

THE IMPACT OF DESIGN TOOLS ON THE DESIGN

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TABLE OF CONTENTS

EREDETISÉGI NYILATKOZAT	4
ACKNOWLEDGMENTS	5
ABSTRACT	6
ABSZTRAKT	7
THESIS STATEMENTS	8
TÉZISEK	12
INTRODUCTION	16
FROM TRIANGLES TO POLYGONS	22
INSPIRATION AND CREATIVE INTENT	24
“STYLUS” AND “STYLE”: THE ETYMOLOGICAL EVIDENCE	26
CLAY AND REED STICK - MESOPOTAMIA	30
ARCHITECTURE BEFORE THE AGE OF PRINTING	36
COMPASS - THE TOOL OF THE MIDDLE AGES	39
Scholasticism and architectural system in Panofsky's theory	40
Principles of geometric construction	42
Album of Villard de Honnecourt	44
Rose windows	45
RENAISSANCE - THE IMPACT OF GUTENBERG	48
Secret Knowledge	52
Dimension jump and the baroque	54
METHODS AND TOOLS FROM THE INDUSTRIAL REVOLUTION	56
Adolf Loos on Architecture	56
Hoffmann, Wright, Mackintosh and the parallel lines	57

AXONOMETRY AND ISOMETRY AS A 3D TOOL	64
New York five, a revival of axonometric projection	66
FUTURE TENDENCIES	74
CASE STUDY: THE LOGIFACES GAME	78
The Concept of Logifaces	82
Educational Opportunities	84
MOTOCOZY - THE DESIGNER'S INTROSPECTION	86
MOTOCOZY - ARTWORK DESCRIPTION	89
1. PROBLEM PRESENTATION AND CURRENT SOLUTION	89
2. BRIEF PRESENTATION OF THE PRODUCT	90
3. APPLICABLE TECHNOLOGY AND INNOVATION	92
4. DEVELOPMENT STEPS	92
5. CURRENT AND EXPECTED TRENDS	93
6. DEMAND SIDE	93
7. IDENTIFIED COMPETITORS	94
8. HOW IS THE PRODUCT BETTER?	95
9. TYPICAL CUSTOMERS	96
10. BUSINESS MODEL	97
11. SALES STRATEGY	98
THE IMPACT OF DESIGN TOOLS IN MOTOCOZY	
100	
BIBLIOGRAPHY	
102	

EREDETISÉGI NYILATKOZAT

Alulírott Lakos Dániel, a Moholy-Nagy Művészeti Egyetem Doktori Iskola doktorjelöltje kijelentem, hogy az IMPACT OF DESIGN TOOLS ON THE DESIGN című doktori értekezésem saját művem, abban a megadott forrásokat használtam fel. Minden olyan részt, amelyet szó szerint vagy azonos tartalommal, de átfogalmazva más forrásból átvettem, egyértelműen, a forrás megadásával megjelöltem.

Kijelentem továbbá, hogy a disszertációt saját szellemi alkotásomként, kizárólag a fenti egyetemhez nyújtom be.

Kelt: Budapest, február 15.

.....

Lakos Dániel

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ABSTRACT

While it is widely accepted today that computer-aided design significantly influences both the final plans and the execution of objects, art historical discussions often provide limited insights into how earlier drawing tools or design methods might have impacted drawings or executed design objects.

In my essay, drawing on examples from historical periods, I will prove that tools or methods from the past often played a role in design, particularly in terms of shaping, decoration, geometric construction, or spatial arrangement. Although design tools and methods are generally accessible to every designer or architect, not every user of these tools becomes an outstanding designer. Therefore, I emphasize that the current design tool or method alone does not guarantee outstanding design; these elements contribute to the inspirational process, whether within the context of an entire era or for an individual designer.

While numerous aspects can influence the design process, my research specifically focuses on tools and methods. Instead of narrowing the scope to a particular period, my aim is to present a comprehensive study on design tools from ancient times to the near future. Finally, using examples from my own work, I illustrate how computer-aided design has influenced the objects I have created.

ABSZTRAKT

Míg ma a számítógépes tervezés tárgyakra vagy építészetre gyakorolt hatását kevesen vitatják, a művészettörténeti diskurzusból hiányzik a korábbi rajzeszközök tervrajzokra vagy a kivitelezett művekre gyakorolt befolyásának vizsgálata.

Dolgozatomban művészettörténeti korszakokból vett példákra támaszkodva bizonyítom, hogy a múltban használt eszközök vagy módszerek gyakran játszottak szerepet a tervezésben, különösen a formálás, díszítés, szerkesztés vagy a térbeli elrendezés területén. Bár a tervezési eszközök és módszerek általában minden tervező vagy építész számára elérhetőek, nem minden eszközhasználó válik kiemelkedő tervezővé. Így hangsúlyozom, hogy a tervezési eszköz vagy módszer önmagában nem garantálja a létrejövő tervek magas minőségét. A tervezési eszközök hozzájárulhatnak az inspirációs folyamathoz, akár egy egész történeti korszak kontextusában, akár egy alkotó esetében.

Noha számos szempont befolyásolhatja a tervezési folyamatot, kutatásom kifejezetten az eszközökre és a módszerekre összpontosít. Ahelyett, hogy egy adott korszakra szűkíteném a kört, célom, hogy átfogó tanulmányt nyújtsak be a tervezési eszközökről, az ókortól a közeljövőig bezárólag. Végül, saját munkáimból vett példákkal illusztrálom, hogy a számítógépes tervezés hogyan befolyásolta az általam készített tárgyakat.

THESIS STATEMENTS

Despite the seemingly commonplace notion that computers significantly impact design today, it is unusual to suggest that in every era, a tool existed influencing the course of design. While numerous studies in tool history are available, there are few examples that thoroughly analyze the impact of tools on the characteristics or creators of a particular art historical period. The aim of my thesis to validate the impact of different tools on different eras and creators.

Although tools and methods may seem like distinct concepts at first glance, they equally impact on the drawing and the implemented object in the design process. I discuss the tool together with the method as they alternate or complement each other. I agree with Mario Carpo that the meaning of 'method' is essentially identical in origin to the meaning of 'shortcut.' That is, both the tool and the method serve to simplify the design process, in a way, to standardize it.¹

From Mesopotamia, only a few architectural remnants have survived, yet a certain character emerges from the recurring nature of specific solutions. I will provide original explanations for these enigmatic details based on the characteristics of the stylus imprints left on clay tablets.

¹Carpo, Mario. 2017. ARCHITECTURE in the AGE of PRINTING : Orality, Writing, Typography, and Printed Images in The... History of Architectural Theory. S.L.: MIT Press. 51.

Although the compass was invented in antiquity, its unmistakable mark on buildings only became apparent in the Gothic era. We will see many evidences on the application of the compass in the Gothic architecture.

In the Renaissance era, architecture was primarily influenced by copying. The advent of book printing enabled this method, making treatises widely accessible to everyone. In this case, indirectly, it was the printing press itself that disseminated the method of copying, which thus became dominant over centuries.

Even in modernity, where individual artistic styles are discussed, tools and methods that affect individuals differently can be identified. One such tool is the parallel ruler. Although presumably many architects of the era used this tool, its impact is not evident in the work of every architect. I will demonstrate the impact of parallel ruler on Frank Lloyd Wright's works, the impact of the grid paper on Josef Hoffmann's works, or the elevation method influenced Charles Rennie Mackintosh.

Although the origin of axonometry dates back to the Filippo Brunelleschi, it played a defining, inspirational role in design in the 20th century. In my essay, I introduce how this construction method influenced designers and architects of De Stijl and Bauhaus. From the postmodern era, I will show the renewed popularity of

axonometric representation, through the works of James Stirling and the New York Five.

The conclusion of my case studies is that same tool can inspire and influence the design in different ways. The use of a tool or method alone does not make anyone a genius creator. True greatness is characterized by a high level of sensitivity and the ability to draw inspiration. Without sensitivity toward inspiration, these factors do not have an impact or do not guarantee a remarkable work. As Hockney or Lucas² claims, that the impact of the tools do not diminish the greatness of the masters. A genius is inspired by countless impressions, great works are built from inspirations, and the impressions feed those inspirations. A drawing tool is just one important impact among many.³

The application of a method or tool generally becomes a routine. A routine is a set of methods and techniques used by a particular designer to solve tasks. This routine then becomes integrated with the creator's style. In my understanding, style encompasses a collection of solutions, characteristic of both the era and the designer, yet remains detached from any specific design challenge. I posit that, style can be viewed as a manifestation of routine in essence.

² see more: Hockney, David. 2006. *Secret Knowledge : Rediscovering the Lost Techniques of the Old Masters*. London: Thames & Hudson. Lucas, Ray. 2019. *Drawing Parallels. Knowledge Production in Axonometric, Isometric and Oblique Drawings* London and New York: Routledge.

³ Hockney, David. 2006.131.

“Understanding a tool doesn’t explain
the magic of creation. Nothing can.”⁴

David Hockney

⁴ David Hockney, and Martin Gayford. 2020. A History of Pictures : From the Cave to the Computer Screen. New York: Abrams. 178.

TÉZISEK

Jóllehet, evidenciának számít, hogy a számítógép jelentős hatással van a tervezésre, szokatlan az állítás, hogy minden korszakban létezett egy eszköz, amely befolyásolta a tervezést. Bár számos eszköz történetét vizsgáló tanulmány áll rendelkezésre, kevés példát találunk olyan elemzésre, amely egy eszköz adott művészettörténeti korszakra vagy alkotóra gyakorolt hatását vizsgálja. Dolgozatom célja bemutatni, hogyan befolyásolták a rajzeszközök korszakonként és alkotónként a terveket és az elkészült tárgyakat, épületeket.

Bár az eszközök és módszerek első pillantásra különböző fogalmaknak tűnnek, mindkettő egyaránt hatással van a tervezési folyamatban alkalmazott rajzra és a megvalósított objektumra. Az eszközt és a módszert együttesen vitatom, mivel felváltva vagy egymást kiegészítve működnek. Egyetértek Mario Carpo-val abban, hogy a "módszer" jelentése lényegében azonos eredetű a "rövidebb út" jelentésével. Vagyis mind az eszköz, mind a módszer a tervezési folyamat egyszerűsítését, egyfajta szabványosítását célozza.⁵

Ugyan Mezopotámiából csak néhány építészeti emlék maradt fenn, de némely megoldások ismétlődő jellegéből egy bizonyos karakterre mégis következtethetünk. Ezen rejtélyes részletekre fogok újszerű magyarázatot nyújtani, a stylus agyagtáblán hagyott lenyomatának jellegzetességei alapján.

⁵ Carpo, Mario. 2017. ARCHITECTURE in the AGE of PRINTING : Orality, Writing, Typography, and Printed Images in The... History of Architectural Theory. S.L.: MIT Press. 51.

Bár körző már az ókorban is létezett, annak az építészetre gyakorolt, látványos hatása csak a gótikában mutatkozott meg. Dolgozatomban több példán keresztül mutatom be a körző alkalmazásának a gótikus építészetre gyakorolt hatását. A reneszánszban az építészetet főként a másolás metódusa befolyásolta. A könyvnyomtatás megjelenésével a mintakönyvek előállítása és terjesztése széles körben vált lehetővé. Ebben az esetben közvetve a könyvnyomtatás volt az az eszköz, amely a másolás metódusát megkönnyítette, és amely ezáltal évszázadokon keresztül volt uralkodó.

Még a modernitásban is, ahol egyéni stílusokról is beszélünk, azonosítani lehet olyan eszközöket és módszereket, amelyek különböző módon befolyásolják az alkotókat. Ilyen eszköz például a párhuzamos vonalzó. Bár valószínűleg sok építész használta ezt az eszközt, nem minden építész munkájában érhetők tetten ennek nyomai. Bemutatom a párhuzamos vonalzó hatását Frank Lloyd Wright munkáiban, a négyzethálós papír használatának jeleit Josef Hoffmann munkáiban, vagy a falnézeteken alapuló tervezési módszer hatását Charles Rennie Mackintosh munkáiban.

Míg az axonometria eredete Filippo Brunelleschihez nyúlik vissza, igazán a 20. századi építészetben és designban játszott meghatározó szerepet. Esszémben bemutatom, hogy ez a szerkesztési eljárás hogyan befolyásolta a De Stijl és a Bauhaus tervezőit. A posztmodern korszakból James Stirling és a New York Five munkáin keresztül mutatom be az axonometrikus ábrázolás visszatérését, és annak munkákban is megnyilvánuló jellegzetességeit.

A példák során keresztül bemutatom, hogy ugyanaz az eszköz akár különböző módon inspirálhatja és befolyásolhatja a tervezést. Az eszköz vagy módszer

használata ugyanakkor önmagában nem tesz senkit zseniális alkotóvá. A valódi nagyság magas szintű érzékenységgel és az ihletre való fogékonysággal jellemezhető. Az érzékenység hiányában ezek a tényezők nem jelentenek ihlető forrást, vagy nem garantálnak korszakalkotó teljesítményt. Ahogyan Hockney vagy Lucas⁶ állítja, az eszköz használata nem von le a mesterek nagyságából. Egy zseni számtalan hatásból inspirálódik, a nagy művek ezekből az inspirációkból épülnek fel. Az ihletet jelentő hatások között a rajzeszköz csak egy fontos tényező a sok közül.⁷

Az egyes módszerek vagy eszközök alkalmazása általában rutinná válik. A rutin olyan módszerek és technikák összessége, amelyeket egy adott tervező használ különböző feladatok megoldására. Később ez a rutin válik a tervező stílusává. Értelmezésemben a stílus magában foglalja a megoldások gyűjteményét, jellemző mind a történeti korszakokra, mind a tervezőre, de mégis leválasztható a konkrét tervezési feladatokról. Állítom, hogy a stílust lényegében a rutin megnyilvánulásaként lehet szemlélni.

⁶ Lásd mag: Hockney, David. 2006. Secret Knowledge : Rediscovering the Lost Techniques of the Old Masters. London: Thames & Hudson. Lucas, Ray. 2019. Drawing Parallels. Knowledge Production in Axonometric, Isometric and Oblique Drawings London and New York: Routledge.

⁷ Hockney, David. 2006.131.

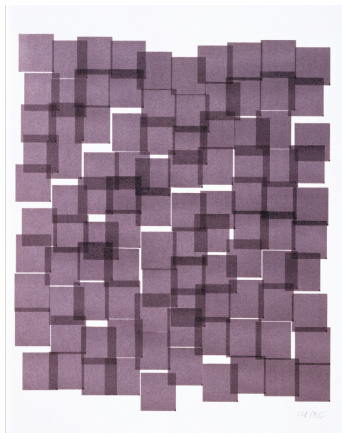
“Egy eszköz megértése nem ad magyarázatot az alkotás varázsára.
Semmi sem képes erre.⁸”

David Hockney

⁸ David Hockney, and Martin Gayford. 2020. A History of Pictures : From the Cave to the Computer Screen. New York: Abrams. 178.



Jack Kerouac, original typewritten scroll of *On The Road* (1957). Ink, paper, tape.



Vera Molnar, *Interstices*, 1986 Plotter drawing 22 × 25 cm
Interstices, 1986

INTRODUCTION

The tools influencing creation – even those considered irrelevant – are present in every artistic discipline. For instance, it matters whether a writer works by hand, with a typewriter, or with a computer. The philosopher Kant, for example, made short notes from which his complete works emerged. The fragmentedness resulting from the method, is palpable in his volumes. Jack Kerouac typed his dynamic masterpiece "On the Road" on a single long scroll. Music history is closely related to the history of the development of instruments. Bach's compositions were influenced by the complexity of the organ. The contrapuntal and harmonic techniques developed in his organ music can be observed in his choral works, orchestral compositions, and keyboard music.⁹ The appearance of canvas as a medium had a general impact on painting, as it provided painters with greater size range and lower costs, granting them more freedom. Similarly, the widespread use of oil paint since the Renaissance allowed for greater color depth, aided by slower drying times, facilitating more precise color mixing and layering.¹⁰

Naturally, contemporary electronic technology has also influenced creators in every artistic discipline, such as the composer Karlheinz Stockhausen or the visual artist Molnár Vera. Despite the well-known examples mentioned above, David

⁹ Williams, Peter. 2007. *J. S. Bach*. Cambridge University Press. 29

¹⁰ <https://birdanddavis.com/blogs/news/a-brief-history-of-oil-paintings>

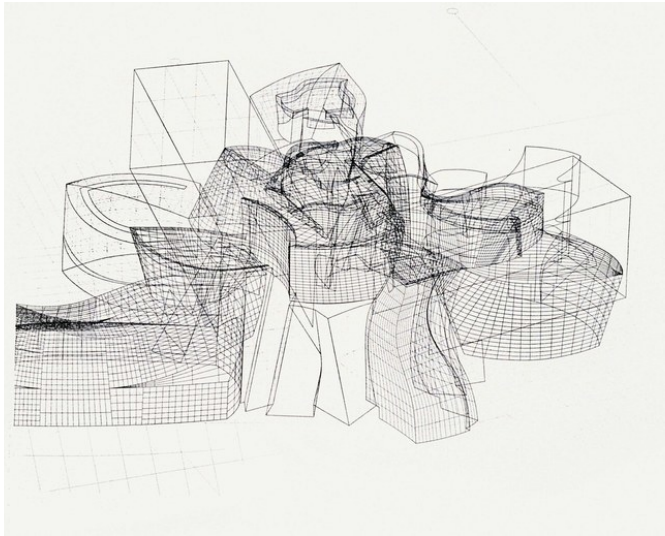
Hockney's work titled "Secret Knowledge"¹¹ sparked a significant debate. In his work, Hockney demonstrates through analyses that painters widely used optical aids from the Renaissance onwards, and their paintings are actually closer to photography than one might think. (I will discuss Hockney's work in more detail later). Many times, I have experienced similar surprises when reporting on my research. Like Hockney, I do not claim that the use of a particular tool turns anyone into a brilliant architect or designer. Moreover, I do not believe that these tools detract from the value of the works. I simply assert that design tools, consciously or subconsciously, have an inspiring effect on the design. I believe that artistic sensitivity is, in fact, signaled by an excellent creator allowing themselves to be inspired by even the simplest tools or phenomena.



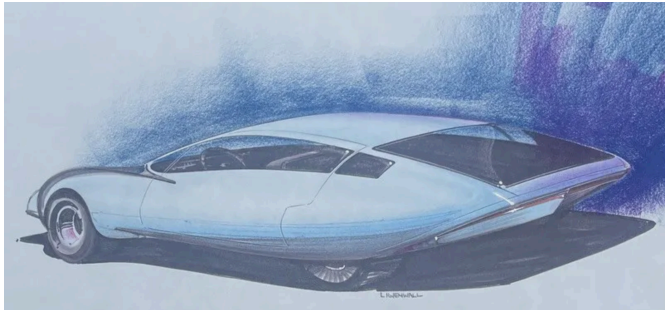
Tim Jenison, inspired by Hockney's book, set out on an ambitious experiment to test his theory. He aimed to recreate Vermeer's painting "The Music Lesson" using a contraption that allows him to paint with the aid of mirrors and lenses.

ILLUSTRATION: SONY PICTURES CLASSICS

¹¹ Hockney, David. 2018. Secret Knowledge : Rediscovering the Lost Techniques of the Old Masters. London: Thames & Hudson.



CAD program generated 3D model from 1992, Frank O. Gehry, Guggenheim Museum in Bilbao.
Photo: Gehry Partners, LLP



Car concept, Edward T. Liljenwall, circa 1969 n.d.

It is needless to say that contemporary architecture is significantly influenced by Computer-Aided Design (CAD) programs in several ways, revolutionizing the design and construction processes. CAD programs have become essential tools for architects, allowing for greater precision, efficiency, and creativity.

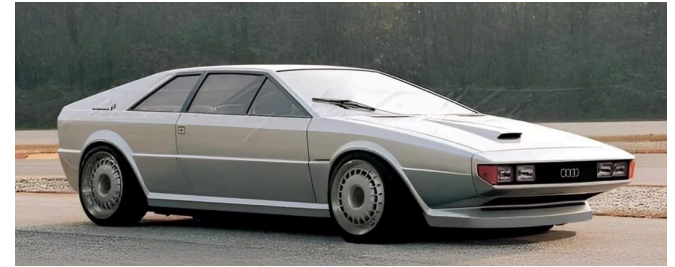
Contemporary design is profoundly influenced by CAD programs, whether it is in the fields of industrial design, interior design, graphic design, or any other design discipline. This technology has revolutionized the design process, offering designers powerful tools and capabilities that have transformed the way they work. CAD programs have transformed contemporary architecture by enhancing design precision, enabling the exploration of complex geometries, streamlining collaboration and project management, and improving overall efficiency in the design and construction processes. Today designers have a powerful digital toolbox that enables them to bring their visions to life in ways that were not possible before the advent of CAD technology.

It often occurs that the facilitator and catalyst of formal development is the computer infrastructure. In the automotive industry, the angular shapes of the 60s and 70s were not necessarily born out of fashion or technology. Even during that time, designers conceptualized teardrop-shaped cars on paper, but due to the absence of CAD and Computer-Aided Manufacturing (CAM) systems, the industry could only manufacture angular, geometric shapes - utilizing otherwise modern deep-drawing technology. It is only in the last decade that the industry has reached a point where it can precisely produce the kind of intricate, free forms that were envisioned in the 60s. Technological evolution frequently liberates the minds of designers. However, I am specifically focusing on instances where the design tool influenced the final product or building, and will omit cases where technological advancements served as the source of inspiration.

The preparation and realization of parametric designs is clearly due to the development of computer technology. As a side effect, surfaces broken down into triangles also came into vogue in object shaping. It is commonplace today that computer-aided design has a serious impact on design. In the following, I will illustrate this impact of the computer on contemporary architecture and design through a few specific examples.

Zaha Hadid, the renowned Iraqi-British architect, was a pioneer in the use of CAD technology in architecture. Her architectural practice, Zaha Hadid Architects, embraced CAD and other digital tools to develop her iconic and avant-garde designs. Zaha Hadid was known for her fascination with complex and innovative architectural forms. CAD software allowed her to design intricate, fluid, and non-linear shapes, forms that would have been challenging to achieve by using traditional drafting methods. Hadid's works often embraced parametric design principles, where parameters and rules are defined within the CAD software to generate complex, interrelated forms. This approach enabled the creation of dynamic and responsive architectural designs. CAD provided a platform for creating highly detailed digital models of her architectural concepts. These models could be manipulated and refined extensively in the digital realm before moving to physical construction.

Beside using CAD programs, Dutch designer Joris Laarman involves 3D printing and robotics, to implement his computer generated unique and intricate designs. One of his notable works is the "MX3D Bridge," the first 3D-printed stainless steel pedestrian bridge in Amsterdam.



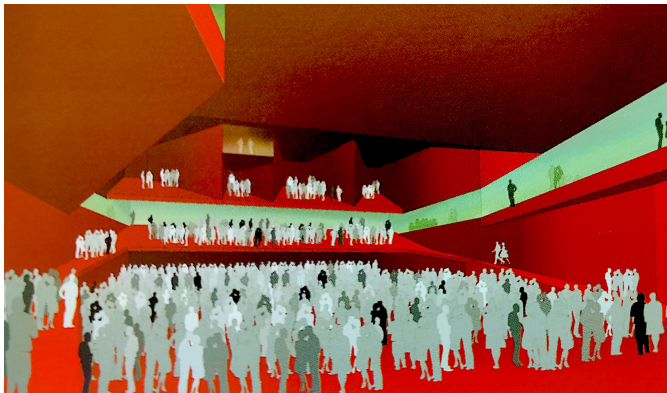
Audi 80 Karman Pik-As by Ital-Design, 1973



Interior of Heydar Aliyev Center, Baku, Zaha Hadid, 2012
Photo: Helene Binet



Mx3d Bridge, Joris Laarman, 2018
Photo: Thea van den Heuvel



Barcelona Forum, competition rendering, Herzog & de Meuron, 2000

The Gantenbein winery, designed by Swiss architect Andrea Deplazes, features a latticed brick facade. The lattice serves a dual purpose; each brick was laid by robots to create a pixelated image of grapes. On the other hand, the lattice functions as a filter for light.

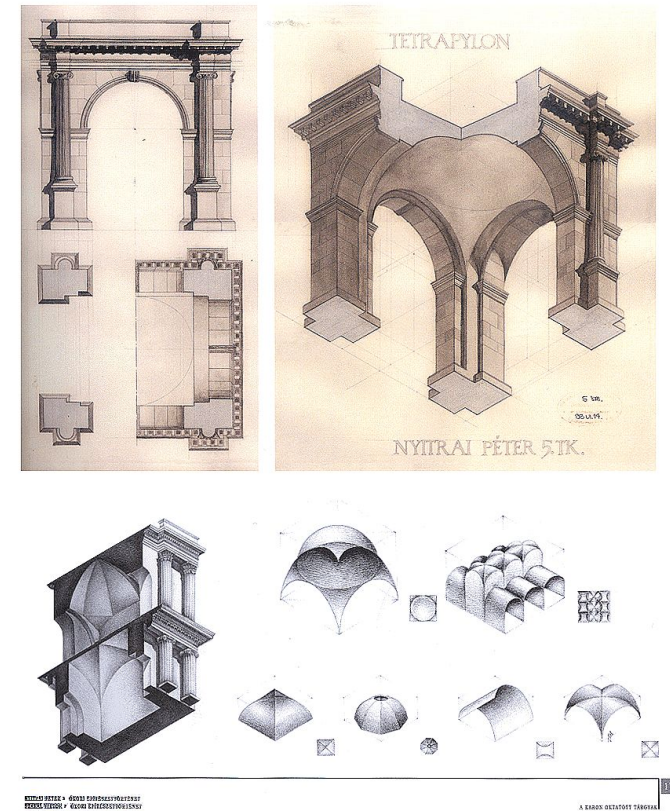
At the beginning of my university studies, in the late 1990s, computers were already being used for design. There were also softwares suitable for creating renderings, but these solutions were still rudimentary. Generating photorealistic images was hardly possible, creating aesthetic images were challenging too. However, from the rapid development of computer technology, one could predict that this tool would become dominant in the future. Despite these potentials, many people - and not only from the elder generations - generally had a bad opinion of computer-aided design. The objections were often about the lack of tactile experiences. Indeed, direct contact with traditional drawing tools, paper, pencil and ruler, grants a personal touch to abstract technical drawings. At the same time, such a connection with the computer is realized only indirectly by printing. The final drawing lacks personal character. This is probably why computer-aided design has often been considered "soulless". Since then, even the most conservative designers have accepted the use of CAD programs to facilitate design.

The tradition of teaching architectural history at the Budapest University of Technology actually dates back to Marcus Vitruvius Pollio and Sebastiano Serlio.¹²

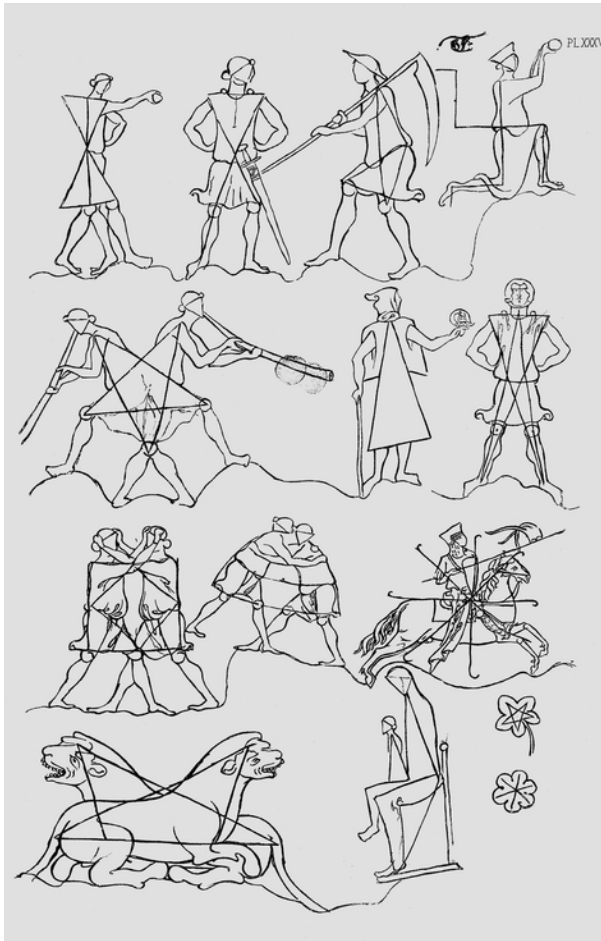
¹² Répás, Ferenc (ed.) 2002, BME Építészmérnöki Kar Évkönyve. Budapest: Terc

The principles of geometric construction processed during the Renaissance are still taught as the basis of the architecture and art history today. Although there can be various principles of organization for the historical approach, the still thriving science of architectural history based on antiquity and column orders seems to persist unbroken even after 500 years. Besides I do not deny the enormous impact of Greek-Roman architectural vocabulary on the world's architecture, in my essay, I would like to propose another approach.

Inspiration is an essential driving force for every creative thought, yet design tools, medium, and method—all these factors not only influence the course of design but also impact the end result. Additionally, numerous other factors, such as accessible materials, culture, resources, clients, and functional expectations, can influence design outcomes. However, in my essay, I want to focus exclusively on design tools and methods.



BME Építészmérnöki Kar Évkönyve, 2002, Terc



The Medieval sketchbook of Villard de Honnecourt, Dover Publications Inc. Mineola, New York, Plate 36

FROM TRIANGLES TO POLYGONS

As observed in Villard de Honnecourt's examples¹³ from the 13th century, attempts to geometrically reduce complex, organic forms date back to the Gothic period. Today, a similar approach is taken with the basic module of computer 3D applications—the triangular form resulting from the polygonal mesh resolution of intricate shapes. Decomposing natural forms into triangles has evolved into a shaping element, influencing fashion both within and beyond the virtual world, often detached from the original context. This trend is evident in various objects featuring many small triangular shapes, such as clothing, ceramics, wall covering elements, and various utilitarian or architectural products, including our own project, the Logifaces game, to be discussed later.

The undeniable dominance of the computer, working in collaboration with CAD applications, as a design tool is evident in today's design landscape. This transformation, pioneered not by artists or architects but by computer processing systems, developed by mathematicians, has profoundly shaped contemporary design trends. While one might question whether designers always desired to create such forms in the past, but the technology was unavailable. For instance, the current trend of the polygonal world of shapes could have emerged at any time, even without a computer, as there were no significant technological barriers to its creation. The absence of objects with this motif in the past was likely due to the lack of inspiration generated by mathematicians and computer scientists who developed polygonal resolution.

¹³ Bowie, Theodore (ed.) 2006. The Medieval sketchbook of Villard de Honnecourt. Dover Publications Inc. Mineola, New York

In my essay, we will see that distinctive individual or era-specific stylistic trends emerged independently of tools in different periods. We will observe this, for example, in the case of axonometry, which, despite being invented centuries earlier,¹⁴ became a fundamental tool for progressive trends in the twentieth century. In Gothic architecture, the defining compass had been known for over a millennium.¹⁵ However, technological innovations make available tools that immediately influence prevailing tendencies. Such inventions include, for instance, the printing press during the Renaissance or the widespread adoption of computers and software innovations in our present day.

I need to emphasise, that a tool does not exclusively dictate a creative direction; the same tool can result in completely different works based on the context and inspiration behind its use. Among the impacts on design, I consider inspiration as a truly important element, and ammunition for it can come from countless factors; the impact of tools is just one among many.

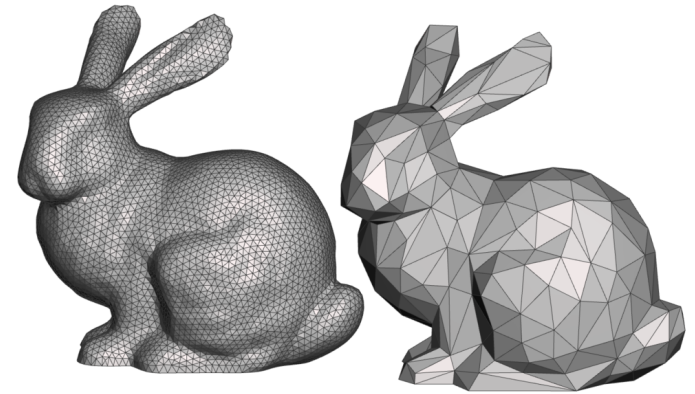
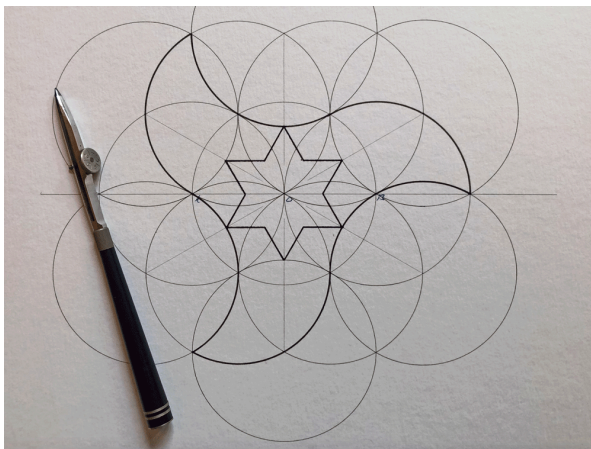
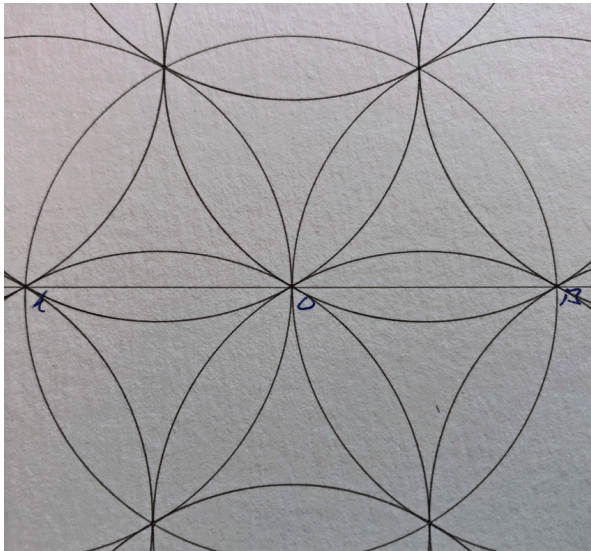


Illustration of polygonal mesh reduction
<https://blender.stackexchange.com/questions/255234/gradual-polygon-reduction>

¹⁴ see more: <https://www.mdpi.com/2504-3900/1/9/884>

¹⁵ see more: <http://www.historyofpencils.com/drawing-tools/drawing-compass/>



INSPIRATION AND CREATIVE INTENT

During my research period, nearly every presentation to a small audience in a university setting led to inquiries about my propositions—occasionally expressed with strong emotions. These doubts posed fundamental challenges to my thesis. The first such occasion surprised me, but since then, I almost look forward to such outbursts. This phenomenon illustrates one aspect of the topic, which I find as exciting as the original proposal itself. The usual objections center around the idea that the concept is born in the mind of the creator, who merely has to put it down on paper. According to my critics, the concept is already created when the inspiration strikes, so the tool cannot influence the sketch that has already taken shape in the creator's mind. The frustration often arises when I advocate for the thesis by referencing the work of widely recognized authorities. How could an architectural icon like Frank Lloyd Wright have been influenced by such an ordinary drawing tool as the parallel ruler? For them, this suggestion amounts to blasphemy. However, this does not diminish the creator's work. I doubt that anyone can be Abbot Suger with a compass or Wright with a parallel ruler.

In the case of Zaha Hadid, it's evident that her buildings are works inspired by computer-aided design, a point on which most would agree. Why would this be offensive to designers of earlier eras? Perhaps the answer to the question can be found precisely in the scholastic approach.¹⁶ If we are convinced that creation is a process guided by God, inspiration by a mere drawing tool is considered blasphemy. My university memories, mentioned above, also confirm that respect

¹⁶ Panofsky, Erwin. 2005. *Gothic Architecture and Scholasticism*. Latrobe, Pa.: Archabbey Press.

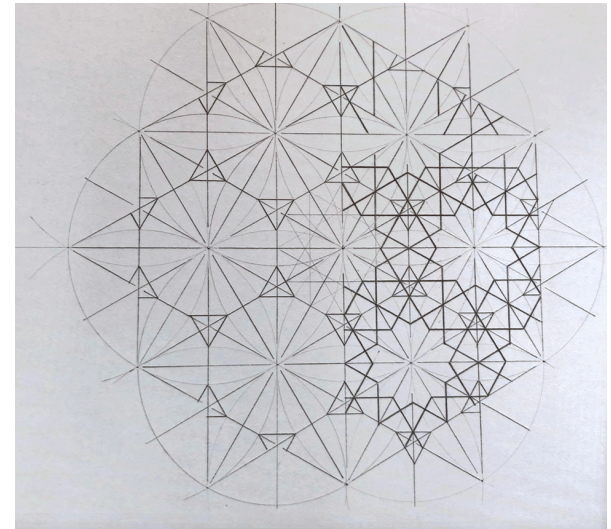
for antiquity still remains an irrevocable taboo. Reflecting on this, we may find ourselves closer to the thinking of the Middle Ages. We can also mention Wittkowers' work,¹⁷ in which he provides numerous examples of the cult of the larger-than-life artist's distinctive personality. Personally, I conclude that the genius artist inherently aims for efficiency in their work, and a part of that efficiency involves developing a well-established method and routine. This particular process leads to the formation of an individual style, where the use of specific tools can play a significant role, among other factors. We shouldn't exclude the possibility of innate talent or even divine guidance. I simply argue that, alongside these, the use of tools can also influence the creation of art.

"... I think that optics don't make marks - they only produce an image, a look, a means of measurement. The artist is still responsible for the conception, and it requires a great skill to overcome the technical problems and to be able to render that image in paint. However, the moment you realise that optics had a deep influence in painting, and were used by artists, you begin to look at paintings in a new way."¹⁸

I believe the thought of David Hockney can be easily extended to the topic of the impact of design tools.

¹⁷ see more: Wittkower, Rudolf, and Margot Wittkower. 2007. *Born under Saturn : The Character and Conduct of Artists : A Documented History from Antiquity to the French Revolution*. New York: New York Review Books.

¹⁸ Hockney, David. 2006. *Secret Knowledge : Rediscovering the Lost Techniques of the Old Masters*. London: Thames & Hudson. 131



Photos illustrating the steps to create an Arabesque motif. The foundation involves a geometric construction method similar to what we will observe in the Gothic era. However, the compass, despite being the same tool, had a different impact on Islamic art.

Photos: <https://www.drawingislamicgeometricdesigns.com/blog/a-compass-exercise-precision-revealed>



An Assyrian scribe with a stylus and clay tablet, relief decoration from Tiglath-Pileser III's Central Palace at Nimrud, about 728 BC. British Museum ME118882; photo by Greta Van Buylaere

"STYLUS" AND "STYLE": THE ETYMOLOGICAL EVIDENCE

What is style? Is it uniqueness, a way of expressing ideas, a characteristic use of artistic elements, or a reflection of personal tastes and cultural influences? In essence, style is a fundamental aspect of human expression and creativity, manifesting itself across various domains. It plays a crucial role in defining individuality, artistic movements, cultural identities, and the overall aesthetic and functional qualities of objects and works of art.¹⁹

However, style does not arise from nothing. The development and evolution of style are complex and multifaceted processes influenced by a wide range of factors, including cultural, historical, personal, and artistic influences. Cultural and historical context, technological advances, education, and training can impact individual style. It is a dynamic and fluid concept that continues to evolve as creative expression and culture itself evolve.

The word "style" itself is an important proof of this theory. "Style" comes from the Greek word "stulos" (στῦλος), which originally meant a pointed instrument for engraving or writing. This instrument has changed significantly in different cultures and over time.

¹⁹ Gay, Peter. 1988. *Style in History* : [Gibbon, Ranke, Macaulay, Burckhardt]. New York: W.W. Norton.

One of the earliest known uses of the stylus was in ancient Mesopotamia, around 3200 BC. The Sumerians used a wedge-shaped stylus made of reeds to inscribe cuneiform writing onto clay tablets. These early styluses were one of the first writing and drawing instruments, allowing for recording of information on durable clay surfaces.²⁰

In ancient Egypt, scribes used styluses made of various materials, including bone, ivory, or metal, to write on papyrus. The stylus was used to create intricate hieroglyphics and other scripts.

The stylus continued to evolve in ancient Greece and Rome. The Greeks used metal styluses to write on wax-coated wooden tablets. The Romans adapted this practice and developed a stylus with a pointed end for writing and a flat end for erasing marks on the wax surface. These early writing tools were called "graphium" in Latin.²¹

In Europe, during the Middle Ages, styluses were used to write on parchment and vellum, which were animal skin-based mediums. Scribes used a metal stylus to create illuminated manuscripts and other important documents.²²

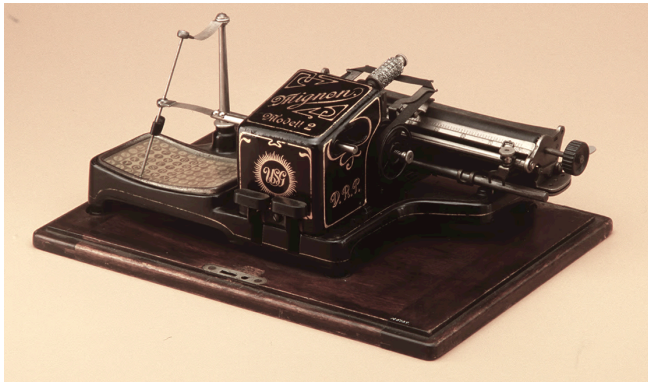
²⁰ Cammarosano, Michele. 2014. The Cuneiform Stylus In: Mesopotamia. *Rivista di Archeologia, Epigrafia e Storia Orientale Antica*, Firenze: Le Lettere

²¹ Terpstra, Taco T. 2014. "The Materiality of Writing in Karanis: Excavating Everyday Writing in a Town in Roman Egypt." *Aegyptus* 94: 89–119. <https://www.jstor.org/stable/44627047>.

²² Baron, Dennis. 1999. "From Pencils to Pixels: The Stages of Literacy Technologies." Edited by GAIL E. HAWISHER and CYNTHIA L. SELFE. JSTOR. University Press of Colorado. 1999. <https://www.jstor.org/stable/j.ctt46nrfk.4>.



PAN-00072053 - Late Medieval stylus - KNAW-DANS, Netherlands - CC BY-NC-SA.
https://www.europeana.eu/item/421/10_17026_dans_24u_h8s9



The early Mignon typewriter with the stylus, 1905
<https://collection.powerhouse.com.au/object/242332>

In China, styluses made of bamboo or bone were used for calligraphy and writing on materials like bamboo strips and silk. These styluses played a significant role in the development of Chinese calligraphy.²³

As paper became more widely available in the early modern era, styluses adapted to this new writing medium. Lead styluses, similar to pencils, were used to write on paper.²⁴

The 19th century saw the invention of styluses specifically designed for use with early writing machines and typewriters. These styluses allowed users to point and print the desired letters one by one.

With the advent of digital technology, styluses evolved to become tools for interacting with touch-sensitive screens and digitized surfaces. These modern styluses can be passive, using a rubber or soft tip for capacitive screens, or active, incorporating technologies like pressure sensitivity and palm rejection.

The ancient Greeks connected the words “stylus” and “style.” The artist’s tool does have an impact on the artist’s work. This metaphor strikingly refers to my thesis.²⁵

²³ Erkes, Edward. 1941. “The Use of Writing in Ancient China.” *Journal of the American Oriental Society* 61 (3): 127. <https://doi.org/10.2307/594499>.

²⁴ Stallybrass, Peter, Roger Chartier, J. Franklin Mowery, and Heather Wolfe. 2004. “Hamlet’s Tables and the Technologies of Writing in Renaissance England.” *Shakespeare Quarterly* 55 (4): 379–419.

²⁵ “Stylus | Etymology of Stylus by Etymonline.” n.d. www.etymonline.com. Accessed March 1, 2024. <https://www.etymonline.com/word/stylus>.

Have the Real Pen Feeling for Kids



Apple iPad advertising <https://www.amazon.in/Compatible-Stylus-Screens-Generation-Alternative/dp/B09BZ6P88K>

In addition to drawing tools and representation techniques influencing design, the question of the relationship between style and method also arises. The aspiring designer seeks a method to best convey their ideas. The discovered method serves as a tool closely tied to the creator's style in the given examples, or in some cases, becomes synonymous with the style itself. It can be argued that the designer's personality contributes to making the method unique, turning it into a consequence of the style. However, as the method becomes routine, it begins to guide the creator's hand. The well-proven, familiar toolkit forms the foundation of the design process. Ultimately, it is impossible to separate this process from the creator and evaluate it independently of the creator's personality and style.

In my assumption, the use of the applied tool and method becomes a signature of the creator. The creator experiences that, in a certain way, they can solve certain problems more easily and quickly. The fast and seamless method becomes more extensive and turns into an inspirational tool, providing solutions to various problems. This routine, encompassing the tool and method, evolves into the distinctive style. In the 18 century, the word is used with the meaning in today's sense. In my interpretation, style is a set of solutions that are typical of the given age and the person of the designer, but are independent of the given design task. A routine is a set of methods and techniques used by a particular designer to solve a task. My assumption is that - to paraphrase Count de Buffon - style is routine itself.



David Hockney, 2009, My window. iPad drawing



Cuneiform stylus and tablet reconstruction
<https://www.snowlizardproducts.com/the-stylus-an-important-part-of-mesopotamian-culture>



Cylinder Seal (with modern impression), royal worshipper before a god on a throne with bull's legs; human-headed bulls below, c. 1820–1730 B.C.E., hematite, 2 cm tall (The Metropolitan Museum of Art)

CLAY AND REED STICK - MESOPOTAMIA

Even in the absence of architectural drawings, we can gain insights into the earliest tools that influenced ancient architecture. In the context of Mesopotamian architecture, where paper or its predecessors were not available, the primary design tools were likely the reed wand paired with clay or the chisel and stone.

The reed stick used for cuneiform writing had a wedge-shaped cross-section, and the impression was left with the end of the stick. The phenomenon of a positive copy taken from an impression was known, as evidenced by the existence of seal presses and seal cylinders, which have survived from the time of Uruk (4th millennium BC). The first surviving copy predates cuneiform writing was created between 7600–6000 BC. In the case of relief representation, the figures appeared as a positive form (engraved on the seal cylinder as a negative, intaglio). Simultaneously, the texts always appeared as negatives pressed into the plane.²⁶

It is important to note that the impression left by a seal cylinder pressed into clay ultimately results in a sunk relief. However, the original cylinder seal is made in the same subtractive manner as a reed stylus pressed into clay, meaning that the text or image is formed by subtracting or pressing into the flat surface. It can be

²⁶ Low Relief (Bas-Relief): Shallow carving with minimal projection from the background.

High Relief (Haut-Relief): Prominent projection of the sculpted elements, creating a more pronounced three-dimensional effect.

Sunk Relief (Intaglio or Incised Relief): Design is carved into the surface, and the background remains raised.

assumed that this subtractive technique was the first. The next stage was the sunk relief, and later, the low relief emerged, protruding from the basic plane.

The general use of relief representation is typical for plastic arts. Until Egyptian times, the surface formation created by indentation and deepening in a relatively thin layer of soft material was decisive. My assumption is that the technique of clay and cuneiform writing also had an impact on the shaping of the reliefs. Recording the impression of the clay, i.e. the letters of cuneiform writing, resulted in a different formative culture.

In nature, negative, intruding forms are rare. The naturally occurring forms are almost always positive. It follows that the building materials found in nature (stone blocks, logs) and the building elements produced from cutting these raw materials are also of a positive nature. Additive thinking, placing forms next to each other, is quite obvious, as seen in the megalithic Stonehenge structure, where the triliths hold stone bridges of similar proportions to the stone columns. At the same time, the formation of negative, or more correctly, positive forms sunk into the plane, is a much more complicated process, both technically and in terms of design.

The usage of clay as a building material led to the creation of bricks. Their size and application have changed only minimally from ancient times to the present day. The marshy river valley lacked wood and stone but offered an abundance of clay. In Mesopotamia, mud bricks made from sun-dried clay were commonly used. Although more durable burnt bricks were also known, adobe bricks, made from



A building depicted in the Stele of Ushumgal and Shara-igizi-
Abzu 2900–2700 BCE
Geography: Mesopotamia, probably from Umma (modern Jokha)
Gypsum alabaster
<https://www.metmuseum.org/art/collection/search/329079>



E-Dublal-Makh Temple

"The Hall of Justice is now roofless and its walls are reduced in height by the action of the elements. Different periods of building, rebuilding or restoration can be traced throughout its structure. The arched doorway belongs to the period of Kuri-galzu about 1600 B. C. The recessed appearance of the walls, giving the effect of a series of stout piers or buttresses of brick is a familiar feature of construction at Ur though by no means a general one."

"The Builders' Art At Ur." *The Museum Journal* XVI, no. 4 (December, 1925): 217-306. Accessed February 03, 2024. <https://www.penn.museum/sites/journal/1356/>

sun-dried clay, proved to be long-lasting in the hot, dry weather, making the use of the more expensive technology seemingly unjustified.²⁷

Clay strongly influenced Mesopotamian architecture. In my thesis, I do not aim to examine the effect of building materials on architecture but rather the impact of design tools. From the perspective of my thesis, Mesopotamian architecture is unique because the medium used for writing and leaving signs—clay—was the same as the building material itself. I believe, the method of architectural decoration mirrors the techniques used in writing or sketching. Through the pressure of the stylus, negative shapes emerge in the clay, eventually resulting in punctuation marks. This negative molding process can be seen in Mesopotamian facade decorations too. Just as cuneiform characters are formed by the impression of the stylus, so do the sculptural decorations of the buildings appear in the facade recesses. The sculptural masses remain within the facade plane. That is, they remain in the negative space where the cuneiform characters are. Since architecture in Mesopotamia was typically based on an additive masonry technique, it would follow that the decoration is additive as well. However, we see the exact opposite. Since the act of impression can be seen in both cases, I assume a close connection between the two methods. It also supports my hypothesis that "subtractive" shaping contradicts the otherwise additive masonry technique.

To illustrate the confusion and contradictions regarding the topic, I quote a longer text from one of the expert on Mesopotamian architecture:

²⁷ Stefano Anastasio, and Piero Gilento. 2020. *Building between the Two Rivers : An Introduction to the Building Archaeology of Ancient Mesopotamia*. Summertown, Oxford: Archaeopress Archaeology.

"Buttresses and recesses. A further building technique that guarantees static function, and, at the same time, produces a decorative effect, is that of masonry with buttresses and recesses. In fact, since at least the 6th millennium BC period we find building-plans whose perimeters alternated buttresses and recesses (Sieversten 1998: 2). This mainly involved large buildings and their outer perimeters, so that the external walls took on a jagged appearance, with a play of lights and shadows that made them look less monotonous than a flat surface. At the same time this feature made the wall more solid. Various hypotheses have been formulated as to the origin of this technique: W. Andrae (1930: 73) suggested that it came from using reeds together with the bricks; conversely, E. Heinrich thought that the recesses recalled slots for the housing of wooden poles (Heinrich 1957: 55); B. Hrouda and J.Cl.- Margueron stressed the importance of this technique for the stability of the structure (Hrouda 1971: 66; Margueron 1989: 57-59); J. Schmidt emphasised its aesthetic value (Schmidt, J. 1974: 185; see also Miglus 1998-2011 for a general overview on this topic)."²⁸

The wall surface of the ziggurats is interrupted by vertical, prominent bands. One could say that these are pillars, rhizalites, or lisenes. However, interpreting these strips as pillars seems incorrect, as the small protrusions, compared to the thickness of the walls, could not have had a static role. Therefore, these bands are insignificant from a static point of view, and their role must be examined from another perspective.



Moulded columns with spiral profile in the northern façade of the temple at Shubat-Enlil, 18th century BC.

<https://www.mpri-series.mpg.de/studies/3/5/index.html>

²⁸ Anastasio, Stefano. 2020. Building between the Two Rivers: An Introduction to the Building Archaeology of Ancient Mesopotamia. Archaeopress



Part of the facade of the temple of Inanna at Uruk, Circa 1413 BCE, The Pergamon Museum, Berlin

<https://www.worldhistory.org/image/2958/facade-of-inannas-temple-at-uruk/>

The need to break and divide the plane accompanies the history of architecture. Only in the 20th century did modern architectural trends find aesthetic value in flat, unbroken surfaces. I assume that there was a strong demand for monolithic molding. Bricks were used out of necessity, as a clay hill would never have become a building, and a stone hill was not available, as in Egypt, for example. According to my assumption, the division of the walls within the monolithic volume is more likely a relief-like, decorative, rhythmic element than serving a purely static role.

The surviving corner relief of the sanctuary of Inanna in the temple complex built by King Karaindas (15th century BC), a descendant of the Kassite dynasty, whose narrow columns contain male and female statues. The pillar spaces are deep, the figures are almost completely spatial, so they are relief-like only to the extent that the sculptures do not protrude from the wall plane. The sculptures - just like the well-known animal reliefs of the Istar Gate - consist of pre-formed, unique brick elements that fit into the structure of the brickwork.

Another part of the church's wall, left on the site, is the ruin of a group of half-columns and wall strips located closely next to each other. Here too, the masonry uniformly follows the rhythm of the bricks laid in the joint in a strict order, the decorative and tectonic facade is formed only in its plasticity. The plastic forms are therefore produced by the individual bricks manufactured in advance, precisely at the given point. This pre-production meant a high degree of precision and a complex logistical task.

Abandoning the use of non-functional architectural and tectonic elements in architecture only started in the 20th century. Architectural decoration, including fake tectonic elements was questioned in the modern trends of the 19th century,

but they are still present repeatedly. Classical tectonic forms also have symbolic meaning. These elements sometimes had a static role, but mostly their function was simply to divide and decorate the facade. It was similar in the discussed Mesopotamian architecture.

So what is the difference between the later, in the depth dimension, relief-like tectonics, which in many cases are quite small in extent, and the tectonic elements mentioned in the Mesopotamian examples? The difference is faint, but still significant. While in antiquity, tectonic elements typically manifested as positive forms—additive panels superimposed on the structure—in Mesopotamian architecture, these elements were often recessed, remaining below the wall plane. A possible interpretation of this complicated solution—moreover, somewhat contradictory to the tectonic effect—is the impact of the medium and the design tool, the clay and reed sticks.

The tectonic motifs sunk in as a relief are therefore connected to the method of cuneiform writing, thus supporting the assumption made in the thesis.



A close-up of the Inanna temple facade



God as architect of the universe. Bible Moralise, Codex Vindobonensis 2554 (French, ca. 1250), in the Österreichische Nationalbibliothek, Vienna, Austria.

ARCHITECTURE BEFORE THE AGE OF PRINTING

The various tools of geometry like the drawing compass and the ruler, had already existed before, but they acquired spiritual significance in this period. "The professional badge of master builders, the compass, is also depicted in the hands of the Creator. In the cycle of the seven liberal arts, the compass is an attribute of geometry. As the most noble craft tool that defines proportions, it can also be a symbol of perfection, unity and flawlessness. As a carpenter's tool, it is sometimes included among the attributes of St. Joseph."²⁹ "The compass came to be a medieval symbol of Euclidian geometry as well as Ptolemaic astronomy and geography³⁰. Since Christ here employs it to make the world, this image asserts the congruence of Christian theology with scientific truth."³¹ The compass often appears as a tool of God in depictions of the creation of the world; in the hands of the Lord, the compass is used to shape the world, thus portraying the compass in action. This visual tradition emphasizes the familiarity and significance of the compass. If God uses the compass to shape the world, it can be assumed that this tool played an important role in the activities of contemporary master builders as well.

Although scholastic teachings heavily relied on the teachings of ancient

²⁹ Seibert, Jutta: Compass. 1986. Lexicon of Christian Art. Verlag Herder.

³⁰ Friedman, John Block. 1974. 'The Architect's Compass in Creation Miniatures of the Later Middle Ages', in *Traditio* 30

³¹ Ittai Weinryb, <https://thevcs.org/beginning#genesis-and-geometry>

philosophers such as Aristotle and Plato, the continuation of architectural traditions reminiscent of antiquity had to wait until the Renaissance. What could be the reason for this? According to Mario Carpo,³² architectural knowledge did not spread in the form of images due to the lack of technical and infrastructural background before the era of printing. The foundational work that later became decisive for Renaissance architecture, Vitruvius' "Ten Books on Architecture," spread through copying during the Middle Ages. The original book—was likely written in the early 1st century—probably did not contain illustrations. If it did, they likely focused on basic geometric constructions. To understand the reason for the lack of illustrations, we need to detach ourselves from the post-Gutenberg world flooded with images and texts. Copying manuscripts led to changes in textual content with each iteration, a fact well known to medieval authors. Moreover, copying drawings was an even more unreliable process, with no guarantee of preserving authenticity. Accessing or possessing codices was practically impossible for a master builder. Even gaining access to a codex posed a significant challenge, and the information it contained could only be noted or, even more likely, memorized. However, after memorization, possession was no longer necessary.

As Carpo argues, it is understandable that medieval master builders did not transmit their knowledge through books. It is presumed that their knowledge spread orally, possibly as a closely guarded secret. Architectural education took a more easily transferable form without images and written text, involving the

³² Carpo, Mario. 2017. *Architecture in the Age of Printing : Orality, Writing, Typography, and Printed Images in The... History of Architectural Theory*. S.L.: MITPress.



Unknown artist (Paris) God as Creator of the World with a Compass, from the Bible moralisée, c.1225–50, Body colour on parchment, 430 x 295 mm, Österreichische Nationalbibliothek, Vienna; Cod. 1179 HAN MAG, fol. 1v, Österreichische Nationalbibliothek

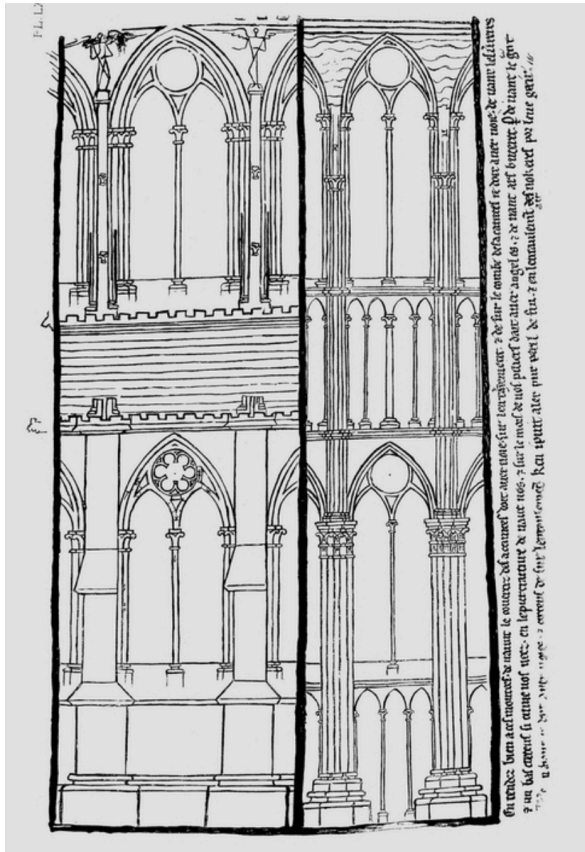


Plate 62. The Cathedral of Rheims

"Four architectonic details of the pillars. The inscription above the top row reads: Here you may see one of the pillars of the Church of Rheims, one of those between two chapels, one on the lateral wall, and one from the nave of the edifice. The joints of all those pillars are as they should be."

Villard, De Honnecourt. Bowie, Theodore (ed.) 2006. *The Medieval Sketchbook of Villard de Honnecourt*. Mineola, N.Y.: Dover Publications

transmission of construction rule systems. Paradoxically, the best evidence that knowledge did not spread in written and illustrated forms is the absence of such works. The next surviving treatise after Vitruvius, created approximately 1200 years later, is associated with Villard de Honnecourt. Villard was not an architect but rather an enthusiast, perhaps a churchman. Unlike Vitruvius' work, Villard's sketchbook was richly illustrated, with relatively little accompanying text. While Villard expressed a desire to share his work with as many people as possible, his drawings were excessively complex for manual copying. Copies of the album did not survive. According to Carpo, the sketchbook of Villard de Honnecourt is somewhat enigmatic, yet its presence paradoxically affirms that prior to the age of mechanical image reproduction, images played a minor role in conveying architectural experiences. The likely lack of interest in copying the album can be attributed to medieval guilds treating their knowledge as a closely guarded secret. "The universals of Gothic architectural thought are neither visible nor visualizable."³³

Furthermore, as Panofsky argues, the medieval architectural knowledge, therefore, according to scholastic thinking, focused not on specific appearance or individual shaping but on classification. Column, finial, jewel – the knowledge revolved around the general geometric design rules of these elements.³⁴

In the following chapter, we will see how the lack of easily accessible treatises, the absence of a unified measurement system, and the influence of scholastic philosophy - along with the use of an ancient tool - affected medieval architecture.

³³ Carpo, Mario. 2017. 35.

³⁴ See more: Panofsky, Erwin. 1985. *Gothic Architecture and Scholasticism*. London, New York, Meridian.

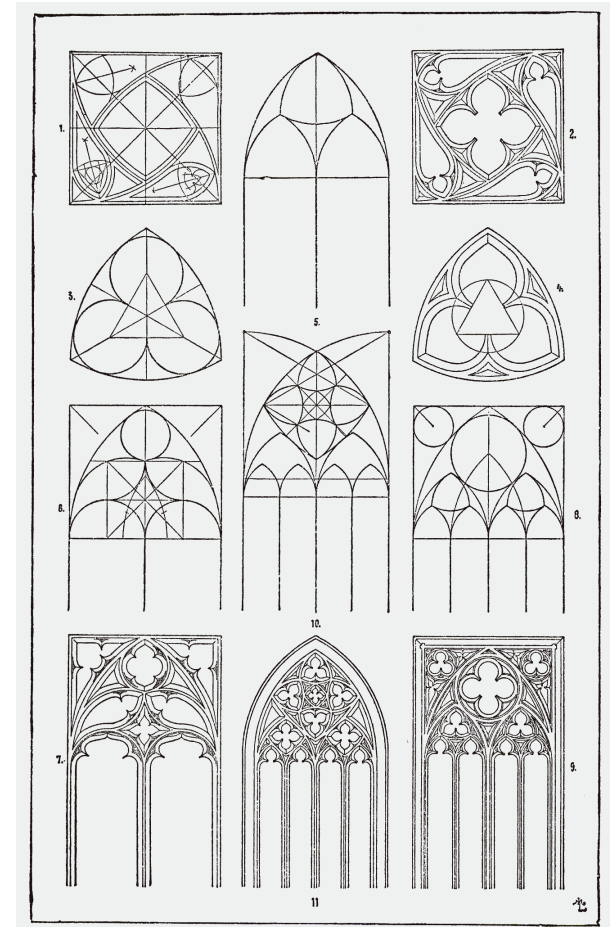
COMPASS - THE TOOL OF THE MIDDLE AGES

Since there was no uniformised system of units in the Middle Ages, the role of the drawing compass was not only to draw circular arcs, but also to copy identical units. It has therefore become an essential, indispensable tool for geometric construction. All the other units followed from the fractions of a base unit defined at a cathedral. The German word *Masswerk* for tracery itself refers precisely to the process of *constructing by measures*. The measure was given special, symbolic significance. Regarding the cathedrals, this was done in such a way that the construction of the vault and the church as a whole could be deduced from a cross-section of a pillar³⁵.

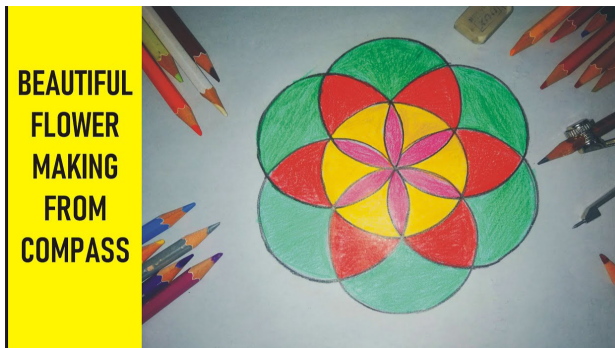
The effect of the compass as a means of inspiration is most evident in the rosaces. Here, the compass definitely acts as a tool to influence the plan. Rosaces became the demonstration of virtuosity of the stonemasonry masters. As the window fields were independent of the supporting structure, the rose window could be freely constructed within this area. Even so, these details were still part of the system, as the stone division of the rosace windows corresponded to the halves of a large, square unit (quarter, eighth, etc.). Over time, a number of motifs were born (arc triangle, arc quadrangle, circle, clover, fish bladder), all of which were made with a compass.

I believe that the elementary school math students' acquaintance with the compass could lead to similar results with time. Constructing a gothic floor plan

³⁵ Panofsky, Erwin. 1985. 50.



Franz Sales Meyer. 1894. *A Handbook of Ornament*. New York, B. Hessling.



BEAUTIFUL
FLOWER
MAKING
FROM
COMPASS

https://www.youtube.com/watch?v=3_CjAtcU95w

would not necessarily require the use of a compass. However, even with a simpler tracery I find it unlikely that someone would create such a complicated system in their head or even on paper without a compass. In my opinion, the compass tool definitely had an impact on how gothic cathedrals look.

Scholasticism and architectural system in Panofsky's theory

Scholasticism was the defining philosophical trend of the Middle Ages. The scholastics created their doctrines by analyzing and commenting on previously created works of great importance. The teaching of St. Thomas Aquinas, according to which reason was also created by God, is of outstanding importance in resolving the tension between faith and reason. In addition to the Bible, the most important starting point was the works of ancient scientists, Aristotle and his student Plato. Euclid's Geometry, also a student of Aristotle, was translated by the scholastic philosopher Abélard in this period. The scholastics organized and divided their thoughts into parts based on the doctrine of logic. According to Panofsky, the division of written works into parts, chapters, subsections and paragraphs, which still seems natural to this day, originates from the logic of the scholastics.

"Hence beauty consists in due proportion; for the senses delight in things duly proportioned, as in what is after their own kind—because even sense is a sort of reason, just as is every cognitive faculty."³⁶

³⁶ "SUMMA THEOLOGIAE: Goodness in General (Prima Pars, Q. 5)." 2017. Newadvent.org. 2017. <https://www.newadvent.org/summa/1005.htm>.

At the same time, the division also had a symbolic significance and played a fundamental role not only in written works, but also in architecture. In the construction of Gothic cathedrals, a division moving from the larger unit to the smaller parts can be observed in a similar way. The scholastics strove for clear wording and clean editing methods, as required by Aristotelian logic. In most case of Gothic cathedrals, the structure of the vault and the church as a whole can be deduced from the cross-section of a pillar. Strict schemes are broken down into basic shapes: square, triangle and circular arc.

"According to classic High Gothic standards the individual elements, while forming an indiscerptible whole, yet must proclaim their identity by remaining clearly separated from each other—the shafts from the wall or the core of the pier, the ribs from their neighbors, all vertical members from their arches; and there must be an unequivocal correlation between them."³⁷



St. Thomas. Woodcut from Hartmann Schedel "Liber chronicarum mundi" (Nuremberg Chronicle) Nuremberg 1493. (Photo by: Photo12/Universal Images Group via Getty Images)

³⁷ Panofsky, Erwin. 1985. Gothic Architecture and Scholasticism. Plume. 50.

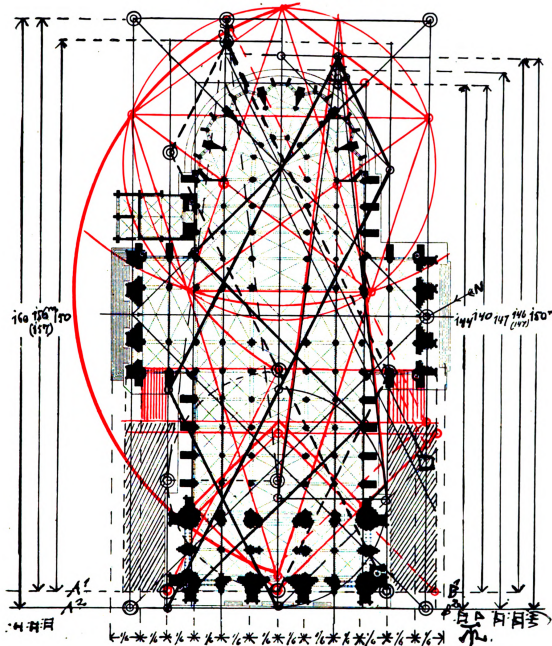


Fig. 75.—The construction of the tower in proportion to the plan of Cologne cathedral, analysis.

from the line over the plinth, while the part between the parapet and the summit of the spire—the third story and the octagonal story of the spire—is proportioned from the line under the plinth!

Equality and harmony are broken; there is disharmony because the medieval drawing has not been understood. The west elevation in Cologne makes no beautiful impression, therefore. The exaggerated decoration which covers restlessly all the surface adds also to this impression, and so does the exaggerated emphasis of the vertical lines of Gothic architecture which attract

Cathedral of Cologne. Base plan analysis from Fredrik Macody Lund. 1921. *Ad Quadratum*.

Principles of geometric construction

An additional point that connects the Gothic with ancient Greek architecture, and which is particularly important for my thesis. The structure covering every detail, the hierarchical relationship system connecting small elements with the largest units, reappeared in Gothic for the first time since ancient architecture. The construction of Gothic cathedrals was analyzed one by one, and the principles of construction according to the golden ratio were revealed.³⁸ Frederik Macody Lund, a Norwegian art historian, meticulously examined various Gothic cathedrals around a hundred years ago. Essentially, using a reverse engineering method, he attempted to decipher the geometric construction methods of Gothic creators. The kind of zeal that is meant to uncover the perfect construction of antique or Gothic sacred buildings and the series of hidden geometric connections can be similar to the intention of the creators.³⁹ At the same time, as Murray also writes, in examinations of this kind, different scholars arrive at different results.

These analytical construction graphics remind us of school geometry lessons rather than architectural blueprints.

"For medieval architects, geometry was much more important than in the work of their successors today. The blueprints of the buildings never contain absolute dimensions or scales, but these would not make sense either, because there is no uniform measurement system, and today's means of marking are also missing. Instead, they have a compass and ruler for constructing, and cords and stakes for

³⁸ Murray, S., 2014. Plotting Gothic: A Paradox. *Architectural Histories*, 2(1), p.Art. 16.

³⁹ Fredrik Macody Lund. 1921. *Ad Quadratum*. B 'T'Batsford Ltp High Holborn, London.

pinning, with which they carry out simple geometric constructions, taught in elementary schools today, on the spot, in original size.”⁴⁰

In addition to its primary function of drawing circular arcs, the compass is also invaluable for duplicating identical units, making it a fundamental and indispensable tool in geometric constructions. The intricate Gothic constructions also evoke the process of proving a theorem. With the help of this simple tool, we can visually display hidden connections that might be obscure at first glance. It is evident that the discovery of these connections held a spiritual value. In ancient times, the followers of Pythagoras founded a religion based on the proof of the Pythagorean theorem.⁴¹

The architectural blueprint of the modern age generally differs from proving a mathematical theorem. A compass became an optional tool; the designer or the architect could usually get by with a ruler. In the case of non-sacred buildings, the rules of the golden ratio and other complicated geometric construction techniques were probably omitted in Gothic architecture as well. I assume that cathedrals, due to their religious purpose, were meant to showcase divine harmony and perfect order. These constructions indeed had to be as perfect as the proof of a mathematical theorem. Based on this, perhaps the idea that the compass, as a tool, itself had a certain spiritual charge did take off.

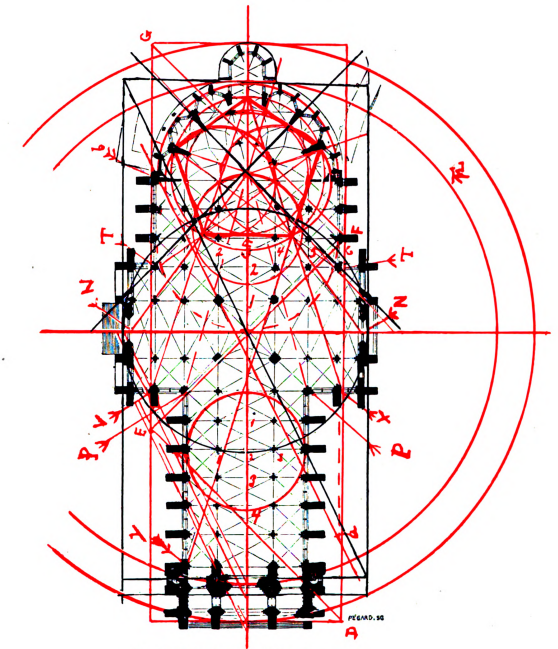


Fig. 66.—Plan of cathedral of Amiens, analysis.

This digression was necessary to understand the cathedral of Cologne and to determine its place in the development.

Fig. 68a gives the plan of the cathedral of Cologne. A glance at the extremity of the chancel shows at once a startling likeness with the two French cathedrals of Amiens and of Beauvais. Similar to the latter, the seven chapels of the apse fall within the same semicircular lines; but the similarity does not extend further with either of them. It may well be that

Cathedral of Amien. Base plan analysis from Fredrik Macody Lund. 1921. *Ad Quadratum*.

⁴⁰ Marosi, Ernő. 1997. *A középkori művészet történetének olvasókönyve*. Budapest, Balassi Kiadó

⁴¹ Dillon, John F, and Carl A Huffman. 2014. "Pythagoreanism in the Academic Tradition: The Early Academy to Numenius." *Cambridge University Press EBooks*, January, 250–73.

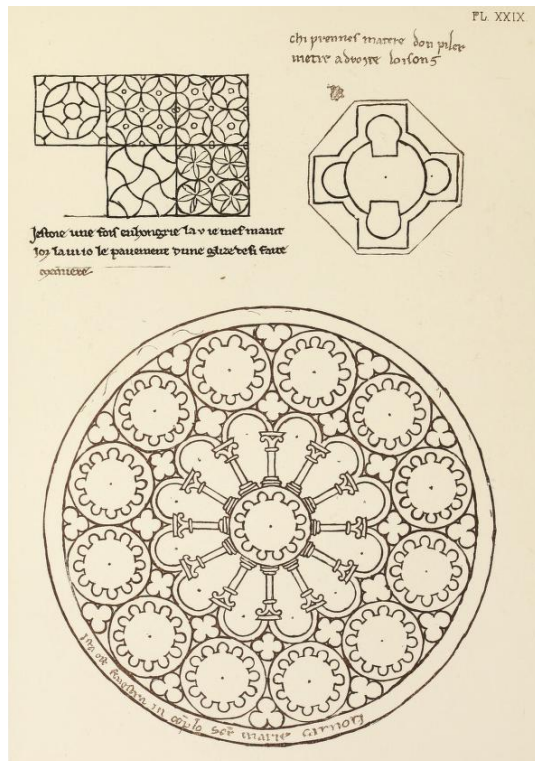


Plate 29. Architectural Details

Bottom text: „Once when I was in Hungary, where I remained for a long time, I saw the paving of a church with this design. ”

Villard, De Honnecourt. Bowie, Theodore (ed.) 2006. *The Medieval Sketchbook of Villard de Honnecourt*. Mineola, N.Y.: Dover Publications

Album of Villard de Honnecourt

Villard de Honnecourt lived in the 13th century. It is unknown what his profession might have been. His Medieval Sketchbook with about 250 drawings has survived, some of them are lost. The drawings are mainly architectural figures, but the portfolio also contains many other sketches related to animals and machines. He also provided the figures with short comments. It is possible to imagine that he intended the material as a kind of textbook, sample collection, which his students also supplemented.⁴² This is how he writes in the introduction to the material:

“Villard de Honnecourt gives you greeting and beseeches all who will work by the aids that are found in this book to pray for his soul and bear him in remembrance. For in this book one can obtain good advice on the grand craft of maconerie and the engiens de carpenterie, and you will find in it the art of drawing . . . the principal features (les traits), as the discipline of geometry . . . requires and teaches them.”⁴³

The folio contains several drawings of animals and people, in which Villard drew the arcs, triangles, and square grids that interpret the forms. His graphics are similar to the abstract explanatory diagrams used in today's drawing education, created to illustrate proportions and shapes. The difference - even compared to

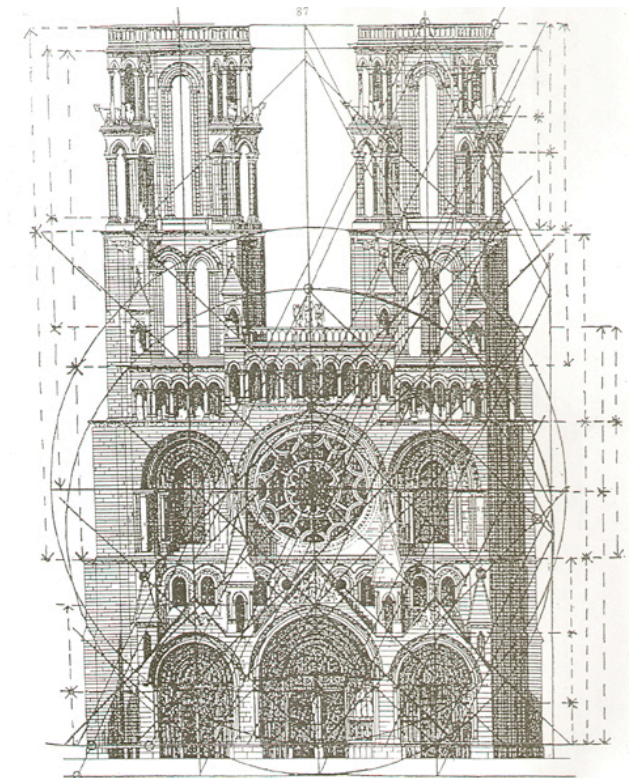
⁴² Villard (de Honnecourt, and Hans Robert Hahnloser. 1972. *Kritische Gesamtausgabe Des Bauhüttenbuches Ms. Fr 19093 Der Pariser Nationalbibliothek*.

⁴³ The English translation is Frankl's, p. 41; there and on following pages he changes the customary reading of the text to conform with his reinterpretation of the drawings on plates 35-38 and 39-41. Passages reprinted by permission of Princeton University Press. Copyright, 1960. The Old French text-“(et) si troveres lc force de le portraiture, les traits, ensi come li ars de iometrie le (com)ma(n)d(e) (et) ensaigne”-is linguistically fully expounded by Hahnloser, pp. 11-17. 272-79.

similar studies by Leonardo da Vinci - is manifested in the fact that the geometric shapes drawn in the animals and portraits (arcs, triangles, squares) seem forced, they follow the real forms to a small extent, in a superficial way. The figures drawn on sheets shared with his studies on Gothic architecture bear witness to the fact that he was looking for the universal harmonic proportions that Gothic architecture also strove for. These figures are meant to prove the generally valid method of applying proportions, where he believed to discover the same formal schemes in cathedrals as in the living world.

Rose windows

The play with the compass as a tool of inspiration is most evident in the gothic windows, on which the compass definitely acts as a tool to influence the design. The word gauge (which is a mirror translation of the German word Maßwerk) itself refers precisely to the construction process. It was possible to show the virtuosity of the master stonemasons in the design and construction in the most free and at the same time most effective way in the stained glass windows. There were no other constraints in the window field, since these are relatively independent of the rhythm of the pillars, that is, of the supporting structure. Even so, they were part of the system, since the stone division of the windows corresponds to the halved fractions (quarters, eighths, etc.) of the large, square unit. Over time, many motifs have been created (arched triangle, arched square, circle, clover, fish bladder), all of them made with a circle.



CATEDRAL DE LAON (M. LUND)

C. CHANPON

Analysis of Notre Dame from Fredrik Macody Lund. 1921. Ad *Quadratum*. B 'T'BATSFORD LTP HIGH

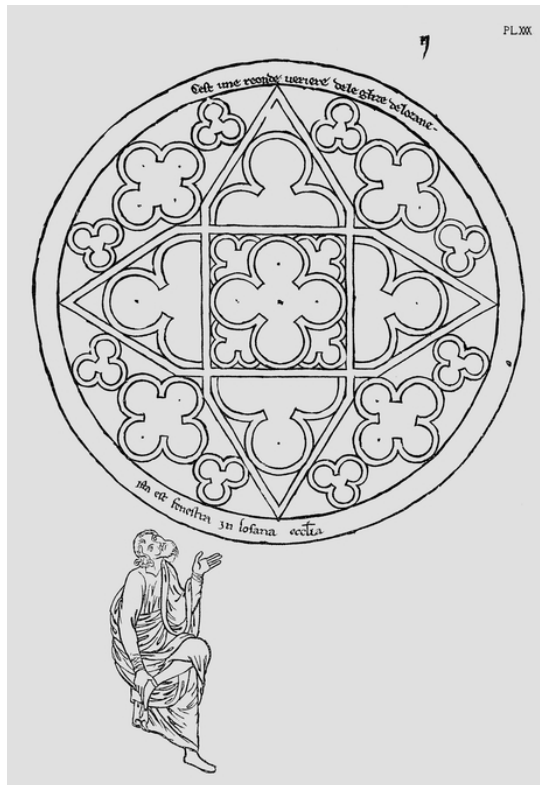
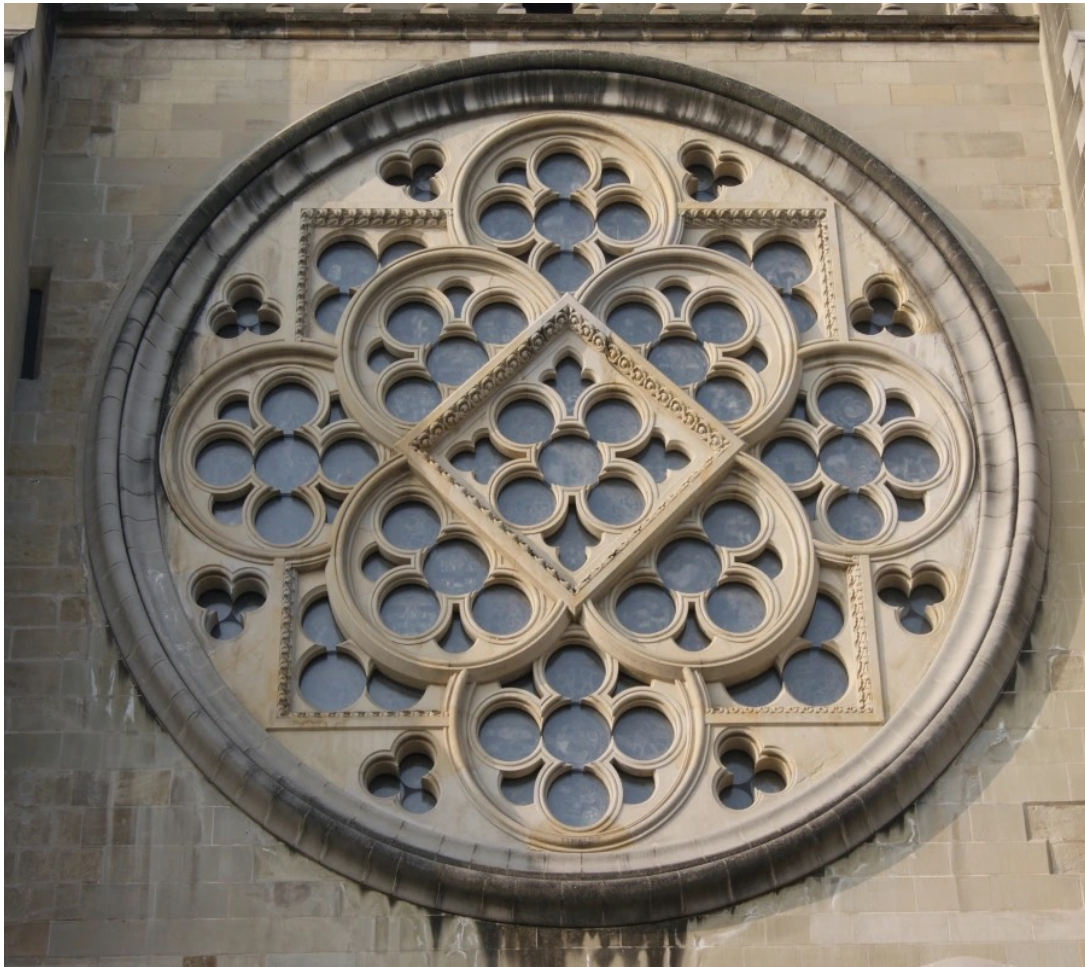


Plate 30: A Rose Window

The inscription, in French and Latin, reads: This is a round window in the Church of Lausanne.

Villard, De Honnecourt. Bowie, Theodore (ed.) 2006. *The Medieval Sketchbook of Villard de Honnecourt*. Mineola, N.Y.: Dover Publications

I believe that the above-mentioned playful acquaintance with the compass in elementary school could lead to similar results if someone were to really delve into the use of the device. While in the case of a Gothic floor plan it would not be absolutely necessary to use a compass - or at least it is conceivable that the creator is not inspired by the tool - even in the case of a simpler instrument, I consider it unlikely that someone would create such a complicated system without a compass in mind or even on paper. It is possible that master builders transmitted the same uncertainty inherent in the theories they employed to the construction site. Shapes left undetermined in the architect's initial design process might have been finalized later on-site, either by the architect or by someone else, with or without the architect's supervision. In such instances, architects likely used discourse to convey information to the workers that was primarily nonvisual. Even in these situations, architects might have still utilized drawings: a schematic drawing can establish norms, such as geometric principles, without fully representing architectural forms. Similarly, a three-dimensional model can be elusive, focusing only on select details of the architectural object.



The rose window of the Lausanne Cathedral
Photo: Peter Bull

RENAISSANCE - THE IMPACT OF GUTENBERG

“Medieval architectural mimesis stressed the reciprocal relationships of discrete parts, not the duplication of the totality of parts.”⁴⁴

As mentioned earlier, medieval master builders transmitted their construction methods orally. As Mario Carpo argues, the perception of medieval structures as architecturally defined units with a recognizable style did not exist in the modern sense. The term 'design,' originating from the Renaissance, signifies that the concept of modern 'design' did not exist before the 16th century. Medieval builders followed abstract and invisible construction principles. This radically changed during the Renaissance. The invention of book printing made it possible to disseminate images and texts. While in the medieval period, copying images did not necessarily imply fidelity to the original, the Renaissance considered imitation as the essence of architecture.

The transition between medieval scholastic culture and the Renaissance is best illustrated by Alberti's book "De re Aedificatoria." The book, in the spirit of ancient times, omits images and specific examples. Illustrations were considered

⁴⁴ Carpo, Mario. 2017. 37.

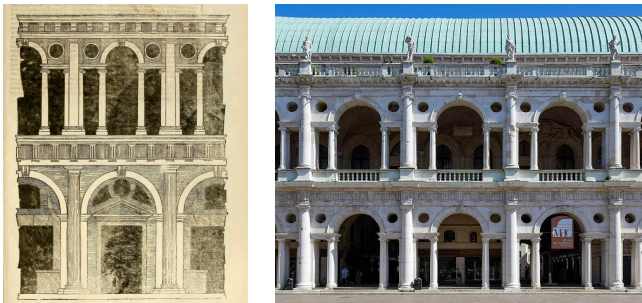
unserious in scientific discussions at that time, akin to how computer-generated imagery was initially limited to video games. Alberti's text primarily focuses on rules but introduces the systematic principles typical of the Renaissance. Although it doesn't define orders explicitly, it distinguishes certain elements (bases, capitals, cornices, moldings). This system essentially anticipated the later precisely reproducible images. What was even more forward-thinking was the use of letters to mark details. Alberti used Latin alphabet letters to indicate various profiles, ensuring the manuscript's accurate reproducibility.

The role of the model replaced rule-based architecture. Imitation was embraced as creativity, almost revolutionary. The difficulty or impossibility of approaching architectural masterpieces was replaced by easily replicable visual and textual information from widely disseminated books. Sebastiano Serlio played a pioneering role in the reinterpretation of Vitruvian doctrines. In his writings between 1537-51⁴⁵, he introduced a visually-based architectural method, systematically classifying ancient orders and linguistically formalizing them. He essentially compiled various architectural details in a pattern book, making them easily incorporable into different designs. His clear intention was to enable even less talented, everyday architects to create in the antique style, without having seen an original ancient monument or conducted extensive studies. Although Renaissance architecture didn't precisely align with Vitruvius' doctrines, it was based on Serlio's five orders. The system further simplified with John Shute, who

⁴⁵ 1996b. Sebastiano Serlio on Architecture. Volume 1, Books I-IV of "Tutte l'Opere d'Architettura et Prospetiva." New Haven, Conn. ; London: Yale University Press.



Model for the unrealised plan of St. Peter's Basilica. 1539-46. Wood
Museo Petriano, Vatican, Rome
<https://www.abitare.it/en/habitat-en/historical-heritage/2018/03/25/san-pietro-storia-chiesa-piu-grande-mondo/>



The original woodcut from Serlio's IV book (1537) and the Basilica Palladiana in Vicenza, designed in 1546.

defined the proportional system, paving the way for innovation within the framework of proportions.⁴⁶

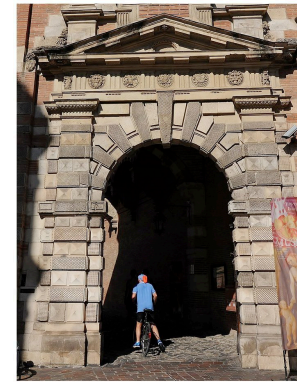
Although Serlio theoretically faithfully processed and first provided illustrations for Vitruvius' foundational work, his explanatory illustrations created an absolutely new international style. Thanks to this, some architectural solutions were named after him, such as the Serlian-style window or portal (see pictures on the right). Indeed, these solutions never existed in ancient times. Ironically, amid the strictest fidelity, unique solutions emerged, eagerly copied by architects, even those less inclined towards individualism. Therefore, it can be said that ancient architectural principles practically served as inspiration for Renaissance architects; later, however, it was the treatises they propagated that inspired the architects of their time.

Renaissance architecture was a precursor to modern mass production. Antonio da Sangallo, the architect of St. Peter's Basilica, produced a massive wooden model for the Pope. The model contained standardized elements, allowing the production of numerous similar columns. While in the medieval era, masters and building materials were transported, in the Renaissance, only books needed to be distributed. Elements didn't need to be pre-manufactured and transported, making the process simpler and cheaper.

⁴⁶ See more: Shute, John. 1563. *The First and Chief Groundes of Architecture Used in All the Auncient and Famous Monymentes & with a Farther & More Ample Discouse [!] Upon the Same, than Hitherto Hath Been Set out by Any Other*. London: Thomas Marshe.

As Mario Carpo argues, Renaissance architects refined and expanded their architectural system based on Vitruvius's ten books in several steps. Their system was much more about their contemporary style than the original antique architecture. The Renaissance architects who published books generally shared an educational intent, a cultural mission that guided the writing of their books. These were the first architectural pattern books, and their impact was significant, as even after half a millennium, some educational principles remain similar. However, Renaissance architects and their architectural products were directly influenced by architectural pattern books, indirectly influenced by the advent of book printing.

When I started to write my paper, I had several intuitions about which period and which creator would provide good examples to support my thesis. No such characteristic creation came to mind from the Renaissance period. Carpo's work greatly aided in understanding this. The Renaissance foreshadowed a somewhat mechanical, quasi-premanufactured approach to design, which persisted into the late postmodern era. The architecture based on modules that could be copied from pattern books in the Renaissance is similar to the easy, low intellectual effort design method of selecting and placing antique architectural modules available in Archicad's element library with a simple click. However, it is important to emphasize that architectural greatness was still able to manifest within these frameworks. Serlio's intention, that even the mediocre architect should have a repertoire of ancient column orders, was fully realized. The widespread schemes dominated the architecture of European cities for centuries.



Portal of hôtel d'Assézat
- 1560 -
Toulouse, France



A delicate door of Serlio's
'Extraordinary Book of Doors',
published in 1551.



Porte de la Commutation
de l'ancien Capitole
(1575)

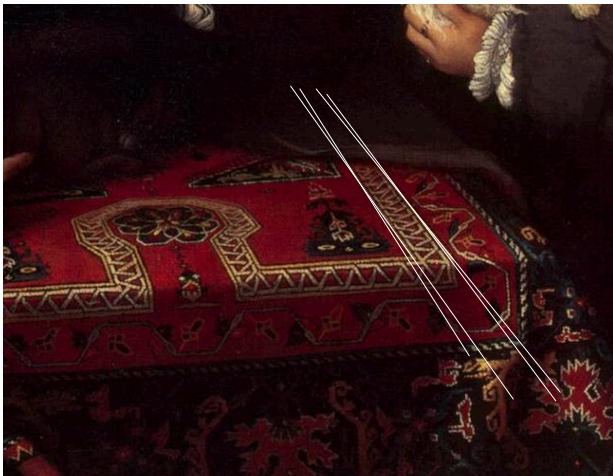


Porte rustique du Livre extraordinaire
de Sebastiano Serlio (1551)

Examples for the impact of Serlio on Renaissance architecture
<https://www.archinform.net/arch/1384.htm>



Lorenzo Lotto: Husband and wife 1543, Hermitage, St. Petersburg
 Faulty perspective possibly caused by a change in the focal point.
 Based on Hockney's research



Secret Knowledge

"Secret Knowledge: Rediscovering the Lost Techniques of the Old Masters" is a book authored by David Hockney. In this book, Hockney presents his theory, known as the Hockney-Falco Thesis, which suggests that certain Renaissance painters used optical devices, such as concave mirrors and lenses, to aid in the creation of their highly detailed and realistic artworks.⁴⁷

Published in 2001, "Secret Knowledge" explores the idea that artists like Jan van Eyck, Michelangelo Merisi da Caravaggio, and Jan Vermeer van Delft, among others, may have employed these optical tools to achieve remarkable levels of precision and accuracy in their paintings. Hockney's theory is based on his examination of artworks from that era, historical documents, and his own experiments with optical devices to recreate the effects observed in the paintings.

Hockney and Falco argue that certain anomalies and features in Renaissance paintings, such as distorted perspectives and unusually sharp detail, suggest the use of optical aids. They also point to historical documents and letters from the Renaissance period that mention the use of optical devices by artists. The authors conducted technical experiments to demonstrate how these optical devices could have been used to create the effects observed in certain paintings.

Since Hockney is a painter himself, he easily notices mistakes, revealing errors, for instance, in line handling and the lighting solutions necessary for photography. Scientists not practicing the painting profession may have overlooked these

⁴⁷ Hockney, David. 2006. *Secret Knowledge*. London, Thames and Hudson.

marks. Although some painters, such as Vermeer, had been previously pointed out for using optical aids, it was only Hockney who shed light on how widely these tools were employed. These masterpieces, starting from the Renaissance, essentially became part of a continuum with the actual chemical processes, leading up to the invention of photography.

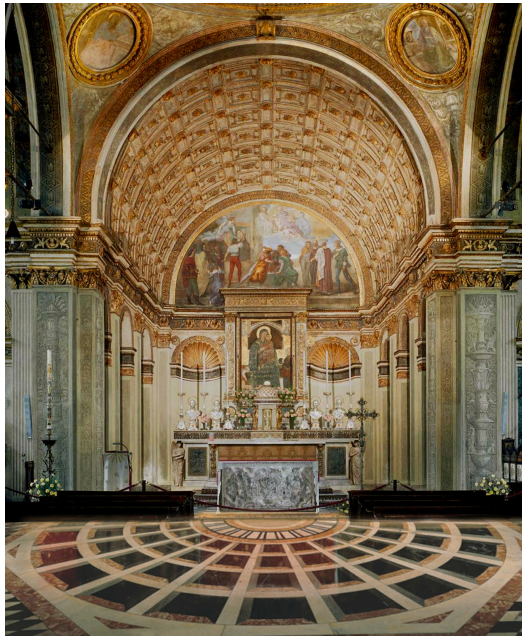
Despite their evidence-based research, this book generated significant discussion and debate within the art community, and it continues to be a topic of interest in the fields of art history and art conservation.

I myself only recently became acquainted with Hockney's book. The book had a great impact on me. I realized that the painter Hockney's approach to art history is similar to my interest in the history of architecture and design. Moreover, he faced the same art historical criticisms as myself, interpreting my thoughts. As iconic artists and architects are admired for their genius, the idea of the impact of tools is disturbing to many. As Hockney claims, I also doubt that the influence of the tools diminishes the greatness of these masters. Just like everyone else, a genius is inspired by countless impressions. Great works are built from inspirations, and those impressions feed those inspirations. The drawing tool is just one important impact among many.

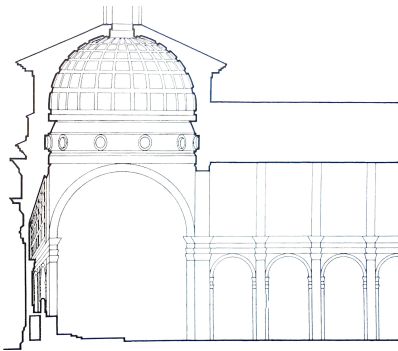


Caravaggio: *Supper at Emmaus*, 1601. National Gallery, London
The oversized right hand, possibly caused by a change in the focal point. Based on Honckney's research





Donato Bramante (1444-1514), Santa Maria presso San Satiro, frontal view of trompe l'oeil chancel, 1482, Milan



Bramante, Santa Maria presso San Satiro (section), 1482. Milan. Photo: © Paul Davies

Dimension jump and the baroque

The mathematics of the Renaissance also led to new discoveries such as perspective, which became one of the basic concepts of the Renaissance style. The two-dimensional mapping of the three-dimensional space based on scientific foundations is attributed to Alberti. What was the impact of the scientific findings related to perspective space on architecture? Reducing the space to a plane is essentially the opposite of designing, since in this case the illusion of the real view is put on paper, contrary to the basic architectural design. The novelty thus caused a double twist in architecture. Experienced architects were now able to manipulate real, three-dimensional space in order to create illusions. This process began in the Renaissance, but was completed later, in the Baroque. For instance, in the church of Sta. Maria Presso S. Satiro, there was no room for a sanctuary. Thus, brilliantly using the tools of perspective, with a flat, relief-like solution, Bramante created a space with an effect of several meters in depth.⁴⁸ Bernini designed the rows of trapezoidal colonnades in St. Peter's Square, extending towards the basilica, in such a way that the huge building appears to be the same size from a distance as it is up close.

In the Baroque era, artists often employed a technique known as "trompe-l'oeil," which translates to "deceive the eye." This technique involves creating a visual illusion to make objects appear three-dimensional, even though they are two-dimensional. Trompe-l'oeil can give the impression of depth and dimension through skillful rendering.

⁴⁸ <https://theframeblog.com/2023/03/12/framing-the-miraculous-the-devotional-functions-of-perspective-in-italian-renaissance-tabernacle-design/>

Another example can be found in the frescoes of Andrea Pozzo, such as those in the Church of Sant'Ignazio in Rome. Pozzo used architectural elements and painted details to create an illusion of a dome where there was none, giving the ceiling a sense of depth and grandeur.

From the Renaissance onwards, the scientific mapping of space became crucial knowledge, employed as a compelling argument in architectural representation. And this exceeded architecture; in painting, artists seized the opportunity to depict architectural details using one-point perspective. To apply perspective effectively, mastering Alberti's construction technique was absolutely necessary. Once they had the tool, they made use of it. The fact that it is possible to engage in architecture without this knowledge is evident nowadays, given the availability of much more complex applications of perspective—yet designers remain incurious about it.

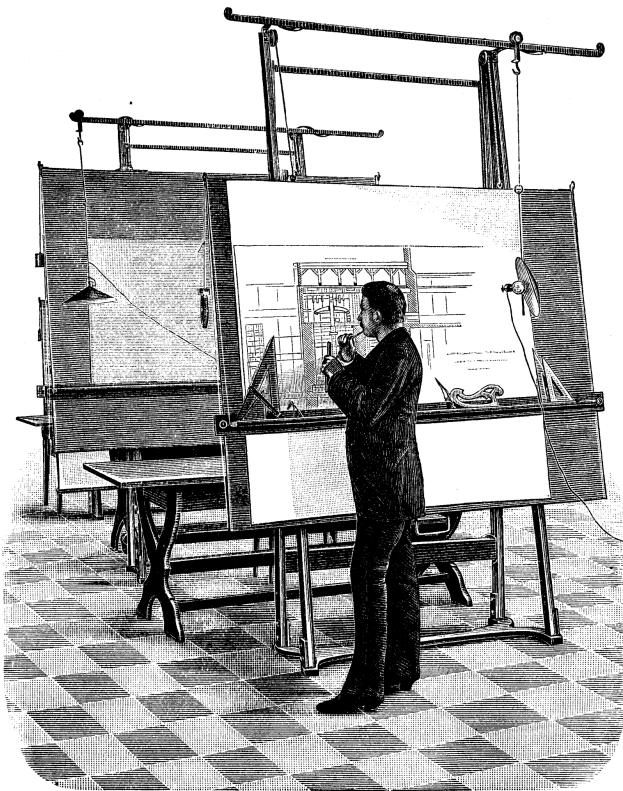
The above examples demonstrate that the relatively newly acquired knowledge related to perspective became an important tool of Baroque architects. However, in later periods, this knowledge became less dominant as a tool. Therefore, it is interesting that, as we will see later, centuries later, axonometric representation similarly became popular – and had a significant impact on designs and realized works. Additional parallel is that axonometric construction disappeared with the advent of computers.



Bramante, Santa Maria presso San Satiro, raking shot of trompe l'oeil chancel. Photo: Vicente Camarasa



View of Rome from the Dome of St. Peter's Basilica
https://en.wikipedia.org/wiki/St._Peter%27s_Square



Architect at his drawing board. This wood engraving was published on May 25, 1893, in *Teknisk Ukeblad*, Norway's leading engineering journal. It illustrates an article about a new kind of upright drawing board delivered by the firm J. M. Voith in Heidenheim a. d. Brenz (in south Germany). The board measures 1800 x 1250 mm, the total height is 2800 mm, and the weight 220 kg.

METHODS AND TOOLS FROM THE INDUSTRIAL REVOLUTION

"From the elevation of a building, from the manner of a piece of ornamentation, one can tell whether the architect was using a no. 1 or no. 5 pencil."⁴⁹

Adolf Loos on Architecture

"Today, however, the skillful draftsman is the master. It is no longer the craft tool that creates the shape, but the pencil. From the profiling of an architectural work and the nature of its ornamental decoration, you can reconstruct whether the architect worked with a single or five-point pencil. And what a terrible destruction of taste burdens the soul of the circulator! Scoring with a drawing pen started a veritable epidemic of squares. There is no window frame or marble slab drawn in 1:100 scale that remains unscored, and masons and stonemasons have to carve and rough out this graphic nonsense with the sweat of their brows. If the artist accidentally got ink in his drawing pen, then the gilder also has his work cut out for him."⁵⁰

⁴⁹ Loos, Adolf, 'Architecture', in *On architecture: studies in Austrian literature, culture and thought*, Riverside: Ariadne Press, 2007, pp. 73–85.

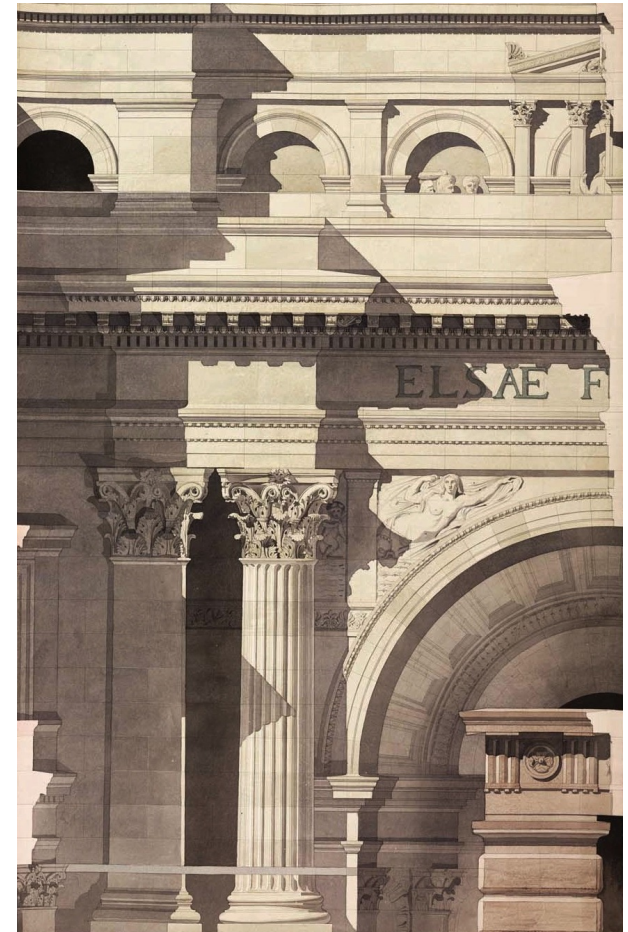
⁵⁰ Loos, Adolf, 2007 p. 73

Loos brilliantly describes the handling of the surfaces of the designs conceived in the “neo” trends around 1900, with characteristic light-shadow effects, rhizalites, and ornamentation. The watercolor technique served as an excellent tool for the plastic representation of the richly articulated facades. On the other hand, the contours of the cuboid stones and smaller details were drawn with a thin pen. In another essay, *Interior Spaces*, written in 1898, he writes about another method used by architects:

"Do you need a baroque bedroom? He makes that. Need a Chinese spittoon? He will do it. Capable of everything. In any style. ... The solution to the mystery of this almost mysterious productivity lies in a piece of tracing paper. As soon as he receives the assignment, he grabs the tracing paper and goes to the library of the industrial school ... He spends the afternoon working hard at the drawing table and copying the baroque bedroom or the Chinese spittoon."⁵¹

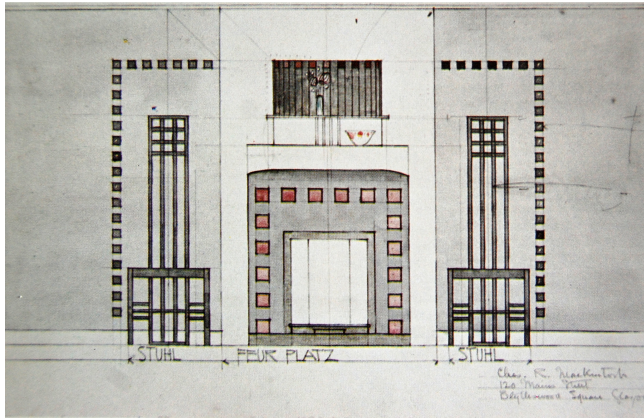
Hoffmann, Wright, Mackintosh and the parallel lines

At the dawn of modernity, a trend emerged that diverged from historicism for the first time in a long while. The new movements emphasized folk romanticism, craftsmanship, nature, drawing inspiration from the period before historicism, the Gothic era. The English Arts and Crafts Movement was the first such trend, serving



Water tower. 1870. Barth, Jules-Chrétien. French 1844-1905. drawing architectural school.

⁵¹ Loos, Adolf: *Belső Terek. Prelúdium 1898*. In: *Ornamens és nevelés. Válogatott írások*. Ed.: Kerékgyártó, Béla 2004, Budapest: Terc p. 67



Charles Rennie Mackintosh: Windyhill House, 1900-1903



Charles Rennie Mackintosh: Hill House Chair, 1900-1903

as a model for the Wiener Werkstätte, the Deutscher Werkbund, and later, somewhat indirectly, for the Bauhaus as well.

Charles Rennie Mackintosh was one of the most famous members of the Arts and Crafts Movement.⁵² He designed many interiors, and in addition to the built-in elements, he also depicted furniture in a strict order on the wall elevations. These plans were beautifully elaborated with watercolors and functioned as visualizations. Comparing the drawings and the objects, it can be assumed that this two-dimensional representation in an elevation plays a major role in the character of typical Mackintosh furniture. The structure of these chairs basically originates from the side or front view. The mostly flat side elements with armrests support the equally flat backrest. Mackintosh also created perspectives of his interiors. Obviously these perspectives included his chairs. These simple constructions could be relatively easily depicted in the perspectives. My assumption is that a mature creator develops a method that is mostly applied in their projects. In the case of Mackintosh, this method also applied to furniture, so for each interior, he planned and depicted them in elevations. Since these are architectural drawings, he represented the chairs using the same tools – namely, a ruler – as the other elements. The use of a ruler significantly limits the design possibilities for an inherently complex spatial geometry object, such as a chair. However, the distinctive furniture obtained in this way can be smoothly placed and easily depicted in a perspective space.

My conclusion is that wall view visualizations, originating from interior design practice, influenced the furniture designed by the creator. The unusual proportions and questionable ergonomics of the furniture may also serve as an explanation for

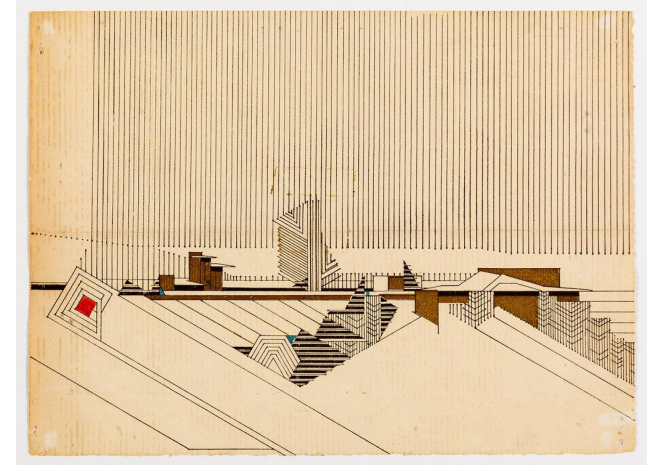
⁵² McKean, John. 2000. *Charles Rennie Mackintosh*. Stillwater, Minnesota: Voyageur Press.

the assumption that Mackintosh implemented the furniture composed in wall views in an unchanged form.

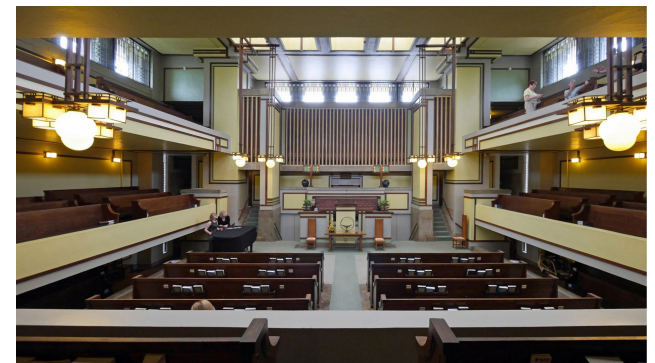
In the meantime, in the U.S., Frank Lloyd Wright was designing some of his greatest buildings.⁵³ Born just a year before Mackintosh, Wright exhibits another characteristic that can be traced back to a design tool: the parallel ruler, which played a decisive role in his architecture. Anyone who has used this tool understands how much it aids in tracing parallel lines, providing a satisfying speed for drawing both parallel and perpendicular lines. Wright's blueprints depict his buildings with a multitude of meticulously drawn parallel lines, clearly created using a parallel ruler. The Unitarian Church, the Prairie Houses, and the Waterfall House, all iconic creations of Wright, are unmistakably grounded in the harmony of emphatically horizontal, parallel lines and shorter, vertical lines that introduce a rhythmic quality to the horizontal elements. In Wright's distinctive visual designs, the precise lines following the orthogonal order of space are complemented by a two-point perspective, emphasizing the dynamism of his buildings. Upon closer observation of Wright's works, from larger masses to the tiniest details, every plane, every mass, every ornament can be broken down into components of an orthogonal system. In this system, almost exclusively parallel or perpendicular lines play a role.

The decorative elements, in particular, provide evidence supporting my assumption that the parallel ruler had a strong influence on Wright. According to the fashion of the time, both were enthusiasts of small, grid-like motifs. It should

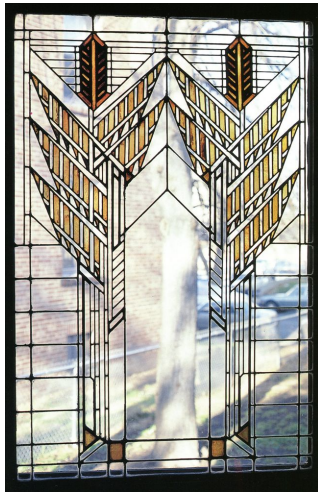
⁵³ Frank Lloyd Wright, and National Concrete Masonry Association. 1989. *The Work of Frank Lloyd Wright*. Herndon, Va.: National Concrete Masonry Association.



Eugene Masselink / Frank Lloyd Wright: New Year card from Taliesin Fellowship, 1946, Drawing Matter collection



Frank Lloyd Wright: Unity Temple, 1908
<https://www.dezeen.com/2017/06/12/unity-temple-frank-lloyd-wright-chicago-oak-park-modern-architecture-150th-birthday/>



Frank Lloyd Wright:
Dana house, 1904

be noted that the parallel ruler and technical drafting tables became popular during this period.

Mackintosh and Wright both created designs for leaded glass windows. Mackintosh's approach was rather traditional. While his designs incorporate arches and other organic motifs within an orthogonal grid, Wright, on the other hand, combines the orthogonal grid system with diagonal lines. While Mackintosh adorned each well-proportioned grid with a motif, occasionally retaining the orthogonal system, Wright abstracted organic motifs are created with the parallel ruler as well. In the Dana Thomas house, motifs such as sumac or butterflies appear, drawn with a parallel ruler, of course.

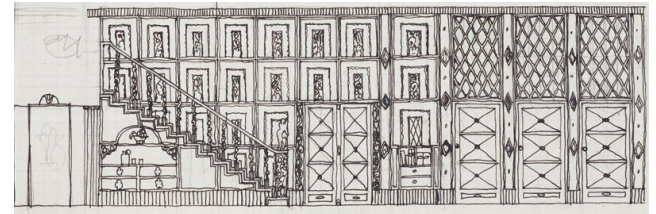


Charles Rennie Mackintosh:
Willow Tearooms, 1903

For Mackintosh, it was natural to counterbalance the grid with an arch, creating roses for instance from curved elements. In Wright's case, the use of the parallel ruler was as defining as the use of the compass in the Middle Ages. In his work, there are so many parallel lines that drawing them without a parallel ruler would have been a serious challenge. It's important to note that the artist is using a tool that allows for easy and efficient work, or at least more efficient compared to earlier methods. Thus, we can assume that without the use of a parallel ruler, Wright would likely have avoided designing numerous motifs with parallel lines, as creating them without the tool would have been a laborious task. However, understanding the tool, we recognize that its use makes the creation of such a design fast and easy.

The grid motif appeared, for example, in the works of representative of the Wiener Werkstätte, Josef Hoffmann.⁵⁴ He was born about two decades earlier and whose works, similar to Mackintosh's interiors and furniture, also featured this pattern. Presumably, they used similar tools, so each of them could have had a parallel ruler, although it is only clearly evident in Wright's case that he used the tool.

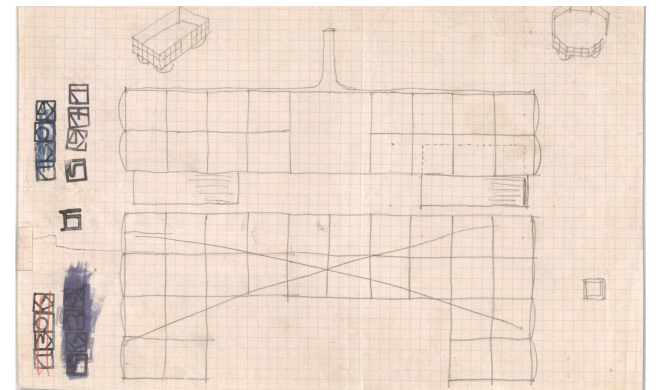
The inspirational tool at Josef Hoffmann was different. His sketches were made on checkered paper. Today, this medium may seem unusual; architects rarely use it as the grid can be too restrictive, and it can be distracting during freehand sketching. However, in Hoffmann's time, checkered paper was considered innovative, it became available around that time. Based on his drawings, it is evident that he took advantage of the ease provided by the medium, allowing him to precisely define rhythms and proportional systems even in his sketches. These are fundamental principles of architecture that appear independently of checkered paper. In many cases, however, the use of checkered paper results in a tight grid formation and precise rhythm. Moreover, in many instances, the grid itself appears as an essential, main decorative element. Studying Hoffmann's works, one gets the impression that the grid has become a distinct obsession for the master. However, due to the inherent nature of the grid, these works appear exceptionally timeless and enduring. In comparison to the works of Wright or Mackintosh, Hoffmann's creations bear much less of the characteristic style of the era.



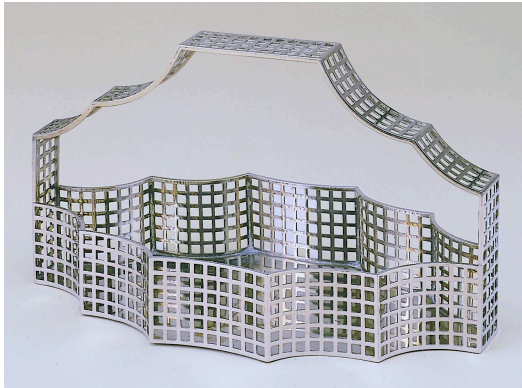
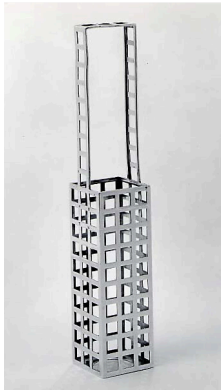
Josef Hoffmann: Design of a lobby for the Skywa-Primavesi villa, Vienna, 1916



Josef Hoffmann: Centerpiece, the original plan and its execution, Silver, Vienna, 1906



⁵⁴ Franz, Josef. 2008. *Josef Hoffmann*. Neue Galerie New York.

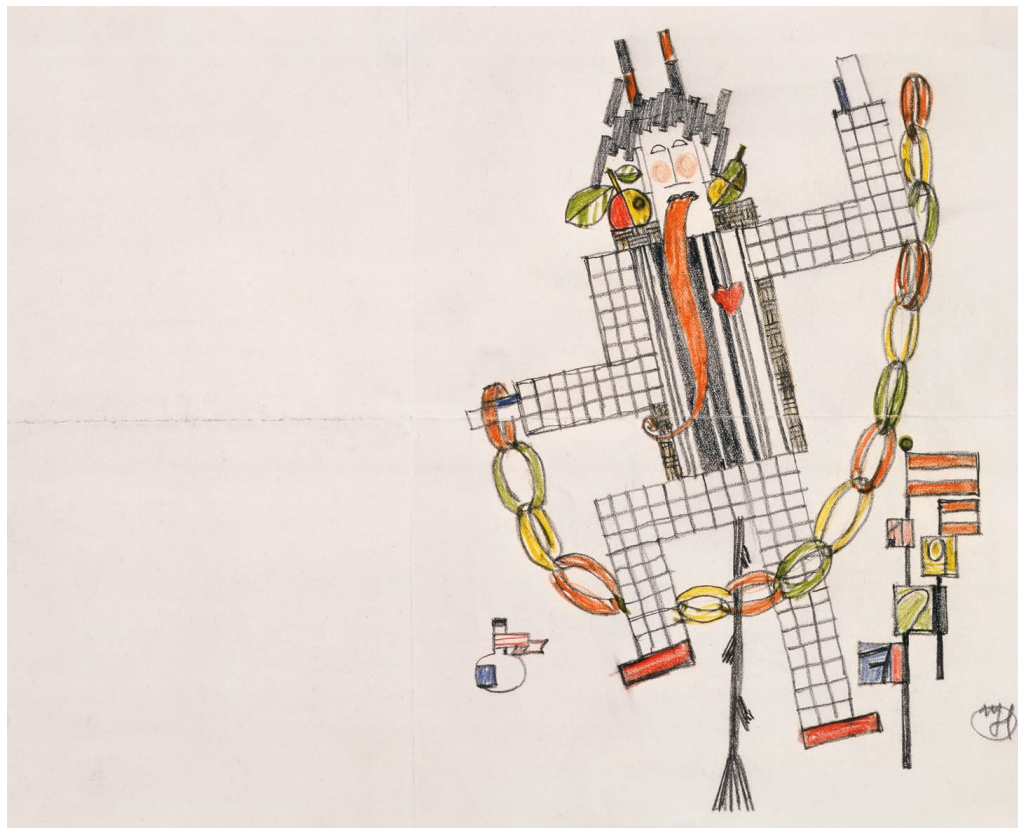


Josef Hoffmann: silver baskets for Wiener Werkstatte, 1905

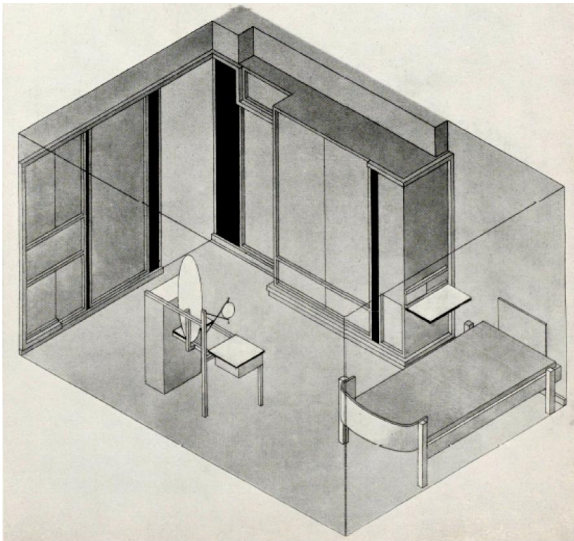
Comparing the works of Hoffmann, Mackintosh, and Wright, it is evident that the same era and similar trends led to different tools or methods. Josef Hoffmann also created elevation views depicting his furniture, but his furniture is more complex in terms of three-dimensionality compared to Mackintosh's. While Mackintosh also used a parallel ruler, it wasn't as defining in his motifs. Just as in contemporary architecture, where everyone uses a computer, it doesn't mean that the tool affects everyone the same way. However, similarities can often be observed.



Josef Hoffmann: Kubus Sofa for Wittmann Furniture 1910



Josef Hoffmann: Untitled, Figure Illustration, 1927
Pencil, crayon on paper



Breuer, M., 1923. Girl's Room. In: Bayer, H., 1923. Staatliches Bauhaus in Weimar 1919-1923. Weimar-München: Bauhausverlag, 163.



Breuer, M., Sommerfeld House armchair, 1921

AXONOMETRY AND ISOMETRY AS A 3D TOOL

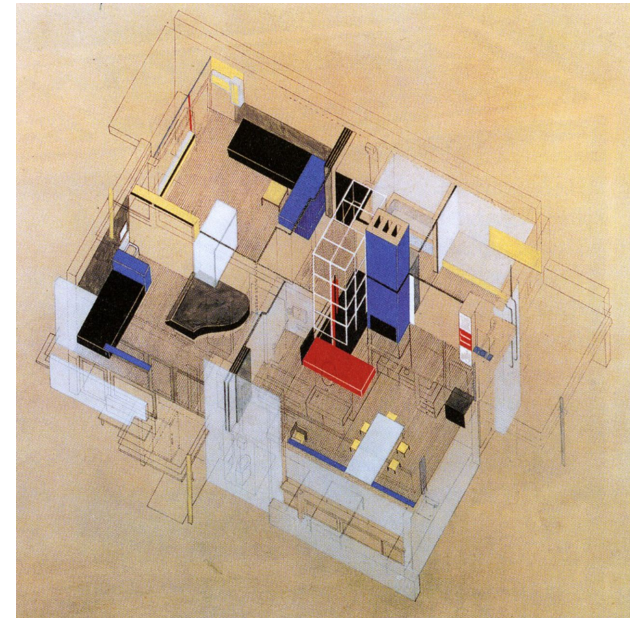
In the early period of the Bauhaus⁵⁵ and DeStijl,⁵⁶ isometry or axonometry was an extremely popular mode of representation. Both axonometry and isometry simplify spatial representation and the three-dimensional construction itself. Their advantage over perspective lies in the fact that length dimensions remain undistorted. In isometry, angles distort in all cases, while in axonometry, they only distort in the z plan. In contrast, perspective construction is complex, leading to numerous distortions that make it challenging to take accurate measurements from. Designers typically used perspective only at the end of the process, for creating visual plans aimed at convincing clients. In contrast, axonometry, as a quasi-interactive spatial representation tool, can be interpreted as a precursor to modern 3D programs as it is useful even in the early stages of the design process. Axonometry can be used for the spatial representation of three-dimensional objects. The method is smooth as long as these objects are relatively simple. What is easy to draw in axonometry includes a wall, extruded masses from free-form curves, truncated forms, and the spatial relationships of these elements. Representing and designing fine details, decorations, and articulations are cumbersome in this mode of representation. Another characteristic of the technique is that maintaining the spatial orthogonal system is essential for smooth use; parallel directions with the x, y, z planes must be assumed.

⁵⁵ Ackermann, Ute, Jeannine Fiedler, Peter Feierabend, and Et Al. 1999. *Bauhaus*. Cologne: Könemann.

⁵⁶ Overy, Paul. 1991. *De Stijl*. London ; New York: Thames And Hudson.

An example from this period is the interior design of Marcel Breuer's Girl's room, where line-like motifs appear around the corner. The different planes are sophisticatedly interconnected in the isometric representation, motifs take a turn and continue on the perpendicular wall. In contrast to the simpler plans depicting the walls with elevations, this method deals with the spatial aspect of an interior. This provides a good basis for comparison with Mackintosh's interiors created from independently treated elevations.

The effect of the method is more prominent in the furniture pieces of Breuer and his contemporaries. For instance, the armchair designed by Breuer for the Sommerfeld House effectively illustrates the impact of axonometric construction. Upon reviewing the chair, one can observe structural elements that are parallel to each other but shifted in space. The different rectangular-shaped blocks are well-distinguished from each other, with each unit maintaining its individual basic form. The composition is extremely clean, with each structural element being vertical, square-sectioned wooden rods whose height does not align with the masses of the upholstered elements. The upholstered elements intersect at just one point, in the case of the armrest and the seat. In the case of traditional - or even contemporary furniture - structures often feature joints creating breaking, turning, curving shapes, T or L-shaped intersections. However, in the Bauhaus or De Stijl movement, emphasis was placed on treating basic forms as unified entities, even where joints would typically occur. A prime example of this dogmatic principle is the Red/Blue Armchair by Gerrit Thomas Rietveld, discussed below.



Gerrit Th. Rietveld: Schröder House, Stichting Auteursrechten G.Th. Rietveld c/o Pictoright Amsterdam





Peter Eisenman, Diagrams, House VI, Eisenman Architects



Parallel to the Bauhaus era, Rietveld⁵⁷ who was a member of De Stijl movement applied the similar axonometric projection method when designing Schröder house. One can notice the similarities of the floating rectangular volumes in both cases. Contrary to the regular buildings of that age, the Schröder house is formed of independent slabs and blocks scattered in a vague silhouette. I believe that axonometric projection provided a perfectly suitable method for the newly developed (Adolf Loos Raumplan or Mies Van der Rohe fluid Space) spatial design concepts compared to the complicated perspective projection or the non-spatial two-dimensional projection. The widespread use of this method had a strong impact on shaping. The construction of beams and slabs overlapping in different spatial and orthogonal directions is an easy and spectacular process in this method. Axonometry-based constructions became a distinctive feature of that era, experiencing a surprising revival half a century later.

New York five, a revival of axonometric projection

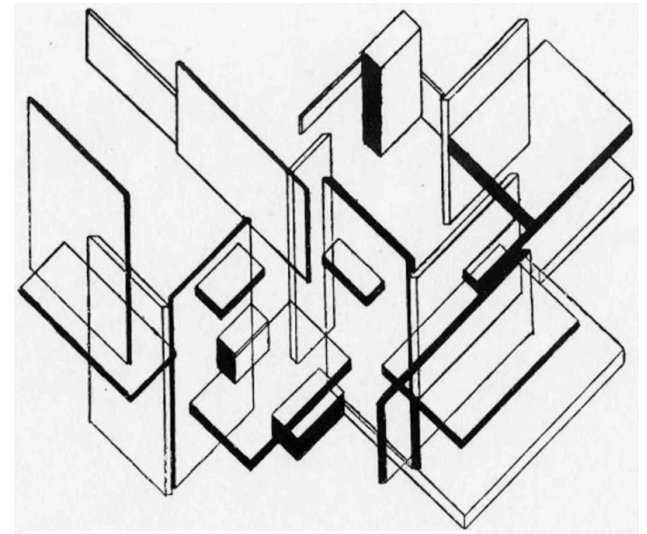
In his book, Ray Lucas⁵⁸ explores the influence of axonometry on the architectural group known as the New York Five, on JJP Oud from the De Stijl movement and on the British postmodern architect James Stirling.

⁵⁷ Gerrit Thomas Rietveld, Marijke Küper, Ida Van Zijl, Centraal Museum (Utrecht, Netherlands, Nederlands Architectuurinstituut, and Centre Georges Pompidou. 1992. *Gerrit Th. Rietveld, 1888-1964 : The Complete Works* : Centraal Museum, Utrecht, 1992. Utrecht: Centraal Museum ; New York.

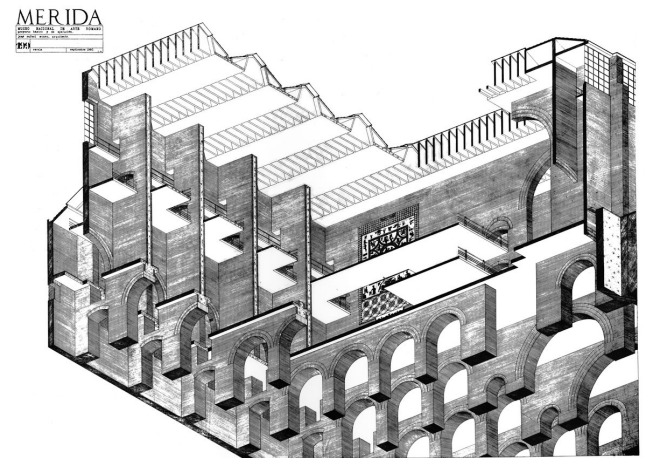
⁵⁸ Lucas, Ray. 2019. *Drawing Parallels*. London and New York, Routledge.

The author explains the use of axonometric representation with various philosophical and conceptual backgrounds. Within the book, Lucas, along with his colleagues, redraws the original plans to shed light on hidden aspects. However, it seems they have missed the most essential and obvious connection. This connection lies in the possibilities of axonometric construction. Like any tool, axonometry is truly effective for a specific task and less so for others. A common characteristic among creators strongly inspired by tools is that they push the boundaries of the tool's application, thus creating a unique style. For example, when Wright draws a butterfly or a sumac motif with a parallel ruler, or when Mackintosh designs a chair in elevation, we can speak of the unconventional use of the tool or method.

Like most Bauhaus creators, JJP Oud⁵⁹ or Theo van Doesburg arranged rectangular volumes using axonometry. "In these drawings [*counter-construction ii*, 1924 and *Hôtel Particulier*, 1923], axonometry is more than a useful graphic tool. It is not only the method of representation that does not privilege one part of the building over another (for example, the facade over the interior). In 'real life', the only way to recall such a house in its totality would be to trace and retrace its interior spaces in times, as in the case of Loos's *Raumplan* houses. Axonometry converts this temporal, semi-conscious process into an experience that is instantaneous and conscious. For van Doesburg these drawings seem to have

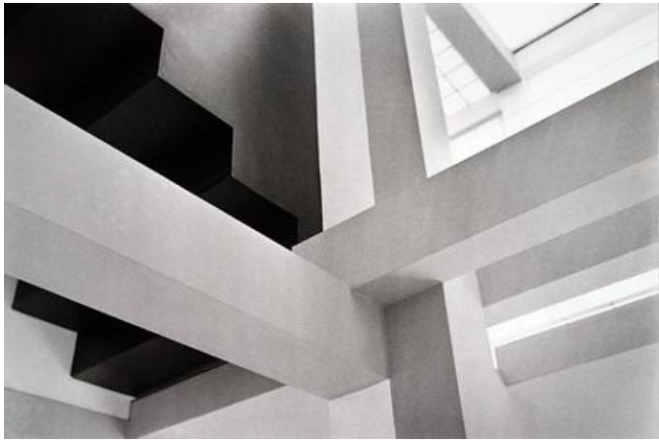


Theo van Doesburg, *Architectuuranalyse* (1923)



Stan Allen (1956), Merida Museum, worm's eye axonometric, hand dated V-84 (May 1984), 1984. 2H pencil on 20-gram Canson tracing paper.

⁵⁹ "Throughout his output, Oud draws in parallel projection, the axonometric drawing is more than a presentation drawing for Oud, but clearly part of his thinking process in arranging geometries, assembling discreet parts, and composing his largely asymmetric plans. Iterations of drawings can be seen throughout his work, where variations are produced serially on tracing paper, becoming ever more detailed throughout the very rational process." In Lucas, Ray. 2019. *Drawing Parallels*. Routledge.



Peter Eisenmann, 1975, House VI. Photo: NJIT



Gerrit Rietveld, Red / Blue Armchair, 1918, Kirkland Museum of Fine & Decorative Art

symbolised his techno-mystical vision of an architecture identical with the flow of lived experience. They were idealised representations of the ineffable. Axonometry was also fundamental to van Doesburg's attempts to represent four-dimensional space."⁶⁰ Although each creator collected in Lucas's book used axonometry, their styles and approaches differ in many ways. However, the commonalities confirm the validity of my proposition.

In his essay, Stan Allen recalls the times he worked with Rafael Moneo on Museum of Merida Museum, "In general, axonometric drawings tend to turn buildings into objects, often floating in abstract and undifferentiated space. From Van Doesburg to Eisenman, the use of axonometric projection has signalled a desire to align architecture with nonrepresentational art practices."⁶¹ I believe, that the effect of the infinite distant vanishing point, as well as the omission of depicting the surroundings, causes this phenomenon, which enhances the unified impression of the completed building.

Eisenman revived this tradition with his iconic House VI. The similarity with Rietveld's Schröder House is definite, where seemingly freely arranged blade walls create a mass with a potentially enclosed effect in space. The beam connections of the house evoke the junctions of Rietveld's iconic chair. House VI. was widely regarded by many critics as Eisenman's most significant work. John Hejduk characterized the dwelling as the "second canonical De Stijl house," drawing parallels to Gerrit Rietveld's Neo-Plastic Schroeder House. Eisenman, however, contested this comparison, asserting that House VI was an "inversion" of De Stijl

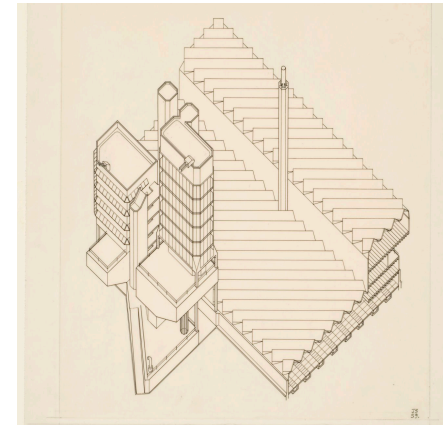
⁶⁰ Colquhoun, Alan. 2002. *Modern Architecture*. Oxford: Oxford University Press. 112-113

⁶¹ <https://drawingmatter.org/stan-allen-on-drawing-with-rafael-moneo/-madrid-1984>

design. Critics have highlighted Eisenman's endeavor to integrate linguistic theory into his designs, notably through his exploration of Noam Chomsky's syntax and transformational grammar. This influence is particularly evident in the series of "transformational" axonometric drawings created for House VI.⁶²

"In traditional terms, the axonometric is an abstract two-dimensional drawing that allows us to 'see' the three-dimensional object in two. It does not pretend to provide a naturalistic image of the building but simply to depict the more objective presence of every element or aspect in the building and their relationships. These relations are measurable, since there are no dimensional distortions as a product of the artificial vanishing point of perspective. That is, the axonometric truthfully provides knowledge about a certain reality of the object; through scale reductions it represents the additional dimensions of space to the knowledge provided by plan and section."⁶³

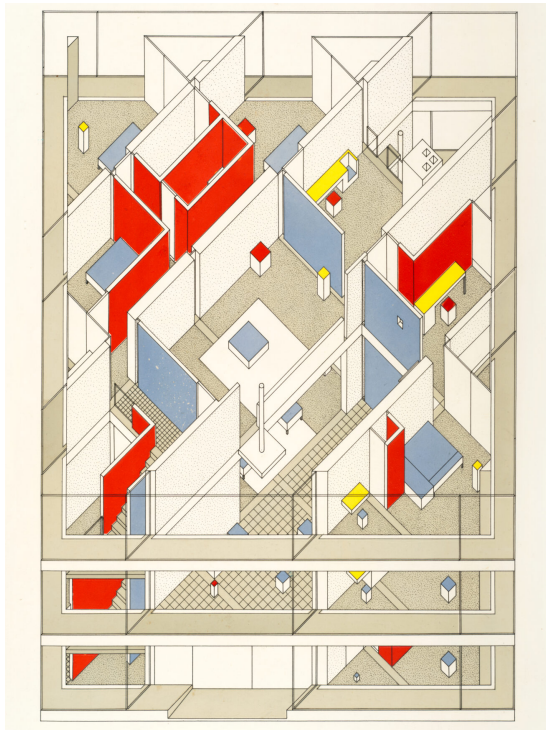
Stirling, the postmodern architect, placed truncated volumes next to each other in his designs on the context-free plane of white paper, rather than using walls. His most famous project is the building for the Engineering Building at the University of Leicester. The complex consists of a series of upright, square-based columns forming the edge of a glass skylight. It is interesting to note that in axonometry, the axes of these elements, which are otherwise rotated 45 degrees, come out precisely horizontal, resulting in a smooth graphic construction. "Stirling's use of the axonometric drawing here bears mention as more than simply an arbitrary



James Stirling and James Gowan, Engineering Building at the University of Leicester, 1959, photo: Canadian Centre for Architecture

⁶² <https://www.getty.edu/research/collections/collection/113Y9G>

⁶³ Eisenman, Peter. 1982a. "Editor's Preface" in Rossi, Aldo. *The Architecture of the City*. Cambridge, Massachusetts: MIT Press.



Diamond House B, Projection
John Hejduk 1963-1967, SFMOMA

choice of representational technique and instead as a reifying of his conceptual strategy of 'articulation' or 'piece-by-piece' composition. As the early drawings make clear, Stirling designed the project in axonometric drawing. To say that somewhat more forcefully, the drawing technique wasn't an after-the-fact means through which to represent the building as it had been conceived; it was the means through which Stirling arrived at and tested design ideas. Leicester is a built axonometric. Robin Evans famously argued that drawing always precedes building in architecture, and that there is a necessary translation, a gap, between drawing and building. But in Stirling's case, and particularly at Leicester, it's as if that gap is missing. He simply 'records' the drawing with the architecture."⁶⁴

One of the members of the New York Five, Hejduk, applied a slightly different axonometry. Instead of a typical, rotated viewpoint, he used parallel projection, where the levels appear as if they were parallelly shifted playing cards (Wall House). The otherwise vast surface of the wall only appears from its edge, reinforcing the gesture of cutting or splitting. In the case of the Diamond House, he employed a double twist: he based it on the usual rhombus-shaped axonometric view but framed it with a cube created by a parallel projection.

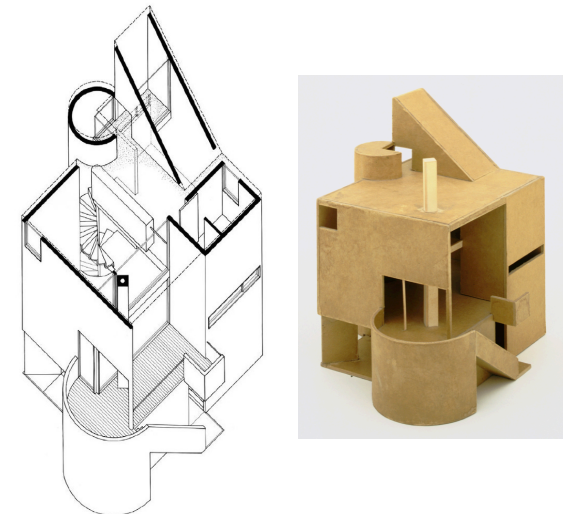
"If you project floor upon floor as in the first isometric drawing you get an overlapping like that which is actually a three dimensional view. Your isometric/axonometric basically, it's once removed from perspective but it's still a three-dimensional view of things. If you take the diamond and you make an isometric of

⁶⁴ Reeser Lawrence, Amanda. 2012. James Stirling: Revisionary Modernist. New Haven, Connecticut: Yale University Press. 95

it, it becomes a series of flat screens overlapping each other which then brings on a sense, a *memory condition*.”⁶⁵

Architect Charles Gwathmey, another member of the New York Five, designed the Gwathmey Residence and Studio in 1965 as a sculptural embodiment on its site. Embracing primitive forms, particularly cubes, Gwathmey crafted distinct spaces by "carving" into the structure. I consider House 1 to be one of the best examples illustrating that through axonometric design process, scale is often lost, and a recognizable 'house mass' is replaced by an object-like form. The volume can be easily broken down into simple geometric forms. As it arises from axonometric design; masses, walls, and pillars dominate, while the positions of the facade openings are almost incidental and changeable. We can easily compare the difference with buildings designed in elevation views, where facades are born as 2D compositions. In this case, the rhythm of window openings becomes more significant, either in an equal manner with massing or at its expense. From this, it follows that due to the wall openings, the scale is easily recognizable, whereas in axonometric design, small objects can appear monumental and, conversely, buildings may seem small.

Through the above examples, we have seen that axonometry has been used in various ways from Bauhaus to Postmodernism by different creators. However, it is precisely these differences that highlight the commonality: the elements of furniture or buildings designed in axonometry retain their well-identifiable basic forms. While, in the case of a typical chair, the armrest merges with the legs and the backrest, in the axonometrically designed chair, these elements maintain their



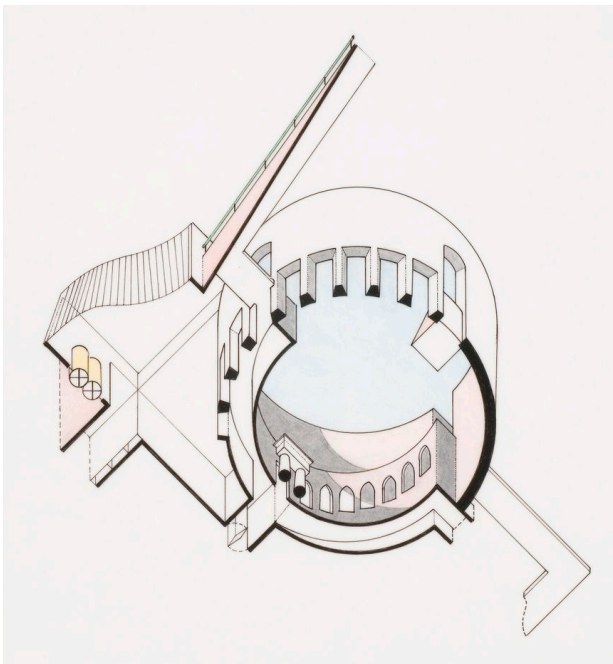
Gwathmey Residence and Studio / Charles Gwathmey, 1965. The model and axonometric drawing of the residence by the architect himself.



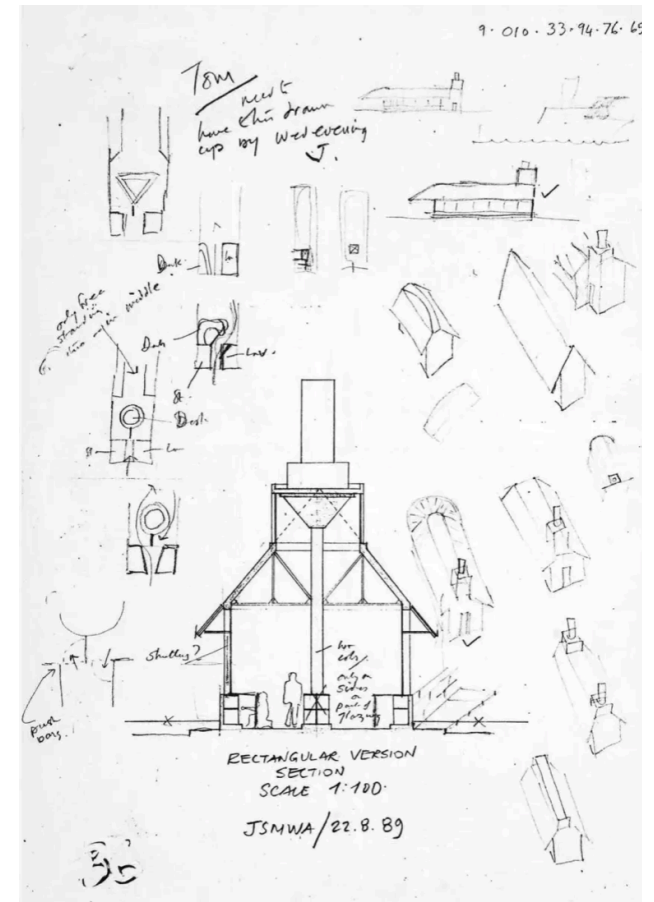
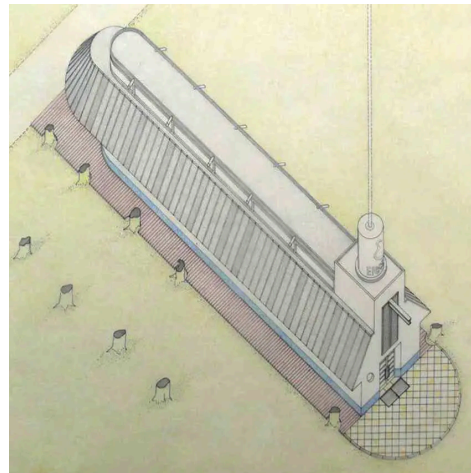
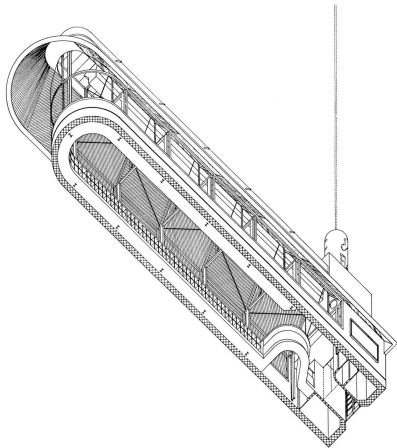
⁶⁵ Hejduk, John. 1985. *Mask of Medusa: Works 1947–1983*. New York: Rizzoli.



Staatsgalerie Extension, Stuttgart. James Stirling 1977-1983
Photo: Richard Bryant



original structural roles intact. Similarly, in a classical building, partition walls blend together. In an ordinary case, these walls delineate the space, with the focus on the room's volume. However, in the case of a building designed in axonometry, the walls slice through the space, and the planes of the walls map out the infinity of the coordinate system, intersecting and capturing pieces from the infinite space. While in a traditional building, the typical goal is to integrate functions into a single mass, in axonometric construction, different forms are arranged additively next to each other. Since there is no vanishing point in axonometry, the volumes and the spaces of a building created in this way are indeed similar to a spatial coordinate system. This also leads to buildings appearing out of scale, which is a common feature of the above examples. While the buildings created in this way can be easily imagined as tabletop decorations or functional objects, smaller items and furniture, on the other hand, appear monumental. And finally, another common characteristic that follows from the above: buildings constructed in axonometry are humorous and ironic. Even Stirling's monumental wing at the University of Leicester has some playful element. This factor is often complemented by direct funny references, as seen in the case of Stirling's Stuttgart Staatsgalerie extension, sometimes spiced up with postmodern quotations, akin to what is typical in postmodern literature. However, the presented examples evoke this sense primarily through their strange additive systems and their out-of-scale effects.



Bookshop pavilion in Venice. The sketches, axonometric drawings, and executed building. James Stirling, 1989

<https://archeyes.com/bookshop-pavilion-in-venice-james-stirling-michael-wilford/>



Juan Noguera, assistant professor Rochester Univ. of Design

"Shown below is a simple in-class demo I showed my students. I prompted OpenAI's Dall-E for images of "Cylinders Embracing Spheres" and threw in words like "Ceramic", "Raku" and "Vessel." ...

What came next (for me) was distilling those ideas into a product concept. I noticed these forms naturally generated a number of open cavities/levels, and thought that those characteristics may be well suited for an object like an organizer/container of small items. I quickly took some of the best or most interesting bits and forms and in my sketchbook, created a few desk organizer ideas. From here, I transferred these ideas to a simple CAD model in Autodesk Fusion360. In my process, I used AI to convert a very abstract idea into form inspiration.

<https://www.rit.edu/spotlights/artificial-intelligence-design>

FUTURE TENDENCIES

At the conclusion of my historical overview, the question arises: what will be the favored design tool of the future, leaving an indelible mark on the objects designed? The surge of AI in the creative professions makes the outcome of the competition between artificial and human intelligence uncertain. The debut of the Chat GPT program in 2022 disrupted the livelihoods of thesis writers from the moment of its release. Skeptics of AI often point out that these programs lack innovative thinking, relying only on existing knowledge. This is evident in chess applications, which, despite their extensive databases of previously played games, struggle to generate genuinely new solutions. How does human thinking differ? Does true innovation exist? Even the greatest inventions can be broken down into elements already known. In my view, innovation is a synthesis, creating something new from existing foundations. Moreover, one of the novelties of AI is deep learning, which can adapt and synthesize existing knowledge, similar to human thinking.

To anticipate future trends, I posed a question to the Chat GPT application: 'Can AI be used for product design?' The response is as follows:

Yes, AI can be used for product design, and it is already being used by many companies for this purpose. AI can be particularly useful in automating certain aspects of the design process, such as generating and testing multiple design variations, identifying design flaws, and predicting how customers might respond to a new product.

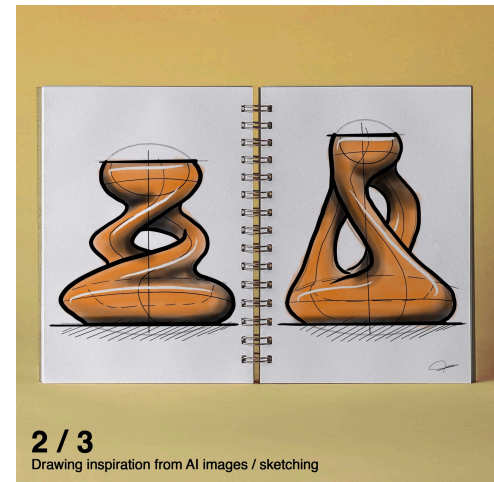
One way AI can be used in product design is through generative design. Generative design algorithms use machine learning to generate and test thousands of design variations based on a set of parameters such as materials, performance goals, and manufacturing constraints. This can help designers quickly identify the best design options and reduce the time and resources needed for product development.

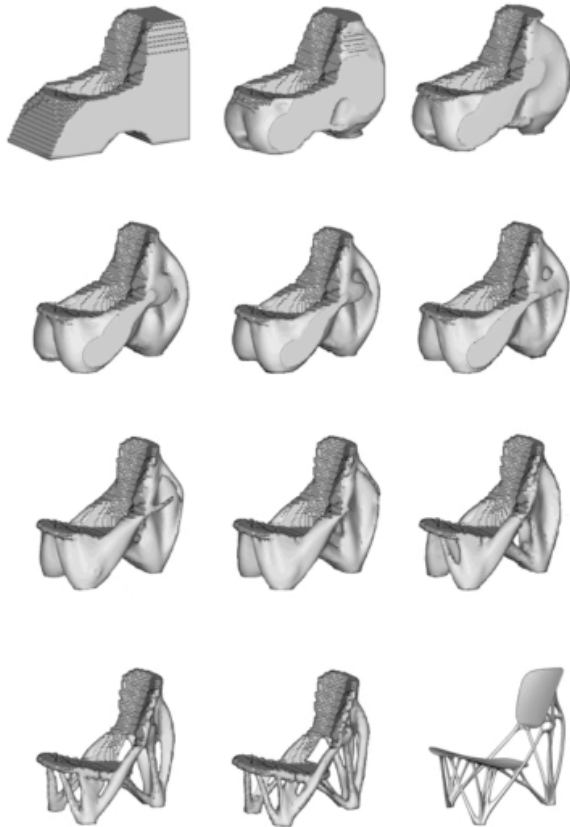
AI can also be used for predictive design, which involves analyzing data from customer feedback, sales data, and other sources to identify patterns and predict how customers will respond to a new product. This can help designers create products that better meet customer needs and preferences.

Additionally, AI-powered tools can help designers optimize product designs for manufacturing, by analyzing manufacturing data and identifying areas for improvement in terms of cost, efficiency, and quality.

Overall, AI can be a powerful tool for product design, helping companies create better products faster and more efficiently. However, it's important to note that AI is not a replacement for human creativity and expertise in the design process. Instead, it should be used as a complementary tool to enhance the designer's abilities and help them make better-informed decisions.

As expected, the text doesn't introduce anything groundbreaking, but it provides a concise summary of the topic. Generic design, indeed, involves a simpler form of artificial intelligence, resembling more of a multivariate optimization process.





Optimization process of a chair from the Bone Furniture collection, Joris Laarman, 2006

Nevertheless, the final results in many cases yield aesthetically interesting and characteristic shapes. This design process is exemplified by Joris Laarman.⁶⁶

Laarman's fascination with digital technology traces back to a documentary he saw in the early 2000s, showcasing a digital tool developed to optimize the geometry of car engine mounts, using the least amount of material possible. Instead of creating a solid, geometrically shaped part, the software generated unexpected organic forms of varying densities, determined by the specific forces the part needed to endure. Although the software was originally designed for maximum efficiency, Laarman recognized its sculptural potential.

"The amazing thing about it, in my opinion, is that it uses an algorithm to optimise a form and reduce its weight, similar to an evolutionary process," Laarman explained.

"But it also creates a really beautiful organic aesthetic. And when I looked at this, it was like watching the industrial age sort of transforming into a digital era. How geometric form dictated by the limitations of industrial machines is replaced by smart form informed by AI. And that started me thinking about using this as sort of a sculpting tool of the future."

The result of Laarman's experiments with the technology was his Bone Chair in 2006, which Laarman designed in tandem with an algorithm and then cast as a single piece of aluminum.

⁶⁶ <https://www.dezeen.com/2020/06/11/joris-laarman-interview-friedman-benda-vdf/>

The chair is so-called because of the similarities between the way the algorithm works and how bones grow, building up matter only where it is needed to maintain an optimal balance between strength and weight.

"It's not just my own aesthetic opinion, it is a computer, basically helping me in ways that I could never think of myself with creating the form," Laarman said.

Artificial intelligence has only been present in our lives for a few years, and many envision it as the precursor to another industrial revolution. I share this opinion myself. I am confident that this technological advancement will have a significant impact on design, leaving its mark on the objects created through its application. However, I am also sure that it will not endanger creativity any more than previous tools have. Even with the use of AI, creators will need to make decisions just as they would with any other tool. The creative process is not only about inspiration but also about the necessity of choosing among numerous possibilities. A skilled creator consciously selects from the available options. This particular consciousness is a human quality that will remain a human factor for a long time, perhaps forever.



Joris Laarman used a computer algorithm to design his Bone Chair in 2006. Photograph by Jon Lam

CASE STUDY: THE LOGIFACES GAME

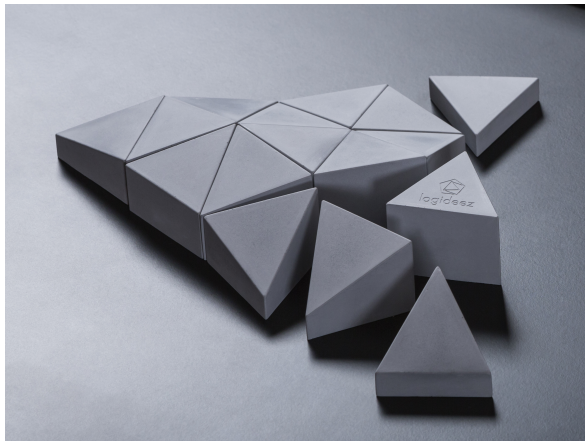
Tervhivatal, our multidisciplinary design studio, was established in 2009 in collaboration with Zsanett Benedek. In 2012, we were invited by MOME to take part in the 1359 cm³ Game Design Competition. Our proposal emerged as a finalist among over two hundred submissions. Named Logifaces, the toy represents a polygonal model widely utilized in virtual, three-dimensional computer design, presented in a traditional manner reminiscent of building blocks.

The concept was born in one night, in my head - so I did not use drawing tools, which is an interesting circumstance from the point of view of this thesis. However, it is clear that the dominant design tool of the time, the computer, left its mark on the object. In the last decade, "faceted design" has become fashionable, and we can find a good number of examples of this in both architecture and design.

"Designed by Tesla's chief designer Franz von Holzhausen, the radical pickup truck has a body that resembles a computer wireframe model or a polygon mesh. These are three-dimensional forms made up of flat polygons with straight edges. The vehicle's exoskeleton is made of stainless steel, which is harder to stamp into shape like the regular steel used to make most car bodies. Instead, the Cybertruck's panels will be folded, leading to its faceted appearance. The resulting crisp, origami-like form is common in architecture, interiors and design. While polyhedrons – solid forms made up of polygonal faces – have featured in architecture since the pyramids, recent advances in computer modelling have allowed ever more complex planar forms to be realised.



Logifaces brochure
Photos: Gergely Schöff



Given their association with computer imagery, science fiction and the radar-evading F117 Nighthawk stealth bomber, objects made up of polygons have a futuristic feel to them, which explains the shock at Tesla's decision to use them on their entry into the staid pickup-truck market."⁶⁷

Even though I had no intention of designing a fashionable object, the Logifaces game still aligns with the trend of computer-generated forms, specifically triangles reduced to meshes. In this way, I was influenced by the computer as a tool in multiple ways, even though I conceived the design mentally.

How did this trend come about and why did it become so popular? In architecture and design, as in all artistic fields, the search for boundaries has been present from the beginning. How high a house can we build, how much can we create a floating effect from stone and concrete, or how can we create the plastic most reminiscent of organic forms? The latter - on a building scale - was such a challenge that only CAD-CAM technology made it possible. Until recently, construction materials, measurement methods, construction tools, cost effectiveness, etc. the shape of the buildings was limited to the simpler, typically brick shape. Anything that deviates from the vertical or horizontal greatly complicates the implementation. Creating organic masses and surfaces in architecture is still an extremely expensive challenge. Of course, the construction of organic, complex forms is only possible today in an approximate way. Three-dimensional computer modeling was initially based primarily on polygonal reduction. This method reduces complex shapes to their simplest basic units, triangles or rectangles. The use of design software with a NURBS background assumed higher capacity computers. The shapes



Cyber Truck designed by Franz von Holzhausen
<https://www.dezeen.com/2019/12/02/10-faceted-architecture-design-projects/>

⁶⁷ <https://www.dezeen.com/2019/12/02/10-faceted-architecture-design-projects/>



https://commons.wikimedia.org/wiki/File:Tantrix_discovery_2.jpg



<https://de.wikipedia.org/wiki/Triominos>

approximated by triangular planes - depending on the resolution, i.e. the relative size of the triangles - are able to imitate the original, organic shape almost perfectly. At the same time, the rough, low-resolution form gives a vivid appearance. This kind of shaping was particularly inspiring for many designers.

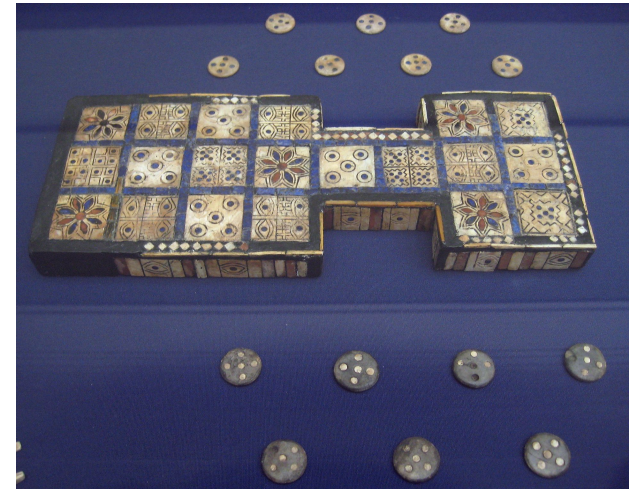
Nevertheless, when conceptualizing our game, I initially overlooked a stylish approach. The idea involved a three-dimensional shift from the existing two-dimensional game, Tantrix. Like Tantrix, connecting elements follows a clear rule. Logifaces shares more similarities with Triomino; however, I was unaware of Triomino at that time. Immediately afterward, on the same morning, we sketched the variety of elements, which remain unchanged.

In 2013, we received the Hungarian Design Award. For this occasion, Professor László Mérő reviewed the game: *Good problem-solving is the basis of everything - both in mathematics and in design. Without this, we cannot come up with solutions that overwrite our fixed schemes. This spirit of innovation and the search for innovative solutions characterises the creations in the design category. Why do we need new kinds of games? Isn't the fruit of the last few thousand years enough, from the dice to the Rubik's cube, from the cob doll to the Barbie doll? A childhood is not enough for these either, and not even a whole life. But just as we need new literary works despite the fact that we haven't even read the old ones, we also need new games that somehow resonate with our lives today. The toy, which was awarded this year's Hungarian Design Award, presents a theme that is thousands of years old in a modern guise. Puzzle games already existed in ancient Babylon, but this game could not have existed then, as it is inspired by today's computer graphics toolkit. That's why we immediately feel at home. It's good to think. More precisely: it is good to think in moderation, just as it is good to drink in*

moderation or climb a mountain. Many of us like to climb mountains, but few of us like to climb the Himalayas. The thing about good puzzle games is that they require just as much thinking as they are enjoyable, and as much as the joy of finding the solution is more than worth the sacrifice made for it, the mental effort. Psychologists have shown that the greatest pleasure comes from tasks that are medium to difficult, but not too difficult. This excludes not only tasks that are too difficult, but also tasks that are too easy: they may require little effort, but they are not worth that much. The prize-winning work in the design category has exactly hit the level of difficulty that creates a pleasant challenge, its clean formality playfully draws you into the complex world of spatial geometry.

We finally came up with the idea to use concrete, which has low investment costs for series production, instead of the more complicated and commonplace wood. In 2014, our design, ready for mass production, debuted on the Indiegogo crowdfunding platform. The set goal was 15,000 USD, which we managed to almost double with about 300 sold sets.

The concrete version became a special design object, a table-top sculpture, and a choice for souvenir or gift. This led us to introduce a wooden version as well, suitable for children and people who are rather interested in playing than owning a design product.



The Royal Game of Ur
One of the five gameboards found by Sir Leonard Woolley in the Royal Cemetery at Ur, now held in the British Museum[1]
Earliest boards date to c. 2600 – c. 2400 BC[a] during the Early Dynastic III, being played popularly in the Middle East through late antiquity and in Kochi, India through the 1950s
https://en.wikipedia.org/wiki/Royal_Game_of_Ur



The Montreal Biosphère, formerly the American Pavilion of Expo 67, by R. Buckminster Fuller, <https://en.wikipedia.org/wiki/>



Kas Oosterhuis, Bálna Budapest, Hungary 2013
photo: Civertan

The Concept of Logifaces

After the turn of the millennium Computer Aided Design (CAD) programs and platforms became much more powerful than before. As computing capacity problems faded, designing complex shapes became possible.⁶⁸ However, the implementation of organic forms is still challenging, as raw materials are usually accessible in basic shapes, typically in rectangular boards or blocks. A possible way to execute multiple curved forms is the polygonal reduction. One of the first pioneers applying this method was Buckminster Fuller⁶⁹ who created geodesic domes arraying a couple of different triangles from the 1950's. This could be done without CAD programs. Implementation of reduced freely formed shapes required a huge computing capacity as it involves many unique triangles and even more unique construction details. An early example of this kind of non-standard architecture is a building located in Budapest, called "Bálna" designed by Kas Oosterhuis⁷⁰ in 2007. The organic shape covered by triangle shaped glass planes fills the void left between a pair of old, lengthwise warehouses at the Danube. Besides architects, faceted style inspired designers as well. A remarkable example from the fashion industry is created by Issey Miyake, the Distortion bag, designed

⁶⁸ Weisberg D. E. *"The Engineering Design Revolution — The People, Companies and Computer Systems That Changed Forever the Practice of Engineering"* Cyon Research, 2008

⁶⁹ Fuller B, López-Pérez D *"Pattern-Thinking"* Lars Müller Publishers 2019

⁷⁰ Oosterhuis K *"Towards a New Kind of Building: A Designers Guide for Non-Standard Architecture"* nai010 publishers 2011

in 2013⁷¹. This bag is made of small identical rigid triangles attached to a flexible textile mesh. In several steps one can transform the flat construction in a three-dimensional organic shaped bag. This piece leads to my next topic, the transitions between 2D and 3D.

A Taiwanese fashion brand, called "Jump from paper"⁷² applies graphics and 2D cartoon-like illustrations to create real-world 3D bags that literally look as if they 'jumped from paper'. Despite their bags looking completely plain, they do have some inner 3D space in order to suit the storage function. Sharona Merlin's "Slim cup"⁷³ from 2010 is an archetype cup from one side - though it is actually flattened.

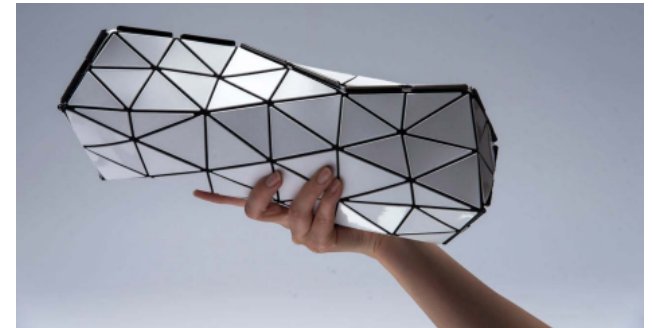
My last example to this topic is a short animation movie, Rabbit and Deer⁷⁴. Péter Vác created it in 2013 and won countless awards worldwide. According to the teaser 'The friendship of Rabbit and Deer is put to the test by Deer's new obsession to find the formula for the 3rd dimension...' In other words, the Deer escapes the 2D world to 3D while the Rabbit has to stay in 2D. The movie explains the dimensional differences in a funny and emotional way.

⁷¹ <https://design-milk.com/distortion-futuristic-bag/>

⁷² <https://www.jumpfrompaper.com/>

⁷³ <https://www.dezeen.com/2010/08/11/slim-cup-by-sharona-merlin/>

⁷⁴ <https://vimeo.com/52744406>



Issey Miyake: Bao Bao Distortion bag, photo: Issey Miyake



Sharona Merlin: Slim Cup, 2010
Photo: Sasha Flit



Péter Váczi: A slide from animation movie titled Rabbit and Deer



I believe that every age has an emerging vision attracting designers. These ideas often turn into superficial styles. Looking back to the early 2010 years, these visions affected the concept of Logifaces as well. The best ideas become timeless even if we are uncertain of their specific origin. I hope Logifaces will stimulate people for a long time.

Educational Opportunities

Present-day education faces several new challenges. The world of the Internet provides almost all knowledge for nowadays children, they live in an unlimited network of connections. This process fundamentally changes the role of the teacher and the role of the education. The whole international educational system should be renewed to satisfy the needs of the students and the teachers too. Teachers are motivated to seek and to find those new methods which help them to find the connection with children and help to cooperate with them.

The last decades' school education mainly focused on seeing. Students used their eyes to understand geometry, sciences and art. They learnt about different three-dimensional shapes or forms by demonstrating them in two-dimensions. This method caused confusion and made the differences between dimensions less understandable. The Logifaces game helps to understand the distinctions of dimensions and improves the spatial-skills. In addition the use of the tool gives the

opportunity of more emphasis on tactility too resulting in a more experienced-based learning. These qualities make the tool suitable for children living with different disabilities like autism, visually, hearing impairment and speech disorders as well.

Logifaces gives the opportunity to explore the connection between mathematical, geometrical thinking and works of art. This approach creates a passage from the knowledge of abstract shapes to the joy of art and creativity.



Visually impaired person solving the puzzle
Photo: Demeter Fogarasi



Photo: Gergely Schöff



The bag designed for carrying the balance bike offers a different solution to the described problem.
Photo: Turnpro advertisement

MOTOCOZY - THE DESIGNER'S INTROSPECTION

The idea of a running bike that can be converted into a stroller has been stirring my imagination for more than ten years. On a family vacation, we tried to walk around Prague with our two small children. The four-year-old, who could already walk, was soon exhausted, but only the youngest had a stroller. From this point on, the walk is more like a survival hike, since with an exhausted small child, careless relaxation becomes hopeless. A transformable bicycle-stroller can provide a solution to this well-known problem - for families with small children. However, several years passed from the idea until the invention based on the new technical solution was born. Nevertheless, we still have to wait for the product, but the patent has already been obtained in the most important target countries.

During the designing process, several colleagues of mine developed the concept using several different software. This object must meet a lot of functional and mechanical requirements. The aesthetic quality, or the character of the shaping, is therefore a secondary consideration from the design point of view.

Despite all this, the changes created in the design process were still inspired and influenced by the softwares we used. I myself know and use the Rhinoceros 3D program. This application is inappropriate for modeling mechanical structures, but it can be used to create forms and modify drafts relatively quickly. The very first models used for visual design were created with this program.

Demeter Fogarasi later joined the process as an intern. He worked with the Solid Works program, which also made mechanical modeling possible. It soon became clear that the sketch I had made was dysfunctional from a mechanical point of view. A process lasting years and full of dead ends began. The end result bears little resemblance to these sketches. At the same time, it can be observed that the solutions of Solid Works, which easily enable the creation of beautiful shape transitions, were used with gusto. This tool is unavailable or is only available in a cumbersome and inaccurate version with Rhinoceros.

From a mechanical point of view, the breakthrough occurred in 2019. That's when I invented the arms that slide on a curved track, which remained a formally defining element of the later constructions and the patent. At that time, Márton Taar took over the duties of the associate, he used the Fusion 360 program. This software enabled even more free shaping in addition to the basic expectations from a mechanical engineering point of view. This again left a mark on the plans. However, the fundamentally important changes were still caused by functional paradigm shifts. This is when the stroller seat separates from the saddle, which is decisive both in terms of appearance and functional operation.

The new Portuguese colleague Iorgos Oliveira Konstantinidis worked on the last stage from 2021. The design was further simplified, at which point the structure consisting of a significantly reduced number of parts, the system of parts suitable for injection molding, was formed. This is also where the handle of the bicycle handlebar and the stroller separated.

Ten years later, the project is still ongoing. During the DLA workshop, I received important feedback regarding the complexity of the model. It was emphasized that the concept had become too complicated compared to the first sketches.

3 IN 1 BABY STROLLER

STROLLER · BACKPACK · BALANCE BIKE



Initial concept sketches by myself, done in Rhino3D



Photos: <https://pockettrailer.hu/>



These early versions kept the seat in a backpack, separate from the bike. The return to the solution resulted in a lighter and more aesthetic construction of the bike. The backpack is also suitable for storing the necessary baby equipment. This feature was missing from the fully integrated version of the bike. This is an instructive lesson about forgetting an important aspect that existed in the very first concept. At this juncture, my former student from MOME, Sebestyén Ócsai, joined our team. He utilizes interactive VR glasses along with Fusion360 software. He has further refined the model, reaching its most complex form to date.

From my thesis point of view, I have many other designs where the mark left by the design tool appears more prominently on the finished object. Such an object is the Logifaces toy family, but also a lot of my furniture, where the *develop surface* tool of the Rhinoceros program tool can be considered an inspiration. However, I consider it is an important lesson that the design tool does not leave its mark on all objects in the same way. In cases where shaping is subordinated to functional, mechanical, and feasibility requirements, the tool used will be less decisive in terms of the end result.

MOTOCOZY - ARTWORK DESCRIPTION

A well-known problem in families with small children is that a child who can already walk requires the use of a stroller for a long time. Typically, around the age of one and a half, he can safely cover relatively long distances, but he gets tired quickly and needs rest. At the same age, he already learns to "ride a motorcycle", but he still needs a stroller that provides a sitting-lying, resting position. From the above, it follows that the parent is forced to bring a stroller in addition to the scooter/running bike. As a father of three children, I had the idea of a construction that combines a running bike with a stroller more than ten years ago. The original design, supported by patent innovation research, satisfies the requirement of simplicity both in terms of use and construction.

1. PROBLEM PRESENTATION AND CURRENT SOLUTION

Children usually start walking at the age of one and a half. However, this is mostly the beginning of a transitional period that lasts for years. During this period, the child is unable to cover longer distances without resting. The parent has to decide whether to carry the stroller empty - thus preparing for carrying the child who will be exhausted later - or undertake to pick it up in defiance of the discomfort, or perhaps carry the increasingly heavy youngster.



Initial test model, SolidWorks, 2017



The strollers on the market can be used up to the age of 3, although even a 4-year-old child can get tired during a long walk. If the child is riding a motorcycle or bicycle, the parent must take the empty stroller. When the child gets back into the stroller, the running bike must be placed somehow on the stroller that is inconvenient for this.

This product eliminates the need to carry an empty stroller, and at the same time provides a solution to ensure the rest of an already tired child. The Motocozy running bike-stroller hybrid educates the child to be independent, as it also carries the relaxation device itself. At the same time, the parent, who is already forced to carry a lot of things, is freed from carrying one of the biggest burdens.

2. BRIEF PRESENTATION OF THE PRODUCT



Study shape designed in 3D Studio, 2019

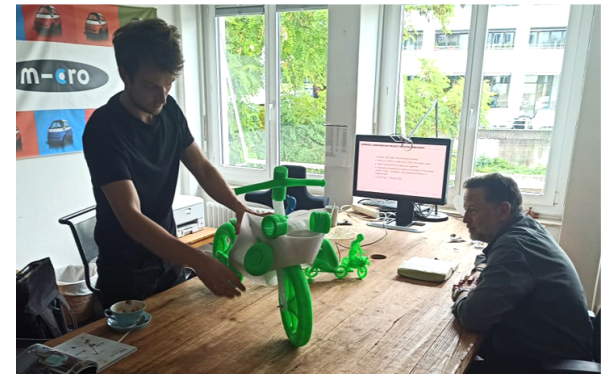
Motocozy is a 2in1 product that can be transformed into a stroller and back into a running bike with a single movement. The invention relieves the burden on the parent, since he or she freed from carrying either the stroller or the running bike. The device can be used comfortably up to the age of 4, which will postpone the use of a stroller by an average of a year. This solution also reduces the physical burden on parents.

In addition to the fact that we see the design of products that benefit parents with small children as a real mission, we must emphasize the fact that this hybrid product greatly reduces the burden on the environment. With the weight of

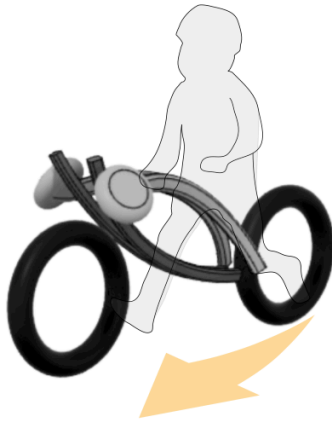
Motocozy around 5 kg, we are at the forefront of stroller products, where models weighing around 15 kg are common. If we succeed in replacing the running bike with our product, we will save quite a few kilograms of material. We also consider it important to save on fuel, since typically the parent prefers to go by car even for a very short distance - to the nearby nursery or kindergarten - for fear that the child will be exhausted before the destination. Last but not least, we consider the education of the child to be independent and an important aspect.



Photo: Mini Glider balance bike



Motocozy presentation in the Micro office to Wim Ouboter, Zürich, 2021



Curved bar system, Fusion360, 2020

3. APPLICABLE TECHNOLOGY AND INNOVATION

The breakthrough was a mechanical solution that proved to be extremely simple, yet - confirmed by patent novelty research - completely novel. By pulling out the bars that move in sync on the curved track, the running bike turns into a stroller with one movement. In addition, the construction is surprisingly simple, easy to implement, and consists of few parts. The separation of the saddle and the stroller seat is also of great importance. A seat intended for relaxation mismatches the function of a comfortable saddle for pedalling, and vice versa. Thus, in addition to the traditional saddle, the stroller seat was placed at the front of the bicycle.

4. DEVELOPMENT STEPS

As a designer, the feasibility of the idea seemed self-evident, since the size of the frame of the running bike is similar to stroller that can be easily folded. At the same time, the frame of a bicycle can be compared to the frame of a stroller. However, about 10 years and countless ideas that turned out to be dead ends followed between the idea and the feasible plan. Based on our parenting routine, it was obvious that only a product can be a real solution that can be easily converted from one function to another with one movement. Typically, we don't even fold a stroller that can be folded relatively easily, because there is so much to do around a small child that there is no time even for that movement. However, any product that actually makes life a little easier for the mother / father becomes an indispensable, must-have product.

The technical background of the product is protected by a patent. After the first submission, the patent was passed without any obstacles, and all 14 claims meet the highest criteria of novelty research.

5. CURRENT AND EXPECTED TRENDS

Increasing urbanization is a trend that can be observed worldwide. There are various forward-looking proposals for micromobilization to sustainably counterbalance urban traffic and the environmental burden. Although these developments are mostly related to the transportation of the larger population, i.e. adults, a couple of developments similar to Motocozy have also entered the market. The rise of hybrid models is expected, since it is a common problem to move a child who is often sleeping or resting from one device to another. It therefore seems reasonable to combine the devices both from the point of view of practicality and sustainability.

6. DEMAND SIDE

In developed countries, 79% of the population already live in cities, and 10 million children are born in such urban environments every year. The "small plastic motorbike" invented by László Neizer,⁷⁵ is extremely popular in our country, and



Test model, created in Fusion360, 2020

⁷⁵ <https://motokidz.eu/maxi-kollekcio/>



Taga bike, combined stroller and bicycle
Photos: Taga



Doona Liki Trike, combined stroller and trike
Photo: Doona

has spread around the world. Katalin Miskolci introduced the product with great success in the USA, where this genre was unknown until then. Based on her report, North America still represents a serious market niche, where, moreover, the use of strollers takes much longer, even until the start of school.

The stroller market is currently worth USD 1 billion and is expected to double within 10 years. The market for children's bicycles totals USD 18 billion, of which the market for running bicycles can be estimated to be close to the share of strollers.

In 2019, we participated as visitors in the most significant professional event, the Kind und Jugend Exhibition in Cologne. Based on the conversations with the manufacturers we met there, it turned out that the number of 100,000 units per year is achievable for each popular stroller product, but it is considered ambitious. However, the competition in this market is very strong, as there are many similar products competing. Based on Australian research, it can be said that an average child uses almost 3 strollers. From this, we come to the conclusion that parents are dissatisfied with strollers - presumably they want to buy smaller and easier to carry strollers for their growing children.

7. IDENTIFIED COMPETITORS

The products listed in the table enhance the functionality of the stroller by incorporating various additional features, making them potential competitors in this aspect. However, it is crucial to note that there is no single alternative solution

for a running bike. These devices augment the stroller function with options like a car seat (Doona), a tricycle (Liki Trike), a bicycle seat (Pahoj), or a child carrier with a cargo bike (Taga).

	Doona	Liki Trike	Pahoj	Taga	Motocozy
duration /years/	*	***	****	****	***
net weight	6,5 kg	6,7 kg	6,7 kg	19-25 kg	5 kg
child weight	15 mo / 13kg	20 kg	22 kg or 110 cm	25 kg	20 kg
child activity	-	+	-	-	+
MSRP	330-665 €	175 € - 336 €	350 €	2200 €	2-300 €

8. HOW IS THE PRODUCT BETTER?

For us, one of the most important bases for comparing products is the child's activity - that is, whether the child sits passively in the device or actively drives it. From this point of view, only one type is our real competitor, although many versions of it are known on the market, so the Liki Trike is just one of many. It is also clear from the linked analyzes that the tricycle is difficult for children to drive,



Doona convertible car seat / stroller
Photos: Doona



Pahoj convertible bicycle seat / stroller
Photos: Pahoj



bike mode



stroller mode

Motocozy study model with integrated stroller seat, created in Fusion360, 2022

as the position of the pedal is uncomfortable. Since there is no gear, the drive either requires too much torque or the vehicle speed will be too low. Based on these facts, it is easy to offer something better than this device.

When it comes to strollers, there are many different purposes, as each product has some strength, usually at the expense of some other function. The Stokke stroller, for instance, is much heavier and more expensive than the others, but the premium quality and unique construction can be attractive. GB's stroller is a world record holder in terms of folding and weight, but at the same time it is less ergonomic, it is not the most comfortable to use, and so on. We are convinced that the stroller operation of our product will be excellent in some aspects (weight, practicality, volume), while in other aspects it will be only good or average. However, we will probably not be better than the current best running bikes, because the weight of the product will definitely be greater than the best ones.

9. TYPICAL CUSTOMERS

Our target audience is an average family living in an urban environment, open to new things, but with an average income. Comfort and tranquility are important to our persona. This person likes to raise her child for sports, a healthy lifestyle, and independence. Someone who is definitely not a fanatical sportsman or a dedicated sling user, or even a die-hard cyclist. Our observation is that the latter hardly use a stroller, preferring to transport their child in a bicycle seat or in a baby carrier. These groups can be considered a subculture, based on our interviews, the

vast majority specifically want to buy Motocozy. Our customers are happy to receive a product that really makes this sometimes difficult time easier. A tired child who wants to rest can cause a lot of stress for the parent. In such cases, even parents experiencing back pain are likely to pick up their child if a stroller is out of reach. This frequently occurs with older children when it's argued that since the child can already walk, bringing a stroller is unnecessary. Unfortunately, as the child gets heavier, there is less and less chance of a stroller being available, so carrying it becomes even more painful. Our experience is that children prefer cycling to walking, as long distances can be covered more comfortably with the help of a running bike than on foot. The essence of the concept is that Motocozy is basically a running bike that can be converted into a stroller if needed.



Using Motocozy means fewer shoes, backaches, and stress - at the same time, more freedom, more space in the trunk, and a child raised to be independent. The target audience with environmental protection and sustainability aspects in mind will also find a good reason to buy Motocozy, as the hybrid solution places a much smaller burden on our planet than a combination of a stroller and a running bike.



Latest renderings by Sebestyén Ócsai, Fusion360

10. BUSINESS MODEL

Our company's income will come from the sale of Motocozy products. As you can see with more serious stroller brands, the basic product will be available with different equipment and accessories later on. The first option that comes to mind



Micro scooter
Photo: Micro

when it comes to accessories is the broadening of the user age. A relatively easy-to-implement solution to this is a Moses basket module addition, with which the product can be used even from newborn age. As a similar module, we would later offer a shell seat module bridging the period between the bassinet and the basic backrest that can be used from the age of one and a half, which offers a half-lying, half-sitting position for babies who cannot yet sit.

11. SALES STRATEGY

Our team's mentor, Wim Ouboter, who is the founding owner of the Zurich-based Micro brand, confirmed in his letter of intent that he would even distribute the finished product under his own brand name. Taking advantage of this opportunity, we are already entering an established sales system, with a reseller network of a premium global brand. Micro's network consists of independent distributors, they do not have their own retail units.

The Micro company's first product - the collapsible adult scooter with an aluminum frame launched in 1997 - laid the foundation for their success. In addition to their additional family of children's bicycles or children's scooters, this year they launched an electric mini-car, the reimaged modern version of the iconic BMW Isetta, the Microlino. This is also why Wim Ouboter did not undertake to finance our project, as they are focusing on the Microlino during this period.

Cooperating with Micro means handing over the sales strategy and all its details

to a truly experienced and capable company. Although it is a great honor and advantage to have such a company as a partner, we are convinced that it is also worth building your own brand so that you can also enjoy the benefits of independence. Our plans therefore include a product that can be customized with small changes, that is, it can also be sold in a private label design. The key to this is the very strong patent that specifically protects the novel, unique mechanism. To show the weight of this, the best example is provided by Micro itself. Their folding scooter, which became successful in no time, already had 500 (!) different - typically Far Eastern - competitors after one year. The reason for this is essentially that this product had no patentable novelty that could have prevented the idea from being stolen. In our case, regardless of the form we planned, the operating principle was protected.

Since Micro is a premium brand, it is conceivable that we produce a model for them in higher quality, from premium materials, while in another business construction - even as our own brand - we make a mid-range version aimed at customers with less money.



Microlino debuted in 2023
Photo: Micro

THE IMPACT OF DESIGN TOOLS IN MOTOCOZY

The development of the convertible balance bike - stroller has been my project for about ten years. The design process roughly began when I started writing my doctoral thesis. This led to the idea of using the investigation of this project to demonstrate my thesis. My aim was to demonstrate that this piece was also influenced by designing tools. Motocozy is a product highly constrained from both functional and mechanical perspectives. This results in a situation where the criteria of shaping are influenced much more by these factors than by design tools or methods. Nevertheless, certain signs can be observed in the evolution of the plans, which act as imprints of the tools used in the design process.

I personally work in the Rhino3D program, which is particularly improper for creating mechanical designs. The first colleague involved in the design, working as an assistant, used SolidWorks. The second colleague brought into the design process used Fusion 360. The current colleague also works in this program. Formative differences can be observed, which are linked to the capabilities of the mentioned programs. Rhino is almost unsuitable for handling solid shapes flexibly. While surfaces can be relatively freely shaped, handling a solid form poses serious difficulties, and even rounding the edges is challenging.

SolidWorks is suitable for performing mechanical tasks. It reliably handles solid shapes, and compared to Rhino, much more complex forms can be modeled without jeopardizing the precise model needed for 3D printing. SolidWorks allows

users to create assemblies by combining multiple parts. Users can position, constrain, and simulate the movement of parts within an assembly, providing a comprehensive view of how different components interact. One of SolidWorks' powerful features is parametric design. Users can assign dimensions and relationships to sketch entities and 3D features, making it easy to modify designs by changing parameters. This parametric approach ensures design flexibility and adaptability.

Contrary to SolidWorks, Fusion 360 supports both parametric and direct modeling. This flexibility allows users to choose between parametric control for design intent or direct modeling for more freeform and flexible design changes.

If we look through the evolution of design over approximately a decade, we can observe a clear difference from the ruggedness of shapes to complex, intricate forms. Naturally, during this time, not only have the applied software changed, but the concept has also refined, and the personnel working on the project have also changed. However, I also consider it palpable to feel the impact of software technology on the designs.

Overall, I believe the influence of the tool is more traceable in designs where the shaping is not as heavily restricted by factors like in the case of Motocozy.

BIBLIOGRAPHY

- "10 Architecture and Design Projects That Feature Faceted Surfaces." 2019. Dezeen. December 2, 2019. <https://www.dezeen.com/2019/12/02/10-faceted-architecture-design-projects/>.
- Abercrombie, Stanley. 1981. Gwathmey Siegel. New York : Whitney Library of Design ; London : Granada.
- Ackermann, Ute, Jeannine Fiedler, Peter Feierabend, and Et Al. 1999. Bauhaus. Cologne: Könemann.
- Alberti, Leon Battista . 2007. De Re Aedificatoria. Tres Cantos Akal.
- Amanda Reeser Lawrence. 2012. James Stirling. Yale University Press.
- "Artificial Intelligence in Design." n.d. RIT. <https://www.rit.edu/spotlights/artificial-intelligence-design>.
- Baron, Dennis. 1999. "From Pencils to Pixels: The Stages of Literacy Technologies." Edited by GAIL E. HAWISHER and CYNTHIA L. SELFE. JSTOR. University Press of Colorado. 1999. <https://www.jstor.org/stable/j.ctt46nrfk.4>.
- Breuer, Marcel, Magdalena Droste, Manfred Ludewig, Angelika Taschen, and Bauhaus-Archiv. 2001. Marcel Breuer, Design. Köln Taschen.
- "CC BY-NC-SA 3.0 de Deed | Namensnennung - Nicht-Kommerziell - Weitergabe Unter Gleichen Bedingungen 3.0 Deutschland | Creative Commons." 2014. Creativecommons.org. Max Planck Research Library for the History and Development of Knowledge. 2014. <http://creativecommons.org/licenses/by-nc-sa/3.0/de/>.
- Constant, Caroline. 1994. The Woodland Cemetery : Toward a Spiritual Landscape : Erik Gunnar Asplund and Sigurd Lewerentz, 1915-61. Stockholm: Bygghörlaget.
- "Drawing with Rafael Moneo, Madrid 1984." n.d. Drawingmatter.org. Accessed February 18, 2024. <https://drawingmatter.org/stan->

- allen-on-drawing-with-rafael-moneo-madrid-1984/.
- Erkes, Edward. 1941. "The Use of Writing in Ancient China." *Journal of the American Oriental Society* 61 (3): 127. <https://doi.org/10.2307/594499>.
- Ford, Edward R. 2012. *Five Houses, Ten Details*. Chronicle Books.
- Franz, Josef. 2008. *Josef Hoffmann*. Neue Galerie New York.
- Gay, Peter. 1988. *Style in History* : [Gibbon, Ranke, Macaulay, Burckhardt]. New York: W.W. Norton.
- Hockney, David , and Martin Gayford. 2020. *A History of Pictures : From the Cave to the Computer Screen*. New York: Abrams.
- Hockney, David. 2006. *Secret Knowledge*. Thames and Hudson.
- "John Hejduk's Axonometric Degree Zero." n.d. *Drawingmatter.org*. <https://drawingmatter.org/john-hejduks-axonometric-degree-zero/>.
- Laarman, Joris, Anita Star, Cooper-Hewitt Museum, Art, Houston, Groninger Museum, and Et Al. 2017. *Joris Laarman Lab*. New York: August Editions.
- Loos, Adolf, Adolf Opel, and Daniel Opel. 2002. *On Architecture*. Riverside, Calif.: Ariadne Press.
- Loos, Adolf: Belső Terek. Prelúdium 1898. In: *Ornamens és nevelés. Válogatott írások*. Ed.: Kerékgyártó, Béla 2004, Budapest: Terc p. 66-70
- López, Daniel, and Richard Buckminster Fuller. 2020. *R. Buckminster Fuller : Pattern Thinking*. Zurich: Lars Müller.
- Lucas, Ray. 2019. *Drawing Parallels*. London and New York: Routledge.
- Lund, Fredrik Macody . 1921. *Ad Quadratum*. B 'T'Batsford Ltp High Holborn, London.
- McKean, John. 2000. *Charles Rennie Mackintosh*. Stillwater, Minnesota: Voyageur Press.
- "Modern Technology Is 'More Magical than Harry Potter' Says Joris Laarman." 2020. *Dezeen*. June 11, 2020. <https://www.dezeen.com/2020/06/11/joris-laarman-interview-friedman-benda-vdf/>.
- Oosterhuis, Kas . 2011. *Towards a New Kind of Building : Tag, Make, Move, Evolve*. Rotterdam: Nai.
- Overy, Paul. 1991. *De Stijl*. London ; New York: Thames And Hudson.

- Panofsky, Erwin. 2005. *Gothic Architecture and Scholasticism*. Latrobe, Pa.: Archabbey Press.
- Rietveld, Gerrit Thomas, Marijke Küper, Ida Van Zijl, Centraal Museum (Utrecht, Netherlands, Nederlands Architectuurinstituut, and Centre Georges Pompidou. 1992. *Gerrit Th. Rietveld, 1888-1964 : The Complete Works* : Centraal Museum, Utrecht, 1992. Utrecht: Centraal Museum ; New York.
- Sas, Péter. 2017. *Kós Károly*. Noran Kiadó.
- Seibert, Jutta. 1986. *Lexicon of Christian Art*. French & European Publications, Incorporated, 1986.
- Serlio, Sebastiano. 1996. *Sebastiano Serlio on Architecture / 1. Books I - v of "Tutte l'Opere d'Architettura et Prospetiva"*. New Haven: Yale Univ. Press.
- Shute, John. 1563. *The First and Chief Groundes of Architecture Used in All the Auncient and Famous Monymentes & with a Farther & More Ample Discourse [!] Uppon the Same, than Hitherto Hath Been Set out by Any Other*. London: Thomas Marshe.
- Sievertsen, Uwe. 2014. "Bauwissen Im Alten Orient." Berlin: Max-Planck-Gesellschaft zur Förderung der Wissenschaften. December 2, 2014. <https://www.mprl-series.mpg.de/studies/3/5/index.html>.
- "Slim Cup by Sharona Merlin." 2010. Dezeen. August 11, 2010. <https://www.dezeen.com/2010/08/11/slim-cup-by-sharona-merlin/>.
- Spiro, Annette, David Ganzoni, and Mario Carpo. 2013. *The Working Drawing : The Architect's Tool*. Zurich: Park Books.
- Sallybrass, Peter, Roger Chartier, J. Franklin Mowery, and Heather Wolfe. 2004. "Hamlet's Tables and the Technologies of Writing in Renaissance England." *Shakespeare Quarterly* 55 (4): 379–419. <https://www.jstor.org/stable/3844198>.
- Stefano Anastasio, and Piero Gilento. 2020. *Building between the Two Rivers : An Introduction to the Building Archaeology of Ancient Mesopotamia*. Summertown, Oxford: Archaeopress Archaeology.
- "Stylus | Etymology of Stylus by Etymonline." n.d. www.etymonline.com. Accessed March 1, 2024. <https://www.etymonline.com/word/stylus>.
- "SUMMA THEOLOGIAE: Goodness in General (Prima Pars, Q. 5)." 2017. [Newadvent.org](http://www.newadvent.org). 2017. <https://www.newadvent.org/summa/1005.htm>.

- Terpstra, Taco T. 2014. "The Materiality of Writing in Karanis: Excavating Everyday Writing in a Town in Roman Egypt." *Aegyptus* 94: 89–119. <https://www.jstor.org/stable/44627047>.
- "The Museum Journal | the Builders' Art at Ur." n.d. The Museum Journal. <https://www.penn.museum/sites/journal/1356/>.
- Villard, De Honnecourt. 2006. *The Medieval Sketchbook of Villard de Honnecourt*. Mineola, N.Y.: Dover Publications ; [Newton Abbot.
- Weisberg , D. E. 2008. *the Engineering Design Revolution — the People, Companies and Computer Systems That Changed Forever the Practice of Engineering*". Cyon Research,.
- Wikipedia Contributors. 2019. "Royal Game of Ur." Wikipedia. Wikimedia Foundation. August 4, 2019. https://en.wikipedia.org/wiki/Royal_Game_of_Ur.
- Williamson, Caroline. 2014. "Futuristic Faceted Bag by Bao Bao Issey Miyake." *Design Milk*. June 30, 2014. <https://design-milk.com/distortion-futuristic-bag/>.
- Wittkower, Rudolf, and Margot Wittkower. 2007. *Born under Saturn : The Character and Conduct of Artists : A Documented History from Antiquity to the French Revolution*. New York: New York Review Books.
- "Working with Asplund." n.d. Drawingmatter.org. <https://drawingmatter.org/working-with-asplund/>.
- Wright, Frank Lloyd , and National Concrete Masonry Association. 1989. *The Work of Frank Lloyd Wright*. Herndon, Va.: National Concrete Masonry Association.