DATA SET-UP

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Graduation Thesis Projec

Egle Jacinaviciute
Master Interior Architecture and Retail Design (MIARD)
Piet Zwart Institute
Willem de Kooning Academy
Hogeschool Rotterdam

Assessor: Max Bruinsma
Advisors: Edwin Larkens, Alex Suarez, Füsun Türetken, Aynav Ziv

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"In consequence, architecture is no longer simply the expression of the play of light and shade on bodies and materials but attains a physiological dimension... One can see that the exigencies of sustainable development are causing an increasingly dramatic and fundamental shift in architecture, from the tectonic to the climatic, the visible to the invisible dimensions."

Philippe Rahm
2010

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Egle Jacinaviciute
egle.jac@gmail.com

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0 ABSTRACT

This thesis takes interest in the means of spatial representation in interior architecture. For many centuries artists and architects were trying to find ways to represent three or more dimensions of data on two dimensional surfaces. With the knowledge of geometry, depicting reality became possible. Nowadays, technology is able to reproduce a reality that is appealing visually but most of the time overtakes other important aspects of the interior.

By integrating invisible data into the visual languages used for representing the interior, Data set-up seeks to expand the range of existing representational tools and methods. This project investigates invisible interior qualities like temperature, light and microscopic views of material surfaces.

It tries to answer questions concerning how interior data can be collected, analysed, sorted out and unified to explain complex processes in the interior environments. The purpose of this investigation is to provoke an immediate awareness of immaterial or invisible dimensions in our environments.

The inspiration for this project derives from traditional representational methods that introduce an analytical instead of realistic approach towards interior. Section, cutaway and exploded view techniques are used to reveal the complex relations between the different elements that constitute the interior.

This project is built on historical research, observation and a series of physical and material experiments. The result of this process is visualized in a structural installation a set-up for collected data. A real scale wireframe structure contextualises information in its original setting. The relation between different components strengthens the understanding of invisible features in a visually perceived environment. It also provides multiple readings of the space and allows the user to experience its features in parts or as whole from various perspectives. Through the individual experience Data set-ups turns data into information and information in to knowledge.

Rather than trying to be applicable for building, 'Data set-up' is meant to give a better understanding of how we perceive a space and how we can extend it with an extra dimensions.

1 INTRODUCTION

1.1 VISUAL REPRESENTATION

The visual languages of architectural representation serve as a major tool to translate abstract ideas into a physical reality. Furthermore, according to Perry Kulper (2015), they have “a capacity to work as a design accomplice, to enabling musings without known outcomes, to speculating on alternative agendas for architecture.” The establishment of certain rules and conventions has led to the formation of a universal visual language that is accessible for specialists regardless place or time. Moreover, the significance of representational drawings becomes clear when we look at them not just as a result of the architectural view of a period but when we see how, in the history of architecture, the style of drawing has remarkably influenced the end product (Gebhard and Nevins, 1977). So the importance is not only the content of what is presented but also the way it is presented. The way architects choose to present space can tell a lot about their approach or intent towards the whole architectural design.

“Architectural representation is not a neutral vehicle transporting conceptions into objects, but a medium that carries and distributes information in a particular mode. It does not necessarily dominate but always interacts with what it represents.” (Evans, 1997).

The representation of a space in its broadest sense could have two main purposes in a design process. First, it can be used as a design tool to turn ideas into physical construct (associating ideas with what is recognized, a familiar language which we all understand). This method is used in an early design stage to define the idea before offering a solution. The second purpose is to communicate and present the work that has already been completed. It can either be a drawing that has been completed without the intent to be realized, the representation of a building that is ready to be built, or a representation of an already existing building or a space. According to Robin Evans (1997), the task of the presentational drawing is to propagate a completely defined idea instead of testing or modifying it. Both methods aim for different goals. That is why it is important to separate these concepts in order to avoid ambiguity. In my work I choose to analyse the second one -

communicative representation.
In recent years the importance and impact of visual culture has risen significantly. Therefore, the discipline of architectural representation has been renewing and expanding, becoming almost an independent field on its own. Digital technologies have made the discipline obtainable for the general public and opened up new ways of production. On the one hand, specialized software for architectural representation stimulates productivity and meets the demands of today's market, on the other, all those predetermined parameters in CAD programs gives a standartise, rigid framework for architectural creativity and expression. Nowadays, progressive software is able to reproduce reality the way we see it, and even go beyond that.

There are numerous examples of rendered reality that somehow seem more real, more persuasive, more thrilling than reality itself.

The ability to manipulate light, camera perspectives, materials and reflections allows us to create things and sensations that couldn't exist in real life, but still look real to us. The main drawback of this is that in most cases the appealing visuals distract us from their lack of content. According to Robin Evans (1997), advanced technologies made architectural drawings more attractive and consumable, which drove these drawings and their purpose further apart. In other words, the representation rather tries to please the eye than communicate the essence and qualities of a built structure. As we now live in a visually overwhelming environment we tend to envision the interior as a set of images. Our vision is overtaking many other senses and experiences that are present in our built environment, and which are at least as important. Architecture and especially interior spaces contain important aspects that we are not consciously aware of, yet they are significant to our perception. In this thesis I would like to focus on those elements of space that we tend to overlook.

2 HISTORICAL RESEARCH

2.1 ARCHITECTURAL AND INTERIOR REPRESENTATION

In a historical context, interior design for a long time stood in the shadow of architecture. To analyse the representation of interior architecture, it is crucial to follow the same steps as architectural language. As we see today, the connections between both fields are evident. During the Renaissance, when architectural representation started to form as a systematic language, the majority of methods used for architectural representation were applied to interiors. It is important to point out that interiors before the nineteenth century were merely an organization of volumes inside of the building. The purpose of the space and atmosphere was created using decorative elements on the surfaces that architecture had provided. So for a long time, a structure of the building was in the hands of an architect, and decoration of the interiors was consigned to painters, sculptors, upholsterers, carpenters, etc.

2.2 RENAISSANCE OF DRAWINGS

In Western civilization before the Renaissance, drawings were rarely used in architectural practice. Architects at the time did not imagine the building as a whole (Perez-Gomez, Pelletier, 1992).

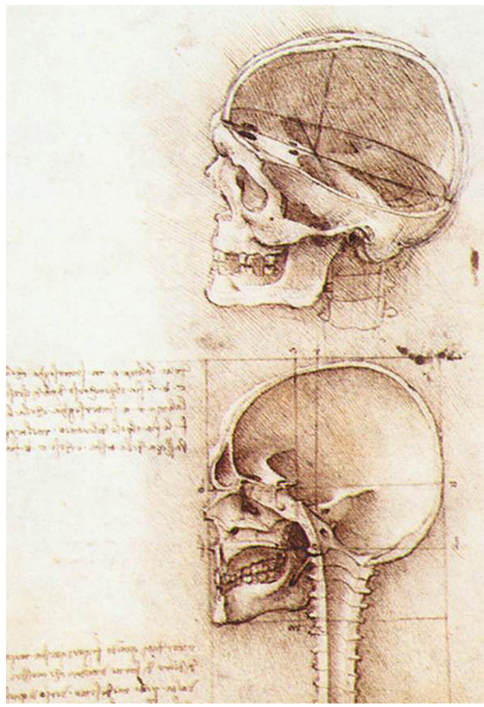


Figure 1. Leonardo da Vinci. Studies of a human skull 1489.

The representational methods varied depending on geographical location, culture, time, etc. Archeologist have found evidence of plans, elevations, and miniature models of buildings or their counterparts way before systematic architectural language started to develop. Most of them have a lack of

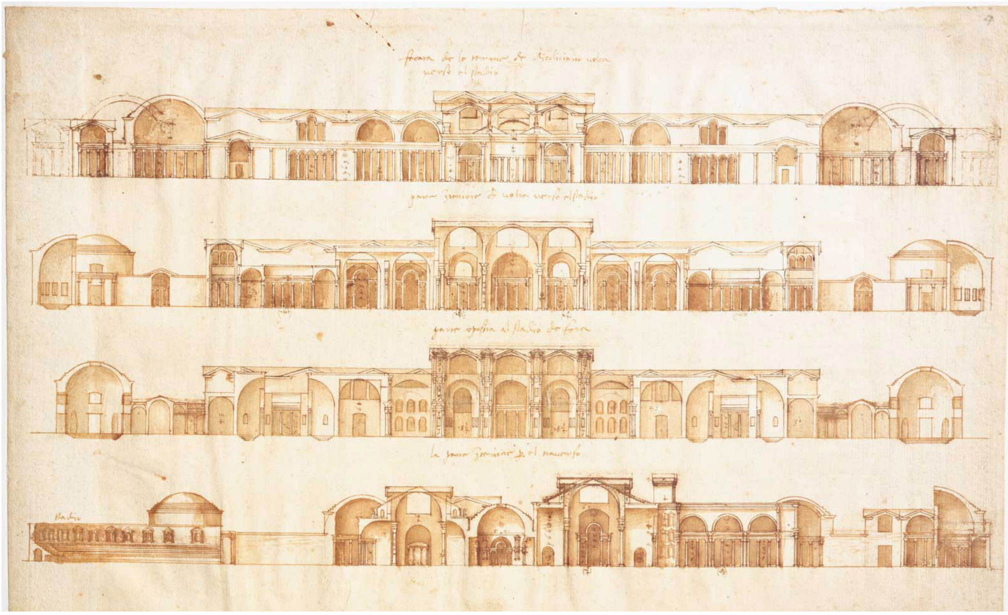


Figure 2. Andrea Palladio. Sections, n.d.

proportion, details, accuracy, and have no notion of scale. It makes them look more like a preliminary sketches to show important details, instead of a whole.

The idea of the interior as a significant space came in the Renaissance, when section and perspective started to be used for architectural representation. The appearance of the cross-section drawing was a major shift in the unification of the inside and the outside, and perspective theory allowed architectural artists to capture space on a plane in the way we naturally see it in three dimensions (Pierce, 1967). These two methods radically changed not only the perception of exterior space but also that of interior.
Leonardo da Vinci was one of the first artists who recognized the significance of inner spaces by looking at them "from the inside, outward." With his drawing methods, he managed to draw attention to the value of the inner cavities in his anatomical studies as well as in his architectural drawings (Pierce, 1967).

"...when Leonardo hatches in the space between the walls of this of his ground plans, just as delicately as he darkens the cavities of the brain in the section, we sense his feeling for space as a significant volume, not an empty void." (Pierce, 1967).

Figure 3.

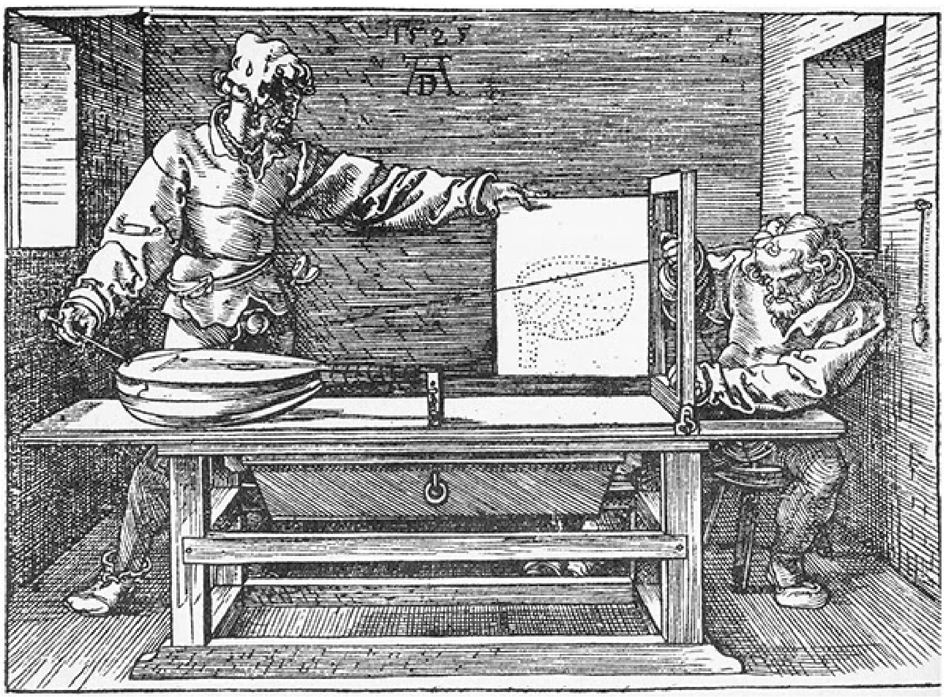


Figure 4. Albrecht Dürer. Man drawing a lute, 1523

Figure 5. Georgius Agricola. Cutaway drawing of an underground fire-setting,, 1556

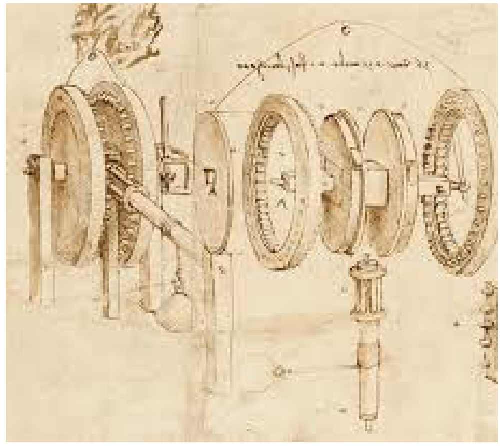


Figure 6. Leonardo da Vinci. Exploded view of a mechanism, n.d

Pierce (1967) also underlines the importance of the introduction of perspective theory. It shifted architecture from a linear to a plastic conception, and marked the fundamental changes in the spatial representation of the built environment. The development of perspective theory allowed the visualization of the interior to be transferred to another medium - drawing without losing the sense of a space. This was impossible to achieve with orthogonal projections.

Perspective theory and the geometrization of depth in two-dimensional plane was a sign of a growing rationalization of perception. The perspectival apparatus of Albrecht Dürer, composed of a fixed point, a glass panel and a yarn established a rigid method by which it became possible to copy the way we see nature. Dürer's idea of connecting vision rays to the object shows the transition between the three-dimensional object and its two dimensional representation. By revealing this invisible connection, Dürer and other pioneers of central perspective didn't change the way we see objects but instead changed the way we perceive them. This connection made an important transition in objectifying human vision. This invention was proof that three-dimensional space can

Cutaway and exploded view drawings were other graphic inventions in the Renaissance which influenced architectural representation. The cutaway drawing was a merging of section and perspective techniques. The section here provided information about inside and outside and the perspective provided dimension and a sensation of depth.

“Through the use of the cutaway perspective, architects could reveal the interior volume of an entire church at a glance. In such drawings, we sense the shift from the notion of a building as a collection of separate parts to a view of a building as a unified and harmonious whole. “ (Pierce, 1967).

Albrecht Dürer was also one of the first to introduce what is now still seen as an essential set of drawings - elevation, plan and cross-section in a one plane (Ferguson, 1999). All of these drawings presented together on one sheet made a combination of structural information available at a glance. If the drawing would be presented in a horizontal line the invisible connections between those modes would be lost, and the reading of the structure would be more difficult.

Despite the fact that most of the representational modes appeared in the Renaissance period, those drawings were not the same as we tend to think about them now. Plans, elevations, sections and perspectives were still not precisely put together in a geometrical system. (Perez-Gomez, Pelletier, 1992).

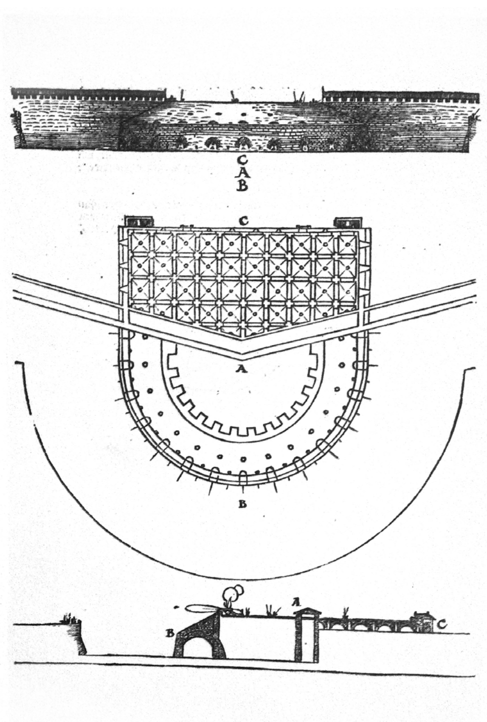


Figure 7. Albrecht Dürer. Rounded Fortification: plan, section, elevation, 1527

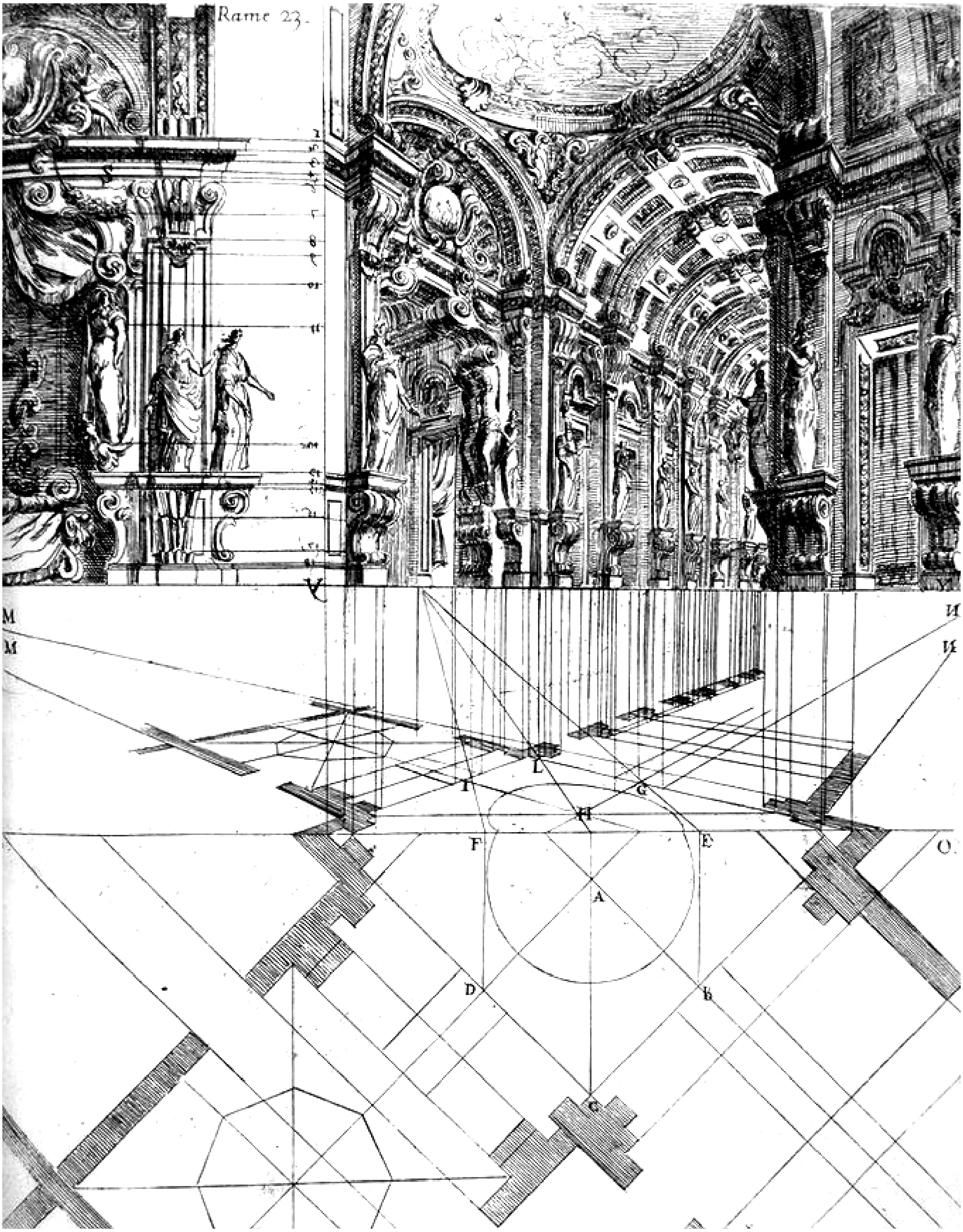


Figure 8. Ferdinando Galli de Bibiena. Stage design showing a scena par angolo, 1711

2.3 DESCRIPTIVE GEOMETRY XVIII-XIX

The set of drawings (figure 8), illustrating a translation from two-dimensional projections into complex three-dimensional space, became possible because of expanding knowledge in geometry. A fundamental subject that developed during the eighteenth and nineteenth centuries made a translation between orthographic projections and three-dimensional representation possible. The École Polytechnique in Paris trained new engineers and architects based on a descriptive geometry that made a representational mode controlled and precise (Perez-Gomez, Pelletier, 1992). This methodology based on scientific knowledge was introduced by Jacques Nicolas Louis Durand in his book "Precis des Leçons d'Architecture" (1802 and 1813). He introduced the use of grids and axis to architecture and objectified the methods for the creation and representation of space (Perez-Gomez, Pelletier, 1992)

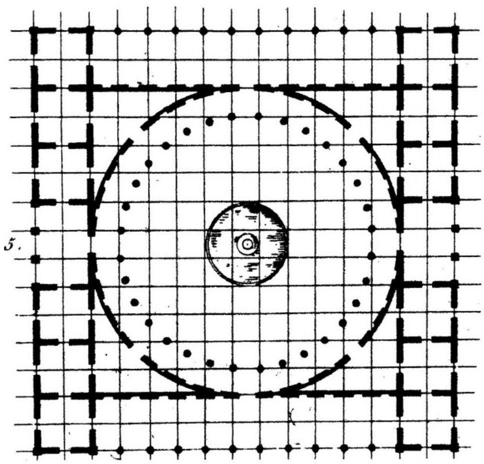


Figure 9. Jean-Nicolas-Louis Durand. A detail of a plate showing the 'Mécanisme de la composition', 1802-1805

2.4 FROM EXTERIOR TO INTERIOR

In the middle of the eighteenth century, the attention to the interior was rising. Existing techniques from earlier methods were modified to be able to fit a new subject matter: the private interior (Evans, 1998). Despite the fact that professional architects had already tackled the hinge of perspective theory, it was not always convenient to represent interior spaces in such a way. In this period, showing an interior using a section was the most common practice. The lack of spaciousness in those drawings was restored using hard shadows. Even though the drawings were highly detailed in architectural elements, the interior décor was hard to read in parallel projection.

The seventeenth to eighteenth century was a transition from interior representation as a copy of the exterior, to an individual attention for a single room. The novelty of eighteen century was that interiors became the subject of architectural drawings (Evans, 1997).

The difficulties the architects met was the appearance of mobile furniture in interior setting. The examples (figure 11, 12) shows how elevation drawings limited the representation of overall space. Furniture that are presented in elevation (figure 12) or separately in a plan (figure 11) and the walls seem to portray no or minimal visual connection to one other. From this drawing it is hard to read an interior as a space. This struggle of representation leaded in to an interior with the focus on the developing a surfaces rather than a spatial experience. The empty space was left undescribed and untouched.

Robin Evans (1997) names them the 'developed surface interiors'. It became a standard mode of producing private interiors during eighteen century. In one hand they were more developed and detailed than a general section view used before, but they lacked unified vision and a connection with its surroundings. At that period most of the time they contained three distinct types of drawing in attempt to illustrate planning of the floor, the character of furniture and the flatness of the wall in one representation. It was a necessity to bring them in one, but the methods from architectural representation didn't serve for the complexity of the interior.

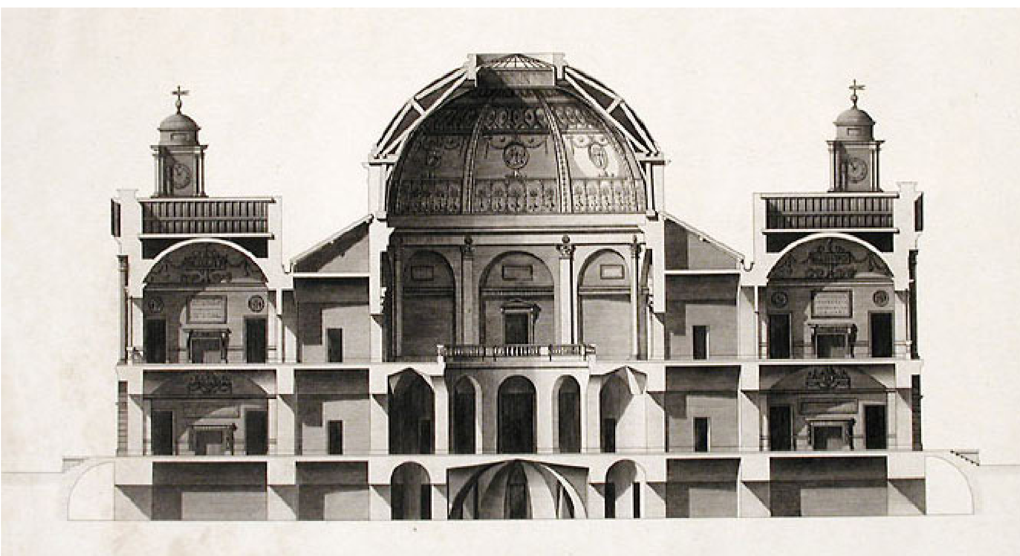


Figure 10. Robert Adam. Cross section of Register House in Edinburgh, n.d

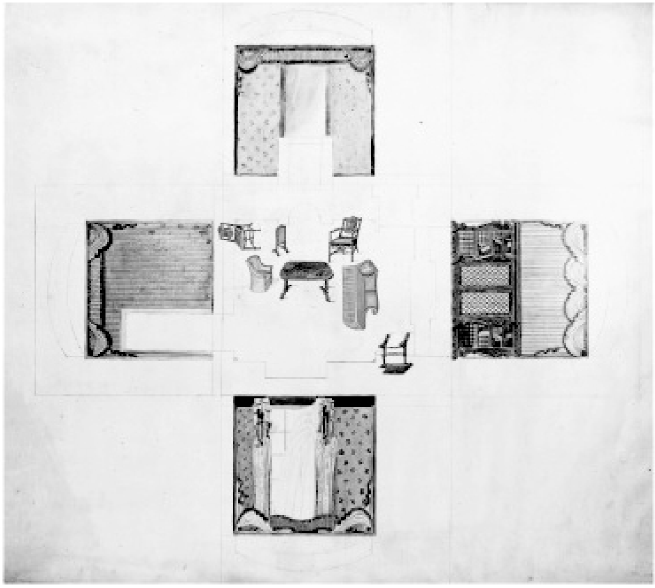


Figure 11. Gillow & Co. Private house interior, n.d

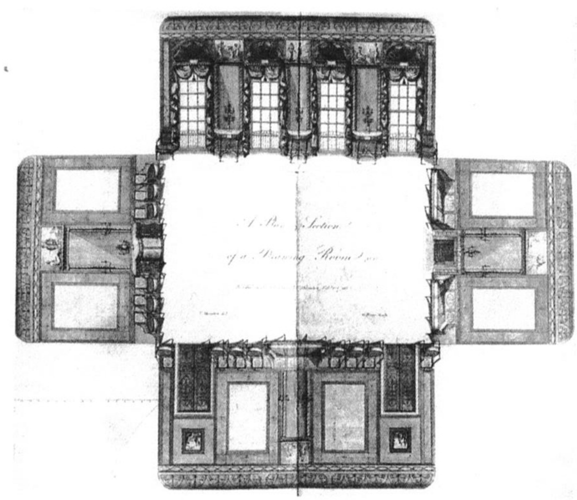
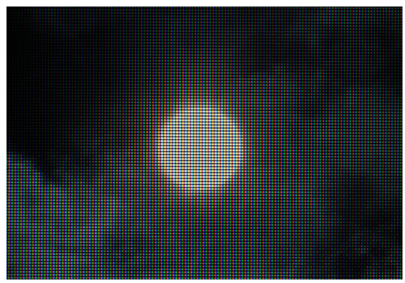


Figure 12. Thomas Sheraton. A plan and section of a drawing room, 1793

2.5 FROM LINE TO DOT

With an appearance of computers a new way of production in graphics was introduced. Computers came in architectural practice in the 1960's. It came from big structural- engineering companies that used computers for data-processing and calculations (Evans, 1997). Rapidly hand drawings were replaced with software generated imagery. The computer aided design (CAD) changed not only the way of constructing, presenting but also perceiving architectural spaces.

Despite the fact that mainly the typologies of architectural drawings remained the same, the method of presenting them radically changed in the age of digitalization. Computer screens introduced new way of constructing an image. Lines were replaced by dots. The accuracy that computers are able to provide in images is based on a dot as an atom in physics, the smallest known unit from which everything is constructed. In display devices pixel represents the smallest element of a picture represented on the screen. A screen become a piece of paper only it provides us with more possibilities. It allows to zoom in and out, visually change the scale of an object. Computer empower us to examine a single dot of information - an atom which we can not see on the paper. In computer we can control a micro-scale. With one move of a hand we can focus on the smallest detail, but at the same time we can observe how it affects the whole. Dots merge and mix to recreate a detailed representation of a reality. Computer introduced us with a method that impressionist tried to reach with painting. They rejected the rigid contours and instead focused on points as a better way to capture the smallest nuances and changes in nature.



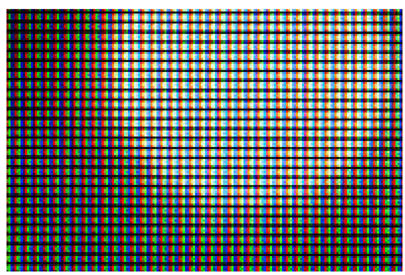


Figure 13. Simon Pyle. Project "Screens", 2014

"The promise of digital media and high-resolution screens is to archive and display limitless records of experience." Simon Pyle

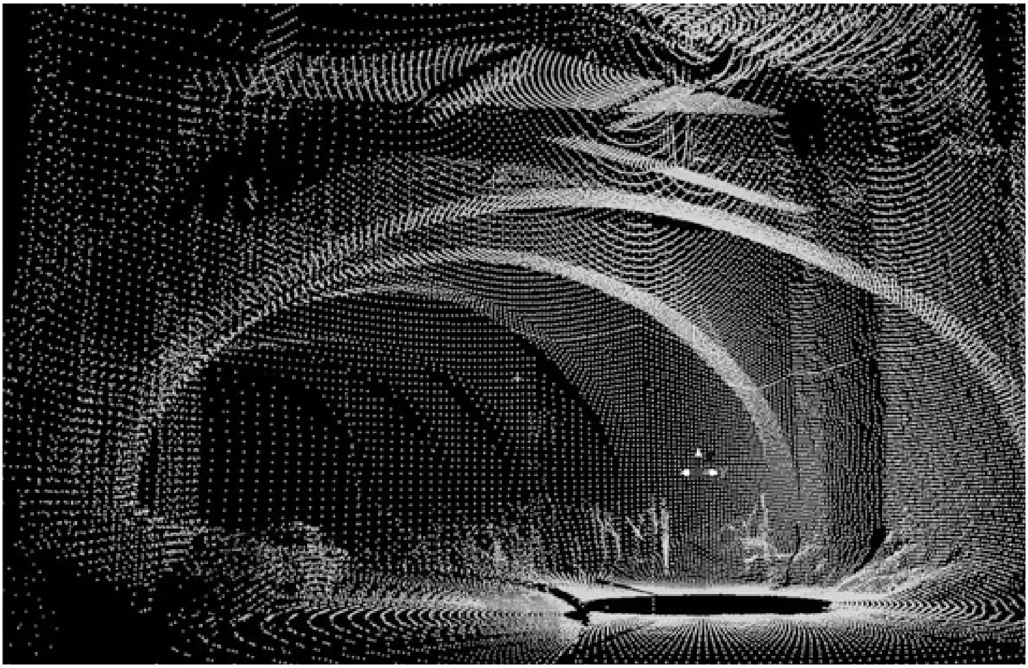


Figure 14. Segment of La Subterranea created with laser scaning technology, 2010

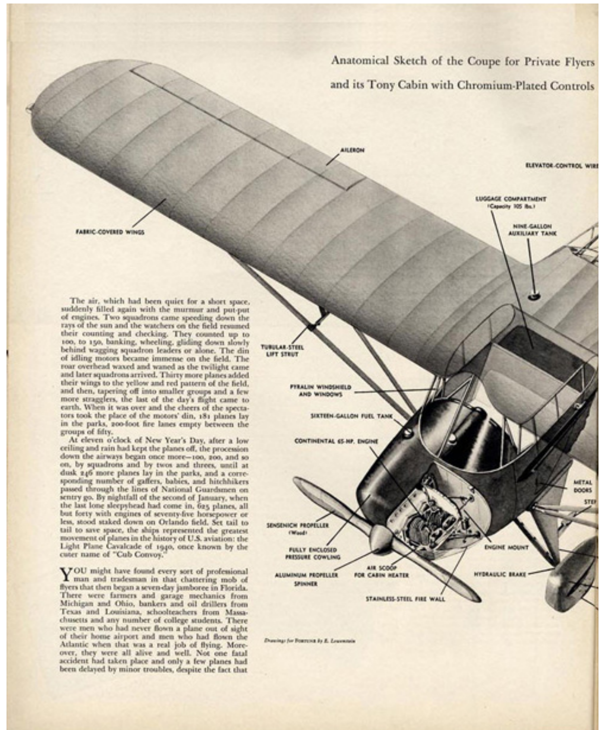
The other technological innovations like 3D portable scanners are also relying on dot as a basis for collecting and representing huge amount of information. It is recently that this technology started to be used for documenting architectural spaces with such a precision. This point cloud view (Figure 14) is an exact representations of the underground tunnel in Guanajuato, Mexico. The project La Subterranea (2007) explores and documents 2km of the abandoned interior of an underground tunnel and viaduct system under the city. This method shows the potential of data visualization and importance of a new methodology in representation in the field of architecture.

Computer aided design changed the way of constructing interiors. Prior to that perspective views of a space were constructed from parallel projections connecting plans with elevations. Now parallel projections embodied in a 3d models. They co-exsist in a model, but at the same time most of the time represented separately.

INSPIRATION 3

3.1 UNFOLDING LAYERS OF INFORMATION

The most important feature that section, cutaway and exploded view drawings have in common is their potential to convey the complex information of the inside. These drawings reveal what is not visible or visually accessible to the human eye. They overstep the limitations of human vision and allow users to access the abstract information about the interior space - the main subject of this thesis. We should look at this type of drawing as a first attempt of an analysis of an object/space instead of just a copy of reality. These drawings investigate the different networks and relations between separate parts.


Anatomical Sketch of the Coupe for Private Flyers and its Tony Cabin with Chromium-Plated Controls

The air, which had been quiet for a short space, suddenly filled again with the murmur and put-put of engines. Two squadrons came speeding down the rays of the sun and the watchers on the field resumed their counting and checking. They counted up to 100, to 150, banking, wheeling, gliding down slowly behind wagging squadron leaders or alone. The din of idling motors became immense on the field. The roar overhead waxed and waned as the twilight came and later squadrons arrived. Thirty more planes added their wings to the yellow and red pattern of the field, and then, tapering off into smaller groups and a few more stragglers, the last of the day's flight came to earth. When it was over and the cheers of the spectators took the place of the motors' din, 181 planes lay in the parks, 200-foot fire lanes empty between the groups of fifty.

At eleven o'clock of New Year's Day, after a low ceiling and rain had kept the planes off, the procession down the airways began once more—100, 200, and so on, by squadrons and by twos and threes, until at dusk 246 more planes lay in the parks, and a corresponding number of gaffers, babies, and hitchhikers passed through the lines of National Guardsmen on sentry go. By nightfall of the second of January, when the last lone sleepyhead had come in, 625 planes, all but forty with engines of seventy-five horsepower or less, stood staked down on Orlando field. Set tail to tail to save space, the ships represented the greatest movement of planes in the history of U.S. aviation: the Light Plane Cavalcade of 1940, once known by the cuter name of "Cub Convoy."

YOU might have found every sort of professional man and tradesman in that chattering mob of flyers that then began a seven-day jamboree in Florida. There were farmers and garage mechanics from Michigan and Ohio, bankers and oil drillers from Texas and Louisiana, schoolteachers from Massachusetts and any number of college students. There were men who had never flown a plane out of sight of their home airport and men who had flown the Atlantic when that was a real job of flying. Moreover, they were all alive and well. Not one fatal accident had taken place and only a few planes had been delayed by minor troubles, despite the fact that

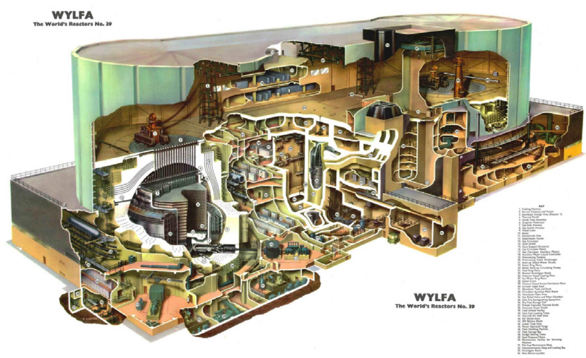
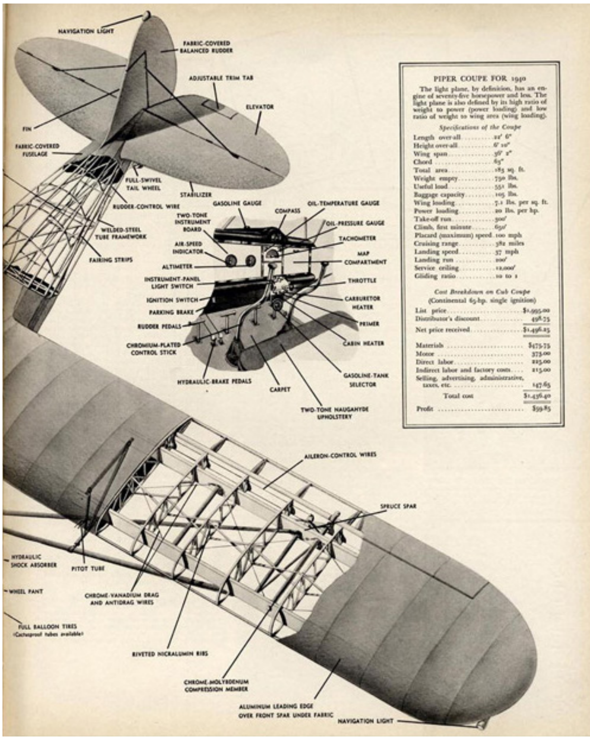


Figure 15. Cutaway drawing of Wylfa Magnox nuclear power plant, 1965

Figure 16. Herbert Bayer. Anatomical sketch of the coupe for private flyers, n.d



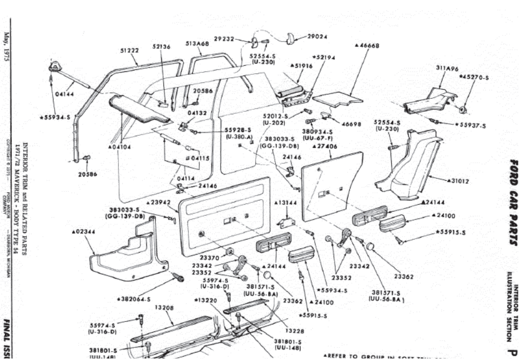


Figure 17. Expoded view of Ford's interior, n.d

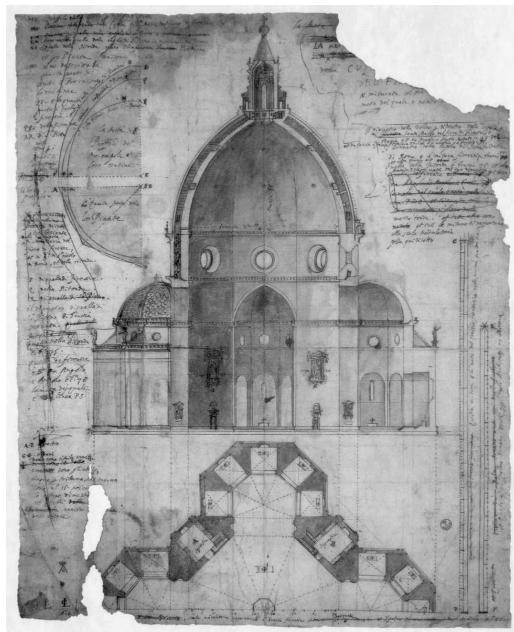


Figure 18. Cigoli, Section of the Florence Cathedral, 1613

3.2 CROSS-SECTIONS

An architectural cross-section is an orthographic projection drawing where the projection plane is positioned intersecting the objects or the space of interest. Objects are depicted according to their relationship to this (typically vertical) 'cut plane'.

Architectural cross-section describes the relationship between different levels of a building and the connection between outside and inside.

Sections allows users to build an understanding of the relationship of the whole piece instead of focusing on details. Section also reveals the in-between space.

In the Cenotaph to Turenne drawn by Étienne-Louis Boullée, the section displays the pyramid shape which can be seen from the outside and a round dome that can only be seen from the inside the building. The section also displays the way that the space between the two accommodates a large void; a relation that would be hard to understand from plans, elevations or perspectives alone.

Figure 19. Étienne-Louis Boullée. Cenotaph to Turenne, 1785

3.3 CUTAWAY DRAWINGS

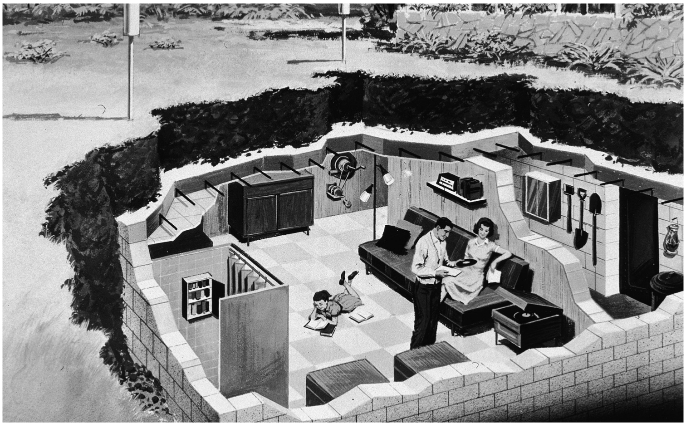


Figure 20. Cutaway drawing of a family in their backyard underground bomb shelter, 1960s

Cutaway drawing is a representation of something in which the outside is omitted to reveal the inner parts. It is presented in a three dimensional way (a drawing or a model) where some parts are deliberately removed or made transparent to make the space inside visible without sacrificing the relationship to the outside. This method gives an insight to spatial organization and reveaals how the space functions.

The perfect example is an illustration of a family‘s backyard underground bomb shelter made in early 1960’s. This drawing contains a variety of information: the simplified construction, building materials, the placement of the shelter in relation to the house, the interior organization, the functions it contains, the size of the space and even the style of the interior. All of these parts inform the viewer about different aspects of this particular space in relation to one another.

The appearance of cutaway drawings was triggered by technological innovations which needed to be communicated. In the 16th century, cutaway views in Georgius Agricola‘s book “De Re Metallica” were used to illustrate underground operations of a mining technique. Renaissance artist and engineer Marino Taccola and later Leonardo da Vinci used the method of those drawings to visualise their innovative engineer projects (Ferguson E. S., 1999). For them, it was important to show not only the appearance of an object, but also to communicate the principle by which the object functions. These drawings manifested the new way of understanding the logic behind the surroundings.

3.4 EXPLODED VIEW

The exploded view is a type of drawing that shows the individual parts of a mechanism or a space separately, but indicates their proper relationship. Exploded views give an overview of all the components in the way that every detail can be seen, while at the same time suggesting an image of the whole. The parts are located along one or severaal axis. None of the parts are hidden behind one another. The exploded view came along with the cutaway drawing, and was among the other graphic inventions of the Renaissance era. The drawing technique can be traced back to the early fifteenth century. The technique was used by artists and engineers such as Mariano Taccola, Francesco di Giorgio and Leonardo da Vinci (Ferguson, 1999).

The exploded view gave the possibility to document new mechanical inventions, where every detail and the connection between them was equal-

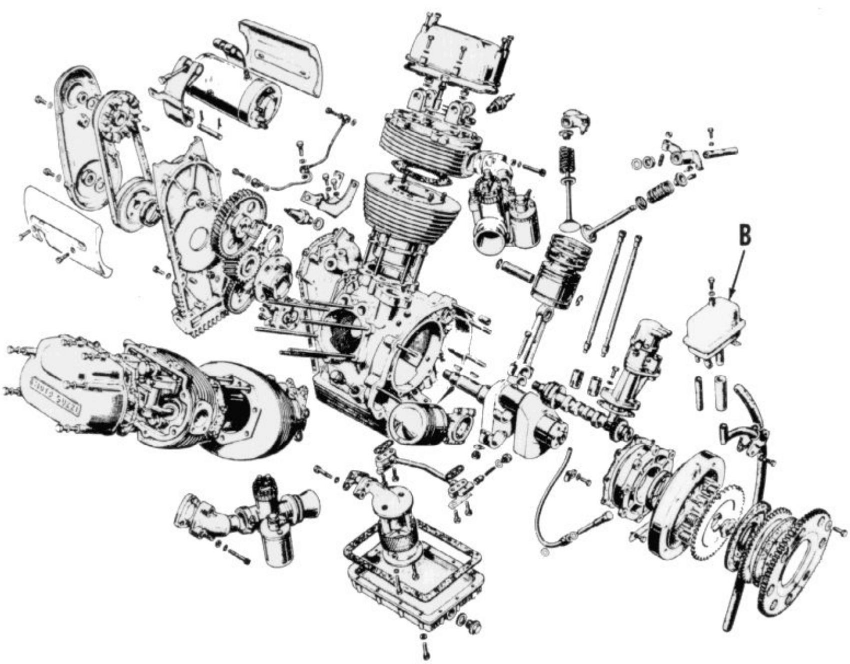


Figure 21. Jens Lyck. Exploded view of an engine, n.d

3.5 RELEVANCE FOR MY THESIS

Section, cutaway and exploded view drawings facilitate a good understanding of spatial ordering, and most importantly provide users with knowledge of spatial relations between separate parts. The appearance of all these techniques pushed spatial representation from merely copying reality to really understanding and visualizing ideas. These graphic inventions of the Renaissance helped to envision the reality in rigorous but at the same time imaginative way. Furthermore, all these representational methods were significant to the representation of interior spaces.

The need for illustrating complexity of spaces or mechanisms leaded to the reintroduction of cutaway and exploded view techniques later in 1960s'. Today, due to digitalization, the amount of available information is rapidly increasing as well.

The difficulty we face nowadays is that we are able to collect more information about our environment without having a systematic way to express it. These principles could help to reimagine ways to bring the complexity of the interior in representational drawings.

THESIS QUESTION 4

4.1 FROM SEEING TO PERCEIVING SPACE

For many years the hegemony of imagery in architecture and interior design shaped our understanding of the built environment as a highly visual field. Plato conceived vision as the greatest gift of humanity. The Finnish architect Pallasmaa, in his book “The Eyes of the Skin Architecture and the Senses”, also considers sight to be our most important sense. However, a space is more than just an image it is a complex overall experience which consists of multiple overlapping layers of information which address a variety of senses.

The main question is, what information does a space consist of? What are the specific components that constitute an interior space? What information could be integrated in a spatial representation to better convey its complexity? How shall we combine all those different types of data and the variety of visual languages they are rendered in into one in order to build a better understanding of a space?

I am seeking to grasp the density of information that is present in every space, and to provoke an immediate awareness of immaterial or invisible dimensions in our environments. In this thesis I aim to explore new ways of collecting and expressing that information. I seek to reveal the layers of interior information and to translate collected data into a hybrid visual language that it is comprehensible not just for professionals.

This project aims to show a method of thinking about interior data not as separate parameters in isolation but rather to reveal the existing connections between them and the environment.

Despite the fact that users have a potential impact on a space, in this thesis I will focus on the autonomous behavior of an interior.

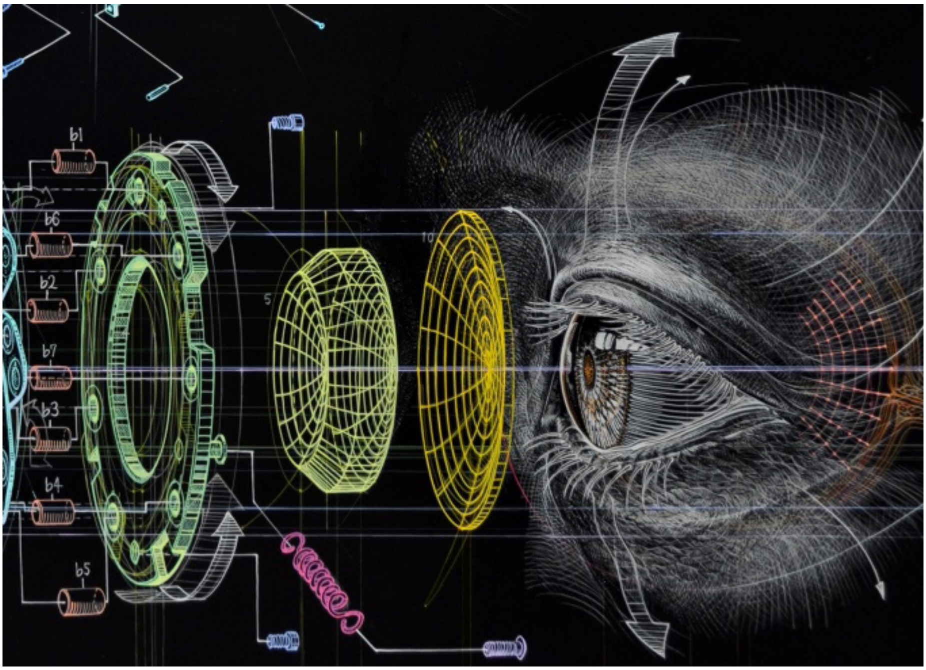


Figure 21. Atsushi Koyama. Undefined 7

METHODOLOGY ¡¡5

5.1 DATA VISUALISATION

The methodology of my design is based on revealing detail and complexity of an interior space through collected data. I use strategies of data visualisation and traditional architectural modes of representation. My investigation includes the invisible or not consciously perceived information of an interior space such as temperature, light distribution and micro readings of material structure. I use digital and analogue tools to document each of those qualities individually in a language they suggest. By observation, analysis and experimentation I look for features that could link those different modes of representation together in one hybrid representation. Based on theoretical research and the examples I have analysed, I apply multiple, layered views to show data sets that human eyes are unable to see directly from a fixed point of view or by natural vision.

Since data has no meaning of its own it has to be interpreted to become meaningful information (Daniel S., n.d). Data becomes accessible when it is sorted out in a way that serves a specific purpose. At this point data becomes information that is accurate and timely, specific and organized for a reason, presented within a context that gives it relevance.

The value of information in comparison with raw data is that it can be understood and have an effect on behaviour, decisions, or outcomes.

In his analysis of data visualisation, statistician and artist Edward R. Tufte describes similarities between the way we think and the way we can better understand data. He states that clarity in thinking is very much like clarity in a display of data. So when principles of thought replicate principles of design, it becomes an act of insight (Tufte, 1990).

5.2 VISUAL PERCEPTION

Psychologists have been studying the field of visual perception extensively. In summation, there are two major theories. There is a division based on work by James J. Gibson (1966) which argues that “perception relies directly on the information present in the stimulus” a theory called bottom-up processing (McLeod. S, 2007). The other theory is based on the work of Richard Gregory (1970) who proposed a ‘top-down’ theory when he stated that “visual perception is not direct, but depends on the perceiver’s expectations and previous knowledge as well as the information available in the stimulus itself” (McLeod. S, 2007).

For the purpose of this thesis, the top down theory is more relevant. I seek to expand the reader’s knowledge by adding up additional information to the already existing background. Top-down processing not only relies on the senses but also involves past knowledge and experience. McLeod (2007) points out that this theory “refers to the use of contextual information in pattern recognition”. The subject uses their previous knowledge to contextualize what they experience at the moment in relation to what they already know.

To receive information from the surroundings, our bodies use sensory receptors. Information is then combined with what we already know, from what we have experienced before, or what we have learned from other sources. Our perception of the surrounding space is a hypothesis based on previous knowledge.

Therefore, we actively construct our perception of reality by confronting new information with old information.

Turning data into information and information to personal knowledge is based on the individual experience of the space.

REFRENCE PROJECTS

¿¿6

6.1 PHILIPPE RAHM. DOMESTIC ASTRONOMY

Figure 22. Philippe Rahm. Domestic astronomy, 2009

An important figure in interior architecture is Swiss architect Philippe Rahm, who tackles invisible dimensions in interior spaces. His main interest lies in the void of space in invisible connections between physical, chemical and biological processes (Rahm, 2010). He draws attention to the interior properties that affect human behaviour in the interior, beyond physical boundaries like walls, floors or ceilings. In his works he tries to redefine the interior through the parameters of interior climate, including convection, conduction, pressure, evaporation, and radiation. He designs interiors according to three basic elements: temperature, light intensity and humidity.

In the classical tradition, the space was arranged according to the symmetry and relation to the proportions of a human body. In more modernistic architectural forms, however, function is preferred. Rahm has gone on record as saying that his ideology is based on "form and function [which] follows climate." He is questioning the conventional spatial organizational model, by designing interiors in which space and function are defined by climate conditions instead of tradition.

In the project "Domestic Astronomy", the author explores possibilities to occupy the space vertically instead of horizontally. Looking at the space (Figure 22), the placement of objects seems to be irrational - the bath tub is located up high, the toilet and wash basin also can't be reached without ladders. However, the diagrams (Figure 23) reveal the invisible dimension of this room. Distribution of temperature here determines the location of a particular zone. Functions are placed in a position that best suit their purpose according to light conditions, humidity and heat distribution. The living zones that require more heat are placed higher, and vice versa. Unseen aspects in this project affect the physical living conditions in order to create a self-contained natural ecosystem. It is a view towards a new interior where a biological dimension is introduced as an axis of the whole interior. Combinations of light, temperature, time and place are reconfigured.

"In consequence, architecture is no longer simply the expression of the play of light and shade on bodies and materials but attains a physiological dimension [...] One can see that the exigencies of sustainable development are causing an increasingly dramatic and fundamental shift in architecture, from the tectonic to the climatic, the visible to the invisible dimensions" (Rahm, 2010).

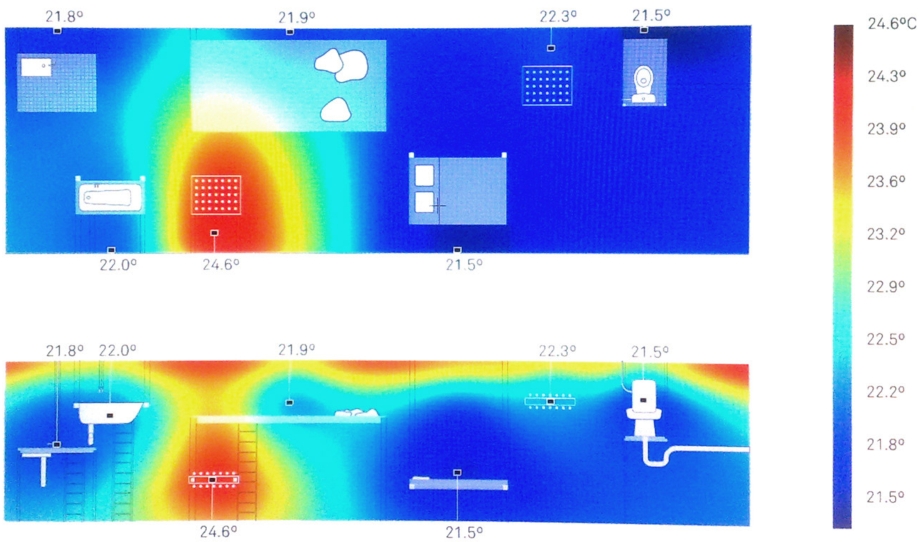


Figure 23. Philippe Rahm. Domestic astronomy, 2009

6.2 DIGITAL ACOUSTIC CARTOGRAPHY

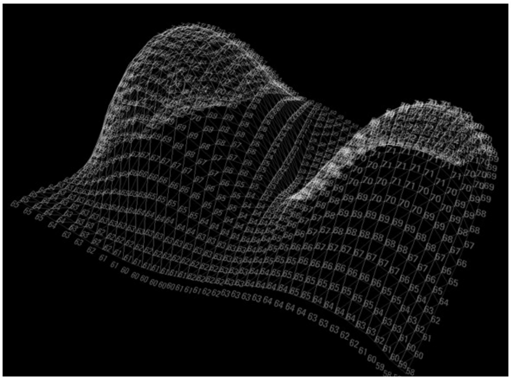


Figure 24. Daniel Rothaug. Noise visualisation by numbers, 2005

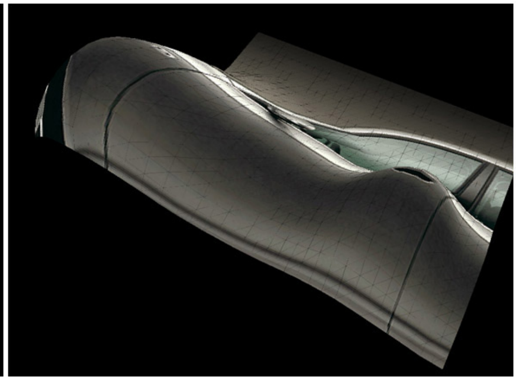


Figure 25. Daniel Rothaug. image of an automobile door shut, 2005

Digital Acoustic Cartography by Daniel Rothaug is an experimental project in which the author maps and records soundscape of various activities. The collected data is processed and presented in three-dimensional, informative visual language. In this project again the invisible becomes visual. The source and the outcome are bound together to better convey the reason and the consequence of the action.

The “acoustic camera” produces images in which the strength of the sound waves is depicted in different colours. Later, according to the colours, a three dimensional model is created and combined with the real image of the sound source. In the picture (Figure 24), one can see the noise diagram which is depicted in three dimensional levels and numbers of decibels. The picture on the right (Figure 25) shows the same diagram, only combined with a realistic image of the sound source. Even though the car door in this picture is distorted, we can recognize the object and relate it with the sound wave. We can clearly see that distortion in the image is not a representation of new doors, but it provides us with additional information about this object. The diagram shows the intensity of sound in different parts of the door, and how it is distributed. The first image only provides us with an abstract information, while the second picture contextualizes the sound and allows us to understand the complexity of the sound in relation to the object.

Here, a realistic image combined with the abstract information contributes to our better understanding of the invisible features of visible objects.

6.3 THE LIVING DEATH CAMP

This project was supported by the European Research Council and is part of a bigger research endeavor titled Forensic Architecture based at Goldsmiths College London. The “Living Death Camp” is a visualization of two concentration camps in former Yugoslavia in 1941-1945, which was completely scanned using laser scanning technology and represented in point cloud.

3D scanning technologists from a London based ScanLAB collaborated with forensic archaeologist Caroline Sturdy-Colls and captured the vanishing traces and the memory of a White House concentration camp in its contemporary surroundings. This project combines laser scanning technology with ground penetrating radar to detect evidence of former prisoners’ life at the site. At the moment the site is under the plans to be turned into a holocaust memorial.

“Through a shared method of analysis and visualisation the project starts to disassemble the traditional archaeological paradigm of prioritising one period of history over another.”

The point cloud method recreates a three dimensional space. Layers of dots create volumes that are full of information without being solid and rigid. This project successfully blends the present and the past and suggest a new method to visualise this information. The combination of architecture and archaeology reveals invisible atmospheres within the site and provides an insight into another dimension. This information affects our understanding and perception about that space.

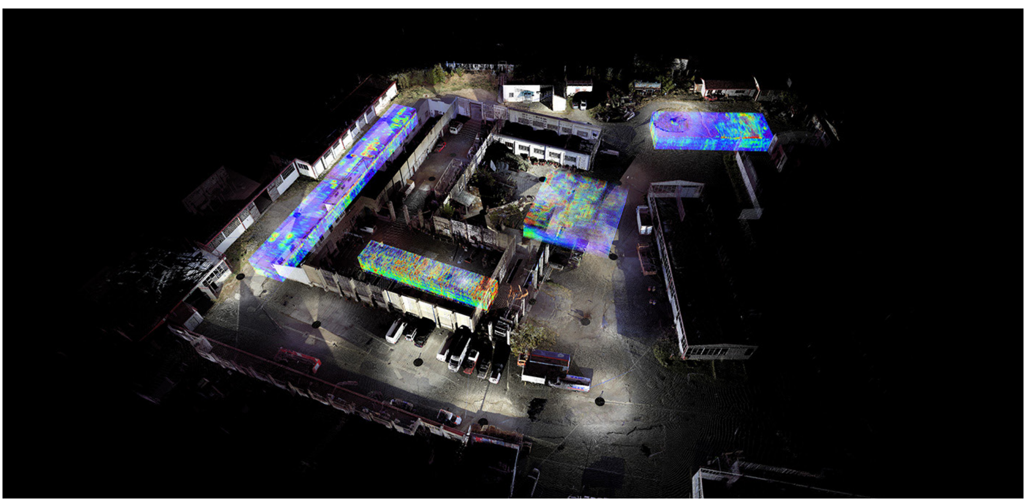


Figure 26. ScanLab. Living death camp from above, 2014

7.4 FLIGHT PATTERNS

Aaron Koblin's project "Flight Patterns" is a video data visualization of 24-hours of aircraft flights over the USA. The author takes raw data and translates it in to a visual language of airplane traffic. As the video progresses, it reveals spatial patterns and rhythms above the country where 140,000 planes pass through every day. He uses colour codes (distinguishing aircraft models, destinations, flying altitudes), and lines and dots to express the activity. Koblin has made several versions of the video, in which he highlighted different types of information like altitudes, regions, and airline hubs. However, the viewers are not empowered to manipulate the appearance to study more closely or just follow one plane or one route. Despite that, this work explores and reveals invisible links between places and time and provides us with a visual overview of things we may know, but cannot see.

It is an interesting example to see how information (the invisible) can transform into visible understanding. How flight patterns re-imagine the map of USA, and how they inform us about the density of population and time changes.

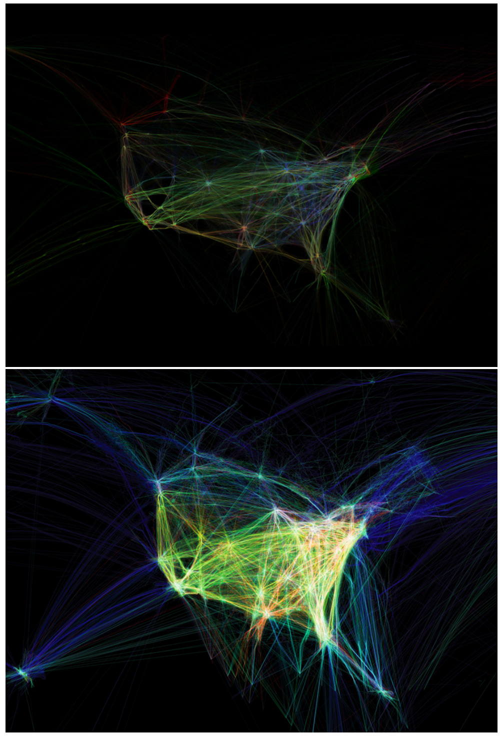


Figure 27. 28. Aaron Koblin. Flight patterns, 2008

"We're constantly collecting more data, and it's starting to be very relevant to our lives. We have the capacity to collect global insights that we couldn't have imagined in the past, and it's extremely exciting. Yet I think it's the tip of the iceberg. As we get more and more transparent with datasets about infrastructure and systems management I have a feeling we'll see big changes in how we think about complexity and our relationship with our actions." (Aaron Koblin)

7 DESIGN RESEARCH

The methods for design research developed while I investigated the qualities of interior spaces, the history of architectural representation and technological innovations. I focused on various invisible interior aspects that exist in every enclosed environment. These features are crucial for experiencing space, and goes beyond our vision. I used analogue and digital methods: a microscope to display the micro scale of materials, the chemical cyanotype technique to capture light exposure, and a digital infrared camera to capture the interior's temperature. I applied these techniques to the space I currently live in. I observed how the application of these different lenses shapes a different understanding of the same site.

In a second phase of design research, my aim was to find ways to combine those different layers of information (that also have different ways of expression) to represent the same space. These multiple layers of information would be an addition to the traditional representation of space. I was looking for a combination of these techniques to build an experience combined from multiple readings of the same interior. My experiments were attempts to display space by making different data sets intercommunicate, resulting in a new visual image in which an invisible reality appears in a recognisable context. Visualising the immaterial or invisible and presenting it in the context of what is visible and recognizable helps the untrained viewer to read the space in a new way. This is what David Levin in his book "The opening of vision nihilism and the postmodern situation" named a new mode of looking and described it as contextual, inclusionary, associative, the gaze that tends to see from a multiplicity of standpoints and perspectives (Levin, 1988).

7.1 MICRO READINGS OF THE INTERIOR

The presence of materials in the interior environment is highly important. Not only the visible aspect of it, but even more their physical existence. The interior encloses the user in a space of which the scale is usually determined by its user, so that they could reach and use every corner of that space. The sense of touch is the unconsciousness of vision that provides three-dimensional information of material bodies.

"The sense of sight is built upon touch, and is a development of touch, considered from the development point of view" (John M. Hull, cited in Hadjiphilippou, 2013).

In other words, the difference between sight and touch is that visual space is presented as a continuum, while tactile space is presented bit by bit. Getting to know the space through touch engages the user to be active in experiencing the variety of objects and textures within the room.

7.2 DOCUMENTING

The study of the microscopic scale reveals features that are usually too small to be seen by the human eye. The optical microscope that was used for this exploration uses multiple lenses and light to enlarge the image x10, x40 or x100 of its original size. The initial idea for using a microscope was to expand the visual perception by allowing the user to see interior surfaces from very close. A microscopic view exaggerates the material's surface and provides a visual access to its structure. It creates a sensation that by seeing an image we can imagine how it feels to touch it.

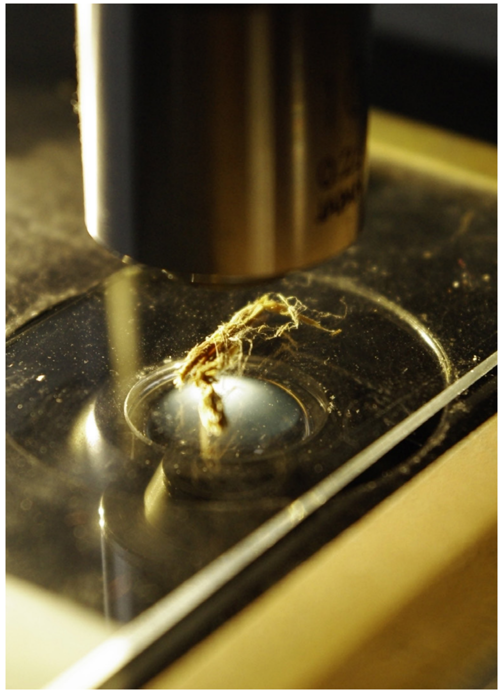


Figure 29.

The procedure for investigating the interior micro-scale included taking samples of materials within the room and placing them beneath the lens of a microscope. The magnified images were photographed using a digital camera. The exploration of the micro interior allowed me to see objects from a close, material perspective. In

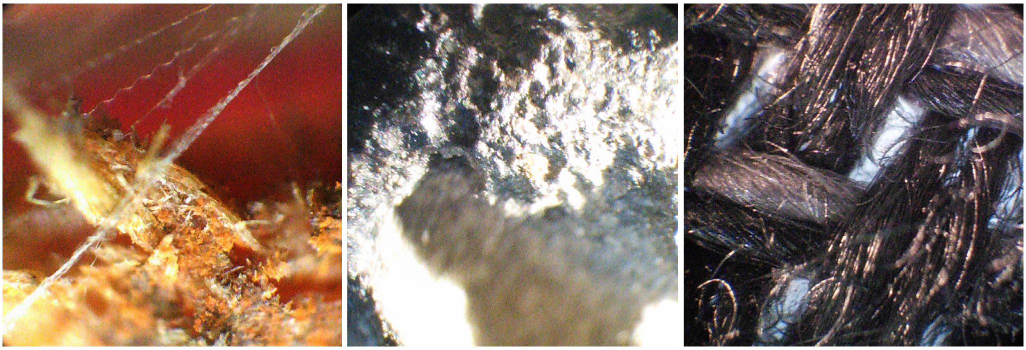


Figure 30.

this scale, the object of investigation becomes irrelevant because the image simply can't cover the whole and the vision is only focused on a miniature spot of material. The series of those pictures have revealed the diversity of materials' tactile features. Materials of a flat surfaces - for example plastered wall - came out to be three dimensional.

After the image is taken and stored in a computer's memory, it immediately loses its context and becomes just another beautiful artefact. It does not speak about the object, nor the placement in the room. It is even hard to say what material it represents. This image only leaves us with a hint of what it might represent. Since my project aims to bring the information back to the interior representation, I found this curtail to link the information back to its source. I experimented with images and models that could help to expose the links between the points of a focus and its original source in the interior space.

7.3 EXPERIMENTING

Many of the models investigate the relation between the microscopic image, its source and a possible representation of it. I was looking for a method that could be an informative way to enrich our perception of an interior space including magnified vision of surfaces. My experiments included layering information, exposing invisible connections, combining vision and touch of micro material structure and bringing the data back to the real environment with beamed projections.

The successful models were those engaging the viewer to be an active participant in exploring micro world of the interior. The best results implementing a microscopic images was achieved with layering information and beaming on real interior objects. Video projections helped to create an extra layer which is temporary and 'immaterial' and at the same time provides an intuitive connection with the object or surface it was taken from.

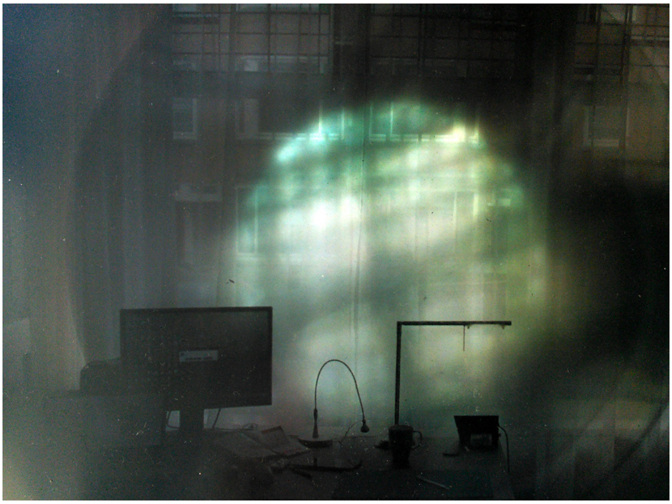


Figure 31.

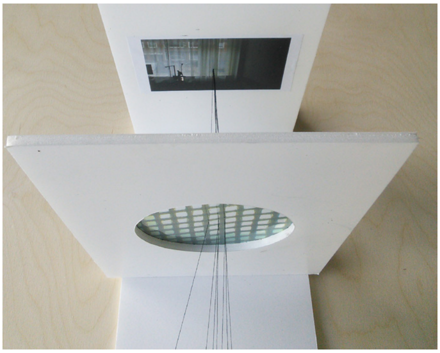


Figure 32.


Figure 33.

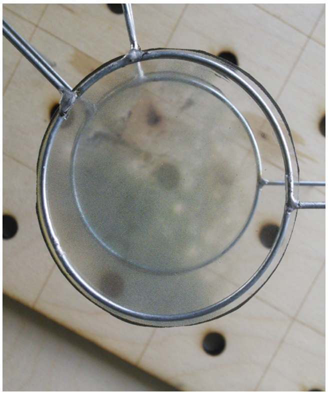


Figure 34.


Figure 35.

DATA SET-UP

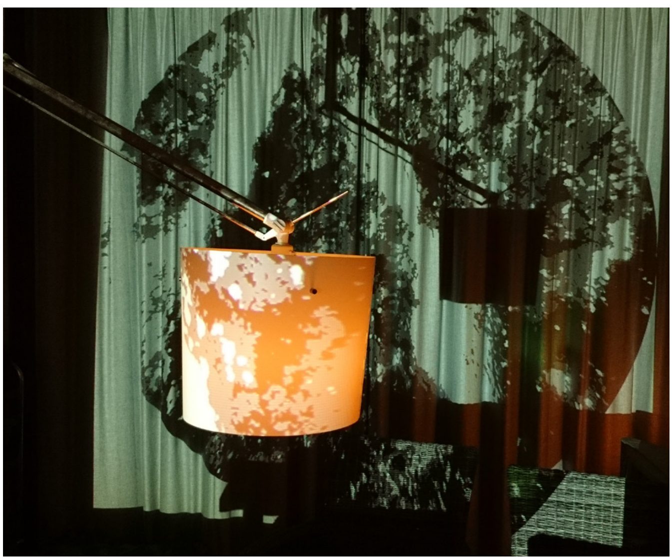
Figure 36.

Figure 37.

Figure 39.

Figure 38.

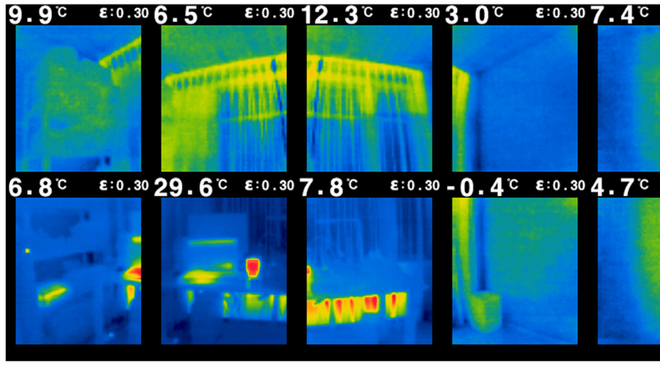
Figure 40.



7.4 TEMPERATURE

Climate is one of the major aspects demarcating the boundary between interior and exterior space. Architecture provides us with shelter from the rain, wind and sun. Meanwhile the interior creates a micro-climate and a comfortable environment. Climate has a strong influence on humans, and therefore affects our activity in the space. Philippe Rahm describes the notion of climate as fundamental in architecture. Today our living environment is highly isolated from the outside. “Today, interior space is insulated to the point where one can practically heat a house with the flick of a lighter.” (Rahm, 2010). We live in controlled climate spaces, which makes it even more crucial to be able show this invisible characteristic and make users aware of its influence on their behaviour.

To investigate the temperature in an interior environment, I choose to use an infrared digital camera. It is a widely used method to evaluate the properties of insulating materials, architectural components or to find thermal leaks in buildings and electrical installations. However, this technology rarely finds its application in depicting the interior climate. Infrared cameras or thermal imaging systems use technology that can detect infrared radiation, which we experience as heat or cold. These cameras detect temperature and create thermal imaging, where a colour code indicates changes in degrees.

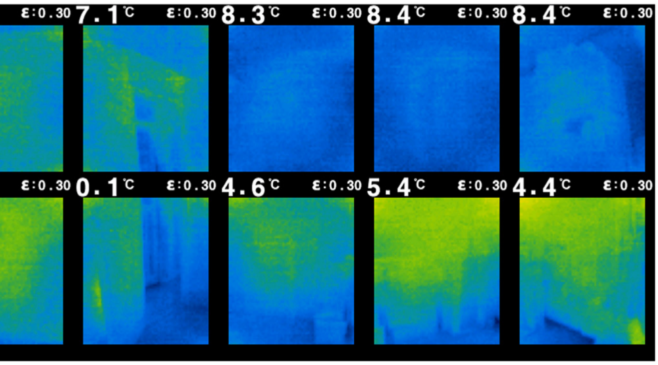


The image enables us to read correct temperature values of material surfaces.

7.4 DOCUMENTING

I begin my experiments with taking pictures of my house using a thermo camera. I looked for a characteristic places in a house where it was possible to find differences in temperature. In the colder season, the obvious places were where the heating system was located, as well as windows and external walls. I also captured various temperature activities in some electrical gadgets like scanner, computer, and television. There were also unexpected places - like uncovered pipes that transfer hot water - which I was not aware of. However, I was unable to detect any in internal activities that possibly could have been hidden in between walls or inside furniture. I re-

Figure 41.



alised that this camera allowed me to capture only the material temperature that was affected by heat radiation. I could not capture the radiation itself. This finding shifted my research towards an investigation of materials relation to temperature. All the pictures that I took revealed how differently various materials absorb or release heat. It is obvious when we compare the picture of a window and a heater with and without a curtain in front.

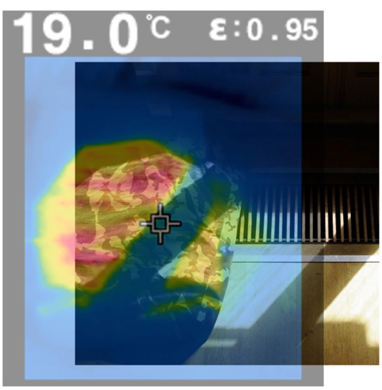
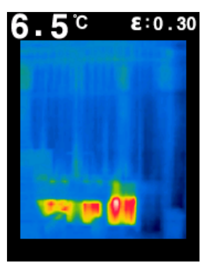


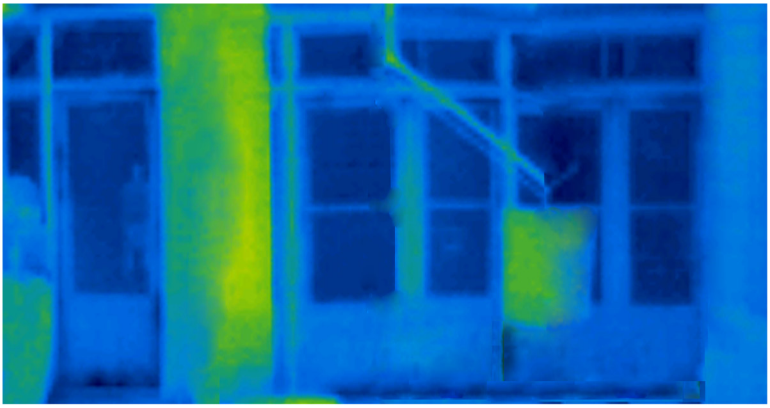
Figure 42.

Another interesting finding was that in these images, the light and shadows are almost eliminated. Most of the time, this causes the flatness of the image. Without shadows it is hard to imagine depth and space. This reduces the perception of space in thermal images. A big difference is when direct sunlight hits interior surfaces. a significant difference in temperatures.

Even though the relation between temperature and light is obvious, these images visualised the actual relation between them. In further observations, I tried to see the differences between the behaviour of light and temperature. From the images we can see that the signature of temperature spreads around, it doesn't have sharp corners and depending on sun exposure time spreads more and more to the sides. Light moves faster than the materials absorbs and releases the heat. Therefore, light leaves traces and the temperature can reveal these for human eye invisible changes.

The correlation between the light, temperature and material that this observation has revealed encouraged my further research and development of multi-layered representation.





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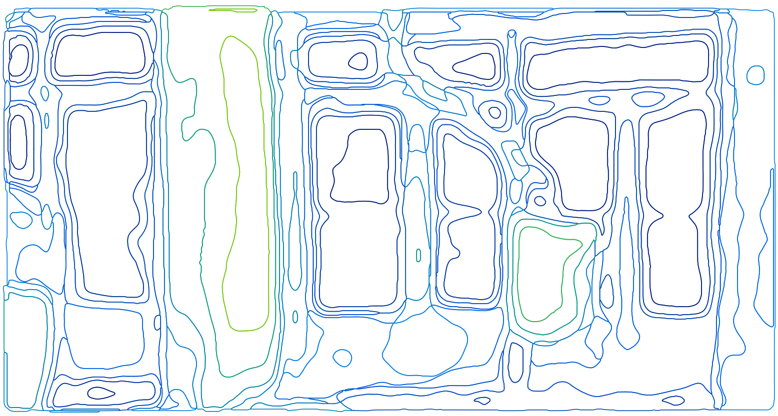

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Figure 45.

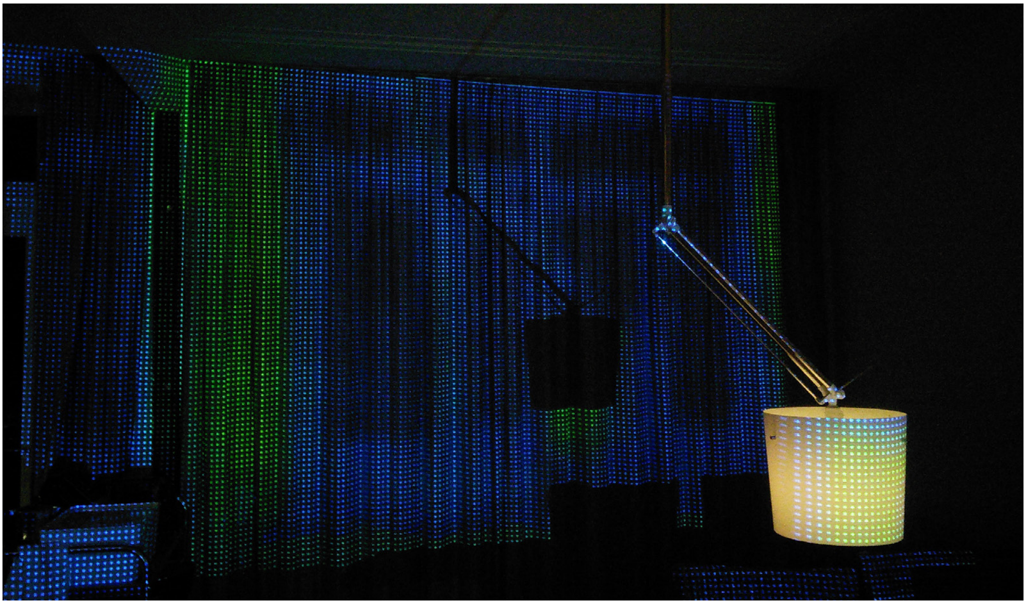


Figure 46.

Figure 47.

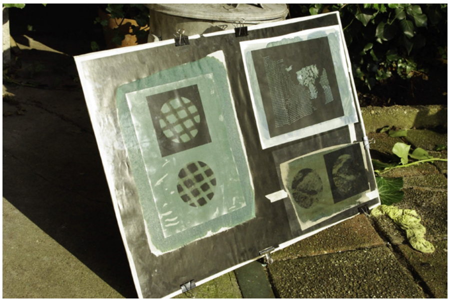
7.5 LIGHT EXPOSURE

While researching the history of architectural and interior representation, I came across the blueprint technique. This method of developing blueprints is called cyanotype, and it is an ultraviolet (UV) sensitive contact printing process. This method of representation was used in the late 19th century for the multiplication of construction drawings. It was the first “photocopy” process to multiply hand drawings. This industrial application borrowed from the field of photography was widely used for the next century by architects and engineers (James, 2009). The blue colour of the cyanotype print is the result of the reaction between two chemicals. When a solution of ferric ammonium citrate and potassium ferricyanide is combined, coated on a paper, and exposed to UV light, it creates the insoluble prussian blue colour.

7.6 EXPERIMENTS

In my first experiments I was interested in this technique as an alternative to printing. This chemical process allowed me to transfer pictures and drawings on to various surfaces like paper, cardboard, textile, leather, wood, etc. However, after some experiments I felt a limitation of what could be achieved. The analysis of the process and the end result made me realise that the interesting part of developing blueprints was the chemical reaction caused by ultraviolet rays of sun. The ability to see instant changes on a material draw attention to the process of actually capturing an exposure of the sun. The spots which were exposed to direct sunlight were more saturated in blue colour than spots that were in a shadow. The intensity of colour was also dependent on time in which the object was exposed to sun.

The following experiment was an attempt to capture and document sun exposure in the room. Even though the light is visible, it is immaterial and changes quickly. In addition, the exposure of light in the space is not so obvious. With this technique, the documentation of light is captured and exposed visually. In order to achieve positive results I constructed a detailed, scaled replica of my house. With this method I wanted to observe the light distribution, in particular the differences between light and hard shadows. In the end the experiment was not entirely successful. I managed to capture the patterns of direct sunlight, but from the model the room exposure was not visible. Chemicals only reacted where they got a significant amount of UV light. Reflected light did not have an impact for the areas that were away from windows.



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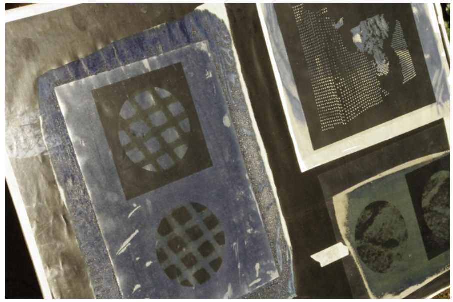

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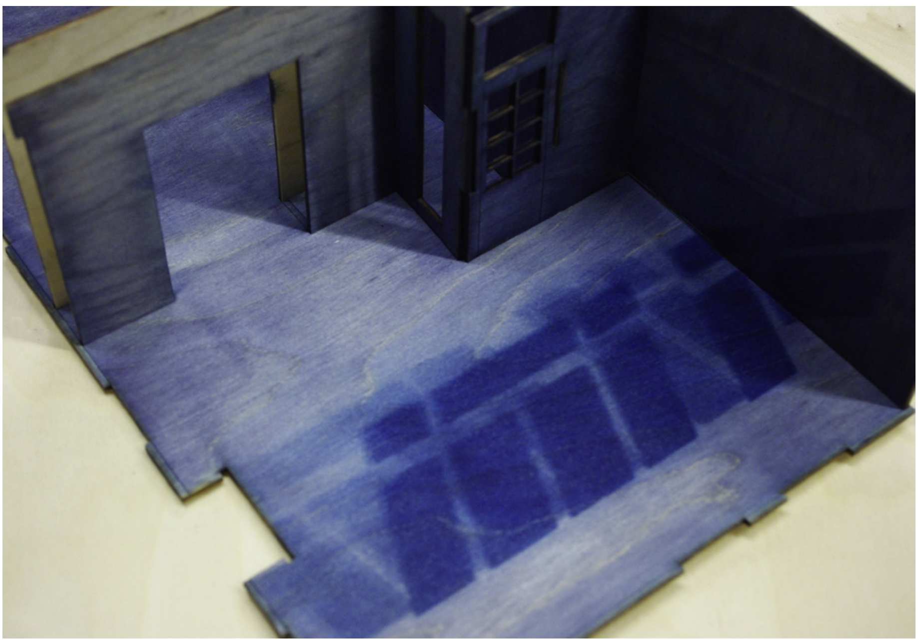


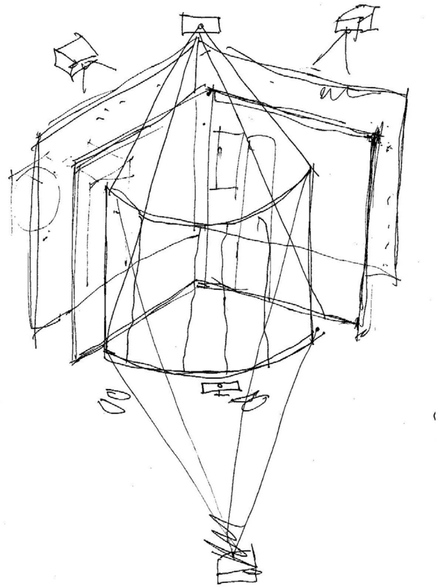
Figure 50.

The experiments with blueprints were important part to examine the immaterial dimension in a space. However, for further development of my project the blueprints were inconvenient to use in 1:1 scale and the scaled models were too small to capture the complexity of details I wanted to achieve.

7.7 PRELIMINARY DESIGN

Documentation and experiments with different techniques revealed the variety of new representational techniques. To achieve a goal of combining all of them together I had to find a way unify the language of data I collected.

The chosed method was to combine physical and digital information in one representation. An idea was to create a spatial experience that could allow user to have variety of perspectives to the same space also incorporating invisible dimensions.



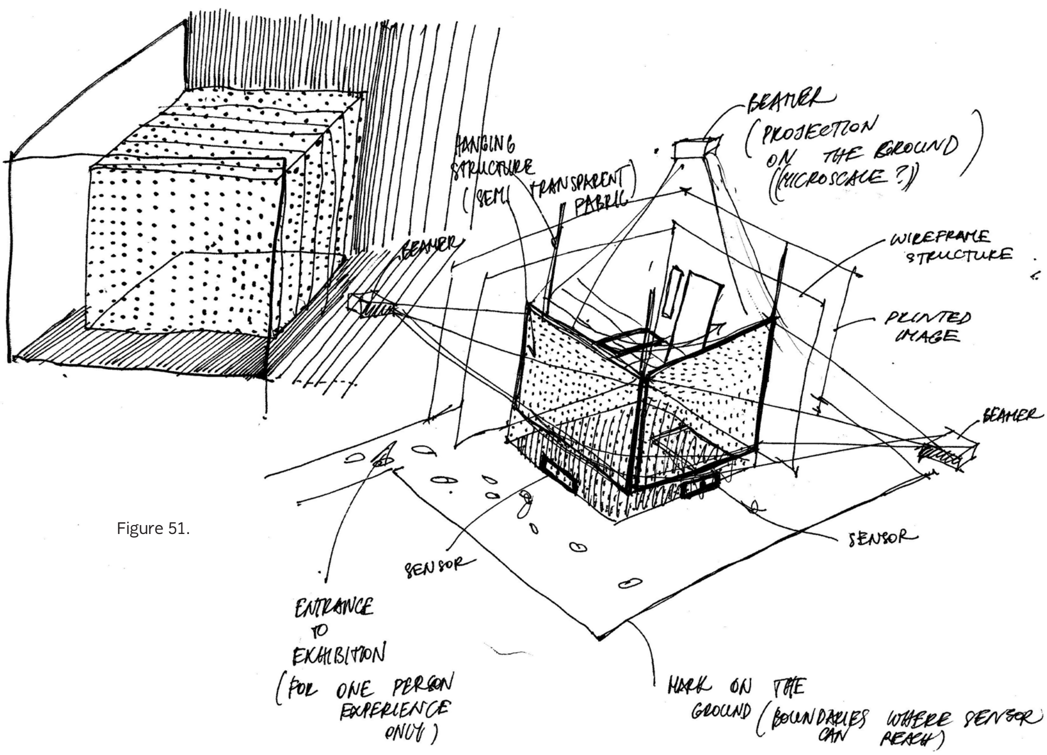


Figure 51.

DATA SET-UP

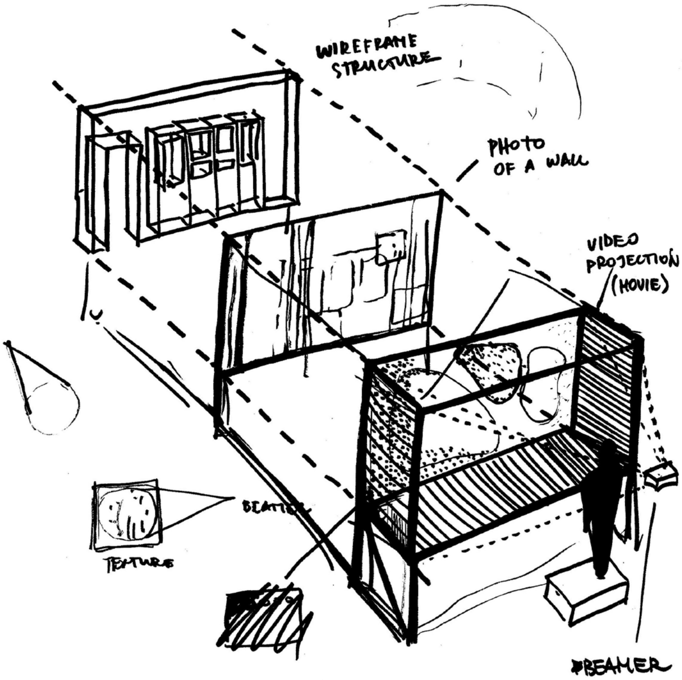


Figure 52.

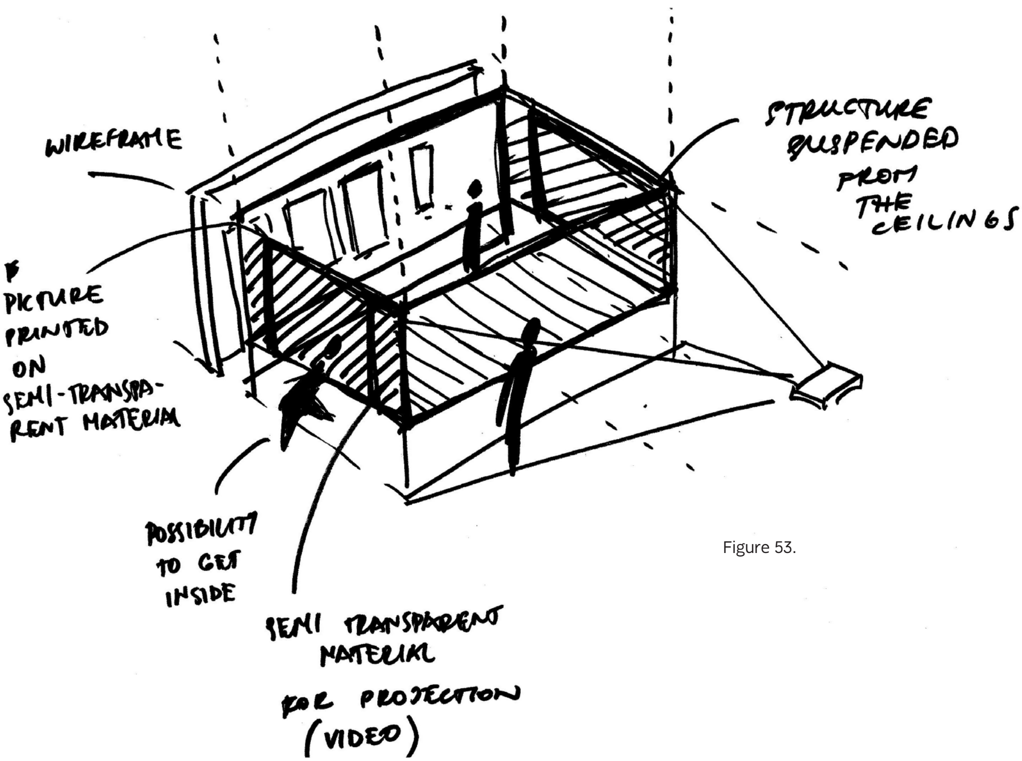
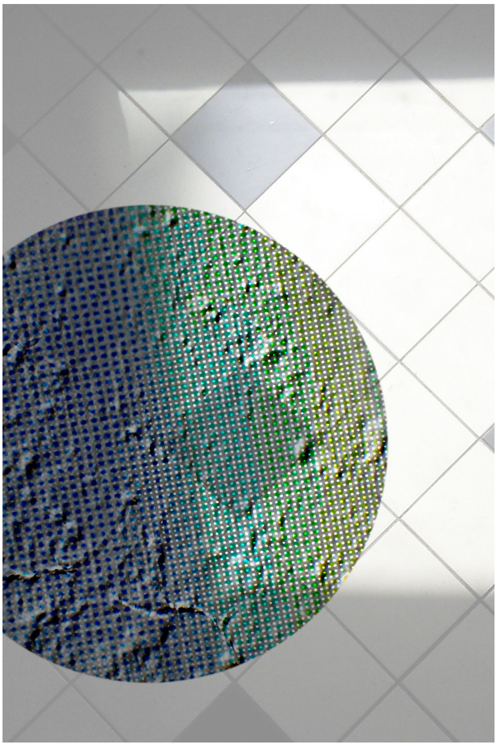


Figure 53.

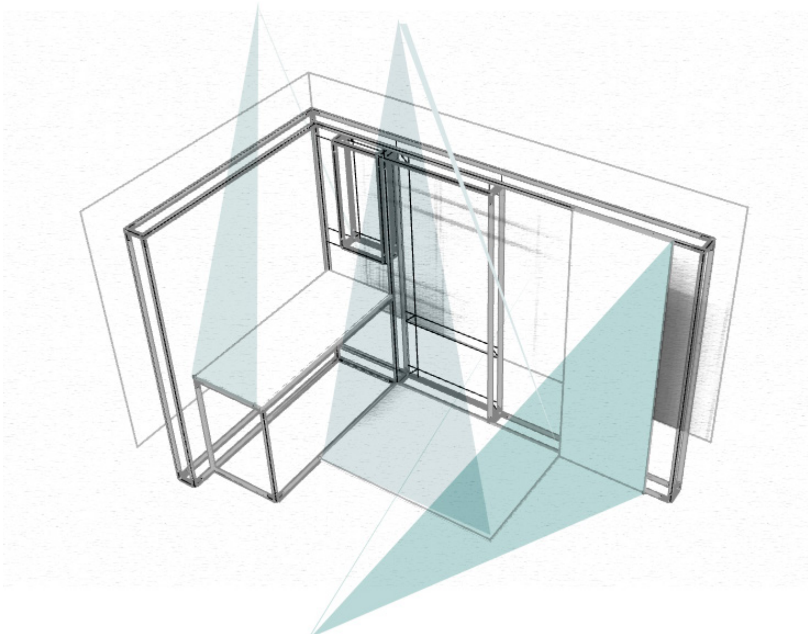
FINAL DESIGN ¡¡8

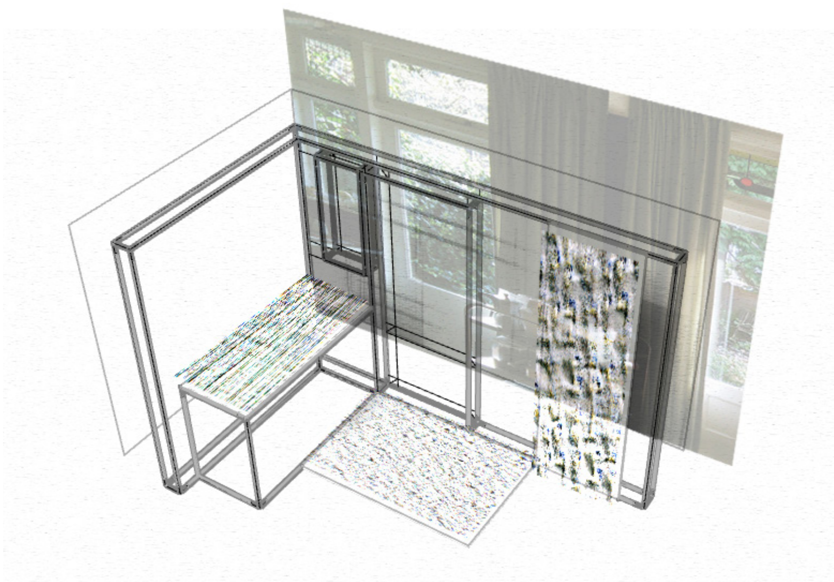


This installation introduces data visualization of invisible interior realities in three dimensional setting. Physical structure recreates a part of an interior I was investigating and the video projections reveal certain invisible/immaterial interior behavior in that particular place. This design suggests hybrid interior representation that combines various representational modes all in one to show multiplicity of standpoints and perspectives towards the interior.

Three-dimensional structure introduces a context for a viewer which allows us to read visualized data without losing a connection with actual space. The structure is presented as an exploded view where interior structure is separated from its two dimensional image. Plain surfaces are activated with data visualization. From a distance it appears as an abstraction but as more closer we get as more details stars to reveal. This engages visitor to 'zoom in' in order to reveal layers of information interior has to offer.

Data visualization is introduced as a video and shows the relation between microscopic material structure, sun light and temperature in time. Data is presented in dots and grids. Data dots are arranged that all of these data sets can be introduced at once without one overlapping another. This method allows to see data sets as separate or as a whole. In this way interior data is not detached from its source and therefore easier to perceive.





CONCLUSION ¡¡9

Data set-up critiques the limitations of standard representational visual languages in interior architecture. It examines how new complementary means of representation can produce a better understanding of an interior space.

This work is only an outline of an investigation to reveal the power of visual representation. It indicates possibilities for altering, stabilising, revealing, configuring the space through different representational modes. This thesis does not try to replace existing methodologies of interior representation, instead suggest an extension for 3D interior representation. By adding invisible dimensions like temperature, sun exposure and micro-scale details, the project broadens the notion of space. It suggest additional methods and tools to explore interior dimensions that appeal to several of our senses. It reveals the wider potential of an interior space.

The interior's purpose is not only a pragmatic, comfortable shelter, or aesthetically decorated and attractive image. The interior is not a plan, section, elevation or perspective view. It is all at once and even more. We can hardly perceive the interior looking from a fixed point of view. The interior is a continuation of points of views. Visible and invisible dimensions, objective and subjective readings. My contribution as a designer is a suggestion of various readings of the same space. Technology gives us a wider range of possibilities to collect as well as reproduce the new data. As a designer I see this data as a way to compensate for the lack of complexity and content in today's interior drawings. These alternative readings of the space can help to draw more attention to the psychological dimensions of an interior instead of purely focusing on visual aspects. In a way this project tries to objectively visualise a "feeling" of the space and introduces new ways to visually represent it.

The final design is a representation of an interior, a set-up for new data dimensions. To give a visual accesses to the information once was invisible.

To conclude it is important to not take for granted certain assumptions about interior representation. The responsibility of a designer is to offer a variety of tools that could help to communicate the overlooked complexity of the interior to its full extent.

"It is not easy to arrive at a conception of a whole which is constructed from parts belonging to different dimensions. And not only nature, but also art, her transformed image, is such a whole. It is difficult enough, oneself, to survey this whole, weather nature or art, but still more difficult to help another to such a comprehensive view."

Paul Klee

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Figure 18. Cigoli. Section of the Florence Cathedral, 1613
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Figure 19. Étienne-Louis Boullée. Cenotaph to Turenne, 1785
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Figure 20. Cutaway drawing of a family in their backyard underground bomb shelter, 1960s
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Figure 27, 28. Aaron Koblin. Flight patterns, 2008
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Figure 29 - 53. Author’s images.

ROTTERDAM, 2015

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