in the early stages of the design process in contrary to the freehand sketch?
- Do the designer -student- assimilate the digital technology represented in the computer software as an assistant tool in all design steps, or it is better to utilize the traditional freehand sketch in specific stages?

**B. Research Goals**

The study aims in this research is to achieve the following:

- Study freehand sketches and computer applications: (defined – their role in difference design process steps – the methods for their use in various stages of design – knowing the advantages and disadvantages of all design techniques).
- Learning how the architecture pioneers deal with design techniques using different tools through the analysis of some of their projects.
- To reach the ideal way helping the architect to create a design process performance and creativity with the required speed through contemporary technology.

**C. Research Methodology**

2- **LITERATURE REVIEW**

Design is a creative process which brings an idea to reality. To help meet this challenge, the architect needs to master a wide range of skills. But, whatever the level of involvement, from the conceptual thinking behind an innovative new product, the designer will invariably find that, of all skills, the most important is freehand sketches.

2.1 **Freehand Sketches**

Freehand sketches are the first academic learning mean of the architect in the architectural design process. Whereas it supports him and improve his
innovating, thinking abilities, and helps him to develop his ideas for reaching the last concept.

2.1.1 Definition
Freehand sketches are a translation or expression of his thought within an understandable and intelligible frame.

It is considered a transformation from the material physical element (mind) to another tangible dimension that can be realized (freehand sketch) [1]. It is also considered a mean for imparting something in mind, as glance or flash, to the papers and then the ideas are organized and developed in the form of layers as a dialogue between anyone and himself [8].

Freehand sketches work on making the coordination between the eye and hand[5], helping in receiving signals from the brain and translating it into drawings. It is considered one of the explanations means that is cognitively realized. It is also considered an abstract language on understanding and communication between the parties of the design process and needs no more than a piece of paper and pencil.

2.1.2 Types
Its types are varied: Diagram, Bubbles Zone, Graphic 2D & 3D and Caricature. Fig. 2. Presented Freehand sketches types.

![Final Sketch](image1)
![Conceptual Sketch](image2)
![A Bubble Diagram](image3)

Figure 2. Freehand sketches types. (Source: The Author)

2.1.3 Freehand Sketches Instrument
Pencil, Coal, Ink, Paper, Clay are the famous instrument.

2.1.4 Role of Sketches in the Design Process
The design is one of the innovative processes entailing that the architectural designer must have some necessary skills; the most important skill is the mastery of drawing using freehand sketch, which has the high impact in the conceptual phase. It is also considered a quick tool for illustrating the view to the costumer if there is a guarantee of his participation in the concept from the beginning, his assimilation of its dimensions and knowing his vision about this idea. Utilizing the digital forms in this early stage of the design could result in adverse consequences[7]. The role of freehand sketches and digital drawing in the design process presented in Fig. 4.

The importance of the freehand sketch in this stage is represented in granting vitality to the idea, making it vibrant and full of more details and covering as many elements as possible in a shorter period of time, such as the quick understanding of the architectural form and giving initial concepts about the project. Thus, it is an efficient mean of thinking, mental stimulation, mental impression production, criticism, discussion and alternative preparation[1]. It often depends on imagination, memory, conception, innovation, sensation and intuition.

2.1.5 Uses of freehand sketches in the design process include[1] & [2] :

A. Thinking tool:
It is a mean for generating, conceiving, putting forth and testing the ideas (visual - inspiration process development - design ideas crystallization - imagining - noticing).

B. Communication tool:
Freehand sketches are a mean of communication between the architect and himself, the architect, work team, the professor and architectural student. It is a mean of dialogue between the architect and the project owner as an abstract language on understanding and communication between the parties of the design process.

C. Interpretation, analysis and comparison tool:
It helps in making the vision and interpretation of the design problems and its solutions and comparing between alternatives for choosing the best.
D. Expression of innovation:
The individual expression of the initial idea and it is also a mean of the innovating process; expression of an idea whether interpreting, explaining, visual, ........., recording the mental impressions.

E. Exploration and development tool:
Whereas it is used as a mean of exploring the design problems and finding out many solutions to it. It also helps the architect to explore and understand the design form and helps in developing the ideas for reaching the final thought.

F. Documentation tool:
It is used in coordination between the eye and hand to be a mean through which the images can be imported, documented[5]and helps also in the historical documentation.

2.2 Digital Architecture
Many years ago before the Invention of computers, all projects were designed by freehand sketch, and that was the standard at the time.

2.2.1 Definition
The digital architecture is a new type of architectural engineering produced by digital technologies and

Now it’s computers, so firms and design professionals invest a lot of money on workstations, software, and training to use the applications, accompanied by an emerging new approach in the forms and functions. The digital architecture uses the computer models, simulation, programming and images for creating the material architectural model[6].

2.2.2 Digital Application Uses in the Design Process
The uses of digital application in the design process include:
- Data Collection& Analysis.
- Conceptual Design Preparation.
- Idea Development.
- Computer Aided Design& Presentation(2D& 3D).
- Simulation.
- Digital and Physical Building Model (Generation of architectural forms) Fig.3.shown models of digital architecture uses.
- Remote Collaboration.
- Virtual Reality.

![Figure 3. Models of digital architecture use in architectural design process.](image)

![Figure 4. The role of freehand sketches and digital drawing in the design process.](image)
### 2.3 Displaying The Architecture Pioneers Thought In Expressing Their Ideas

Table 1. The percentage of using the freehand sketches and computer application in architectural design.

<table>
<thead>
<tr>
<th>Architectural School/ Movement</th>
<th>Pioneer Architects</th>
<th>Usage Percentage</th>
<th>Stage Of The Architectural Work Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture Of Modernism (International technique)</td>
<td>Le Corbusier 1950 [9]&amp; [10]</td>
<td>100% Of freehand sketch in all design stages</td>
<td>Chapelle Notre Dame du Haut, Ronchamp, France</td>
</tr>
<tr>
<td></td>
<td>Frank Lloyd Wright 1959 [11]</td>
<td>100% of freehand sketch in all design stages</td>
<td>Guggenheim Museum, New York City</td>
</tr>
<tr>
<td>High-tech Vision</td>
<td>Norman Foster 1977&amp; 1991 [9]&amp; [12]</td>
<td>100% of freehand sketch in the first stage and then depending on the computer application in a large percentage</td>
<td>Hammersmith Congress Centre + Century Tower</td>
</tr>
<tr>
<td>High-Tech Sustainability</td>
<td>Renzo Piano 1995 [13]</td>
<td>50% of the freehand sketch and 50% of computer applications</td>
<td></td>
</tr>
<tr>
<td>Post Modern Architecture</td>
<td>Rasem Badran 1998[14]</td>
<td>100% of freehand sketch in all design stages</td>
<td>Amman City Hall - Jordan</td>
</tr>
</tbody>
</table>
### 3- LOCAL EGYPTIAN REALITY (ARCHITECTURAL EDUCATION)

From the teaching experience of the researcher and college staff questionnaires the following was found:

#### 3-1 Conducting A Theoretical Dialogue Questionnaire

With The Teaching Staff members in the division teaching the architectural design subject during the academic year 2012-2013 and some of them teaching the design subject to three classes, with a number of [8] teaching staff members out of a total [15] members, the following was found:

- The feeling that there is a conflict between the students' ability to innovate in the design process and to use the computer applications, to the contrary, it hinders the most students' thought concerning the easiness of ideas impart, quotation and inclusion from the digital library available for saving time and effort.
- Confirming the student should be learn freehand sketches as a mean for drawing skills and bringing confidence to the beginner architect.
- The inability of (10% approximately) to purchase a personal computer (Laptop).
- The most of students realize no benefit from the full possibilities of computer applications.

#### 3-2 Via Following Up The Distinct Students In The Different Study Years

The Third And Fourth Classes, The Following Was Found:

- A number of students (12.1%) do not use computer applications and deliver the final project in the traditional method (freehand sketches).
- A number of the students (24.9%) have used the computer applications in producing the digital drawings with a percentage reaches 81-100%.
- A great part of the students (41.4%) has used the computer applications in producing the drawings with a percentage reaches 40%.
- A number of the students (21.6%) have used the computer applications in producing the drawings with a percentage reaches 41-80%.

* The researcher has taught the architectural design course to the first and third classes, in addition to the computer applications course to the second class of an architectural department at Faculty of Engineering-Al-Mattaria, Helwan university, Cairo, Egypt, academic years 2010 until 2013.
3-3 Via Conducting A Questionnaire Among The Profession Practitioners

The Following Was Found:
- Resorting to freehand sketches is made in the early stages thought that needs to quickness and quick response.
- Resorting to the computer applications in the presence of architectural synonym and elements repeated in the size of great projects.

4- DISCUSSION

Even in a time of computers and contemporary technology, still considered freehand sketches of the most important tools used in the design process, design exploration, and graphic communication. Architectural sketches support the projection of thoughts and facilitate evaluation. The ability to critique enhances judgment, but digital tools, not as a passive mechanism, is an active tool after finishing the primary concept. This study helped to clarify the mechanism using freehand sketches versus computer applications in design process to consider the importance of them in design stages.

4.1 Design Process: Freehand Sketches Techniques versus Computer Applications

Dealing with the digital architecture and different computer applications has produced many new techniques and method that the architect can pass through in a different design stages after it was confined to the use of a freehand sketch for expressing his ideas. When the architect uses the computer in the design process and representation, then he connect to it and forms a double intellectual system in which the information and ideas are exchanged between the tool and human. The elements of the system influence each other so that each one changes due to the change of the other, consequently, any change occurs in the computer or designer results “in the consequence of design” These techniques can be summarized as follows:
- Using the sketches in all the design process stages (The traditional method).
- Using the sketches in the most of design process stages and utilizing the computer applications in the last stage.
- Using the sketches in the early stages of the design process and preparation and completing stage for ideas by utilizing the computer applications.
- Use of computer applications in the whole design process stages.
- Final product of the design process without drawings.

4.1.1 Using the sketches in all the design process stages (The traditional method)

The thinking is devoted to the architectural project in all its stages starting from establishing the primary ideas, selecting the optimum alternative and reaching the final product by making the drawings and producing the project in its final form. A project which made by the freehand sketches in all the design process stages shown in Fig.5.

4.1.2 Using the sketches in the most of the design process stages and utilizing the computer applications in the last stage

The initial thinking is devoted to the architectural design by freehand sketches; selection between the different design alternatives is made manually and finally making the drawings and finishing the design idea using the computer as a last step within the
process of reaching the final product of design (the initial architectural design). A project in which the sketch has been used in the whole design process steps and using computer application in the architectural Presentation shown in Fig.6.

4.1.3 Using the sketches in the early stages of the design process and preparation and completing stage for ideas by utilizing the computer applications

The architect uses the computer applications in the design and production process after establishing the concept in the form of freehand sketches expressing his ideas and forms a double intellectual system in which the information and ideas are exchanged between the tool and human, Fig.7. shows a project of architect Frank Gehry, in which the initial idea was established by the sketch and the remaining stages was completed by the computer application. The elements of the system influence each other so that each one changes due to the change of the other, consequently, any change occurs in the software or designer results, it causes a change in the consequence of design.

![Figure 5. Proposal for Mazoon university competition – Sultanate of Oman – design By Dr. M.Taha.](image)

![Figure 6. Proposal for Dome mall competition – Kuwait – design by the Researcher.](image)

![Figure 7. Project for Emr Communication And Technology Center – Frank Gehry[15].](image)
The Impact Of Digital Architecture On Freehand Sketches Through Design Process

4.1.4 Use of Computer applications in the whole design process stages
The computer applications cover all design process stages. Whereas it helps in making drawings translating the initial ideas by utilizing the light pen, especially under the devices of Tablet, Stylus or Ipad and using especially applications, such as Sketchbook from autodesk, Fig.8. Shown the tools used in translating the initial drawings. There are invented tools like ideas translation tool, Thought Translation Device, transforming the ideas to computer and then selecting the optimum alternative and completing and analyzing this alternative for developing it and reaching the final project, but it did not broadly applied until now.

4.1.5 Final product of the design process without drawings
Some of the computer applications created a virtual architecture contains no tangible physical element, including virtual reality which is an experimentation simulates the reality and helps the customer in experimenting the building simulation of the building performance and entering into its different parts and making the modifications when necessary without a high cost. These facts are made and formed across specialized computer software. The virtual space is a new digital architectural pattern, Cyberspace, consists of Virtual City, including markets, museums, gardens and libraries. NOX Studio[3][4] in Rotterdam has designed a program for an architectural competition consists of an electronic site interacts with the user. Whereas it constitutes a virtual tower linked to a network above the city and interacts with variables, such as electricity and communication activities or any other information resulted from the populations' behavioral patterns. All these information is to be collected and represented in three-dimensional charts above the existing streets map, the matter which enables the citizens of the city to control their consumption patterns.

4.2 Freehand Sketches And Digital Architecture Between Acceptance And Rejection
There is controversy among the architects around the feasible usage of free sketches and computer in the design process. Whereas some advocates the usage of free sketches in the beginnings of design process based on that the design process is an innovative process undertaken by the architect himself. However, others are of the view that the computer can help the architect in reaching optimum solutions via its advanced software and applications and providing quick alternatives in a technology more precisely.

In a comparative study [9] among 10 architects, the most well-known among them was Sir Norman Foster about their method in dealing with the early stages of the architectural design process (three developing stages of the design). The conclusion of this study has proved the usage of all surveyed architects of free sketches as a sole design tool in the first stage of design and remains as an important tool in the second stage, along with the stereoscopic models and CAD software. Whereas in the third stage it used free sketches in a smaller percentage with the models and CAD software in developing the design. It was noticed that the office of foster and partners has used CAD software as a tool for producing the three-dimensional models in the first stage of the design and as an assistant to the designer of architectural forming.

4.3 Factors Affecting The Rate Of Sketches Uses Or Computer Applications
Ratio is determined using sketches and computer applications in the design process on various factors such as Time and speed, effort, project size.

4.3.1 Time and speed
The achievement of the initial idea requires a limited time in most projects and sometimes the designer's team needs to, in addition to the quick achievement of
the design idea regardless the time, determine the technique used in the design process stages. Whereas the freehand sketches are used in all the design process stages, and the computer applications are used in the last stage.

**4.3.2 Effort**

There is a need to reduce the idea's effort and cost of some projects. The availability of a big digital architectural library has led to the easiness of making a quick model, whether by using part or whole of the similar projects contained in the digital library or incorporating parts of drawings of previous projects with the aim of reaching a new digital project.

**4.3.3 Project size**

The selection of used technique is affected by the project size. The selection of using the computer applications in design is based on the numerous synonyms and repetition of design elements in the projects. It is nice to making the preparation of small projects by freehand drawings.

**4.4 Advantages And Disadvantages Of The Sketches And Computer Applications**

The Advantages and disadvantages of the freehand sketches and digital drawings using computer applications must be realized to identify the impact of these applications on sketches.

<table>
<thead>
<tr>
<th>Comparison Aspect</th>
<th>Freehand Sketches</th>
<th>Digital Drawings Using The Computer Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>Easy hand control - Receiving the idea from the mind and expressing it quickly - Precise details can be expressed - Enjoying the hand work - Have a special lustre - Increased range of innovation and creativity - making an original copy.</td>
<td>Saving time and effort - accuracy - simulation of the reality and nature to some extent due the difference of software - easiness of repetition and using synonyms - easiness of the work in layers and closing any layer - make dazzling - there is no need to a especially skill in most cases - easy to go back and delete - possibility of printing many copies very quickly - easy to access via the digital survey of the computer and reuse it as a file - support the designer's abilities and complete its deficiencies, such as easiness of painting, the presence of much software facilitating the work and making many of effects and technologies on the final drawings.</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>No undo command - Take a time - Need to skill and talent (imagination) - Making one original copy - The difficulty of modification and delete - Modification takes more time.</td>
<td>Costly to some extent due to the necessity of some technical supplies (computer, scanner, .....) - there is no original copy - take a deal of time for making the (boring) precise details - hindering the architectural student's thought due to the easiness of quotation and incorporation from the digital library - failures.</td>
</tr>
</tbody>
</table>

**4.5 Local Reality In The Architectural Education**

Architectural education in the drawing studios in Egypt and many Arab countries up to now, especially in the architectural design course, depends on the architectural project which commences with the definition of problem (project name), then determining the programme and the land allocated to the project (realistic or virtual for dealing with a specified problem, such as slope or curve in the land, .....), collecting and analyzing the information, establishing the appropriate areas and studying the functional relationships _ diagram _ and the design limitations and opportunities, establishing the domains, formulating the initial ideas or alternatives, verbal discussions and effective criticism and then developing the thought for reaching the final idea.

The architectural illustration manual of the project is mandatory in the first study years. The last two levels of the architectural educations allow the use of computer applications. Most of the students submit their projects using this method due to their passion towards computer and it is rarely that a project is submitted using freehand sketches.

**5. RESEARCH OUTCOMES: FREEHAND SKETCHING VERSUS COMPUTER TECHNIQUE**

Despite inevitable entering of the computer age in the field of architecture and urbanism, yet the brilliance of a freehand sketch remains as an important tool for expressing ideas, imagination, architectural innovation, ideas development and enhancement, architectural communication and architectural criticism. Consequently, there is no fear of this
technological tool concerning freehand sketches, to the contrary, it boosts and supports the freehand sketches in the different design process stages, grants the architectural practitioner new methods supporting his thinking and, consequently, contributes to the creation of a new architecture or architectural school. Years ago, many great and successful ideas of freehand sketches have emerged for the first time and with the entering of a computer to the field of architectural drawings, then the most famous scenario is representing in establishing the initial idea by freehand sketches on the papers due to the easiness of imparting the idea's mental image from mind to the paper, developing and enhancing it by the same tool. After architect finishes the idea, Completion is made by the computer applications.

5.1 Conclusion

The research has concluded to the following:
A. The first stage of the design is more successful through using freehand sketches which need to innovation, imagination and translates the ideas to the papers than computer applications.
B. The methods and techniques used by the architect for drawing, interpreting and communicating with his ideas in the design process greatly affect the final product of design; it is the architectural idea.
C. Digital architecture presents the design in a more comprehensive and clearer understanding of the building in a realistic conception and so that the designer – student or practitioner – can realize the impact of light, shadow, color, texture, reflection and formation on the design for reducing faults and learning from it as most realistic models.
D. The time and size of the project come under the factors affecting the selection of the optimum Technique.
E. It is found that students commence the design – after manually establishing a simple idea – with a three dimensional model explore the design in a different Technique. The computer can enhance the quality of design via enhancing the students' abilities to understand the ideas, such as light, texture and shape.
F. There are advantages and disadvantages of using freehand sketches or using the computer applications in the different design stages and the appropriateness method of the two methods for each stage of design stages.
G. The cost may be one of the impediments hindering the utilization of computer software (the price of devices, software, training, maintenance and periodical development) and making a radical change to the work systems in the design units is required.

Using the computer applications in the design process is a set reality, proceeding a tangible progress and will have a decisive role in the future, because it is historically established that there is a new technology contribute to the presence of a new architectural school. This issue does not mean canceling or degrading the freehand sketches and to allege that it became of the past, rather, a coexistence and harmony must be made between freehand sketches and digital drawings, this issue which opens up the possibility of a new supportive culture between the traditional and the digital scope in forming new techniques and new knowledge.

5.2 Recommendation

This Paper is recommended to merge the two methods and exchange between them due to the easiness of using all advantages, avoiding disadvantages and making use of freehand sketches and digital drawings in the suitable stage of the design process stages and creating the balance and integration between them for displaying the best product as much as possible.
- The staff should be guidance the architectural student to recourse to the computer applications after establishing the initial idea and no permission to the architectural student to use the computer in the first years of architectural education for upgrading his free architectural sketches skill.
- Accreditation of the expected impact of computer applications on the architectural design process of buildings within the architectural courses in a manner helps the students to understand this impact, along with training them to know how they can deal with these new applications using the techniques enabling them to provide the innovative solutions of the architectural product upon practicing the profession.

Future goals:
A. Attempting to produce or develop a system, tool or software provides the aid in architectural design so that they can fulfill the requirements of architects and architectural students in the first stages of architectural design.
B. Attempting to prepare the linkage or integration between more than one assistant software in more than one stage of the architectural design stages for making use of the most advantages of this software collectively and to avoid its disadvantages, so that it shall be easy to architects to access to the desired design consequences in a less time and higher quality.
REFERENCES