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Drawing is Not Enough. Design Tools for the Reuse of Modernist Buildings



Introduction

The question of what design tools are, how they work and how they can be used for architectural design was introduced in two papers. One was presented by Christof Ehrlich and another one by myself, at a conference on “*Design - Creativity and Materialization*” which took place at the Brandenburg University of Technology in 1999 (Ehrlich, 1999; Gänshirt, 1999). Motivated by the search for better ways of discussing, explaining and teaching architectural design, these questions became a research focus for the following years, eventually resulting in a doctoral dissertation (Gänshirt, 2008) and a book which had already been printed the year before (Gänshirt, 2007). Whilst the two papers went largely unnoticed, in the years following the book publication research on design tools became, at least in German speaking academia, a major topic. By surveying the body of research published over these years, we now can formulate new answers regarding the initial question.

Background

Looking at the drawing or drafting tools on an architects work place (fig. 1), we see orderly arranged on the white desktop, wooden and plastic triangles, a set of French curves, one two-sided and two triangular architect's scale rulers, a wooden proportional scissors circle, a small broom, pencil, rubber, pencil leads, ink bottle, technical or construction drawings on transparent paper, a lamp and a desk top telephone. Albeit these objects are presented in a museum-like setting and certainly do not represent the historic working situation accurately, we can accept them as being roughly representative of architects typical workplace equipment around the middle of 20th century. Even as a student in the 1980s in Germany, or a young architect in Porto at the beginning of the 1990s, my own desks and the tools on them still looked quite similar.

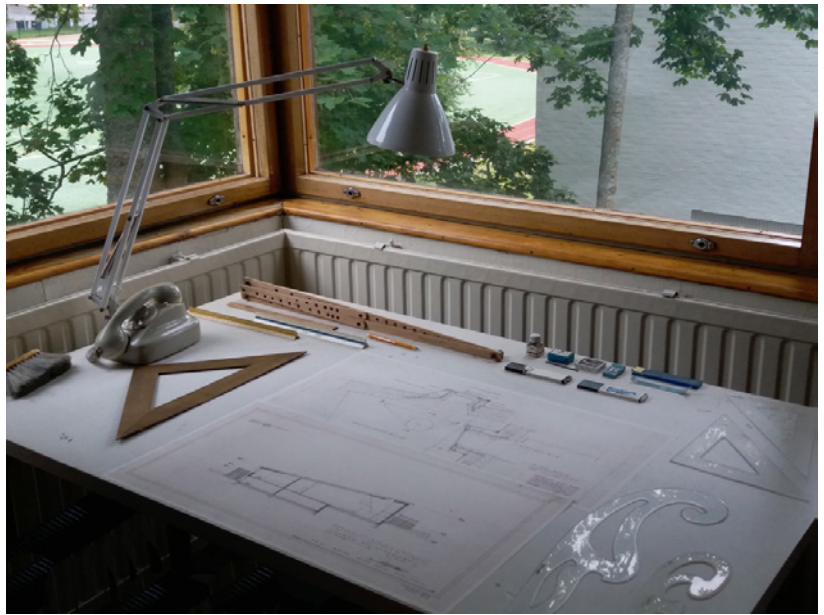
Nevertheless, when I started my research on design tools, these objects did not seem too revealing (an assumption that was proven wrong soon after). Most architects at that time were probably using the same or very similar drafting tools, but still they produced quite different works. Therefore it seemed preferable to take one step back and instead look into the objects architects produced with the help of these physical tools. In Alvar Aalto's home office for example (fig. 2) we see paintings, sketches, scale drawings, models, prototypes, photographs and so on. These objects could be considered the main media or design tools architects used to find their ideas and develop their projects. Most of the research in my doctoral dissertation was dedicated to these design tools/media.

The methodology of this research was based on the concept of the design cycle (fig. 3), which in certain ways can be related to Donald A. Schön's theory of reflective practice (Schön, 1983). Assuming a design process starts with thinking about something (it actually can start at any point of the design cycle), which then can be expressed by the use of

Frontispiece Architect's office.
Partial view of the drawing space in the studio
building Alvar Aalto designed 1954–1955 to
expand his practice,
Helsinki Munkkiniemi, photo cg. 2018

Fig. 1 Architects workplace around the middle of 20th century, working desk in the house of Alvar Aalto, Helsinki, photo cg, 2017

Fig. 2 Architects office around the middle of 20th century, in the house of Alvar Aalto, as exhibited in 2017, Helsinki, photo cg, 2017



different visual or verbal design tools (the media used to express and develop design projects), then it will subsequently be perceived by the same person, or others, to be critically analyzed. Depending on the result of this analysis, the idea will be approved, rejected, or changed for improvement. The improved version can then be expressed again, using the same or other design tools, thus starting the next design cycle. The diagram illustrates that the design tools are essential to the process. Without those, no architectural idea can be expressed, perceived, nor can communication with others or communal reflection take place.

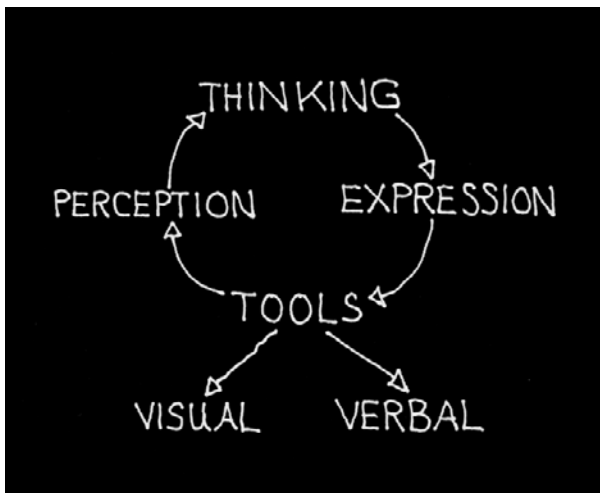


Fig. 3 Design cycle diagram, illustrating the importance of design tools for the process (Gänshirt 2007, p. 79)

Fig. 4 Table of visual and verbal design tools (Gänshirt, 2007, p. 102)

Systematically analyzing the media used to express and develop design ideas resulted in a table of design tools (fig. 4). Consisting of two columns of visual and verbal design tools the diagram is organized according to complexity, by using Marshall McLuhans thesis that the newer and more complex media always contain the older and simpler ones (McLuhan, 1964, p. 22). Each of the media listed was then studied, combining the phenomenological approach to media theory developed by Vilém Flusser (Flusser, 1991) with Otl Aicher's descriptions of his design activities (Aicher, 1991), and historic analysis. Using my own practical experience as background knowledge, the research also looked into published statements by outstanding expert practitioners, as well as architectural and design theory. Starting research into design tools more or less from scratch, it resulted in an overview, without the possibility of going too much in depth. Because of this, the list of further research on this subject included at the end of the book wasn't modest.

Through research on design tools that was published over the following years, my understanding of design tools in the sense of *media used to express and develop design* was questioned in various ways. So much so that it was no longer tenable and it needed to be revised. In order to do this I will discuss research developed in the years following the publication of *Tools for Ideas* in June 2007.

Research on Design Tools, 2007-2018

In November 2007 an exhibition opened that was prepared by architecture students and teachers from TU Dortmund on the theme *Die Medien der Architektur [The Media of Architecture]*. The following year the same exhibition was shown again at the *House of the Architects* of the AKNW Düsseldorf. A 3-day symposium accompanied the first exhibition, as well as a catalogue (Hnilica, Sonne, Wittmann, 2007). Four years later a book with the same title, containing the conference proceedings, was published (Sonne, 2011).

About 15 months later, on October 15th 2008, a large exhibition entitled *The Force Is in the Mind - The Making of Architecture* opened at the *Architectural Centre (Az W)* in Vienna, Austria.² The beautifully presented show (fig.5) displayed a broad range of objects and artifacts. Cultural theorist Elke Krasny, in cooperation with Gudrun Hausegger and Robert Temel, collected these artifacts in contemporary architecture practices, and from the archives of renowned architects. Accompanied by a richly illustrated exhibition catalogue with the same title (Krasny, 2008), the exhibition showed an amazing variety of things architects used for design purposes. Ranging from the drafting tools and design media (mainly sketches, drawings, models) mentioned above all the way to the most unexpected items, for example entire beds, or shotguns used to transform clay bricks. Krasny explains: *"Photographs document what it actually looks like in the studios during the work process. The work process itself is shown on the basis of one specific project from each office, by showing the means used for the design involved to provide unusual insights into the working world of architecture."*³

This research demonstrated two things: Firstly, from an empirical point of view, it is much more revealing than assumed to do actual field research about design tools and their use. Going directly into the offices and archives to study how architectural design is done in contemporary

Fig. 5 View of the exhibition at the Architectural Centre (Az W) in Vienna, Austria, photo © Peter Kubelka, 2008



practice, and which physical tools and processes are actually being used reveals the liberties architects take to stimulate their design. Secondly, the tools and processes used in advanced architectural practices are much more diverse (and therefore interesting) than expected.

Krasny's descriptive approach made me understand how much my own research was rather based on methodologies from architectural history and theory, aiming towards theory building, than on straightforward field research. Over the following years, Krasny conducted similar research projects in Canada, the results of which were used to expand the exhibition. It eventually was shown in Halifax, Nova Scotia, Canada,⁴ and in Montréal, Canada.⁵ In Graz, Austria, it was shown for the last time in 2011, and discussed at a symposium⁶. These exhibitions and the catalogue/book published with the first of them (Krasny, 2008) revealed, that besides the standard design tools that have been common to architecture practice since the Renaissance period, architects at times can be quite creative in finding or producing highly specific tools. Some of these tools, nevertheless, might be used only once for a particular design task (fig. 6).

One of the most charming responses to the question of what *design tools* could be is a piece of thin plywood, of about A4 sheet size, covered with laser-ray drawings, outlining a series of common objects, represented in roughly 1:1 scale, which are numbered from 1 to 5 and combined with uncommon names. We see a *question-screw* (what looks like a simple corkscrew), an *ideas-catcher* (metal fish hook), a *concept sharpener* (commonly used for pencils), an *eye-opener* (actually opens beer bottles), and the largest, a standard claw hammer named *hammer of innovation*. A metric ruler on the lower edge of the sheet supports



Fig. 6 Shotgun and clay blocks used as design tools by R&S(n), Paris, exhibition at the Architectural Centre (Az W) in Vienna, Austria, photo © Peter Kubelka, 2008

the sense of craftsmanship and objectivity. This object is called “Toolkit” and was distributed in 2010 by the Zurich University of the Arts (ZHdK) to promote their Master of Arts in Design program (fig.7).

The implicit messages are plenty. The program demonstrates sustainability by using basic natural materials like wood, instead of plastics. Nevertheless the program teaches how to apply advanced digital technology like laser cutting, being quite recent at the time. Studying in the program will be fun, using party utensils such as wine and beer bottle openers as design tools. Being hands-on and practice-oriented, it will by no means become too theoretical or intellectual.

Most interesting is the design process the toolkit suggest, by numbering the tools and arranging them accordingly. Starting with (1) good questions one might (2) catch an idea, the concept of which then

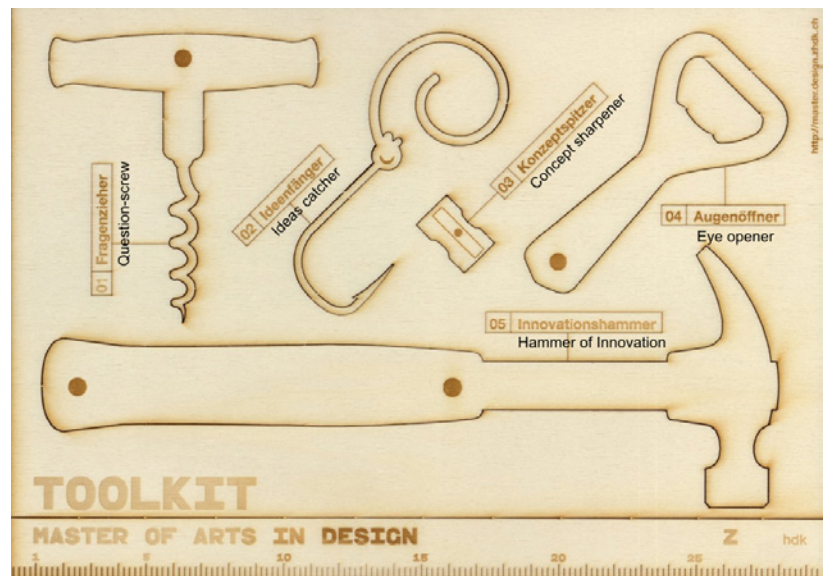
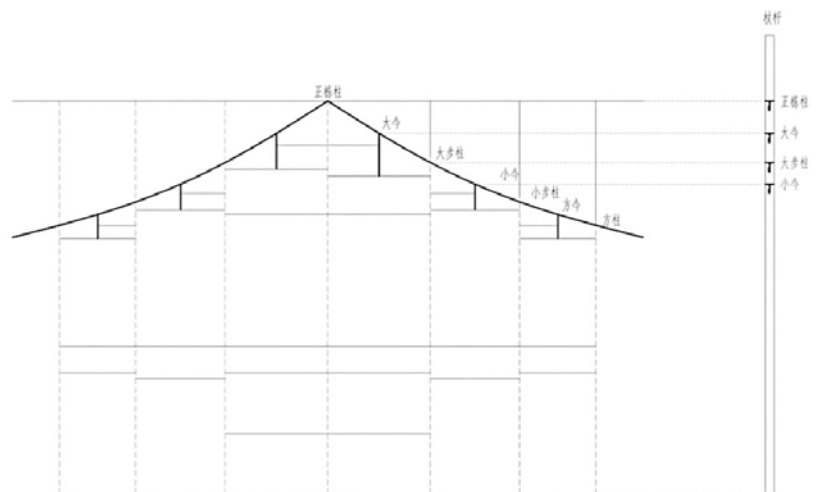


Fig. 7 Toolkit, Zurich University of the Arts, photo and translations cg 2010

Fig. 8 Single-line drawing and the related Zhàng Gān (video still from Lu 2014)



can be (3) sharpened and that way will help to (4) open your eyes. It finally needs to be (5) hammered or forged with a powerful innovation. Later on, all outcomes of the process can be measured precisely and compared by using the metric ruler printed on the lower edge of the sheet. Obviously, the depicted objects are not directly design tools, they are rather symbolizing larger categories of tools which represent a sequence of fundamental activities in a design process.

Research on the history of physical design tools used by carpenters working in traditional ways dating back to Imperial China is more hands-on. This research has recently been undertaken by Adam Brillhart, a PhD student of Wang Shu at the Architecture Department of the China Academy of Arts in Hangzhou (Brillhart, 2018)⁷. As part of their traditional design and building process, each time a building is designed, these carpenters produce a four-sided wooden measuring stick termed “Zhàng Gān” (丈杆, literally: measuring stick) in Zhejiang province, which has all the measurements needed for the construction of a traditional wooden house structure (fig. 8). Markings are distributed on each face of the stick according to systematic knowledge. The stick with these measurements represents all the construction drawings that would be needed to construct any wooden structure (with the exception of animal shelters) consisting of columns, brackets, beams as well as a roof. It is used across the rural parts of Zhejiang and Fujian provinces. Measurements expressing the basic relationships of each transverse frame are transferred to the stick on the basis of a quickly constructed single-line drawing. The operation of the stick during the construction process establishes all the measurements needed to produce every structural element of the building. *“The Zhàng Gān is essentially a preliminary full scale realization of the drawing (whether imagined or materialized) in one dimension. Each structural frame is “projected” onto a face of the Zhàng Gān.”* (Brillhart, 2018, p. 77) According to Brillhart, these measuring sticks are still in use today. The carpenters continue to dismiss the reduced-scale drawings used in modern architecture for being not reliable enough for their purposes. This design tool epitomizes an interesting link between the purely physical tools used by craftsmen, and the drawings as well as other media produced by architects working in the European tradition.

Other doctoral dissertations were dedicated to *“Designing (tools (for designing (tools (for...))))”* (Fischer, 2008), or to design tools like models (Wendler, 2013 and Couto Duarte, 2016), color and drawing (Moutinho, 2016), concept and diagram (Stapenhorst, 2016), or a data-based design instrument for floor plans named *Space Index* (Dillenburger, 2016). Further titles are *“Recurrence and Ambiguity, Design Tools of Architecture”* (Hartmann, 2016), *“Theorie der Städtebaumetaphern. Peter Eisenman und Stadt als Text”* (Gerber, 2012), *“Design Things - Collecting as a Tool for Modern Architecture”* (Froschauer, 2019, forthcoming), or, surprisingly, *“Hiking as a Method of Cognition for Large-scale Landscape Design”* (Schultz, 2014). Richly

illustrated monographs on design tools were published with titles like *"The Working Drawing - Tool of the Architect"* (Spiro, Ganzoni, 2013), *"The Architectural Model - Tool, Fetish, Small Utopia"* (Schmal, Elser, 2012), *"Planbilder: Medien der Architekturgestaltung"* (Hillnhütter, 2015). Frei Otto's many ways of *Thinking in Models* was presented in an exhibition and a catalogue publication (Vrachliotis, Kleinmanns, Kunz, Kurz, 2017). Architectural photography as a design tool was discussed in *"Architectural Photography and Its Uses"* (Fitz, Lenz, 2015), and partly also in *"Architektur Fotografie. Darstellung - Verwendung - Gestaltung"* (Locher, Sachsse, 2016). Writing as an architectural design tool was examined in *"Archiscripts"*, the 11th edition of the Graz Architecture Magazine GAM (Gethmann, Eckhard, Wagner, 2015). Looking into traditional tools, not in the sense of design tools but as an inspiration for design is *"The Hard Life"*, a book on the things and objects of everyday rural life in Portugal (Morrison, 2017). They were collected and presented by British designer Jasper Morrison. In autumn 2011, even the catalogue cover of an architecture editorial house read: *"Birkhäuser/tools"*⁸.

As a minimum twelve symposia related to the topic of architectural design and its tools were held in Europe over the last twelve years:

1. *"Kulturtechnik Entwerfen"*, June 2006, TU Graz, joined with
2. *"Kulturtechnik Entwerfen"*, October 2007, University of the Arts, Berlin, with a book published in 2009 (Gethmann, Hauser, 2009)
3. *"The Media of Architecture"*, TU Dortmund, November 2007, with a book published in 2011 (Sonne, 2011)
4. *"Metaphors in/on Architecture and Urbanism"*, November 2009, Ecole Spéciale d'Architecture (ESA), Paris, with a book published in 2013 (Gerber, Patterson, 2013)
5. *"Working / Thinking Tools. Manual Intelligence and Transmediality of Creative Processes"*, 2011, RWTH Aachen, with a book published in 2012 (Schmitz, Groninger, 2012)
6. *"Wissenschaft Entwerfen" ("The Science of Design")*, November 2011, Universität Basel, with a book published in 2013 (Ammon, Froschauer, 2013)
7. *"Diagrammatic of Architecture"*, 2011, Cologne University, with a book published in 2013 (Boschung, Jachmann, 2013)
8. *"Raumfinden - Werkzeuge des Entwerfens - 17 Positionen aus Kanada und Österreich"*,⁹ 2011, Haus der Architektur, Graz
9. *"Imagery in the Age of Modeling. Operative Artifacts in the Design Process in Architecture and Engineering"*, May 2013, Basle University¹⁰, with a book published in 2017 (Ammon, Hinterwaldner, 2017)
10. *"Reflexives Entwerfen. Entwerfen und Forschen in der Architektur"*, June 2013, Hanover University, with a book published in 2014 (Buchert, 2014)

11. "Skizzieren, Zeichnen, Skripten, Modellieren. Artefakte des Entwerfens und ihre Wissenspraktiken," November 2017, Institut für Architektur, TU Berlin, with an exhibition held at the Architecture Museum of TU Berlin
12. "Design Tools", 2012, Bauhaus-University Weimar, with a book published in 2018 (Wittmann, 2018)

Almost fully recognized was the topic of design tools in German-speaking academia with a Junior-Professorship and a chair named *Tool Cultures*, which was established in 2014 at the Architecture Faculty of RWTH Aachen and offered to Carolin Stapenhorst.

The last symposium listed above was part of the most wide-ranging research program on design tools so far. This was undertaken from 2010 to 2013 at the Bauhaus-University in Weimar. Directed by art historian Barbara Wittmann, the *Internationales Kolleg für Kulturtechnikforschung und Medienphilosophie* (IKKM, *International College for Cultural Technique Research and Media Philosophy*) conducted a research fellowship program named *Werkzeuge des Entwerfens* (*Design Tools*), which comprised of 8 researchers in total, i.e. 7 research fellows¹¹ and a junior professor leading the group. A number of additional external researchers were affiliated and contributed to the symposia and publications produced¹². One of the goals of this program was to invite research from disciplines other than architecture, including philosophy, art and architecture history, and cultural studies. The final outcome has recently been published as a collection of 13 essays covering a wide and somewhat varying range of topics related to architectural design: "*Thinking and Making Tools, Animation, Diagrams, Experiment, Creativity Techniques, Model, Drawing the New, Notations, Parallel Projections, Participation, Grids, Reconstruction, Collecting*" (Wittmann, 2018, p. 5, transl. cg).

Probably the most all-inclusive list of design tools so far is to be found in a book first published in 1985, titled *Sun Wind and Light, architectural design strategies* (DeKay and Brown, 1985, 2000, 2014). Even though the concept of design tools is not discussed in the book, its third edition contains a *Design Tool Index* of 15 pages (pp. 399–413), indicating all sorts of tables, graphs, design guidelines, building elements and so on. It seems that in the eyes of these authors, almost anything related to building and design can be called a design tool. With the book's background in the US counterculture environmentalism of the 1960ies, and its broad understanding of the term tool, it could be influenced by the famous *Whole Earth Catalogue*, published by Stewart Brand (Brand, 1968). The cover displayed the first photograph of the whole earth and the slogan "access to tools"¹³. The broad interpretation of the term tool this catalogue represents includes everything from books (mostly) to claw hammers.

In Search of a Design Tool Taxonomy

The research discussed above represents very different perspectives of design tools; still, all of them are somehow valid. In the end, it seems it is rather the use we make of something, more than the things we use, that defines design tools. The term “design tool” is, linguistically speaking, at times a metaphor without any binding scientific definition, and sometimes it can literally be a physical tool used for design purposes.¹⁴ Its openness emphasizes the potential instrumentality of all things regarding all sorts of design activities. Over the last decade, it has been used for things as different as simple objects, media used for design purposes, cultural techniques, materials, artifacts, computer programs, design activities, or more abstractly, formal principles or thinking strategies. With this in mind, does a term still make sense if it can be used for virtually anything? It certainly challenges our understanding of the term if it is used for activities like collecting or hiking. Nevertheless we can maintain that it does make sense, because it provides us with the very specific perspective of someone who is actively engaged in designing. In addition, it implies the challenge to better understand and represent the large range of possible design tools and uses.

Theoretically, we must conclude, anything can become a design tool, and in many different modes. Already a simple piece of stone, picked up from the border of a street, can be used in so many different ways: For sketching, drawing, in a gesture, throwing (to pro-ject...), hammering (i.e. as a medium transmitting an energetic impulse), cutting (depending on it's shape), as a model (or part of), as a symbol, for aesthetic contemplation (like a Chinese scholar's rock, Gōngshí, 供石, or a Chinese dream stone from Dali), as a color, material or texture sample, a stepping stone, to combine into a mosaic pattern, a stone garden, a street paving, a wall, an arc, a building, a city, etc. In practice, certainly there is more liberty in the choice and use of design tools than most of us previously imagined, but still many limitations and constraints are to be observed: practical, pragmatic, moral, legal, ethic, aesthetic, economic, intellectual ones.

If anything can be used for design, the next question is how the design tools available can be ordered, categorized, or classified, if we can imagine something like a design tool taxonomy. One of the main difficulties of the body of research produced over the last decade is the apparent randomness of themes and topics addressed. Now the only design tools that seem to be missing are the ones “drawn with a very fine camelhair brush”, or “that from a long way off look like flies”, or those “belonging to the emperor”, to quote from the arbitrary taxonomy of animals Jorge Luis Borges referred to an “unknown (or false) Chinese encyclopedia writer”, when discussing the ambiguities, redundancies and deficiencies of existing classifications (Borges, 1942). This randomness makes it difficult not only to accept and fully understand the concept of design tools, but also to see which areas might have

been overlooked, where contradictions or overlaps occur, and what importance in the larger field of design research should be given to single or groups of design tools, and if there are things currently called tools we should, for the sake of clarity, rather use other terms for.

What this research has demonstrated is that the initial table published in 2007, consisting of two columns, one of visual and one of verbal design tools (see fig. 4), can be expanded in several ways. The design cycle now becomes the core of a map of design tools, but besides the visual and the verbal ones, other groups should address the other senses: haptic, acoustic, olfactory and even gustatory groups could be defined (the latter being of no relevance for architecture though). Overarching all senses would be the group of synesthetic design tools, addressing the comprehensive architectural and atmospheric experience. The most important synesthetic design tool would be the human body, which carries the organs to perceive a situation simultaneously with the five Aristotelian senses, plus all the others, which have been identified since. Each one of these sensory design media/tool groups (A) can be used in many ways, most importantly the two fundamental modes of design thinking: creative and critical, the outcomes of which can be expressed and perceived. These columns become a matrix when combined with the spectrum of possible design use/tool categories (B), ranging from the immaterial through the medial to the most basic material uses of design tools. Without implying a hierarchy, the continuum would start on the immaterial side with philosophies (including ethics and aesthetics), theories, concepts, ideas and narratives, producing or influencing, next ways of design thinking like creative and critical, visual and verbal thinking. Then there would be the ways of design acting, on a more abstract level the cultural techniques and more concretely the media uses those are based on, which always are means of perception as much as means of expression, then all sorts of apparatuses, machines and physical tools. The works and artworks produced by these means would be the next category, followed by the simple objects (like for example bricks, boards or beams) and raw materials available for design uses.

In conclusion, we can propose to order design tools in a matrix where the columns are defined by groups of design media/tools (group A), grouped regarding the senses they address, and the rows by design use/tool categories (group B), according to the possible, observed or imagined uses we can make of them (fig.9). The media/tools (group A) are mostly the ones closer to the project and the manifold ways of representing it, the use/tools (group B) are nearer to the designing individuals and the things available to them. Theoretically, each design medium/tool has the potential to address all senses (but would have a tendency towards one or two of them) and to be used or reflected in all the different design use/tool categories mentioned above, from the most basic material ones to the most philosophical. Addressing these ambiguities might help us to be a little clearer and more explicit in the

many ways design tools are currently discussed. Even though this matrix needs to be considered as an open one, and one that theoretically has infinite numbers of columns and rows, and each column could also become a row and vice versa, the grouping of design tools according to (A) the senses they address and (B) the uses we make of them would allow us to better understand the structure of the research field and its inherent ambiguities.

Design Tools for the Reuse of Modernist Buildings

Even though some still maintain that, “*the drawing is the architect’s tool*,”¹⁵ it is obvious that the complexity of contemporary architecture practice requires more design tools than just one. Even nowadays, the way the term drawing is used encompasses everything from sketch, scale drawing, axonometric or perspective views to photorealistic renderings created by the latest software. Besides that, architects produce different types of scale models and write all sorts of texts, ranging from project descriptions to entire books, to develop and convey their ideas. They routinely rely on the calculations of engineers and the work of professional photographers. Discussing the use of drawings, models, sketches and computers, Álvaro Siza for example explains that those design tools have to be used in complementary ways, because each of them can be misleading (Couto Duarte, 2016, Anexos p. 34, 36).¹⁶ The contents of his archive at the Serralves Foundation in Porto reveal the instrumentality of “*correspondence with his clients, the photographic record of the places where the works are to be built, relations with regulatory authorities and the opinions of the multiple actors involved in the construction processes, the models that support the perception of the proposals, the minutes of meetings and reports of the tensions arising at the building sites*”¹⁷ for Siza’s architectural production (Tavares, 2017).

The research discussed above reveals a broad, at times confusing, range of design tools and practices used today. Here an important question comes up: How can we find the right design tool for a given task?¹⁸ The open matrix described above might be useful for that purpose, besides from providing a more coherent way of ordering and categorizing design tools (fig. 9). Mapping the spectrum of tools/uses on the categories of tools/media and vice versa allows one to search systematically for the most promising combinations. Showing only the larger or more general categories of tools, the matrix already adds up to 36 rows for tools/uses and 40 columns for tools/media, which combined result in more than a thousand different possibilities. Rows and columns left without text are indicating the openness of the matrix; they can be filled in as needed. The matrix would endlessly expand by going deeper into detail within the categories (for example the category of 2D drawing would then split up into plan, section, elevation, details, in different scales...).

Now we can use this matrix to tentatively map those combinations of design tools/media with design tools/uses we consider most interesting or especially useful for design tasks related to the reuse of modernist buildings. In the matrix diagram (fig. 9), those are marked with blue color. Red areas indicate combinations that are more conventionally used in architecture practice. Because of their availability, the habits and conventions of our profession they are often the first choice. Those “standard tools” are mostly in the group of visual design tools, used in many different ways, plus verbal descriptions and calculations. They represent a mindset that usually develops ideas for structures that do not exist yet, because of that it has to rely on rather abstract and reduced ways of representation. On the other hand, with a design for the reuse of an existing building, a whole range of other design media and uses comes into reach, which is much more concrete, complex, and closer to multidimensional reality. Obviously, the existing building itself is not only a challenge but also a great opportunity.

Fig. 9 Open Matrix of Design Tools.
Red: design tools use/media combinations which are conventionally used in architecture practice;
Blue: combinations which are of additional/special interest for the reuse of modernist buildings (cg, 2018)

Design tools (in the sense of used/considered as tools)			Design tools (in the sense of media used for design)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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It represents both, a wealth of information and possibilities, to be explored in combination with a series other than “standard” design tools. The most unavoidable constraints are represented by the existing structure, it’s history and pretended future uses.

To understand an existing building as a design tool requires adopting a different mindset, one that embraces the experience of immersing oneself in the built space and the atmosphere it creates, using one’s own body with all its senses as an exploratory device for synesthetic data collection. The existing building, which at the same time is the *representation* of an architectural project (awaiting improvement) and the project itself (demanding respect), invites the practice of design in close contact to a given spatial reality. A building also is an invaluable source of information, to be experienced, discussed, criticized, sketched, drawn, photographed, or 3D-Laser-scanned and transferred into BIM software. What is specific in modernist buildings are the modern, and sometimes problematic materials used (often in minimalized dimensions), a design narrowly conditioned by previously given functions, which makes a change of functions more difficult, and aesthetics that at times can be perceived as problematic.

On top of that, the existing building comes with a history, with (maybe forgotten) narratives based on it’s creation, and initial uses, which later on became obsolete. Because it is modernist, the building must also have some kind of relation (which might be strong or weak, positive or negative) to the architectural theory of the time it was created. This immaterial part of the building can become an important resource for the reuse-project to develop. It offers the possibility to use the verbal design tools in order to create a narrative based not only on it’s history and previous uses, but on the discussion, critique and theory of modernist architecture itself. A narrative, which then could become instrumental to establish the direction and the meaning of the reuse project.

Conclusion

Over the last decade, the question of what design tools are, how they work and how they can be used for architectural design has been responded to in many ways. Research on design tools since 2007 sums up to more than 25 books published, most of them doctoral dissertations, conference proceedings or exhibition catalogues (individual papers were not considered here)¹⁹. An evaluation of these publications led to the conclusion that the term *design tool* is mainly understood in two ways: Firstly, the visual, verbal, combined and synesthetic *media* used for design, and secondly the broad range of material, medial and immaterial uses made of them. An open matrix based on these categories has been proposed which can now be used to map, and identify promising combinations of design media and uses. Applied to a reflection on tools for the reuse of modernist buildings, the matrix shows that besides the usual visual and verbal design tools,

synesthetic media like the building itself, the atmosphere it produces, and the human body exploring it are additional design tools to utilize, as much as critique, discussion and theory of modernist architecture. A narrative rising from the buildings history set in relation to modernist theory could become a strong conceptual basis for a design process.

For further research, the proposed matrix still needs to be tested, refined, and probably expanded.²⁰ It can be used to map and compare existing design tools, or to identify areas for future research. Used within a design process, it may help to map the ongoing activities, and to identify the next steps to take. The matrix will hopefully raise the awareness for and facilitate positioning within the large range of available possibilities of design.

1 → The author would like to thank Xi'an Jiaotong-Liverpool University, in Suzhou, China, for generously founding his work on this research, as well as his travel to participate in the RMB conference in April 2018 at the University of Coimbra, Portugal. He also would like to thank Shayne Jones for discussing and revising earlier versions of this text.

2 → https://past.azw.at/page.php?node_id=3&page_id=538, accessed July 25, 2018

3 → Quoted from: https://past.azw.at/page.php?node_id=3&page_id=538&lang_id=en, accessed July 25, 2018

4 → Thinking out Loud. The Making of Architecture Exhibition, 10-28 January 2011, Dalhousie Faculty of Architecture and Planning, Halifax, Nova Scotia, Canada, from: <http://www.elkekrasny.at/archives/689>, accessed July 25, 2018

5 → See: <https://salledepression.uqam.ca/communiqués-de-presse/général/10728-penser-tout-haut-faire-l'architecture-au-centre-de-design>, 11 février au 18 avril 2010, accessed July 25, 2018

6 → See: <https://hda-graz.at/programm/raumfinden-werkzeuge-des-entwerfens>, accessed July 25, 2018

7 → The author would like to thank Dr. Adam Brillhart for his advice on this topic.

8 → See: https://issuu.com/birkhauser.ch/docs/birkhauser_tools, accessed July 21, 2018

9 → See: <https://hda-graz.at/programm/raumfinden-werkzeuge-des-entwerfens>, accessed July 25, 2018

10 → Call for Papers: "Imagery in the Age of Modelling. Operative Artifacts in the Design Process in Architecture and Engineering" (Basel). In: ArtHist.net, Jul 13, 2012, <https://arthist.net/archive/3636>, accessed July 25, 2018 (scroll down for English version)

11 → Namely: Eva Maria Froschauer (architecture history, 10/2011-12/2012), Stefanie Klamm (history, 11/2011-10/2012), Ana Ofak (media science, 2/2011-12/2012), Ulrich Richtmeyer (philosophy, media science, 1/2011-2/2012), Susanne Schregel (history, 2/2011-12/2012), Nicole Stöcklmayr (architecture, media science, 9/2010-3/2013), Franziska Uhlig (art history, 9/2010-3/2013), see <https://www.ikkm-weimar.de/forschung/vergangen/werkzeuge-des-entwerfens/>, accessed July 21, 2018

12 → Namely: Nathalie Bredella, Gert Hasenhütl, Peter Heinrich Jahn, Lutz Robbers, Wladimir Velinski, see <https://www.ikkm-weimar.de/forschung/vergangen/werkzeuge-des-entwerfens/>, accessed July 21, 2018

13 → The author would like to thank Professor Thomas Fischer for this suggestion.

14 → The author would like to thank Shayne Jones for this clarification.

15 → See for example Peichel, 2013

16 → Anexo B, Interview with Álvaro Siza Vieira, 2012, p. 34: “João Miguel Couto Duarte: Ao longo de um projecto, há fases em que utiliza mais a maquete, outras em que utiliza mais o desenho, ou é indiferenciado? Álvaro Siza Vieira: Têm de ser complementares, assim como o esboço tem de ser acompanhado, muito rapidamente, pelos primeiros esquemas [desenhados] à escala. Tem de haver um diálogo. Todos os meios que nós usamos são também meios de enganar, enganam muito.” P. 36: “ASV: Têm de ser utilizados muitos meios. JMCD: No fundo, trabalha com o cruzamento de todos esses meios. ASV: É. E também com o computador (...) é imprescindível. (...) Alterou muito o trabalho de arquitectura.”

17 → Quoted from: https://www.domusweb.it/en/news/2016/06/14/serralves_museum_raw_material.html, accessed August 22, 2018

18 → Question raised by Professor Gonçalo Canto Moniz during a discussion at the the RMB conference in Coimbra, April 2018

19 → Please see the references listed below.

20 → In case you would be interested in working with the matrix, please contact the author for a free copy of the Excel file.

References

Aicher, O. (1991). *die welt als entwurf*. Berlin: Ernst & Sohn

Ammon, S.; Froschauer, E. (eds.) (2013).

Wissenschaft Entwerfen (“The Science of Design”), (Conference proceedings), München: Fink

Ammon, S.; Hinterwaldner, I. (eds.) (2017).

Bildlichkeit im Zeitalter der Modellierung. Operative Artefakte in Entwurfsprozessen der Architektur und des Ingenieurwesens, (Conference proceedings), München: Fink

Borges, J. L. (1942). El idioma analítico de John Wilkins, in: *La Nación*, Argentina, 8 February 1942, quoted after “*The Analytical Language of John Wilkins*”, available on <http://www.alamut.com/subj/artifice/language/johnWilkins.html>, accessed July 15, 2018

Brand, S. (ed.) (1968). *Whole Earth Catalog, access to tools*.

Brillhart, A. (2018). *The Boundless Workshop: Tools and the Representational Framework of Construction*. Doctoral dissertation, Hangzhou: China Academy of Arts

Buchert, M. (ed.) (2014). *Reflexives Entwerfen. Entwerfen und Forschen in der Architektur*. (Conference proceedings), Berlin: Jovis

Couto Duarte, J. M. (2016). *Para uma Definição de Maqueta: Representação e Projecto de Objectos Arquitectónicos*. Doctoral dissertation, Lisbon: Universidade de Lisboa

DeKay, M.; Brown, G. Z. (1985, 2000, 2014). *Sun Wind and Light, architectural design strategies*. Hoboken: Wiley

Dillenburger, B. (2016). *Raumindex. Ein datenbasiertes Entwurfsinstrument. [Space Index. A data-based design instrument]* Doctoral dissertation no. ETH 23596, Zürich: ETH

Ehrlich, C. (1999). Die Konstruktion der Idee und ihre Werkzeuge. In: *Cloud-Cuckoo-Land – International Journal of Architectural Theory*, No. 1/1999, available on <http://www.cloud-cuckoo.net/openarchive/wolke/deu/Themen/991/Ehrlich/ehrich.html>, accessed July 2018

Fischer, T. (2008). *Designing (tools (for designing (tools (for...))))*. Doctoral dissertation, Melbourne: Royal Melbourne Institute of Technology (RMIT) University, available on <https://researchbank.rmit.edu.au/view/rmit:9761>, accessed July 2018

Fitz, A.; Lenz, G. (eds) (2015). *Vom Nutzen der Architekturfotografie / Architectural Photography and Its Uses*. Basel, Berlin: Birkhäuser

Flusser, V. (1991). *Gesten. Versuch einer Phänomenologie*. Bensheim und Düsseldorf: Bollmann

Froschauer, E. M. (2019). *Entwurfsdinge. Vom Sammeln als Werkzeug moderner Architektur*. Berlin, Birkhäuser (forthcoming)

Gänshirt, C. (1999). Sechs Werkzeuge des Entwerfens. In: *Cloud-Cuckoo-Land – International Journal of Architectural Theory*, No. 1/1999, available on <http://www.cloud-cuckoo.net/openarchive/wolke/deu/Themen/991/Gaenshirt/gaenshirt.html>, accessed July 2018

Gänshirt, C. (2007, 2011). *Tools for Ideas, Introduction to Architectural Design*. Basel; Boston: Birkhäuser, 2nd ed. Basel: Birkhäuser; Chinese ed. Beijing: China Architecture and Building Press

Gänshirt, C. (2008). *Werkzeuge des Entwerfens. Untersuchungen zu Praxis und Theorie entworfenen Handelns*. Doctoral dissertation, Cottbus: Brandenburgische Technische Universität

Gethmann, D.; Hauser, S. (eds.) (2009). *Kulturtechnik Entwerfen. Praktiken, Konzepte und Medien in Architektur und Design Science*. (Conference proceedings), Bielefeld: Transcript

Gethmann, D.; Eckhard, P.; Wagner, A. (eds.) (2015). *Archiscripts*. GAM Graz Architecture Magazine 11, Basel: Birkhäuser

Gerber, A.; Patterson, B. (eds.) (2013). *Metaphors in Architecture and Urbanism. An Introduction*. (Conference proceedings), Bielefeld: Transcript

- Gerber, A. (2012). *Theorie der Städtebaumetaphern. Peter Eisenman und Stadt als Text*, Doctoral dissertation, Zürich: Chronos
-
- Hartmann, J. (2016). *Wiederkehr und Mehrdeutigkeit, Entwurfswerkzeuge der Architektur*. Doctoral dissertation, Wiesbaden: Springer Vieweg
-
- Hillnhütter, S. (ed.) (2015). *Planbilder: Medien der Architekturgestaltung*. Kunsthistorisches Jahrbuch für Bildkritik, Bildwelten des Wissens Bd. 11, Berlin: De Gruyter
-
- Hnilica, S.; Sonne, W.; Wittmann, R. (eds.) (2007). *Die Medien der Architektur. Eine Ausstellung des A:AI Archiv für Architektur und Ingenieurbaukunst NRW*, Dortmund: A:AI
-
- Hnilica, S. (2012). *Metaphern für die Stadt. Zur Bedeutung von Denkmodellen für die Architekturtheorie*. Bielefeld: Transcript
-
- Krasny, E. (2008). *The Force Is in the Mind. The Making of Architecture*. (Exhibition catalogue), Basel, Boston, Berlin: Birkhäuser
-
- Locher, H.; Sachsse, R. (eds.) (2016). *Architektur Fotografie. Darstellung – Verwendung – Gestaltung. Transformationen des Visuellen Band 3*. Berlin, München: Deutscher Kunstverlag
-
- LU, C. (2014). *Carpentry in Southern China*. Documentary Film, 永嘉县山坑村
-
- McLuhan, M. (1964). *Understanding Media*. Toronto: University of Toronto
- Moutinho, N. A. (2016). *A Cor no Processo Criativo – O espaço da cor no desenho de arquitetura*. Doctoral dissertation, Lisbon: Universidade de Lisboa
-
- Morrison, J. (2017). *The Hard Life*. Zürich: Lars Müller
-
- Peichl, G. (2013): *Die Zeichnung ist die Sprache der Architekten. [The Drawing is the Architect's Language]*, edited by Eva-Maria Barkhofen, Berlin: Akademie der Künste
-
- Reichle, I.; Siegel, S.; Spelten, A. (eds.) (2008). *Visuelle Modelle*. München: Fink
-
- Schmal, P. C.; Elser, O. (eds.) (2012). *Das Architekturmodell: Werkzeug, Fetisch, kleine Utopie*. (Exhibition catalogue Deutsches Architektur Museum Frankfurt am Main), Zürich: Scheidegger & Spiess
-
- Schmitz, T. H.; Groninger, H. (eds.) (2012). *Werkzeug – Denkzeug. Manuelle Intelligenz und Transmedialität kreativer Prozesse*. (Conference proceedings), Bielefeld: Transcript
-
- Schmitz, T. H.; Häußling, R.; Mareis, C.; Groninger, H. (eds.) (2016). *Manifestationen im Entwurf. Design – Architektur – Ingenieurwesen*. Bielefeld: Transcript
-
- Schön, D. A. (1983). *The Reflective Practitioner. How Professionals Think in Action*. New York: Basic Books, 1983, 1991, reprint: Adlershot: Ashgate, 1995, 1996 ... 2003
- Sonne, W. (ed.) (2011). *Die Medien der Architektur*. (Conference proceedings), Berlin, München: Deutscher Kunstverlag
-
- Stapenhorst, C. (2016): *Concept. A Dialogic Instrument in Architectural Design*. Doctoral dissertation, Berlin: Jovis
-
- Schultz, H. (2014). *Landschaften auf den Grund gehen. Wandern als Erkenntnismethode beim großräumigen Landschaftsentwerfen*. Doctoral dissertation, Berlin: Jovis
-
- Tavares, A. (2017). *Matéria-prima: Um olhar sobre o arquivo de Álvaro Siza. [Raw Material: A View of the Archive of Álvaro Siza.] 'From the Collection' series vol. 7*, Porto: Serralves
-
- Vrachliotis, G.; Kleinmanns, J.; Kunz, M.; Kurz, P. (eds.) (2017). *Frei Otto: Denken in Modellen*. (Exhibition catalogue), Leipzig: Spector
-
- Wendler, R. (2013). *Das Modell zwischen Kunst und Wissenschaft*. München: Fink
-
- Wittmann, B. (ed.) (2018). *Werkzeuge des Entwerfens*. Schriften des IKKM – Internationalen Kollegs für Kulturtechnikforschung und Medienphilosophie Band 30, Zürich, Diaphanes