A NOTE ON THE ROLE OF DRAWINGS IN ARCHITECTURAL DESIGN AND EDUCATION

Olivera Dulić [1]
Milena Krklješ [2]

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Summary: *The research presented in this paper addresses the process of architectural design and particularly the role of graphic representations in that process. The present paper gives a brief state-of-the-art in the fields of design process and drawings that are involved in that process, but also tries to emphasize the importance of process drawings in the context of the architectural studio which represents the basic framework for acquiring the skills of architectural design. The findings of this study indicate that different types of drawings play a key role in the design process and that the creation of these graphic representations can be identified with the thinking process in architecture.*

Keywords: *design process; design drawings; architectural representations; architectural education; process drawings*

1. INTRODUCTION

Since the 1960s, many studies have been conducted resulting in an important contribution to the understanding of a design process. Two broad themes occur in the literature concerned with the design process – first is that design is essentially a process of creative mental synthesis, the second is that drawings play a central role in the design process [1]. The research presented in this paper provides a brief state-of-the-art in this area and demonstrates that the topic of the design process is one of the most interesting areas of design research domain. Observing from the field of architecture, the architectural design might be observed as a creative activity which brings together scientific and technological knowledge. Owing to the complexity of design process, one cannot use precise or fixed formulas which unite form, function, context and available technologies. With an understanding of first principles, experience, intuition and spatial imagination, most designers reach heuristically their design solutions [2].
This paper presents an exploratory investigation, which started from the point of literature review, with the main goal of investigating the importance of drawings in the process of architectural designing. Research covers some of the most important aspects of the process of architectural design and it demonstrates various approaches and theories in the study of this complex activity.

[1] Olivera Dulić, M.Arch., Teaching and Research Assistant, University of Novi Sad, Faculty of Civil Engineering Subotica, Kozaračka 2a, Subotica, Serbia, tel: +381 24 554 300, e-mail: olivera@gf.uns.ac.rs
[2] Milena Krklješ, PhD, Associate Professor, University of Novi Sad, Faculty of Technical Sciences, Dositeja Obradovića 6, Novi Sad, Serbia, tel: +381 21 485 24 62, e-mail: mkrkljes@uns.ac.rs

The remainder of the paper is structured as follows. First, we will give a brief outline of different interpretations of the design process, followed by general attitudes about the role of graphic representations in that process. Subsequently, the architectural design studio as a main pedagogical model in architectural education will be explored. This paper concludes by introducing the discussion on the role of drawings in the studio environment, while at the same time highlights the differences between final and process drawings in architectural design.

2. THE PROCESS OF ARCHITECTURAL DESIGN

During the past 50 years, a considerable amount of literature has been published on the topic of the design process in various disciplines. In terms of architectural discipline, the design process can generally be described as a problem-solving action which covers numerous activities that must be carried out to solve a design problem. The design problem is categorized as an ill-defined problem since a designer does not know in advance what the goal state is or whether a potential solution is really appropriate [3]. According to Sperling [4], the design is the key element which gives the architect basis for action in both material and immaterial reality. In a comprehensive study, van Dooren et. al proposed a definition where "the design process is a process of thinking in broad outlines and in detail, of doing and reflecting, of intensive work and taking distance, of naming and valuing, of questioning and answering, of diverging and converging, and of seeing what is and what could be there" [5, p. 59].

The design process can be linked to a learning process since the designer's approach is simultaneously educational and solution seeking. Namely, the designer learns about the problem by posing possible solutions to it [6]. From an educational perspective, it is particularly important to teach students about the experimental character of designing, since they usually have misconceptions about the design process [5]. In general, students believe that this process contains a certain amount of mysticism and that the best solutions occur completely by accident, through inspiration, rather than through hard work and thinking about a design problem.

The design research also shows that external memory aids are used in the design process. Those external memory aids are certain types of drawings which allow shifts in attention resulting in new ways of interpreting a design problem [7]. A design process might be described as an activity of planning for the making of something new, which is, in the case of architecture, an artefact of the physical environment. Since the artefact is non-existent in the design process, it can, therefore, be inferred that design requires generating, transforming and refining images of that artefact, or making representations which enable communication and examination of the ideas involved. Thus, as Goldschmidt claims: "the ultimate objective of the process of designing is the production of visual representations of the designed entity with enough completion and coherence to allow its construction or the construction of a visual simulation of it, physically or mentally" [8, p. 125]. Or, as put forward by Goel and Pirolli [9], the design activity involves the mental formulation of future states of affairs, where the products of design are external representations of such potential futures. Based on the above said, it can be argued that the designers start the design process by generating partial images of possible aspects of the designed entity [8].

3. GRAPHICAL REPRESENTATIONS IN THE DESIGN PROCESS

The importance of graphical representations within a design process has been widely accepted and acknowledged. For example, Senturer and Istek claim that it is not possible to carry out any activity of design without representational mediums [10]. Therefore, sketches, diagrams, plans, elevations and other types of drawings are the basic tool of the designer to clarify the ideas he thinks with. Since the design process in architecture primarily deals with the creation of forms, it relies on visual imagery and graphical representations as tools that help to express it [11]. Purcell and Gero draw our attention to the long tradition of using drawings as a part of the design process, ever since the Renaissance, when paper became readily available [7], [8]. They also draw a distinction between different types of representations and their use in the design process. Namely, functional diagrams or sketch plans are used in the early part of the design process, together with an unstructured form of representation such as sketching. On the other hand, less abstract and more realistic representations are employed in the later part of the process, which is marked by the usage of highly structured and detailed representations which document a design that is being developed [7]. Considering this evidence, it seems that the design moves from the preliminary phase through refinement to detailed design, followed by the increase in the level of detail of the drawn artefacts that are produced. In the context of the research presented in this paper, it is particularly important to point out that early forms of graphic representations are an essential part of the design process and that more unstructured forms are related to creativity and innovation in the design.

There has also been some work that has begun to indicate what is the role of pictorial representations in design. The design sketch can be considered as the basis of a visual and mental transaction between the design and the representation [12]. As mentioned by Suwa and Tversky, external representations, such as sketches, diagrams or even hand-written memos not only serve as memory aids, but they also facilitate inference, problem-solving and understanding. By putting down their ideas on paper, architects inspect their own work and see unanticipated relations that suggest ways to refine ideas. This cycle of sketching, inspecting and revising resembles having a conversation with one's self [13]. Suwa, Purcell and Gero [14] demonstrated that sketches serve as an external memory in which designers can leave ideas for later inspection and that they provide visual cues for the association of functional issues.

While engineers have laboratories for experimenting, designer use images as their space for research. Apart from its function in presenting a final design proposal, a graphical representation has an important role in the process itself as it serves as a tool for thinking during the design process. Thus, through the process of sketching, the design process unfolds [5]. Goel [15] argued that drawings are ‘external symbol systems’ representing real-world artefacts that can be manipulated and reasoned with. Additionally, he concluded that freehand sketches, by being syntactically and semantically dense and ambiguous, play an important role in the creative, explorative, open-ended phase of problem-solving. The same author also identified two types of operation occurring between successive sketches in the early stages of design, namely lateral transformations and vertical transformations. In a lateral transformation, the movement is from one idea to a slightly different idea. In a vertical transformation, the movement is from one idea to a more detailed and exacting version of the same idea. Relying on the distinction offered

by Goel, Purcell and Gero further clarified that lateral transformations occur in the preliminary design phases and are associated with unstructured sketches while vertical transformations predominantly occur during the refinement design phases and are associated with more detailed drawings [7].

Goldschmidt, an authority on the role of sketching, pointed out that some sketches do not follow ideas in the mind of a designer, but they rather precede it. In a series of quick sketches, the designer transforms the image by adding, deleting, modifying or replacing certain parts thus searching for an appropriate solution to the design problem. Or, to put it simply, architect often use sketching not to record an idea but to help generate it. This kind of sketching was described by the same author as visual thinking [16]. In another major study, Goldschmidt reported that sketching is an inherently creative process through which new artefacts are brought into being [8].

Finally, we may distinguish between the main instrumental purpose and the broader symbolical functions of drawings. The main role of drawing lies in the intention to describe the design so that those for whom it is intended can implement it. On the contrary, their symbolic function encompasses the expression of a way of thinking about the particular design represented, or about architecture in general [17].

4. ARCHITECTURAL EDUCATION AND THE DESIGN STUDIO

Design education deals with teaching students how to design, or how to discover their own methods of designing [11]. Traditionally, the design studio is acknowledged as the most important part of the educational curriculum in schools of architecture. The design studio represents a place where students should grasp, present, and defend design ideas, and acquire architectural skills and techniques [18]. The studio also provides a cultural forum to code, construct and enrich the understanding and perception of a space based on the knowledge acquired [19]. The studio has a primary task of teaching three basic aspects of design education. These aspects refer to the skills of visualization, representation, and ability to 'think architecturally'. In architecture, this 'way of thinking' refers to a particular domain of problems and solutions that characterize, and are fundamental to professional practice [20, p. 6]. The fact that learning these aspects has to occur simultaneously brings difficulties in an already complex teaching setting [21].

From the pedagogical point of view, the architectural education is grounded on the constructivist methodology which considers learning as an active process where learner constructs knowledge through practice and interaction with the environment [22]. However, as Casakin [18] points out, the main characteristic of traditional experience-based and case-based educational approaches is that they only judge the quality of the final solution, while disregarding the knowledge acquired by students during the process of designing. The reason for this, as Oxman [23] claims, lies in the fact that traditional educational models are based upon the replication of professional task performance. Hence, the measure of learning is equated with the design product rather than learning increment. According to the same author, it was Schön who presented two important modifications to the traditional model of design education. His idea of reflection on the problem in the medium of conceptual drawings introduced a cognitive orientation to design reasoning. The second modification implies the definition of the distinction

between the interactive modes of visual reasoning and design ideation. Nonetheless, despite these changes, the educational focus still remains on the representation of the design object, rather than on a clear articulation of knowledge.

A significant difference between education in the field of design and education in other academic disciplines lies in the fact that students are focused on desired outcomes rather than on principles and theories. Based on this, they are expected to produce similar results with new features, without being provided with the set of first principles that can guide their own designs [24]. Curry [25] pointed out that the designing involves more than developing skills in a studio setting where students solve incrementally more complex design problems over a set period of time under a sporadic guidance of an experienced tutor. To the contrary, learning the process of design requires a shift in the way one thinks about the design problems.

This view is supported by Oxman [26], as she argues for the development of thinking skills as a critical part of design education. With these skills developed on an advanced level, students may create an organizational structure of meta-knowledge which will help them to apply specific parts of it in a particular situation.

5. DRAWINGS WITHIN THE ARCHITECTURAL STUDIO

The design paradigm based on visual thinking and reasoning has had a strong influence on the field of design research as well as on its pedagogy over the past three decades. Schön's characterization of visual reasoning in design as 'a dialogue with the materials of the problem' has been associated with the paper-based media [27], [28].

Although many years have passed, this is still the most dominant model for explicating thought and reasoning in many design studios. Hence, the general characterization of a design process as a reflection supported by graphical representations has had a major influence on the architectural design education [28]. On this basis, it can be argued that the graphic thinking is a pillar of architectural education and the acquisition of architectural skills. The attitude widely accepted both by architects in practice and by educators is that the drawing act is inseparable from the design process itself [29].

The significance of drawings within the studio context is a well-recognized phenomenon in design research [11], [30]–[32]. As we have seen from the previous stances discussed in this paper, there is also strong agreement among researchers about the relationship between the act of drawing and the act of designing [33]. Design artefacts are the main result of design studios and communication tools between educators and students. These artefacts include diagrams, rough sketches, drawings and models. Without these artefacts, educators cannot understand and evaluate students' design proposals.

Therefore, it is important for the instructor to understand the student's ability to produce them [34]. The language of designing in a studio results in a process of verbal and visual communication between instructors and students, where ideas and designs are discussed through verbal and visual dialogue [33]. According to Uluoğlu, the most important premise in teaching architectural design is to enable students to understand that designing is a conscious activity or a practice of skills which requires specific knowledge of that field [35]. The same author assumes that the most complex segment of the design process is a preliminary phase or incorporation of thoughts and intentions into the designs.

5.1 Process drawings and final drawings in the architectural studio

The difference between preliminary 'process' drawings and 'final' working drawings is that the first category directly shows goals and constraints of the design process while in the second those goals and constraints have been transformed on material properties [36]. Process drawings usually include diagrams and rough sketches, which show possible paths for the concept development. Goldschmidt [8] acknowledges this distinct category of drawings which architects usually make in the early stages of design process, and labels them as 'study sketches'. These sketches are made on transparent tracing paper and are sometimes so idiosyncratic that they are only comprehensible to their maker.

Gurel and Basa [30] have examined the status of final graphical representations within the design studio environment. According to their understanding, the concept of final representation is embodied in a visual language of its own which is, in most cases, distant from the design process. This causes the fact that their aesthetic expression becomes the dominant factor in the perception of the whole project, but also in the perception of student work during the entire studio course Their longitudinal study has shown that insisting on final graphic representations redirects students' attention from the design process to the final product, which dilutes the process of design education. The lack of ongoing dialogue through process drawings surely does not encourage deep learning and puts the focus on the product of learning instead of the process of learning [33]. Therefore, we can notice that while both aspects of the drawing are important, special attention must be paid to the process drawings in the context of the architectural studio to enable the quality mastering of design skills.

6. CONCLUSIONS

The research presented in this paper has stopped short of proposing new interpretations of the role of drawings in the process of architectural design. It rather has sought to reframe an understanding of that process and of contemporary studio practice. This paper aimed to bring together, in a brief form, some of the most important views regarding the notions of the architectural design process, graphic representations, architectural studio and drawings that are made in its context.

The present research has led us to conclude out that the early forms of graphic representations are an essential part of the design process and that more unstructured forms are related to creativity and innovation in the design. This implies the importance of process drawings for structuring and manipulating of knowledge in design, therefore learning through the application of this type of graphic representations can be considered an important educational goal in architectural education. Valls et al. [37] have already noted that students of architecture must reach the point where drawing and representation blend together and drawing becomes thinking.

The detailed literature review has opened many new research questions which could be analysed in the future, while this paper might serve as a theoretical basis in this field. In the interest of developing a better understanding of the design process, further studies on the studio setting and its representations should follow.

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БЕЛЕШКА О УЛОЗИ ЦРТЕЖА У ПРОЦЕСУ АРХИТЕКТОНСКОГ ПРОЈЕКТОВАЊА

Резиме: *Истраживање представљено у овом раду испитује процес архитектонског пројектовања и посебно улогу графичких приказа у том процесу. Приказани рад даје кратак преглед стања у области архитектонског пројектовања и цртежа који су у тај процес укључени, док истовремено покушава да нагласи важност процесних цртежа у контексту архитектонског студија који представља основни педагошки оквир за стицање вештина архитектонског пројектовања. Резултати овог истраживања указују да различити типови цртежа имају кључну улогу у процесу пројектовања и да е креирање ових графичких приказа може посветити са процесом размишљања у архитектури.*

Кључне речи: *процес пројектовања; цртежи; графички прикази; архитектонско образовање; процесни цртежи*