ANALOG VS DIGITAL - 2D VS 3D

The role of Critical Points for Change (CPC) as a bridging mechanism between traditional poles of architectural design.

P. PARTHENIOS

Doctor of Design, Harvard GSD
Assistant Professor, Technical University of Crete

Abstract

Architectural design, especially conceptual design, is not a linear process; it consists of sub-processes, levels of refinement, which are individual but interact with each other. Each level of refinement corresponds to the types of media and tools used during conceptual design. Architects take advantage of a broad palette of tools and media for design, because each tool has its own strengths and weaknesses and provides an additional value—an added level of vision—to the architect. This closely relates to the notion of Critical Points for Change (CPC) a contribution this study makes towards a better understanding of the uniqueness of the conceptual design process. CPC are crucial moments when the architect suddenly becomes able to "see" something which drives him to go back and either alter his idea and refine it or reject it and pursue a new one. They are crucial parts of the design process because they are a vital mechanism for enhancing design. Critical Points for Change can prove a valuable mechanism to facilitate the switch between traditional poles of architectural design, such as analog/digital and 2D/3D, thus triggering their potential tendency for convergence.

Keywords: Conceptual design, dipoles, design process, tool, analog, digital.

Introduction

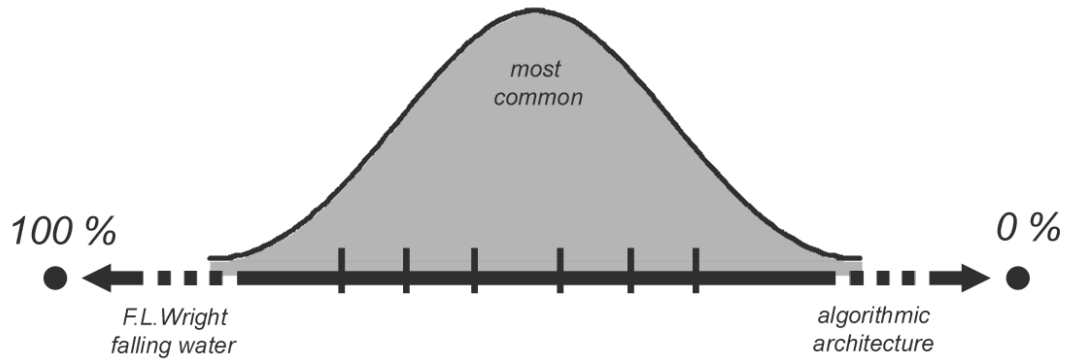
Polarity is an attractive word -especially today. There has been an increasing tendency lately for discovering new territories lying in between traditional poles of architectural design. Interest has shifted from studying concrete milestones of architectural design to more ambiguous areas resulting from attempts to converge conflicting dipoles. As the Organizing Committee of the 5th EAAE/ENHSA Architectural Theory Subgroup Workshop aptly points out, “on a technical level, this is due to techniques of fabrication linking the design and representation process directly with fabrication, whereas in the level of perception and representation, it follows the aftermath of folding in architecture and its claim for a new continuity based on the abolishment of the traditional spatial dipoles (interior/exterior, up/down et.al.)”. Despite the often unsuccessful, shallow results that the fashionable trend of contemporary flamboyant architectural publications impose to architectural theory, there is a series of valuable valid arguments that exist in juxtaposing traditional poles of architectural design.

Dipoles as extremes

Dipoles in cognitive science help put things in perspective. By pointing out the two edges it is easier to understand the space in between. This preference is similar to the following problem: when given a straight line and asked to mark an eighth of its length, it is easier to divide it in half, then divide the remaining length in half and the remainder in half again. The mind works better when comparing than when calculating. This notion relates also to one of the most common practices in architectural design, the comparative method. The architect creates many alternatives in order to be able to compare, reject, and select. It is easier for the human mind to select one solution among others than to conceive of it originally and directly. Dipoles prove crucial in enhancing the design process, since they act as orientation benchmarks in the architect’s mind.

Two extreme poles are used in the following example [1] to demonstrate what percentage of the final design is in the architect’s mind from the very beginning and what percentage is created throughout the design process with the help of tools. The first pole represents the perception that one hundred percent (100%) of the final design is in the architect’s mind at the very beginning. In other words, the architect has a very clear picture of what he/she wants to design before beginning designing and design tools are just means to document it. Legend has it that Frank Lloyd Wright had not drawn a single line until a few hours before the first presentation of the famous Falling Water House to the client. When Wright’s colleagues came to him shocked that the client is visiting the office and they had not designed anything, he calmly responded “don’t worry, I have everything inside here”; and

he pointed his head. Supposedly Wright then sat at his desk and drew the whole house in three hours, with all its details, as it was eventually built. On the other hand, the second pole represents the perception that zero percent (0%) of the final design is in the architect's mind at the very beginning. An example of that could be algorithmic architecture: the architect has no idea, no starting point when beginning to design. Design solutions derive from exploring mathematical formulas which are translated to spatial structures through a series of transformations. Parametric design facilitates the design process which is a continuous dialog between the architect's mind and his/her design tools. Supposedly in this extreme pole, the design solution is solely a result of explorations with the help of the tools. There is no doubt that in most cases of everyday architectural practice the truth lies somewhere in between the two extreme poles of the abovementioned example. Nevertheless, this dipole contributes in a better understanding of the conceptual design process.



[1]: What percentage of the final design is in the architect's mind from the beginning?

Seizing the Concept

Bernard Tschumi describes three approaches to seize a concept, to "have a design": the more inspirational one, the more systematic one and the one based on random trials[1]. In the first case the architect's inspiration is triggered by something (anything) and the concept emerges inside his head in a single moment (for example the

[11] Parthenios, P (2005) Conceptual Design Tools for Architects, Harvard Design School, Cambridge, MA, pp. 43-44

Frensoy Art Center project). In the second one the architect comes to the design solution through systematically studying the rules and restrictions that apply to the specific project and after creating a matrix of all the possible design permutations in order to compare them and select the most appropriate one (for example the Parc de la Villette project). In the third approach, the architect tries different things in almost random, accidental directions, in "trial and error" mode, until one idea proves to work (for example the Museum of Contemporary Art in Sao Paolo)[2]. The first one, the inspirational, is parallel to Jerry Laiserin's Form-Making approach, while the second one, the systematic, correlates to the Form-Finding approach[3]. The third one, with the random trials, is essentially comprised of iterative "inspirational" attempts, thus belonging in the Form-Making approach. It is also the most common in architectural practice.

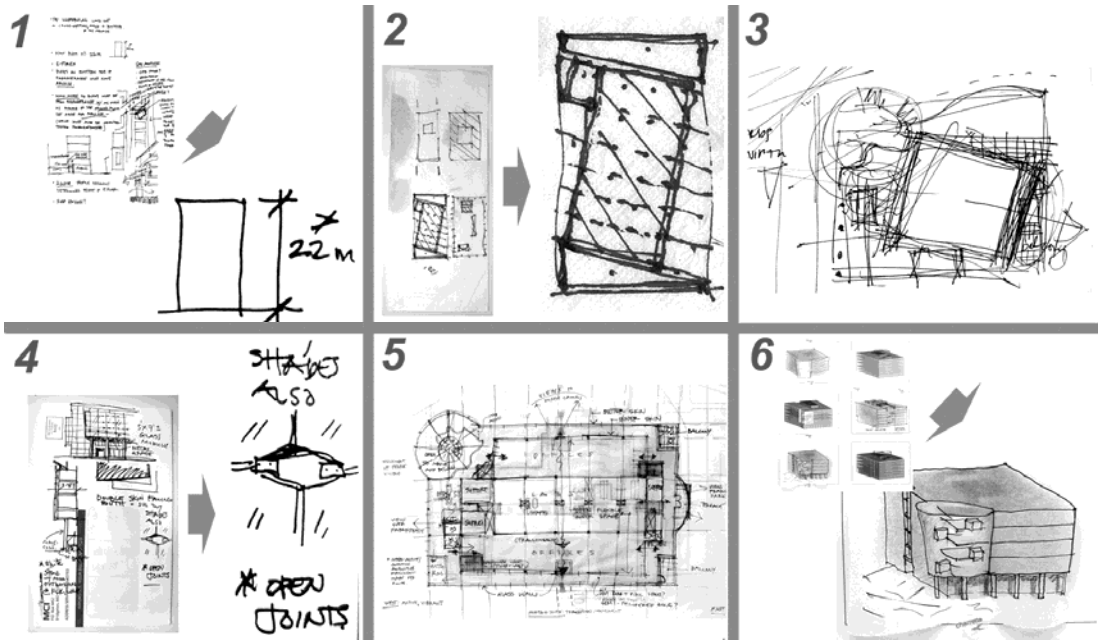
According to the Form Making approach, design evolves from Form towards Analysis. Design process is made of "true" consequential logical statements, which build up towards the final design solution. On the other hand, according to the Form Finding approach, design evolves from Analysis towards Form. Design process is made of continuous nodes of questioning/testing, which act as levels of refinement. These are called Critical Points for Change (CPC). The Critical Points for Change are moments when the architect "sees" something which drives him to go back and either alter his idea or start with a new one. They either trigger alterations which refine the design solution or provoke the rejection of the idea and the pursuit of a better one. Hence, they can prove a vital mechanism for enhancing the design process.

Case Study

The following Case Study demonstrates an example from everyday architectural practice. It is used in this paper in order to indicate the importance of CPC as a bridging mechanism between traditional poles of architectural design, in particular analog VS digital and 2D VS 3D. Audrey, a senior architect in Stubbins Associates, worked with two junior architects on a 6,000 m2 research lab. She began with small sketches on her sketchbook which analyzed and filtered the information that the client had given. The first sketches were very simple and represented the basic requirements of the project. They included thoughts, questions, solutions, forms and ideas. Gradually these sketches became geometric attempts to capture the main concept and in the next stage they adopted a bigger, common scale on tracing paper. The beauty of this initial step of conceptual design lies in the

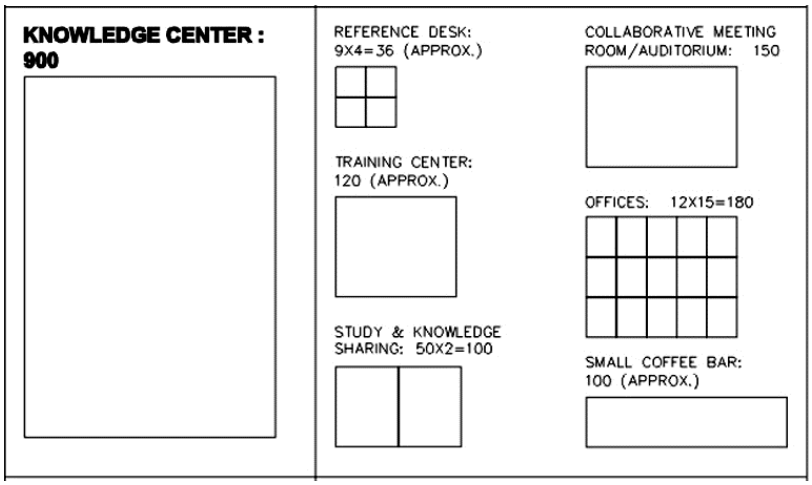
[2] Parthenios, P (2005) Conceptual Design Tools for Architects, Harvard Design School, Cambridge, MA, pp. 40-51
[3] In Proceedings of the 3rd International Conference on Design Computing and Cognition (DCC 08), Atlanta, GA (Jun 2008)

freedom and ambiguity that allow the architect to address anything she wants in no particular order or hierarchy [2].



[2]: Sketches at different stages.

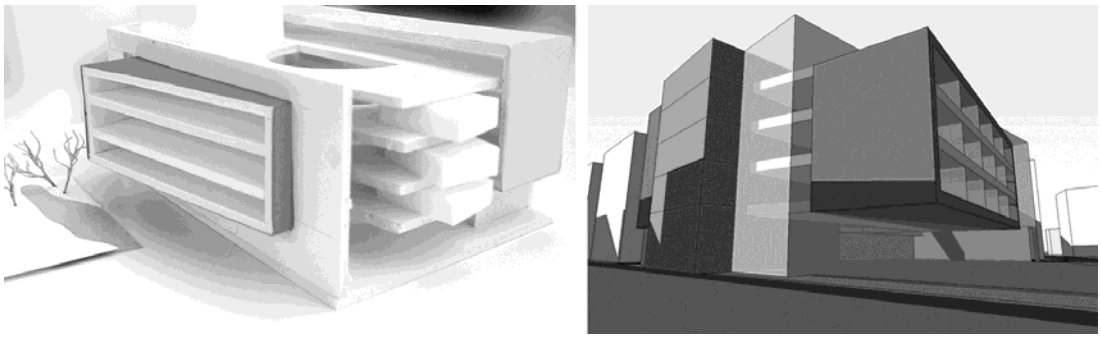
When Audrey reached a concept that she believed had good potential, she asked her two team members to take the space requirements that the client had given them in Excel spreadsheets, analyze them and translate them into geometry. This was done in AutoCAD 2D with simple rectangles that represented each module and led into some primitive plan layouts [3].



[3]: Translation of space requirements into geometry..

After accomplishing a satisfying layout of the plans which matched the main idea in sketches, Audrey wanted to see how that would look in 3D. She let the two team members play individually in 3D and explore a number of variations. They used SketchUp to create simple digital 3D models. They would print screenshots of the models, hang them on the wall so that everyone on the team could look at them without necessarily having to meet, and Audrey would often stop by, overlay a piece of tracing paper and sketch on them.

At some point, and while presenting the digital 3D model to the board of her firm, Audrey realized that “I knew what I wanted the building to do but it was not really doing it”. While trying to discover where the dissonance was, one of the team members reminded Audrey of a sketch she had made a few days ago and had left aside. It turned out to be a more suitable solution which they developed further and based their design on. Altering the main idea meant that they had to go back and do the layout in AutoCAD again, along with new sketches and new digital 3D models. The satisfactory result of this process progressed to the next level, which was building a physical 3D model [4].



[4]: Physical 3D model (left) and digital 3D model (right).

The physical model gave Audrey an additional level of vision and allowed her to understand more aspects of the design. “It is not the same as having a piece there that you can break, stick things on, or take them off; it’s not a tangible thing”. The new media triggered alterations which meant the architects had to go back again and update the AutoCAD drawings, the sketches and the digital 3D model.

Design Process

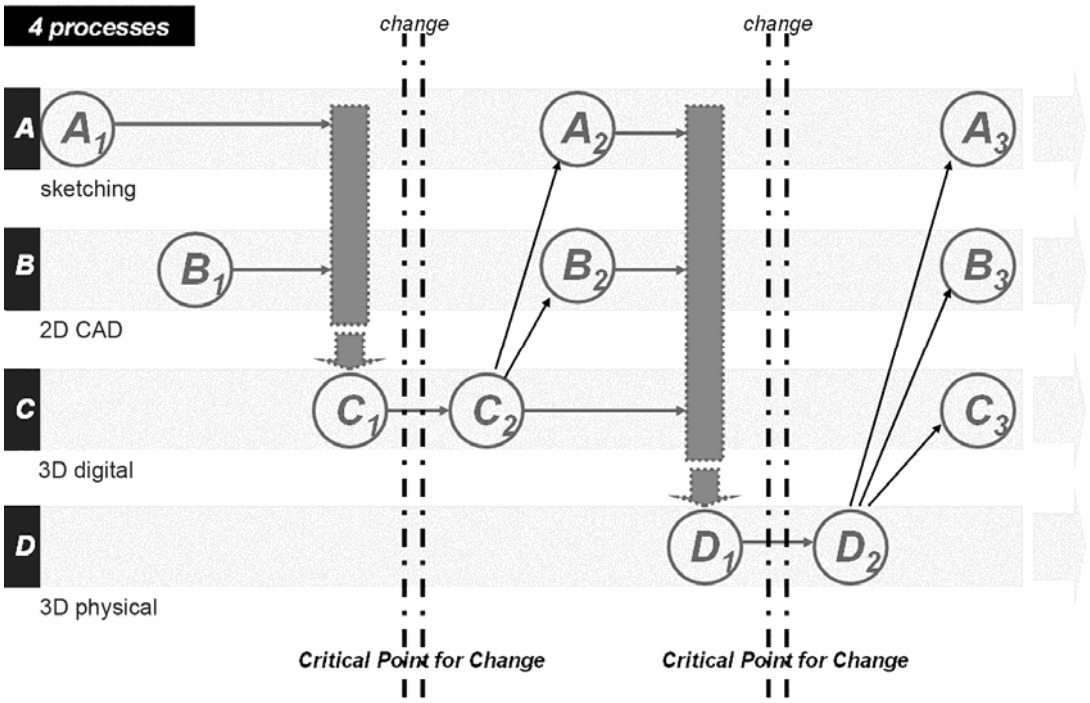
Design process is not linear. It consists of sub-processes which are individual but interact with each other. The above Case Study highlights four separate sub-processes [5], which play a valuable role during decision making:

a) Sketching,

b) 2D CAD,

c) 3D digital modeling, and

d) 3D physical modeling.



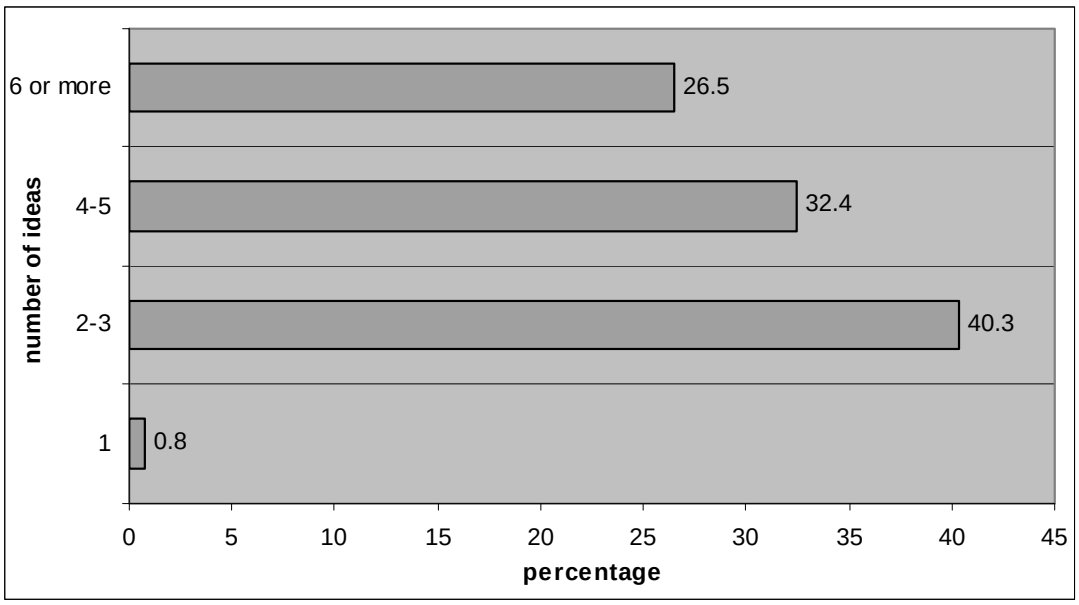
[5]: Design process is not linear

Each of the four processes has its own unique value and grants the architect an additional level of vision. The sub-processes correspond to the four types of media and tools used during conceptual design: paper & pencil for sketches, AutoCAD for digital 2D drawing, SketchUp for digital 3D modeling, and carton & wood for physical 3D modeling. Only when the architects used a digital 3D model were they able to see an aspect of the design –which sketches and 2D CAD could not reveal- and decide that they had to go back and change the main idea. Going back entails a manual update of the design with new sketches and new CAD drawings. Similarly, only when the architects built a physical 3D model were they able to see another aspect of their design that needed to be altered; they decided to go back again and make the appropriate changes. Then again they had to re-input information in new CAD drawings, a new digital 3D model, and new sketches.

Critical Points for Change

Often switching to a new design sub-process, a new level of refinement, would provoke a CPC, a Critical Point for Change. Through the help of a new tool, the architect becomes able to "see" something that was not visible before and can decide to go back and a) alter the design idea, b) abandon it and begin from scratch, or c) abandon it and pick an idea that had been discarded or left "inactive". Moreover half of the architects who participated in the Survey on Tools for Conceptual Design[4] reported that several times they had changed their minds and that they went back even if they had proceeded to the design development stage.

Even though CPC might look like irregularities that make the conceptual design process inefficient, the truth is that they are absolutely necessary for a creative, genuine course of design exploration. Besides, the desired outcome does not emerge on the first try. Architects need to explore a number of ideas until they can choose the optimal one [6]. Less than one percent of the architects explore only one idea: 40% explore two to three ideas, 32% explore four to five ideas and 27% explore more than six ideas until they decide to choose the "one".

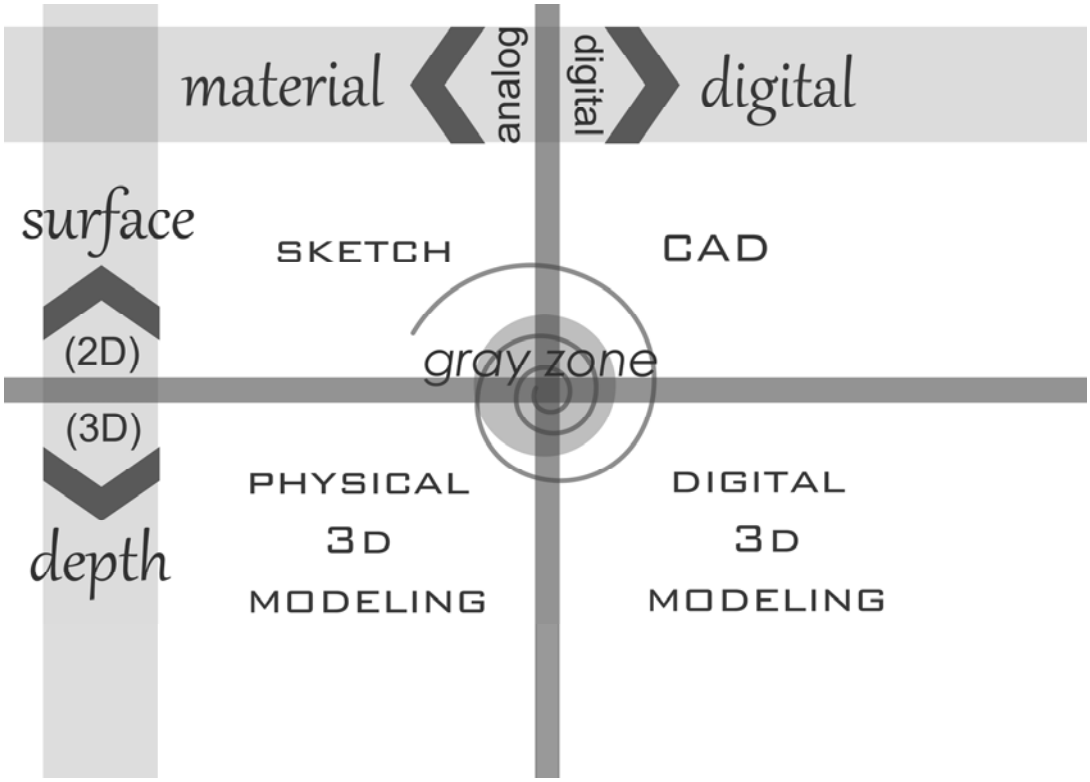


[6]: Number of ideas architects usually explore until they decide to choose the "one".

[4] Parthenios, P (2005) Conceptual Design Tools for Architects, Harvard Design School, Cambridge, MA, pp. 64-110

Conclusion

Figure 3 shows a matrix [7] of the tools and media used in the previous Case Study. These correspond to two traditional dipoles in architectural design, 2D VS 3D and analog VS digital, or in other words, Surface VS Depth and Material VS Digital. It can be argued that architects narrow their choices when performing design exploration solely inside one of the above four fields, whereas switching fields grants them the possibility of achieving more satisficing (Simon) design results. Critical Points for Change can prove a valuable mechanism to facilitate this switch, thus bridging traditional poles of architectural design. Moreover, despite the inefficiencies which are inevitably created, Critical Points for Change could provoke a gradual convergence of apparent divergent poles, thus triggering dipoles to melt. Further research should focus in this gray zone between merged poles, where boundaries are not clear and properties are transposable.



[7]: Two traditional dipoles in architectural design