The oscillation between *becoming*-tool and *becoming*-prosthesis in architectural designs

La oscilación entre "devenir-herramienta" y "devenir-prótesis" en la representación arquitectónica

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Abstract: This study explores the architectural design tools that have evolved through digital media in the post-digital era, which is evaluated through analog and digital hybridize. It raises the question of how the tool, as a mediator between the designer-subject and the designed-object in the architectural design process, can be re-examined in a hybrid design environment. The study proposes that what connects the designer-subject and the designed-object can be understood not only as a tool but also as a prosthesis. In this context, the "tool" in architectural design is described by the oscillation between the concepts of "*becoming*-tool" and "*becoming*-prosthesis" and their impact on the designer-subject through bodily, cognitive, and consciousness extensions. The relations among the concepts are discussed by folding them on each other using the hermeneutic methodology.

Keywords: Architectural representation; architectural design; prosthesis; post-digital; design tool.

Resumen: Este estudio trata sobre la discusión de las herramientas en la representación arquitectónica, que se afirma se ha expandido a través de los medios digitales en el contexto del periodo post-digital, que se considera como la hibridación de lo analógico y lo digital. Para abrir la discusión, la cuestión de cómo la herramienta, como mediadora de la relación entre el sujeto diseñador y el objeto de diseño en el proceso de diseño arquitectónico, puede ser rediscutida en un entorno de diseño donde lo analógico y lo digital se hibridan en el contexto de la relación del diseñador con la herramienta. La hipótesis del estudio es que el vínculo que establece la relación diseñador-sujeto y objeto diseñado ya no puede discutirse sólo como herramienta, sino también como prótesis. En este contexto, la "herramienta" en la representación arquitectónica se explica a través de la oscilación entre los conceptos "devenir-herramienta" y "devenir-prótesis" y el efecto de esta oscilación en el sujeto diseñador a través de su extensión corporal, cognitiva y consciente. Las relaciones entre los conceptos se discuten plegándose unos a otros con la metodología hermenéutica.

Palabras clave: Representación arquitectónica; diseño arquitectónico; prótesis; post-digital; instrumento de diseño.

INTRODUCTION

The designer-subject is on a journey through the architectural design process. Meanwhile, a language is needed in which that journey gains visibility and/or can be shared (albeit partially) alongside the knowledge and senses that guides it. This language can be considered through the architectural representation in architectural design.[1]

"When we talk about architectural representation, we think of orthographic drawings such as plans, sections, elevations, perspective and axonometric drawings, freehand drawings, sketches, models, and collages; besides, with the development of technology, photographs, films, three-dimensional digital models, animations, and simulations come."[2] On the other hand, these tools turn into design tools in the context of the way the designer-subject expresses the thoughts in the architectural design process. However, "each [design tool] has its own rules and ways of working, limitations and possibilities (...)."[3] For this reason, it is important to use design tools together with in the design process (which varies at different stages) to remove these limits. Besides, supporting the architectural design process with different media (analog or digital) further enriches the design process. Therefore, this study discusses the use of tools, which is evaluated through the hybridization of analog and digital in the architectural design process.

The hybridization of analog and digital in the design environment, brought on by the advancement of technology and digitalization, has heightened the debate of tool use in architectural design. However, lead this discussion, it is essential to first remember the theoretical equivalents of the words, analog and digital. The meaning of digital is "divisible into discrete, countable units,"[4] while the meaning of analog is "indivisible into countable units."[5] Cramer explains these definitions through an example of violin and guitar: "The fingerboard of a violin is analog: it is fretless, and thus undivided and continuous. The fingerboard of a guitar, on the other hand, is digital: it is divided by frets into discrete notes."[6] It is clear from this premise that

we cannot separate design tools as digital and analog. However, it is possible to discuss the *digitization of tools*.[7] Drawings plans, sections, and elevations through computer programs is an example. In this context, the separation of digital and analog is not meaningful since the architectural design process is fed from different layers of information. Therefore, through the concept of post-digital, we now speak of hybridisms.

In the context of the architectural design process, the integration of digital and analog –one of the key approaches of the post-digital concept– enriches architectural knowledge and creates hybridization scenarios in different contexts. One of them can be examined through the designer-subject (architect). For instance, today, the designer-subjects has become hybridized in the practices of thinking and applying because they can use both analog and digital media simultaneously. Therefore, the hybridized designer-subject has an agency that can generate their own language and method within multiple fields of knowledge. The techniques/tools used for this language, on the other hand, inherently affect the relation to the designed-object in various ways. Speed can be seen as one of these relations. In this context, the concepts of *slow speed drawings* and *fast speed drawings* discussed by Maroto Ramos and García Martínez using the sketches/drawings of TYIN Tegnestue can be considered as an example.[8] In addition to the speed factor, time also influences the relation with the tool. For example, while computer-aided design tools in the last century were a foreign domain that had to be learned and then integrated, today, the generation born into an already digital world has gained a proficiency with the tool due to digital literacy.

Therefore, the fact that we cannot act independently from the digital media/environment today, opens up a space where we can question our relationship with the tool. This argument is evaluated from the question: *How can the designer-subject and tool relationship be re-discussed in a design environment where analog and digital are hybridized?* The

question arises from the hypothesis that *the thing that establishes the designer-subject and designed-object relationship cannot be discussed as a mere tool but also as a prosthesis*. For this reason, the discussion of *tool* in the architectural design process is explained through a journey that oscillates between *becoming*-tool and *becoming*-prosthesis.

The connection between the designer-subject and the design tool(s) gains visibility in the design process. Therefore, the concept of "becoming-..."[9] is emphasized the process. In this context, *becoming*-tool and *becoming*-prosthesis, the main point of this study, indicate the potential of the tool and prosthesis to create a new network of relations each time they flow together with the designer-subject during the process. The *becoming*-tool concept is used to express how architectural design tools are used and internalized, together with items used to develop and express ideas in the design process. On the other hand, the *becoming*-prosthesis concept expresses how the tool is used as a designer's extension. The oscillation between the *becoming*-tool and *becoming*-prosthesis concepts is dealt with establishing conceptual relations. The relations among the concepts are discussed by folding them on each other using the hermeneutic methodology.

"*BECOMING*-TOOL" OR "*BECOMING*-PROSTHESIS"?

The designer-subject chooses the tool to be used in the design process according to its "potential and function"[10] and constructs the process accordingly. Here, one can talk about the relationship between *the user and the function of the tool*. Baber,[11] says this relationship allows people to think about objects, and this corresponds to *vorhanden*.[12] In the design process, the designer-subject knows that they have to think about each tool they choose and the possibilities of that tool in light of such a relationship. Thus, the tool can be "understood" and "used" in the design process. On the other hand, *the link between user and tool* is a practical form of relationship. Baber,[13] again, discusses this kind of relationship through the concept of *zuhanden.*[14] Thus, the use of the tool "becomes a dance"[15] between

theoretical and practical relation forms. Based on this argument, the (design) tool can be considered "intermediary, being in-between,"[16] as it enables the designer-subject to perform in the process.

The design tool and the designer-subject relationship in the architectural design process is reshaped together with each changing tool. In this context, the tool can be considered both as something that enables the thought/imagined thing to acquire visibility and as something that is internalized through the way in which the technique is used. The drawings of [Enric] Miralles could be considered an example in this context, because "repeating a drawing over and over again makes everything fall into place little by little. The relationships between all the variables became closer and closer with each drawing."[17]

In addition, drawing tools (such as pen, paper, ruler, and computer) affect how the designer-subject thinks. For example, when using a mouse and keyboard, one should first know how to draw with these tools and be familiar with the program in which these tools are used. Thus, another layer, which has its kind of thinking system, is added between the designer-subject and the tool. While using computer-aided design tools opens up many areas, such as testing different geometries/structures, experimenting with materials and construction techniques, and futuristic approaches in the context of architectural design, it also affects the way of thinking of the designer-subject. For that reason, the effect of digital on designers cannot be readily or fully comprehended. However, no matter how broad the domain is, the concept of digital is always linked to analog. Architectural design occurs in an oscillation in which these two information webs are intertwined countless times. Therefore, it is essential to utilize analog and digital in both process and the tool use. For example, the calculations and notes in Hecker's Offer House Villa drawing (Figure 1) give clues to the computable and incomputable knowledge of the drawing produced by hybridizing analog and digital.
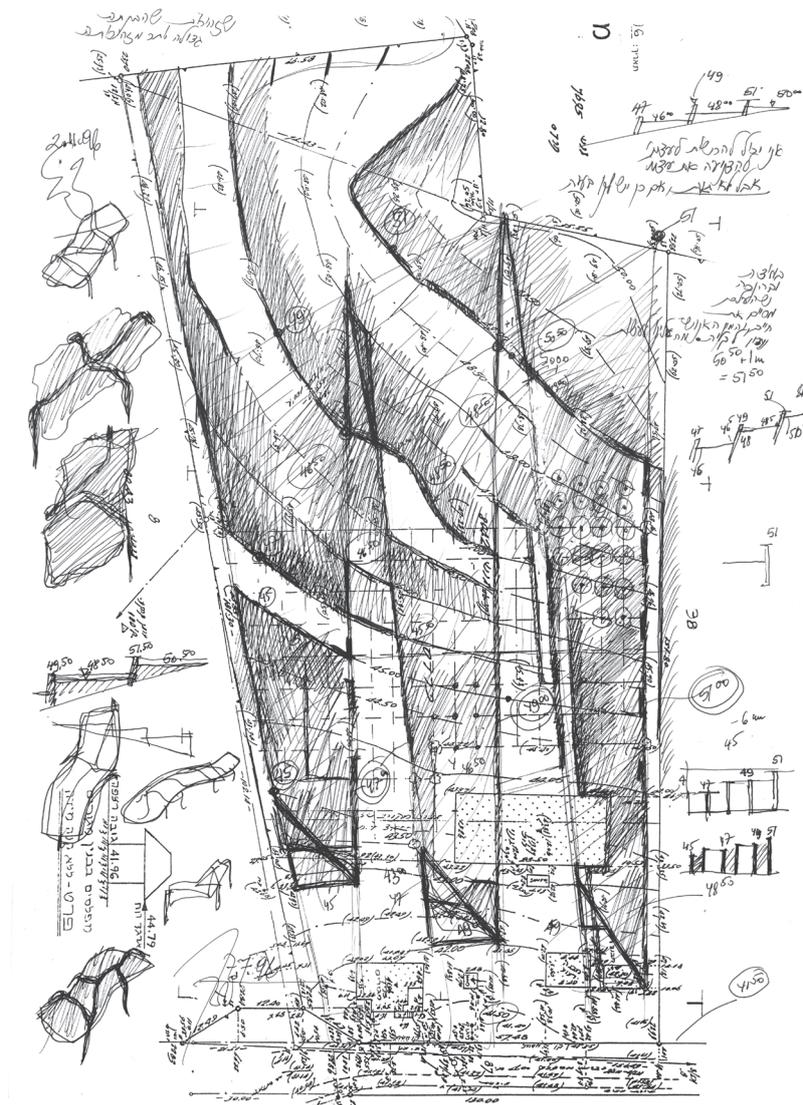
Figure 1. Zvi Hecker, Offer House Villa, 1997 ©ZviHecker-2023.[18]

This[18] hybridization arises because *digital technology and media cannot be regarded as separate from people and social life.* [19] "As an ecosystem," post-digital can be evaluated as "living, breathing, expanding, and fluid."[20] This situation means that "post-digital is hard to define, messy and unpredictable (…)"[21] and opens up the concept to different disciplines, constantly expanding the grounds for discussion. On the other hand, the post-digital, "in reference to the critical thinking (…),"[22] questions the relationship between

'old and new media.' In this context, many researchers state that 'old' and 'new' media have merged with post-digital, underlining the fact that any relevant distinction is meaningless today.[23] This hybridization situation can also be considered through "the porousness of the boundaries between human and non-human"[24] - which is also one of the characteristics of the post-digital age. However, in this study, the post-digital concept is handled through the unity of the *old* and the *new,* and used as the hybridity of analog and digital.

It should be emphasized that digital media has expanded the field of architectural design with the introduction of computers (as a tool/environment) –from which we are almost inseparable– in our world today. They have become more than *a tool as an intermediary element that helps to do something* because of its many potentials, such as speeding up the design process and enabling visionary design approaches. In this case, the state of being a kind of *extension* that becomes more noticeable with digitalization in the design process elevates design tools to a level where they can be regarded as prostheses at the moment of action. Therefore, one can first discuss the relation between the concept of prosthesis and architecture.

"Prosthetic Theory," written by Wigley discusses prosthetics and the conceptual relationship with architecture in different contexts, and is one of the essential sources of related literature. In this article, Wigley cites Ambroise Pare's[25] work to replace body parts destroyed by military weapons as an example to refer to the early studies on it. This study, which begins with the intention of filling the gap of a missing piece, is also related to the concept's meaning. Because the word prosthesis comes from Greek meaning "a placing," "a position," "a proposition," "laid down," to be "defended against attack," to "make a stand,"[26] using this definition, Wigley states that "the prosthesis is always structural, establishing the place it seems to be added to"[27] and emphasizes that it has a close connection with architecture. He states, "... the concept of the prosthesis is always already architectural and, again, because architectural discourse

is itself a prosthesis."[28] This argument summarizes the close relationship between architecture and prosthesis. Therefore, the prosthesis concept, which has the potential to take place in different sections of architectural knowledge, has been discussed through the tool use in the architectural design process within the scope of the study.

From its inception, the *remediation* or *filling the gap of a missing piece* is intrinsic to the concept of prosthesis. In this sense, this *filling the gap* underlies the relationship between the concept of prosthesis and other disciplines, just like in the relationship between the architectural design process and the prosthesis. For that reason, one can say that the prosthesis is a kind of tool in the sense of an *intermediary*. Nevertheless, by their very nature, a difference between the tool and the prosthesis arises in moments of design action. While this difference emerges from the relationship between the designer-subject and the tool's potential and function, it occurs when the designer is personalized in the way the designer uses and grasps that tool. Thus, an oscillation takes place between the *becoming*-tool and the *becoming*-prosthesis that completes the gap in the subject. At such moments, the *becoming*-prosthesis emerges when we are not independent of the tool, that is, "the tool relates to our scale."[29]

In the design process, the *becoming*-tool occurs when the relationship between the subject and the object becomes an extension. However, the *becoming*-prosthesis occurs when we cannot be independent of the tool. In this way, the *becoming*-tool refers to moments when body, cognition and consciousness are simultaneously extended; the *becoming*-prosthesis refers to moments when body, cognition, and consciousness are simultaneously extended and internalized. In order to discuss these moments in the context of analog-digital hybridization, various examples are utilized in which different architectural representation tools (such as plans, 3d models, and collages) are used.
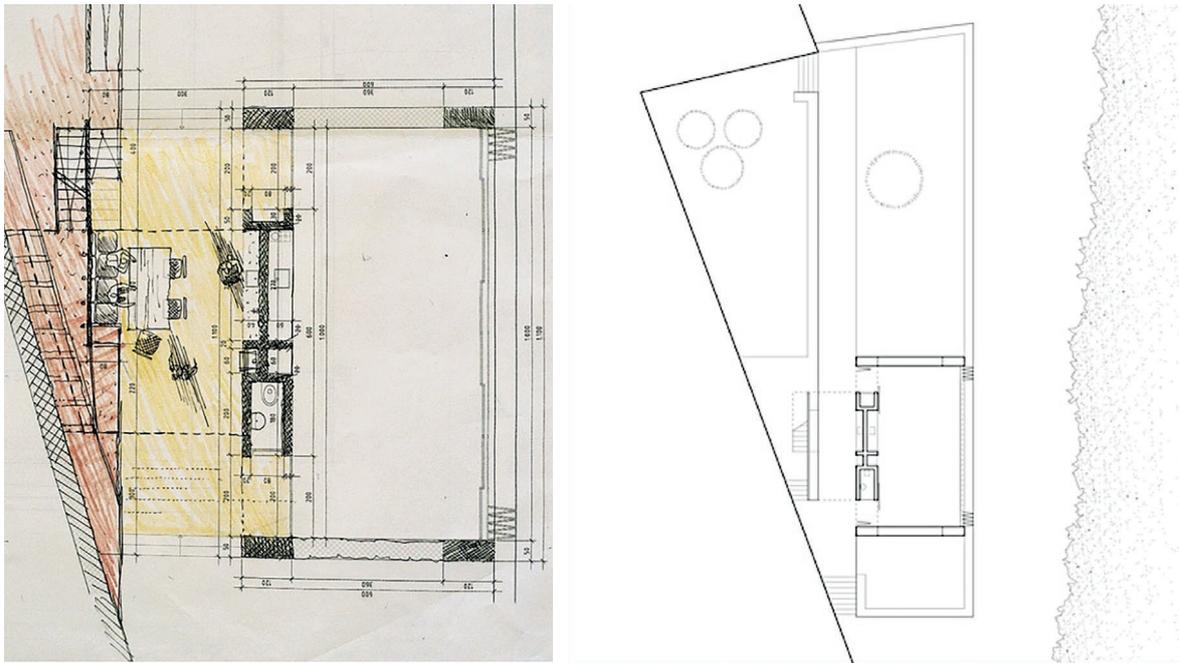
Figure 2. Han Tümertekin, B2 House, 1999-2001 ©HanTümertekin-2023.

Firstly, when evaluating the drawings of the B2 House,[30] we notice how the plan, which is an architectural representation tool, turns into a design tool (Figure 2-left). Here, the designer-subject enters into a dialogue with the future resident of the space. In addition, the designer shows how the user can move in the space and how it can be used. While this approach shows the reader how the plan is handled in the analog environment as a design tool, the measurements in the plan highlight its digital dimension. The plan drawing, which has turned into a design tool in the process, has become an extension of the mind of the designer-subject, and the internalization of the dialogue with the plan has become a kind of prosthesis that mediates the externalization of thought. However, when we look at the drawing made in the digital media (Figure 2-right), the dialogue phase is over or no longer visible because the *becoming*-prosthesis still needs to be realized in the sense of internalization. Since this version of the plan does not provide any information

for the observer about the design process, it becomes difficult to say that it has turned into a *becoming*-tool and *becoming*-prosthesis. Therefore, only in the context of this sample (Figure 2-left), one can say that there is an oscillation between the *becoming*-tool and the *becoming*-prosthesis.

As another example, looking at Zaha Hadid's Guangzhou Opera House project (Figure 3), one can say that the digitally (both as drawing/modeling tools and media) produced drawings/images are not just an architectural representation tool, as in the B2 House's plan produced in digital media (Figure 2-right). For this, one can first use Hadid's statements about the design process of the project: "The main steel structure (...) was assembled accurately using laser and GPS positioning systems. (...) GFRG panels (...) were fabricated directly from the 3D computer files we supplied –allowing for an almost perfect
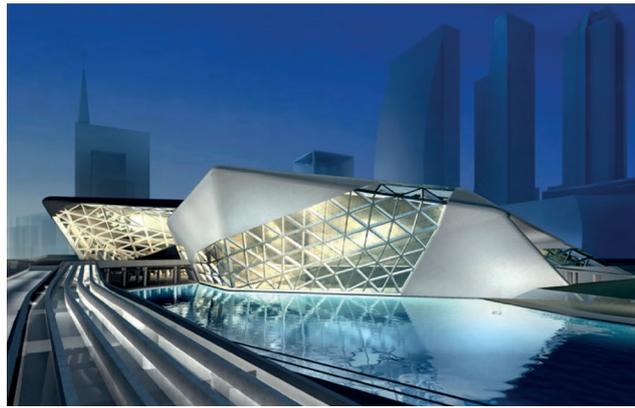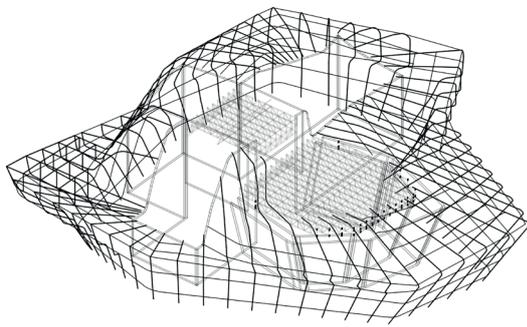
Figure 3. Zaha Hadid, Guangzhou Opera House, 2004-2010 ©ZahaHadidArchitects-2023.

precision– making the interior a truly uplifting and transformative space."[31] Considering this context, experimenting with new forms using computer-aided design programs and creating the architectural elements that reveal this form with instant action sections in the design process can be an indicator of how the digital environment and drawing tools shape the design process. Thus, three-dimensional modeling programs become design tools and take the design process to a different dimension. The oscillation between the *becoming*-tool and the *becoming*-prosthesis occurs in the digital environment.

Finally, the use of tools in the architectural design process are discussed through collage and photography. Fala Atelier's Apartment with Five Blues project is an ideal example. The narrative presented by the collage produced in the digital media (Figure 4-left), while detaching the reader from the perception of reality, establishes a story about a possible life scenario. Every detail in the collage offers information about life there, at different scales. Therefore, this approach triggers the oscillation between the *becoming*-tool and the *becoming*-prosthesis by transforming the collage into a design tool. In addition, it can be underlined that the project's design approach impacts this detailed view. In the apartment project, according to the designers: "The long main space serves as living but

also as dining and kitchen area; it is a living gallery rather than a living room. Its curved wall is punctuated by hand-painted doors in different shades of blue, hanging detached from the floor like a set of monochrome paintings."[32] The expressions "a living gallery" and being like a "painting" here point to a design process at the intersection of reality and artistic expression. Producing the collage of the project, such as a painting that makes us feel the tangibility of everyday life, can be the reason for the almost one-to-one similarity between collage and photography. Conversely, this approach expresses how much the representation tool used in the process has been internalized and turned into a design tool. Therefore, in the context of "valorizes the ordinary"[33] expression of the post-digital, this collage oscillates between the *becoming*-tool and the *becoming*-prosthesis.

The examples herein demonstrate how the hybridization of analog and digital can transform architectural representation tools into design tools. For this to take place, it is necessary to be at the stage of the design process where the subject and the object establish a dialogue. This dialogue reveals that the oscillation of the *becoming*-tool and the *becoming*-prosthetic changes the designer-subject and designed-object.
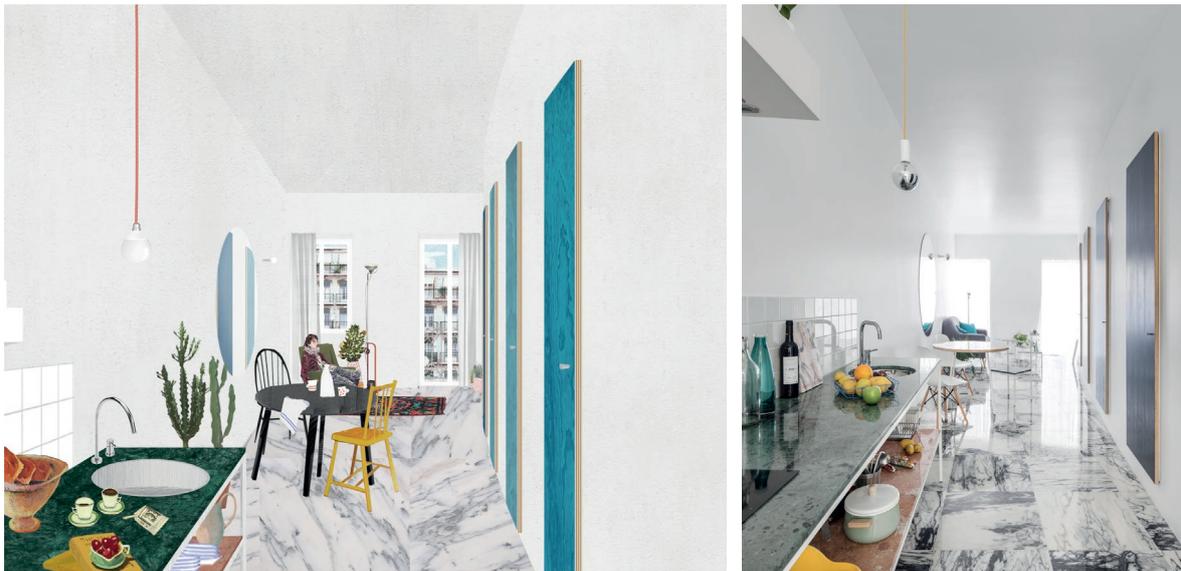
Figure 4. Fala Atelier, Apartment with five blues, 2015-2016 ©FalaAtelier-2023.

THE CHANGES IN THE DESIGNER-SUBJECT

The *becoming*-tool and *becoming*-prosthetic, revealed by the simultaneous extension of body, cognition and consciousness during the design process, and the oscillation between them affects the designer-subject. This situation can be viewed through the lens of McLuhan's claim that "any extension affects the whole system."[34] Thus, the tool and/or prosthesis –as an extension– change and transform the designer-subject. This argument can be evaluated through Wigley's words: "The prosthesis reconstructs the body, transforming its limits, at once extending and convoluting its borders. The body itself becomes artifice."[35] The body (together with cognition and consciousness), which hybridizes with this transformation between natural and artificial, can easily navigate between analog and digital. During this navigation, the designer-subject assumes an intermediary position, both designing the process and creating a personal language. In these

moments, the tool use (drawing and design tools) can become an extension of the designer in the design process.

In the context of the use of tools, when the drawing tools change, the transformation of these tools into extensions and how they affect the designer-subject differ. In this regard, Leandri et al.'s study[36] on how digital freehand drawing on tablets and CAD drawing with a mouse affects cognitive processes can be utilized. Researchers examining brain activities at both moments of action found that different cognitive connections were established by tactile transmission between holding a pen and holding a mouse. One can say that this differentiation also affects the body, cognitive, and consciousness extensions through cognitive connections. So, how do these mentioned extensions take place?
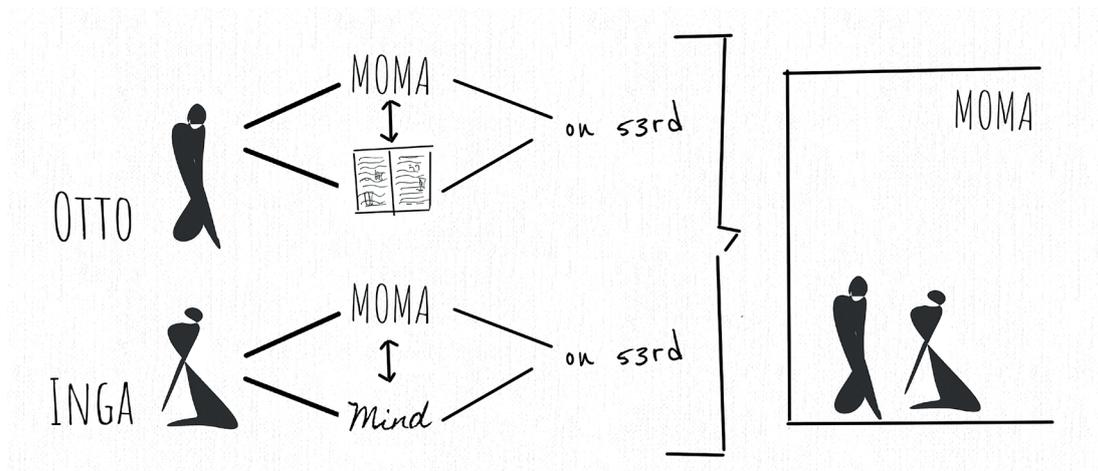
Figure 5. An example of an illustration by Otto and Inga.

To discuss this question, we can refer to the research of Clark and Chalmers. They advocate mental/cognitive extension in the context of "active externalism"[37] (developing between the brain-body-environment) that includes the influence of the environment as per the example of Otto and Inga[38] (Figure 5). A few years later, Clark discusses mental extension through the example of "the artist and its sketchpad."[39] In their examples, Clark and Chalmers distinguish mind extensions from consciousness extensions and argue that they are only mind extensions. However, Loughlin, who opposed this view, develops a hypothesis on consciousness extensions using the example of Otto and the artist, and argues that the artist's interaction with the sketchbook is a conscious process.[40] According to him: "... this would also apply to those moments when the artist is so fully immersed in the artistic process that the back-and-forth between him and his sketchpad or canvas can be best characterized as a "flow". Even during such "flow" moments, the artistic process remains a conscious one, even if not an explicitly self-reflective one."[41]

On the other hand, Otto's way of benefiting from the information in his notebook is a mental extension in the context of "external belief."[42] In this context, the designer subject's way of benefiting from the world of knowledge that establishes the design is also a mental extension.[43] However, since the design is a process that takes place in the *flow*, the designer-subject also extends consciously, as in the creative process and conscious experience in the artist's sketchpad example. As Loughlin puts it, "The designer-subject is an example of consciousness extension."[44]

According to these approaches, the cognition concept is used in this study as "the internal interpretation and transformation of stored information" –as a "mental activity"[45]– to comprehend *cognitive extension*. Moreover, the consciousness concept is used as a "perception and comprehension ability" to comprehend *consciousness extension*. Since the architectural design process has an "iterative"[46] and sometimes *ambiguous* nature, the relationship between cognition and consciousness also points to this nature. Thus, the tool used in the design process (as the *becoming*-tool and the *becoming*-prosthesis) affect the designer-subject through bodily extension due to its relationship with the body, cognitive and consciousness extensions due to *perception / comprehension / interpretation / transformation*

ability. The designer-subject changes and transforms in the process when it extends *bodily, cognitively, and consciously.* In this way, the oscillation between the *becoming*-tool and the *becoming*-prosthesis enriches tool use in the design process and the discussion of architectural representation.

IN LIEU OF CONCLUSION

In order to discuss tool use in the context of the architectural design process with the post-digital, many concepts that contribute to the relevant literature are folded over each other and conceptually reveal a new range of discussion. First, the tool concept is discussed through architectural representation and it is associated with the prosthesis concept in the differences that emerged due to the folding of analog and digital concepts. Then, the effect of the gap that occurs when the tool and prosthesis concepts are folded on the designer-subject is discussed. On the other hand, the designer-subject is folded over the body and cognition in the context of the *becoming*-tool and the *becoming*-prosthesis due to the emphasis on the architectural design process, and the cognition-consciousness network used there. Thus, the hybridity potential that emerges after multiple folding is utilized. The discussion of tool uses in the architectural design process through the post-digital becomes problematic.

Consequently, the relationship between the tool and the designer-subject points to a kind of extension (bodily, cognitively, and consciously). This occurs through the interaction and exchange between the designer-subject and the design-tool. Thus, the

moments when the body, cognition, and consciousness are simultaneously extended reveal the *becoming*-tool, and the moments when this extension is realized and internalized reveal the *becoming*-prosthetic. As the examples discussed in the study show, the oscillation between the *becoming*-tool and the *becoming*-prosthesis occurs at the moments when the representation tool transitions into a design tool and the dialogue between the subject-object is established. Although this dialogue varies with different tools, it is common regarding the initiation of the oscillation between the *becoming*-tool and the *becoming*-prosthesis; just as in the dialogue established with the plan at B2 House, with three-dimensional modeling programs at Guangzhou Opera House, and with the collage at Apartment with Five Blues. However, as in the examples, the differentiation of the design tool (plan, modeling program, or collage) changes the forms of dialogue established with the tool and the moments of internalizing it. This change also allows the *becoming*-prosthesis to be achieved with different tools. Therefore, the mediator item (tool and/or prosthesis) is fed from a hybrid field of knowledge. On the other hand, the design process takes place with instantaneous action segments oscillating between the *becoming*-tool and *becoming*-prosthesis. This oscillation between the *becoming*-tool and *becoming*-prosthesis affects and changes the designer-subject in the design process. Due to this mutual interaction and transformation between the designer-subject and the design tool, one can say that the thing that establishes the multiple relations between the designer-subject and the design object is no longer just a tool, but also a prosthesis.

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3 Christian Gänshirt, *Tools for Ideas: An Introduction to Architectural Design* (Basel: Birkhäuser, 2007), 81. The square bracket in the quote is added by the author.

4 Florian Cramer, "What is 'Post-digital'?," *APRJA* 3, no. 1 (2014): 15, *Post-digital Research,* eds. Christian Ulrik Andersen and Geoff Cox, https://aprja.net//article/view/116068/165295

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9   In this study, the 'becoming' concept has been used as the possibility of change in a thing.

10 In his doctoral thesis, Köknar underlined the difference in concepts are tools' potential, function, use, and understanding of the tool. In this article, I benefited from the difference between the concepts in Sait Ali Köknar, "Tasarım Araçları Bakışıyla Bir Tasarım Okuması" (PhD diss., İstanbul Technical University, 2009), 1-32.

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13 Baber, *Cognition and Tool Use,* 6.

14 *Zuhanden* was translated as 'ready-to-hand.' In Heidegger, *Being and Time*.

15 Baber, *Cognition and Tool Use,* 6.

16 Köknar, "Tasarım Araçları," 61.

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26 Wigley, "Prosthetic Theory," 9.

27 Wigley, "Prosthetic Theory," 9.

28 Wigley, "Prosthetic Theory," 9.

29 Based on his quotation from Hofstadter, Köknar uses it to understand designing the situation of perception and conceptualization with our own scale. Köknar, "Tasarım Araçları," 23.

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31 The quote is taken from Zaha Hadid Architects' Archive, ©ZahaHadidArchitects. Email message to author, January 20, 2023.

32 The quote is taken from Fala Atelier's Archieve, © FalaAtelier. Email message to author, April 18, 2023.

33 Swarnabh Ghosh, "Can't Be Bothered: The Chic Indifference of Post-Digital Drawing," *Metropolis*, August 1, 2018, https://metropolismag.com/viewpoints/postdigital-drawing-aesthetic/

34 According to McLuhan "Any extension, whether of skin, hand, or foot, affects the whole psychic and social complex." I benefited from this hypothesis to explain an extension and its effect. Marshall McLuhan, *Understanding Media: The Extensions of Man* (Cambridge, MA: The MIT Press, 1994), 4.

35 Wigley, "Prosthetic Theory," 9.

36 Gaia Leandri et al., "El cerebro del arquitecto y la mano pensante. The architect's brain and the thinking hand," *EGA Expresión Gráfica Arquitectónica* 27, no. 46 (2022): 184-93, https://doi.org/10.4995/ega.2022.18434

37 Andy Clark and David Chalmers, "The Extended Mind," *Analysis* 58, no. 1 (January 1998): 8-12.

38 Clark and Chalmers discuss the extension of the mind into the world through two fictional characters, Otto and Inga. While Inga is a healthy person, Otto has Alzheimer's disease. Both want to go to the Museum of Modern Art for an exhibition. Inga remembers the location of the museum. However, Otto gets help from his notebook for the museum's location. Clark and Chalmers argue that Otto's notebook and Inga's mind play the same role (arguing that the differences are shallow) and that Otto's mind goes beyond the boundaries of his skull, forming a system with the notebook and extending to the world. Clark and Chalmers, "The Extended Mind," 12-19.

39 Andy Clark, *Natural-Born Cyborgs: Minds, Technologies, and the Future of Human Intelligence* (Oxford: Oxford University Press, 2003), 77.

40 Victor Loughlin, "Sketch This: Extended Mind and Consciousness Extension," *Phenomenology and the Cognitive Sciences* 12 (May 2012): 41-50.

41 Loughlin, "Sketch This," 46.

42 Clark and Chalmers made the following inference from the Otto example: "The information in the notebook functions just like the information constituting an ordinary non-occurrent belief; it just happens that this information lies beyond the skin." Clark and Chalmers, "The Extended Mind," 13. Thus, for the Otto example- because of his notebook- a mental extension is used in the context of external belief.

43 This mental extension could be about both internal and external beliefs. While the designer uses a notebook/ sketchpad for an external belief, he/she uses his/her memory (internalized knowledge) for an internal belief. The example of Otto and Inga that Clark and Chalmers discussed on the mind extension over internal and external belief is utilized. Clark and Chalmers, "The Extended Mind," 12-13.

44 The original quotation is: "The artist is an example of consciousness extension." Loughlin, "Sketch This," 47.

45 Edward E. Smith and Stephen M. Kosslyn, *Cognitive Psychology: Mind and Brain* (London: Pearson New International Edition, 2014), 3.

46 Christopher Hoadley and Charles Cox, "What Is Design Knowledge and How Do We Teach It?," in *Educating Learning Technology Designers: Guiding and Inspiring Creators of Innovative Educational Tools,* eds. Chris DiGiano, Shelley Goldman and Michael Chorost (New York: Routledge, 2009), 19-35.

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