

Shadowscape in Urban Housing

low-level daylit interior for intimacy at home

08/15/2023

Spring semester 2023

Theoretically orientated Master's project

Student: Hui-Yi Yang / 210058 / Architect

Master's supervisor: Katja Bülow

Co-supervisor: Fabio Gigone

Character: 203,132

The Royal Danish Academy of Fine Arts School of Architecture, Design and Conservation

Spatial Design

huya2112@edu.kglakademi.dk

CONTENT

Introduction p.1

Chapter 1. TOPIC

1.1 Shadowscape in Urban Housing p.2

1.2 What enhances privacy in Danish home? p.2

1.3 What is the essence of intimacy in Danish home? p.2-3

1.4 Shadowscape p.3-5

1.5 Research Question p.6

1.6 Hypothesis p.6

1.7 Background and Motivation p.6-8

1.8 Method p.9-11

Chapter 2. THEORY STUDIES

2.1 Privacy/ Intimacy Studies p.13-18

2.2 Shadow Studies p.18-28

2.3 Window in domestic space Studies p.28-38

2.4 Conclusion p.38-39

Chapter 3. HOUSING CASE STUDIES

3.1 Urban-scale case studies p.42-50

3.2 Interior-scale case studies p.50-84

3.3 Conclusion p.85

Chapter 4. CONCLUSION

4.1 Comparison of theory studies and housing case studies p.86

4.2 Conclusion p.87-88

Chapter 5. DESIGN

5.1 Design Strategies p.90

5.2 Design Development p.90-95

5.3 Design p.96-105

Bibliography p.106-107

Figures p.108-109

INTRODUCTION

The background of the study of shadowscape is motivated by the increasingly dense and complex living environment of Copenhagen, and on the modern residential architecture that seeks for daylight and views through large windows. These two main factors contribute to the issue of privacy in the interiors of homes in Copenhagen: the full-height windows expose the occupants to the dense and complex external environment and to a risk of too much daylight, especially sunlight, which arises a problem of maintaining intimacy in relation to privacy, especially during the months when the daylight is over abundant in Denmark. This issue also interferes the daily practice of low-level daylit interior at home situated in the Danish culture of hygge. This has led to my interest in the study of shadowscape. Based on the hypothesis that shadow has a direct relation to intimacy in home interiors, I aim to investigate the performance of shadowscape at home and the impact of shadows on the perceived intimacy of occupants. The results of this research are to address the issue of privacy in the changing grain of urban housing in Copenhagen.

The main objective of this research is to understand the role that shadowscape has in sheltering from excessive daylight, and the possibilities to enhance intimacy in relation to privacy in urban interior of homes in Copenhagen. My study aims to examine the notions of shadowscape and privacy/intimacy in domestic interiors. Moreover, I argue that in the urban context of Copenhagen, a certain type of shadowscape enhances the sense of intimacy. In the framework of the Theoretically orientated Master's project, I will focus on both theory studies and housing case studies within the context of shadowscape. The analysis methods derived from the theory studies will be applied to the housing case studies, and the learning outcome will also bring reflection to the theory studies. With the cross studies of theory studies and housing case studies, these two studies will inform each other. Lastly, an initial design will be incorporated into one of the housing case studies to suggest a model of shadowscape within the domestic interior as a demonstration.

Chapter 1

TOPIC

1.1 Shadowscape in Urban Housing- low-level daylight interior for intimacy at home

The relationship between the performance of shadowscape and the sense of intimacy in Copenhagen's homes is a result of my interest in shadowscape's contribution to the sense of intimacy in domestic interiors. In addition, the strong connection between low-level daylight interiors and indoor intimacy, which is a common practice in Danish hygge culture, convinced me that some certain types of shadowscape could enhance the perception of intimacy in Copenhagen's homes.

In order to examine the relationship between shadowscape, intimacy, and home interiors in Copenhagen, two key questions arise for myself. Firstly, what enhances privacy in Danish home? Secondly, what is the essence of intimacy in Danish home? These inquiries aim to shed light on the intricate connections between these elements.

1.2 What enhances privacy in Danish home?

Intimacy- the condition of hygge

Intimacy, which could be considered as one of the conditions of hygge, allows the possibilities to enhance privacy. Intimacy, as one of the concepts of privacy, acts as a result of facilitating hygge in Danish home. To refer to the description of hygge by Jeppe Trolle Linnet, who has authored numerous books on the subject on hygge, he regards hygge as a vehicle for social control which centre to providing intimacy for Danish home. "The experiential qualities that hygge offers are crucially positioned in relation to the modern family's moral duty to provide a haven of intimacy that will 'heal' each family member in his or her ongoing encounters with the world."¹ As hygge is an essential cultural feature in Denmark, the condition of hygge which creates intimacy could be a way to enhance privacy in Danish home.

1.3 What is the essence of intimacy in Danish home?

Low-level illumination/daylit environment

The fundamental aspect of intimacy within Danish homes can be attributed to the presence of low-level illumination/daylit, closely linked to the concept of hygge. Particularly influenced by the long and dark winter seasons, the implementation of low-level illumination/daylit in an overall dim environment contributes to the creation of a spatial quality that fosters an atmosphere conducive to intimacy. This phenomenon accentuates the indoor ambiance, giving rise to an intimate setting. "The practice of toning homespun atmosphere is a widely shared culture in Denmark... This affective and aesthetic orchestration of space to maintain the condition of hygge, loosely translated as coziness but also connoting intimacy, conviviality, and enclosedness, by deploying hyggelys, or "cozy-light," is a key element of Danish national identity, widely practiced in the long, dark winter months."² The low-level illumination/daylit is a way to

hygge which "tinctures the surroundings, blur the boundaries between things, and shapes a vague, enfolding, intimate space..."³ Dimming the brightness of both artificial and natural lighting is crucial for cultivating intimacy in Danish homes. This intentional adjustment serves as a pivotal connection point that links shadowscape, intimacy, and the Danish home. In the following discussion, I will delve into the concept of shadowscape, exploring its relationship with intimacy and the Danish home to provide a concise understanding of their interconnections.

1.4 Shadowscape

Definition of Shadowscape

What is shadowscape? Shadow is a "partial darkness or obscurity within a part of space from which rays from a source of light are cut off by an interposed opaque body", and the archaic meaning of it also contains the notion of "shelter", "to shelter from the sun"⁴. The meaning of "-scape" is "used to frame a terminology referring to an area that has a particular character because of the type of things that can be seen, heard, smelled, or experienced in it, or to a work of art that represents such an area."⁵ When combined, shadowscape refers to a landscape of shadows that can be perceived by many senses, and to a landscape of shelter from the daylight.

"Shadowscape" is the term developed from my understanding of "Windowscape". As Yoshiharu Tsukamoto describes the definition of Windowscape "by placing the window at the center of the ecosystem of the behavior of various elements, we shift the logic of space from a production logic that tries to enclose it as an object to an empirical logic that finds value in adjacent things."⁶ Therefore, Windowscape is the internal spatial environment that has the window as its centre. Windowscape is generated when the window is the primary object of observation. Equally, in relation to shadowscape, I aim to consider the interior shadow as primary objects of observation, and windows as the secondary ones. Therefore, from the observation of shadow to windows, expanding the view to the adjacent things in the interior that surrounds these two elements, the resulting landscape from this perspective is the shadowscape.

Composition of shadowscape in domestic space

Shadowscape is mainly formed by shadow and windows, and it also consists of adjacent things in the interior that surrounds these two elements. This is a view which could see how occupants sheltered by shadows, and how intimacy is created within a certain type of environment. It is based on the perspective of indoor to explore how one experiences the shadowscape at home. Such a spatial condition is to understand the relationship between shadowscape and the

¹ Jeppe Trolle Linnet, September 2011, *Social Analysis, The International Journal of Anthropology* 55(2):21-44, p.30

² Mikkel Bille, Peter Bjerregaard, Tim Flohr Sørensen, *Staging Atmospheres: Materiality, culture, and the texture of the in-between* (Elsevier B.V., 2015), Quoted from Tim Edensor, *From Light to Dark: Daylight, Illumination, and Gloom*. Minneapolis (University of Minnesota Press, 2017), p.158

³ Ibid., p. 158

⁴ "Shadow." Merriam-Webster.com Dictionary, Merriam-Webster, <https://www.merriam-webster.com/dictionary/shadow>.

⁵ "-scape." Cambridge Advanced Learner's Dictionary.com, <https://dictionary.cambridge.org/zht/%E8%A9%9E%E5%85%B8/%E8%8B%B1%E8%AA%9E/scape>

⁶ Tsukamoto, Yoshiharu, *WindowScape: Window Behaviourology*(Firmuatosha), p.24

intimacy in relation to privacy. For example, in Vilhelm Hammershøi's "Interior in Strandgade" (Fig.1.1), the shadows, the window and the enclosure of the space manifests in the shadowscape. From the darkest area where the walls meet the floor, gradually fading as they approach the window, the shadows merge with the skylight that is brought in by the window, and as they merge with the skylight that is reflected through the interior space and furniture, creating many areas of varying degrees of shadows and nuances of colour. Notably, the sunlight from outside is blocked by the composition of the window, creating a clear shape of shadow and light on the floor. Through the analysis of this painting, shadowscape is regarded as a richly layered landscape of shadows and shelter from the daylight of its occupants, and it is consisted of shadow, window and enclosure of the space.

As Lisa Heschong describes: "An analogy can be made to the design of a room, with the sun as the light source, and the window enclosure and its attachments as part of the 'daylight luminaire.' Exterior awnings, overhangs, fins, and louvers can serve to shield the eyes of the room's occupants from direct sunlight, while also reflecting and diffusing it in useful direction."⁷ The way of looking at the composition of indoor daylight is similar to the way of looking at the composition of shadowscape. Shadow, as the foremost factor of shadowscape, varies mainly with the daylight from windows. If we observe the shadow itself, we can only tell the differentiation of darkness or brightness, colours, sharpness or softness of shadows. If we consider the second primary factor of the shadowscape, windows, the daylight from windows could explain the performance of shadow. Windows in shadowscape contain its position, its partitions, its materials, and its details. By introducing the daylight to interior, windows provide information about the exterior, such as weather and distance between its own building and other buildings. By looking at shadow and windows together, it allows occupants to understand the relationship between interior and exterior. As the last elements of shadowscape, the enclosure of space includes the spatial configuration, the materials, and the furniture of the room, all of which contribute to form the character and subtle changes in the expression of shadowscape.

The deliberate reduction of luminance in both artificial and natural lighting plays a pivotal role in fostering intimacy within Danish residential spaces. Therefore, I argued that a certain type of shadowscape in domestic interior is a phenomenon to create low-level illumination/daylit state. The perspectives of observing shadowscape in domestic space is mostly established in the interiors. When the perspective of observation is situated in interiors, one could understand the external impact which exterior bring into interior, and clearly understand the low-level daylit condition inside. As Ali Madanipour said: "The various perspectives on space can be classified as those looking from inside, i.e., the subjective views from the first person's point of view, and those looking from outside, i.e., the third person's external view. What is a home for one person, becomes a mere object for another."⁸ As the observation of shadowscape is to answer how we can adjust or maintain the shadowscape to create low-level illumination/daylit condition, I believe this inward manner of reading can address the shadowscape in a immerse way which is close to the situation that occupants perceive.

Shadowscape and intimacy in domestic interiors

Shadowscape is regarded as a richly layered landscape of shadows and shelter from the daylight of its occupants, and it is therefore continuous and shifting by its shadow distribution through the time and by the condition of the sky (clear or overcast). This characteristic intersects with our perception of intimacy in relation privacy, because they both could be seen as a shifting boundary through different circumstances, psychologically and physically. According to Irwin Altman, he saw privacy as a generic process that differently occurs among cultures in terms of the behavioural mechanism used to regulate desired levels of privacy. "My analysis treats privacy as a dynamic and dialectic interaction with others... privacy is a boundary and control process whereby people sometimes make themselves open and accessible to others and sometimes close themselves off from others. As in a dialectic process in which oppositional qualities or

closed shift over time and with circumstances."⁹ To refer his view toward the notion of privacy, I believed that when locating the notion of privacy into Danish home context, the certain type of shadowscape which could create low-level illumination/daylit condition for intimacy can be seen as a culturally specific quality of intimacy in relation to privacy. Its setting for the desired intimacy occurs at some certain time when the low-level illumination/daylit state is needed. As a result, low-level illumination/daylit environment –that a certain type of shadowscape could create– is a phenomenon that maintain the intimacy in relation to privacy indoor in Danish home, especially during the months when the daylight is over-abundant with its low angle.



Fig.1.1, "Interior in Strandgade, Sunlight on the Floor", 1901, Vilhelm Hammershøi

⁷ Lisa Heschong, *Visual Delight in Architecture* (Routledge, 2021), p.115

⁸ Ali Madanipour, *Public and Private Spaces of the City* (Routledge, 2003), p.145

⁹ Irwin Altman, *Privacy Regulation: Culturally Universal or Culturally Specific?*, *Journal of Social Issues* 33, no. 3 (Wiley-Blackwell, Summer, 1977), p.66

1.5 Research Question

How can we maintain intimacy in Danish homes during the months when the daylight is over-abundant, which could disturb the condition for intimacy?

In Nordic context, sunlight changes drastically throughout a year, including its angle and its quantity. What type of shadowscape could shelter the over-abundant daylight, especially during March to October, in order to maintain intimacy with low-level daylight environment in Danish home? To put this concern into the changing grain of urban housing in Copenhagen, the attention to which type of shadowscape which relates to the setting of windows, shadow and interior has to be strengthened to understand how Danish home maintains intimacy with low-level daylight in the presence of over-abundant daylight.

1.6 Hypothesis

Low-contrast shadowscape- the dim environment dominated by diffused daylight without too much direct sunlight create a sense of intimacy in Danish home.

It is my hypothesis that low-contrast shadowscape, which is a dim environment dominated by diffused daylight without too much direct sunlight, creates a low-level daylight state in Danish home. The low-level daylight state provides a sense of intimacy in relation to privacy at home. This hypothesis came from three main points. Firstly, the practice of hygge at Danish home with toning down the brightness of artificial light and daylight in the interior connects the sense of intimacy to the dim environment. Secondly, based on the observation of several paintings depicting low-contrast shadowscape which brought a sense of intimacy to viewers, it triggers my interest to investigate the relationship between the shadowscape and the atmosphere in those paintings. Lastly, from my empirical observation of shadowscape in several interiors of housing in Copenhagen. In these interiors with their window setting, the distribution of shadow, and the spatial organisation which contributed to the low-contrast shadowscape brought me a sense of intimacy, and the experience convinces me that the perception of low-contrast shadowscape has a relation to the feeling of intimacy. These theories, observations will be elaborated and analysed in my study to reflect this hypothesis.

1.7 Background and Motivation

Shadowscape in urban housing in Copenhagen

This study of shadowscape is situated within the urban typology of Copenhagen for three main motives: In Copenhagen's Nordic climate, the emphasis on daylight is driven by the short-daylight winters. Modern architectural trends, characterized by large windows, prioritize the integration of natural light and outdoor views, while neglecting the importance of the privacy and intimate qualities. To refer to the sketch of Le Corbusier and De Pierrefeu "Home of Man" (Fig.1.2). In the sketch, Le Corbusier begins with a view of the landscape from the outside, proceeds to draw a chair and a person looking out, and then frames the view with a large window. This reflects the tendency of modern housing to look outwards, but without considering how we can retain the quality of privacy of the interior beyond the outlook. This issue is also reflected in Copenhagen's modern residential architecture with large windows. Numerous

modern residential buildings in Copenhagen prioritize large windows to maximize views and daylight. However, this emphasis on expansive windows could result in excessive and prolonged exposure to daylight, especially during the long-daylight summer. This study aims to investigate the privacy issues arising from the pursuit of extensive views and light in modern homes with large windows.

Secondly, based on my personal experience, I argue that the typical Dannebrog window in traditional urban detached house in Copenhagen seems to foster a profound sense of intimacy within the home, which suggests that the key to enhance privacy in modern housing with large windows may already exist within the architectural practices of traditional Danish urban housing based on its window setting. The objective of this study is to gain a deeper understanding of the living environment in Copenhagen's Nordic climate and to examine whether the current large window layout in modern housing is suitable for fostering intimacy. This will be achieved through a comparative case study analysis of residential interiors and their window openings dated 1889 and 2018, accordingly.

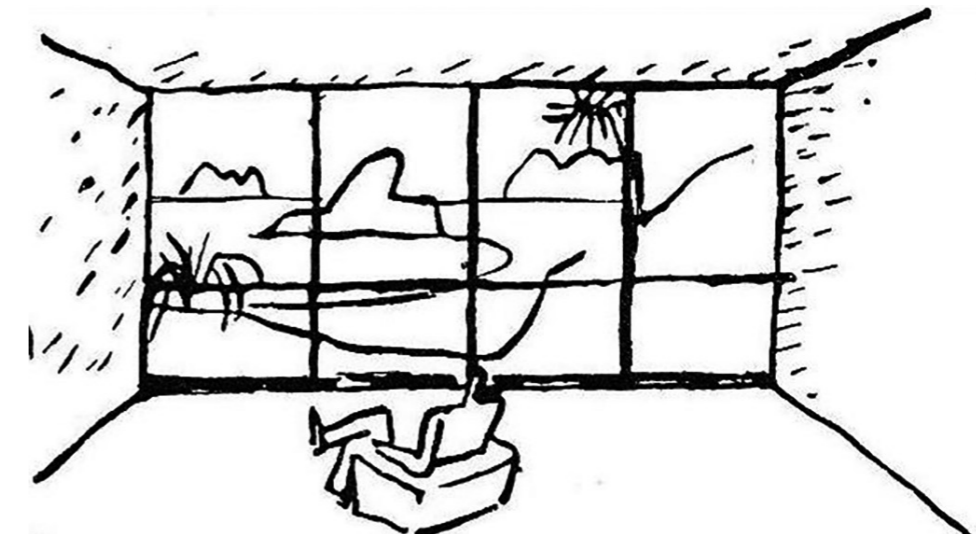


Fig.1.2, "Home of Man", 1948, Le Corbusier and De Pierrefeu

Lastly, according to the urban development of Copenhagen (Fig.1.3), by 2031, a rapid increase in new housing will be built in the developed areas of the city, resulting in a complex urban space, and this makes me consider whether we need to rethink the boundary between indoor and outdoor residential space given the changing urban context. In Cooperation agreement between the government and Copenhagen Municipality: "As a follow-up to the agreement on The Foundation for Mixed Cities - more affordable housing and a way out of homelessness concluded on 26 November 2021, the government and the Municipality of Copenhagen hereby enter into a cooperation agreement. The purpose is to ensure the greatest possible effect of the initiatives in the housing agreement with a view to establishing more social housing in Copenhagen and thereby promoting mixed urban and residential areas."¹⁰ While Copenhagen reaching the goal of Mixed Cities by 2031, living condition in city will become more complicated and dense. As the living environment mixes with other functions of the built space, the boundaries between home and the outside world need to be considered thoroughly in order to provide intimacy for the occupants at home.



Fig.1.3, "Potential for addition social housing- Selected options until 2031 for more social housing in existing urban areas", Copenhagen Municipality- 'More Social Housing in Copenhagen', 23 June 2022

1.8 Method

Theoretically orientated master's project

Based on the "Guidelines for Master's project at the architectural degree programme - Academic Regulations 2017" (Fig.1.4), Theoretically orientated master's project consists of the following three main aspects of study: program, strategy, and model. The difference between the guideline and structure of my study is that I will include an initial design in the discussion of the "Model" in order to demonstrate one of the examples of solution for the current issue in a housing case study. I expect the role of shadowscape in domestic interiors in urban context can be revealed through these following ways of studies as below.

I aim to explore shadowscape with two main studies: theory studies and housing case studies. Afterwards, an initial design will be incorporated into one of the housing case studies to provide an optimal model of shadowscape as a demonstration. Theoretical studies will enrich my knowledge of the fields related to this project, including shadow, privacy/intimacy and window in domestic space to find intersection to these three subjects in my project. This contributed to the way in which I found approach to the housing case studies. The studies of housing cases will utilize historically, observational, and anthropological investigation, and it will enhance the efficiency to value the solution model. Through the historical investigation of housing case studies, I aim to discover how urban development have changed the external environment for residential architecture in Copenhagen over time and to contribute to the projection of future housing architecture. Through the observational investigation of housing case studies, I aim to analyse the performance of shadowscape in the interiors. The intention of anthropological investigation is to understand the interior situation of domestic spaces and to progress the understanding of the impact of daylight and shadow introduced by windows to the intimacy of interiors, as well as the boundaries between interiors and exteriors.

Theory Studies

Within theory studies, I aim to find ways of studying shadowscape by reading literature on shadow, privacy/intimacy, and domestic interiors. In the study of privacy/intimacy, I chose phenomenological, historically, and conceptual approach to understand several notions of privacy in relation to the Danish architectural context in different periods of time, and to deduce the interpretation of privacy and intimacy in modern homes. In my studies on shadow, I have chosen research done on shadow within art history, architectural methodology and architectural studies, using these different perspectives to understand how people perceive, observe shadows, and the use of shadow in architecture. For the study of the window in domestic space, I chose the historically and perception approach to understand the development of window in two different periods in Copenhagen when the city is expanding with a great need of housing. By understanding the window of these two periods, I aim to require the shift of the design of windows for housing through time. The perception approach of studying windows allows me to understand how low-level daylight environment mainly formed by windows' setting affect occupants' perception, and the relationship between the cultural practice of hygge and the low-level daylight state. Also, in the perception approach, I aim to understand the role of window in Danish housing, with the comparison of two different kinds of window in different periods. The comparison of these

¹⁰ Samarbejdsaftale mellem regeringen (Socialdemokratiet) og Københavns Kommune om: Flere almene boliger i København, 23. juni 2022, p.7.

two windows allows me to gain an insight of how window effects on occupants' perception on the light and shadow in the room and the window itself. Through these readings, I aim to yield a way to investigate shadowscape of the urban dwellings in Copenhagen.

Housing Case Studies

The drivers of choosing, Kartoffelrækkerne (Fig.1.5) and Dortheavej Residence (Fig.1.6) case studies is that they are both the production of similar background, during the time when Copenhagen was in desperate need of great quantity of housing. Together with the fact that these cases are representative of a certain period of residential architecture and that the architects who designed them are also representative of the period. By listing them in a timeline and comparing the period in which they were produced with the way they respond to the orientation of daylight, I expect the result to be a timeline and a macro view of the historical changes in urban context, in Danish housing, and in the way residential architecture respond to the daylight and shadow. In addition, the subject of privacy/intimacy is also examined in the context of urban context. The relationship between the building and the exterior can be clearly identified from an urban perspective. This allows me to understand, in the framework of an interior-scale analysis of shadowscape, how the daylight and shadow of the external environment affects us when viewing the exterior from inside, and how this affects the privacy/intimacy of an individual in the interior.

In the interior-scale case studies, I aim to focus on observations of shadowscape- the relationship between interiors in relation to daylight and shadow, and the effect of window details on shadows. By looking at the interior scale, I could understand the composition of various shadows and how the details of space and windows can be used to produce a solution model that balances the interior and exterior boundaries. Moreover, I will conduct anthropological interview, where I want to understand the intimacy that shadowscape brings to the occupants. In order to understand how shadowscape affects their perception of intimacy in the space, I will interview the occupants about their living situation in the room. Lastly, by doing a physical model of Dortheavej Residence to analyze tectonics, materials of space, it will be developed into a solution model in order to reform the shadowscape in the interior. The objective of the reformation of shadowscape in Dortheavej Residence is to enhance the intimacy in the interior.



Fig.1.5, Kartoffelrækkerne, 1880, The Royal Library's picture collection



Fig.1.6, Dortheavej Residence, 2017, Lejerbo

The Royal Danish Academy of Fine Arts
Schools of Architecture, Design and Conservation



Theoretically orientated Master's project

It is possible to complete a Master's project in which the main emphasis is on a more theoretically orientated study. A theoretically orientated Master's project must document the student's ability to:

- Program, organise and complete studies and analyses of conditions concerning design based on an independently interpreted programme.
- Understand and demonstrate knowledge of architectural methods, tools and representation forms.
- Develop analysis and solution models, and demonstrate knowledge of skills related to the architectural profession and its specialisations.

Fig.1.4, "Guidelines for Master's project at the architectural degree programme - Academic Regulations 2017"

Chapter 2 THEORY STUDIES

In the chapter on theory studies, my learning objectives are to understand how privacy/intimacy, shadow and windows in domestic space intersect in Copenhagen's urban housing typology. I learnt the nature of privacy/ intimacy, shadow and windows in domestic space through theory studies and positioned their features in the Copenhagen homes. By understanding the nature of these three and their relationship in Copenhagen home, the role of shadowscape in Copenhagen's domestic space can be clarified. In addition, by understanding the role of shadowscape in Copenhagen home, I could also understand how to analyse the performance of shadowscape in the housing case studies.

In the studies of privacy/ intimacy, I learnt about the nature of privacy and intimacy through conceptual, phenomenological and historically approaches. Conceptual approach enables me to understand the basic definitions of privacy/intimacy and how they can be redefined in specific contexts. Phenomenological approach allows me to understand how privacy/intimacy is perceived and its conditions of existence, and historically approach allows me to understand how privacy/intimacy has evolved in different spatial and temporal contexts and the current situation it is facing.

In shadow studies, I have adopted observational, perceptual and architectural approaches to understand the nature of shadows, how they can be observed and how they can be used in architecture. In observational approach studies, I have learnt how to observe shadows at different scales and how to categorize the performance of shadows in detail, which has enabled me to compare different shadow performances and understand how to observe shadows in a more explicit manner. The perceptual approach allows me to understand how different shadow performances bring different experiences to a person, and to understand which shadow performance is closer to a person's perception of the whole environment or a particular object. In the architectural approach, I understand how shadow is used in architecture to emphasize the transition and organization of different spaces, which in turn affects people's perception of different spaces. This allows me to understand the relationship between shadow and spatial organization, as well as how shadow can be used as a medium for spatial transformations and qualities.

In window in domestic space studies, I employ the historical and perception approach to understand the development of the window in domestic space in Copenhagen and how the performance of light and shadow in the interiors formed by windows affect one's perception. I chose to study the development of windows at two different periods- 19th and 20th-21st, when the city is expanding with numerous housings were built. By comparing windows design in these two periods, I aim to understand the background of the design of the windows in its form which has a relation to the light and shadow in the interiors. In the perception approach studies, I understand the relationship between low-level daylight environment and Danish hygge which closely link to the sense of intimacy. This allows me to understand what kind of shadowscape is needed in the interior of the Copenhagen homes in order to obtain the sense of intimacy. Moreover, in perception approach studies, I learnt about how typical Dannebrog windows and energy-efficient window affect occupants' perception in Copenhagen homes, which reveals the importance of the compositions of window which influence occupants' perception of the interiors and the window itself.

2.1 Privacy/ Intimacy Studies

Conceptual approach

In this section, I aim to gain an understanding of the different aspects of the notion of privacy, which enhance my ability to have my own arguments towards the issue and notion of privacy in the context of Danish domestic space in the following studies. From my understanding of these different notions of privacy in this section, the six notions of privacy intersect with each other on a certain level, and it is difficult to prioritize one notion over another. However, the notion of intimacy is my focus in this study due to its emphasis on one's relationship with others. My argument toward this notion is that the close relationship in the form of privacy should not only be limited within the human relationship, but within the one between occupants and the place as well. This redefined notion of intimacy is situated in my observation and experience in the context of Danish domestic space, which I will explore further in this section.

Daniel Solove, who is well known for his academic work on privacy after studying the concept of privacy in great depth, has classified the different conceptions of privacy into six general types. One of these six general types of privacy is intimacy- "control over, or limited access to, one's intimate relationships or aspects of life."¹¹ This perspective connects privacy with personal human relationships, with sharing information with some other people that the individual cares or loves. However, Solove concluded that this definition tends to be too broad in scope, and it is overly limiting as a general theory because it focuses on interpersonal relationships alone. In my opinion, intimacy does not only exist in the relationship between family members, but also in the relationship between the individual member's life and the place itself. Home as a place for the individual to dwell, retreat from outside, it is also a place that individual has an intimate relationship with. Therefore, I argue that intimacy should enable individual family members to feel intimate with the space itself, and this enhances the sense of privacy at home.

"Traditionally, theorists of privacy have attempted to locate the essential elements common to the aspects of life we deem "private" and then formulate a conception based on these elements. A robust discourse has developed about conceptualizing privacy, and a multitude of different conceptions of privacy have been proposed and critiqued."¹² Although there have been many different conceptions of privacy written by scholars, in general they can be classified into six general types by Professor Daniel J. Solove:

¹¹ Daniel Solove, *Understanding Privacy* (Cambridge: Harvard University Press, 2009), p.13.

¹² Ibid., p. 12-13

(1)The right to be let alone- Samuel Warren and Louis Brandeis's famous formulation of the right to privacy.

"In 1890, Samuel Warren and Louis Brandis penned their famous article 'The Right to Privacy,' arguing for the legal recognition of a right to privacy, which they defined as a 'right to be let alone'."¹³ The purpose of the 'right to be alone' is to protect individual's privacy, and the notion of it influenced privacy law in United States. After the article was published, courts and legislatures began to recognize the right to privacy.

(2)Limited access to the self- the ability to shield oneself from unwanted access by others.

"For philosopher Sissela Bok, privacy is 'the condition of being protected from unwanted access by others- either physical access, personal information, or attention'." This explained the concept of privacy includes both unwanted access by physical and psychological intrusion, including the attention from others. Furthermore, according to Ernest Van Den Haag,"Privacy is the exclusive access of a person (or other legal entity) to a realm of his own. The right to privacy entitles one to exclude others from (a) watching, (b)utilizing, (c)invading (intruding upon, or in other ways affecting) his private realm."¹⁴

(3)Secrecy-the concealment of certain matters from others.

The secrecy ones want to keep with themselves is regarded as one of the common concepts of privacy. Psychologist Sidney Jourard emphasizes secrecy in his definition of privacy:" Privacy is an outcome of a person's wish to withhold from others certain knowledge as to his past and present experience and action and his intentions for the future."¹⁵

(4)Control over personal information- the ability to exercise control over information about oneself.

Controlling personal information is one of the most predominant theories of privacy. According to Alan Westin,"Privacy is the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others."¹⁶

(5)Personhood- the protection of one's personality, individuality, and dignity.

Protecting personhood is viewed as another theory of privacy. "Building upon Warren and Brandeis's notion of 'inviolate personality,' American jurist and law professor Paul Freund coined the term 'personhood' to refer to "those attributes of an individual which are irreducible in his selfhood'."¹⁷ According to this, if we value something can be regarded as part of the identity of individuals, the protection of it can be part of the concept of privacy.

(6)Intimacy- control over, or limited access to, one's intimate relationships or aspects of life.

"An increasingly popular theory understands privacy as a form of intimacy. This theory appropriately recognizes that privacy is essential not just for individual self-creation, but also for human relationships."¹⁸ Made exception for privacy for individuals, this concept argues for a form of privacy within groups who have closer relationship.

Lastly, Solove also argues the concepts of privacy are either too broad or too narrow to apply in every situation. "In any case, we need to resolve privacy issues by looking to the specific context. How we value privacy and countervailing interests depend upon the circumstances of each situation."¹⁹

Phenomenological approach

In the section, I aim to understand privacy as a phenomenon. What I have learnt from this section is two main features of privacy. First, privacy and public are relative values. There is no absolute private and absolute public, but rather a relative public and a relative private that are compared to each other. The need for more or less privacy is evaluated by comparing the different levels of privacy and public with each other. Secondly, privacy is differently desired in the various cultures, at different times and in different situations. Therefore, the need for "more" or "less" privacy should be carefully considered with its changeability through time, circumstances, and culture. This study enhances my understanding of the way to evaluate occupants' desired level of privacy in housing case studies, especially the interview questions.

(1)Privacy and public as a shifting boundary

A comprehensive understanding of the value of privacy necessitates a simultaneous examination of the concepts of public and privacy. Through a comparative analysis of various levels of privacy and public, one can discern the subtle shifts in their respective values. Such an exploration sheds light on the nuanced dynamics that underlie the evolving notions of privacy and public. "...the most common usage of private is one in which the term is contrasted with some larger (more public) body: private tuition is contrasted with schools, private devotions and private Christians with the church...., and private individuals with the family. As these examples indicate, the boundary of the private is constantly shifting."²⁰ Therefore, privacy is a shifting territory that could be seen corporally and mentally. Furthermore, looking into the interface which crosses the blurry boundary of public and privacy, we could reveal its complex and shifting value.

(2)Privacy as a culturally specific phenomenon

Privacy is regarded as a culturally specific phenomenon, and it is changed through different circumstances and time." All cultures have evolved mechanisms by which members can regulate privacy, but that the particular pattern mechanisms may differ across cultures."²¹ To refer to Irwin Altman, his analysis treats privacy as a dynamic and dialectic interaction with others. Within the specific culture context, "...privacy is a boundary and control process whereby people sometimes make themselves open and accessible to others and sometimes close themselves off from others. As in a dialectic process in which oppositional qualities or closed shift over time and with circumstances."²² As the perception of privacy evolves over time and in different circumstances, an evaluation of privacy satisfaction can be conducted by considering the extent of privacy in relation to the desired level. This assessment involves examining whether there is an excessive or inadequate level of privacy, thus determining the degree to which it aligns with the preferred level of privacy.

13 Samuel Warren, and Louis Brandeis, *The Right to Privacy*, (Harvard Law Review IV, no. 5, 15 December 1890), p.193-220.

14 Ernest Van Den Haag, *On Privacy*, in *Nomos XIII: Privacy* 149, 149 (J. Roland Pennock & J.W. Chapman eds., 1971).

15 Sidney M. Jourard, *Some Psychological Aspects of Privacy*, 31 *Law and Contemporary Problems* 307, 307(1966)

16 Alan Westin, *Privacy and Freedom* 7 (1967)

17 Paul Freund, Address at the American Law Institute, 52nd Annual Meeting 42-43 (1975); see also J. Braxton Craven, Jr., *Personhood: The Right to Be Let Alone*, 1976 *Duke Law Journal* 699, 702 n.15 (1977) (citing Freund's formulation of personhood).

18 Daniel J. Solove, *Understanding Privacy* (Harvard University Press, 2008), p.34.

19 *Ibid.*, p. 48

20 Castiglione Dario, *Shifting the Boundaries: Transformation of the Languages of Public and Private in the Eighteenth Century*. (University of Exeter Press, 1995), p.9.

21 Irwin Altman, *Privacy Regulation: Culturally Universal or Culturally Specific?*, *Journal of Social Issues* 33, no. 3: 66-84. (Wiley-Blackwell, Summer 1977), p.70.

22 *Ibid.*, p. 67

Historically approach

In this section, I briefly examine privacy from the perspective of some social clusters that typically entail European culture. These clusters must be considered as non-exclusionary social environments and, therefore, the nature of privacy related to the individual social configurations coexists –although potentially engages or prevails– with the others.

From reading the development of privacy through different periods in European culture, I have understood that nowadays household are within a relatively more public environment with a weaker spatial organization of neighborhood, with the background of urbanization. In the meanwhile, privacy within individuals is emphasized. The home has taken on an even more crucial role in providing sufficient privacy for both the family and individuals.

(1) Society

Privacy is evolved through different changes of societies in the history. “Private life is not something given in nature from the beginning of time. It is a historical reality, which different societies have construed in different ways. The boundaries of private life are not laid down once and for all; the division of human activity between public and private spheres is subject to change.”²³ Also, the possibility to have a private life was a privilege for those who had private income. Those who must work for living have to experience an intertwining of public and private life. “...the twentieth century may be seen as a period during which the differentiation of public and private, at first limited to bourgeoisie, slowly spread throughout the population. Thus, in one sense the history of private life is a history of democratization.”²⁴ This explains the development of privacy is closely connected societal change. To understand privacy within specific contexts, we have to look at privacy under its own social background.

(2) Neighborhood

Neighborhood used to serve as a transitional space between public and private. Compared to the modern neighborhood which neighbors seldom know each other, the old neighborhood remains as a space between outside and inside of home. “The space of the neighborhood or village, open to all, is governed by a communal code, but its focus remains the enclosed space of the home. It is an outside defined with reference to an inside, a public space whose center is a private one.”²⁵ The old form of spatial organization of neighborhood therefore forms a relatively private space outside of the individual housing and enhances the privacy in the home.

However, through the destruction of this transitional space-neighborhood by urbanization, the task of relating public to private in the house itself become even more difficult and important. “Modern urban design and architecture have disrupted the space of the neighborhood. Small streets have been eliminated, small shops have been replaced by shopping centers usually reached by automobile.”²⁶ As housing units have distanced from each other because of the consideration of automobile, the spatial organization of neighborhood nowadays has become weaker due to the decrease of human-scale space in the neighborhood. Furthermore, the urbanization of situating household into different functions of different buildings, which is the policy Copenhagen Municipality is carrying in the developed area. From the aspect of spatial organization, I argued that household is exposed to a relatively public space of neighborhood. Therefore, the home has played an even more important role in this context. “The home has become a place for intimacy, integration, and wholeness,”²⁷ writes Gullestad, while neighborhood and society have lost these qualities, she believes. The family’s house becomes a home by virtue of a special kind of togetherness that is lacking in the modern public sphere, to which it acts as a countermeasure. Within this background, nowadays the home has become a place for wholeness, providing shelter for family and individual family members.

(3) Family and individuals

“The modern family, exclusively concerned with private functions, is no longer the same as the family that once performed public function as well... it is within the family that individuals have won the right to an autonomous private life.”²⁸ According to Antoine Prost, the private life in home used to be divided into two forms: one is the privacy within the family and the other is within individuals. In the modern home, as the work migrated from the domestic space to public places with many regulations, the right of individuals retreated to the family. This change has broken down the old family structure, and the physical aspects of individual identity gained new importance. Accordingly, individual’s privacy has become significant because of the task of group as family has decreased. Therefore, I raise a question of how the home nowadays provide privacy both for the family and individuals since the structure of family become weaker by the society change.

Conclusion

How can the domestic space itself act as a vehicle of intimacy, preventing the relatively public state from the neighbourhood outside and providing intimacy for individuals and family at home, and how can this space be modified according to the time, the circumstances, and the level of privacy desired by the occupants?

Through conceptual approach studies, I have learnt about one of the notions of privacy-intimacy, which is control over, or limited access to, one’s intimate relationships or aspects of life. Since this notion is limited to interpersonal relationships, through my observation of the residential space, I aim to expand the notion of intimacy between the occupants to the intimate relationship between the occupants and the space itself. Through the intimate relationship between occupants and the space itself, it is therefore conceivable that occupants may feel intimate in the residential space as well.

Furthermore, through the phenomenological approach of privacy studies, I recognised that privacy is a phenomenon that shifts through time, circumstances and contexts. In order to understand the satisfaction of privacy, one should investigate the need for desired behaviour and ask if there is “too much” or “too little” privacy within the specific context. Therefore, the desired level of intimacy provided to occupants in a residential space needs to be considered in accordance with time, circumstances and contexts.

In the historically approach of privacy studies, I learned that in the background of urbanisation, as the distance between residential units increased and small-scale community spaces disappeared, the spatial organisation of the neighbourhood outside the house was weakened. In addition, given that the Copenhagen Municipality will place the housing in a mixed function urban texture, the spatial organisation of the neighbourhood will be weakened even further. In conjunction with the changes in the social structure, the importance of individual privacy is becoming more and more important in family. In this context, how to enhance privacy at home, so that the family and individual members can obtain the desired intimacy is an important issue.

In conclusion, given the weakening of the spatial structure of the neighbourhood and the relative emphasis on the in-

²³ Antoine Prost(Ed.), Gérard Vincent(Ed.), Arthur Goldhammer(Ed.), *A History of Private Life: Riddles of Identity in Modern Times* (Belknap Press of Harvard University Press, 1991), p.3

²⁴ Ibid., p. 7

²⁵ Ibid., p. 103

²⁶ Ibid., p. 111

²⁷ Marianne Gullestad, Vol. 18, No. 3, *Representations of Europe: Transforming State, Society, and Identity* (Aug., 1991), pp. 480-499 (Wiley, 1991)

²⁸ Ibid., p. 51

dividual's privacy in the home, I ask the following question: how can the domestic space itself act as a medium for providing intimacy, preventing the public neighbourhood from the outside and providing the individual's intimacy within the home? Moreover, this space can be adjusted according to the time, the situation, and the degree of privacy desired by the occupants. Based on this question, and the context of Danish domestic space, I have a preliminary hypothesis-In the context of Danish home, when the culture needs for hygge- low-level illumination/ daylight for intimacy is commonly practiced. I believe that a certain type of shadowscape at home creates an intimate spatial quality for individual family members to feel intimate in the space, especially during March to October, when the sun sets at a later time and at a lower angle in a year. By doing so, it enhances the privacy at home. The certain type of shadowscape could be a way to create intimacy, which I expect to learn from the shadow studies as below.

2.2 Shadow Studies

Observational approach

This section focuses on the methodology employed for systematically observing and analyzing various aspects of shadows. Through the conducted studies, an understanding has been developed regarding the systematic observation of shadows across different scales within a given space. This includes the observation of shadows within the overall environment, as well as the examination of shadows cast by larger objects and the intricate textures and details of shadow formations. This approach serves as a valuable means to observe and investigate shadows within housing case studies.

(1)Scale of Shadow

Sophus Frandsen, who was a Danish architect and academic, studied and taught architect students in lighting at The Royal Danish Art Academy for 50 years. He developed Four-Shadow concept based on the size of shadow that occupants observe in a normal side-lit room (Fig.2.1). "The terms big and small shadow are to be seen in relation to the size of the human form..."²⁹ As an illustrative example, the concept of shadow size can be understood in two distinct contexts. On one hand, the "big shadow" refers to the overall shadow that encompasses the entire room or space under consideration. Conversely, the "small shadow" pertains to the shadow cast by a minute object, such as a pen placed on a table. It is important to note that the perception of shadow size is contingent upon the observer's perspective, which is relative to the size of a human being. "In the room the two big shadows, A and to a certain degree of B, occur where the light is relatively weak, dominated by the light reflected from the surfaces. The two small shadows, C and D, occur where the daylight is relatively strong, dominated by light from the window. Consequently, the two big shadows are those related to the lighting of the room as such, shadow A in the upper part and shadow B behind the furniture and larger architectural elements. The two small shadows are those associated with the light on small objects, shadow C on all things we handle, shadow D in the tiniest visible details."³⁰ By means of the Four-Shadow concept established by Sophus, we can distinguish between the different sizes of shadows and intensity of the daylight from outside observed by the human.

(2)Texture of shadow

In addition to the categories of A, B, C and D shadows, Sophus adds the types of shadow which contains 11 levels of the performance of shadow (Fig.2.2). The system of the types differs between the levels of "sharp or soft" of the shadow, allowing us to break down the performance of the shadow at various

types." Obviously the handling of shadows asks for more than just two words: 'soft and 'sharp'. But everything in between. So that is what is proposed here, in a scale of shadows... In principle it is constructed as a grey scale, each step being visually equivalent to all other steps."³¹ Combined with the scale of shadow in Four-shadow concept, we can categorize shadow with its size and its texture altogether which shown in the scale number of Fig. 2.2. "To sum up, the four categories differ from each others in several ways. By their position in the room. By their size. By their illumination level. And one thing more, by their precision. The smaller the shadow, the stronger the contrast, since the gradation from bright to dark occurs at a decreasing viewing angle."³²

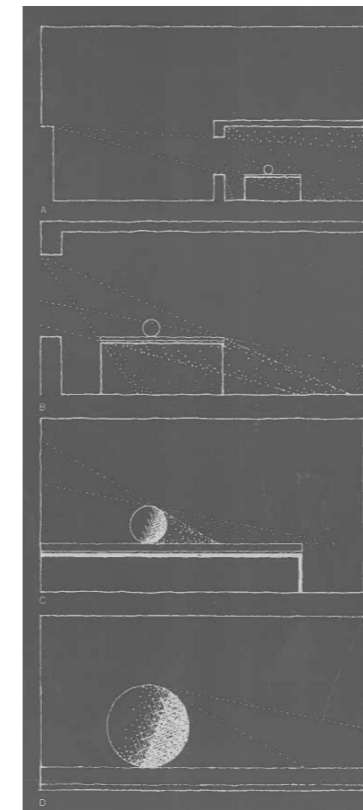


Fig.2.1, "The Four Shadows", A to D shadow are listed in alphabetical order from the first to the last diagram.

- A.The big room shadow: shadow-type 4.5-10
- B.The big object shadow: shadow-type 3-7
- C.The small object shadow: shadow-type 1.5-4.5
- D.The small detail / texture shadow: shadow-type 0-1.5

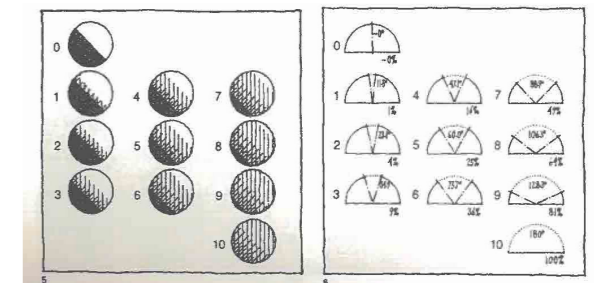


Fig.2.2, "The Shadow Types", The individual shadow-types are characterized by the distribution and transition of the half-shadow

29 Frandsen Sophus, *The scale of light, International Lightning Review, ILR* (Philips Lighting, Luminaire Group, 1987), p. 111

30 Ibid., p. 111

31 Ibid., p. 109

32 Ibid., p. 111

Perceptual approach

This section focuses on the exploration of how painters perceive and depict shadows in their artworks, aiming to elucidate the specific perceptions they intend to evoke in viewers through their portrayal of shadows. By understanding the shadow depicted by the artist, I aim to understand how shadows can be categorised from a perceiver's point of view and the perceptions that different types of shadows bring to the viewer.

I learnt two points in this section. Firstly, from a perceiver's point of view, we can categorise shadows into three types - shadow, half-shadow and cast shadow. This categorisation is helpful when studying housing case studies, not only from an observer's perspective, but also from a perceiver's perspective which is closer to occupant's viewpoint. Secondly, Impressionist paintings tend to capture the dynamic qualities of light and shadow, closely aligning with human perception of the surrounding environment. In contrast, Cubist and Surrealist paintings often deviate from the representation of nature form of light and shadow, instead exploring abstract and decorative compositions. Furthermore, the way of depicting shadow and light in Impressionist paintings is close to the state of low-contrast shadowscape, and the one in Cubist and Surrealist's paintings is close to the state of high-contrast shadowscape. This finding allows me to argue that low-contrast shadowscape enable occupants to perceive the overall environment compared to the high-contrast shadowscape.

(1)Category of the perception of shadow distribution on objects

Filippo Baldinucci, was a Florentine art historian, and the first who made full use of documents to realize the importance of drawings in the study of painting (Fig.2.3). He wrote: "Shadow is the darkness created by opaque bodies on the opposite side of the illuminated part."³³ He categorized shadows in different degrees. "It (shadow) is divided in three degrees called shadow, half-shadow and cast shadow. By shadow (It. ombra) is meant that which a body creates on itself, as for instance a sphere that has light on one part and gradually becomes half light and half dark, and that dark part is described as shadow (It. penumbra). Half-shadow (It. mezz' ombra) is called that area that is between light and the shadow through which the one passes to the other, as we have said, gradually diminishing little by little according to the roundness of the object. Cast shadow (It. sbattimento) is the shadow that is caused on the ground or elsewhere by the depicted object . . ."³⁴ The use of three different terms of shadow- shadow, half-shadow and cast shadow suggest how shadow is perceived in regard to the shadow distribution of an object, which related to how human as a perceiver to perceive shadow on objects. Therefore, we can categorize the shadow on objects we perceive in this manner.

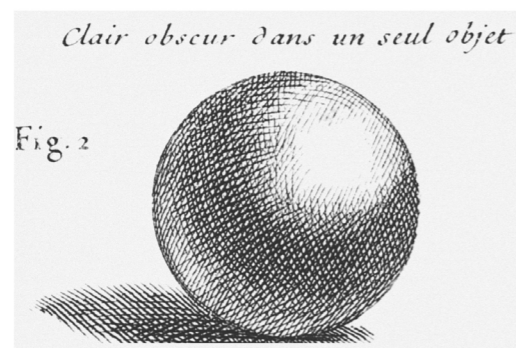


Fig.2.3, "Elémens de la Peinture Pratique", Paris, 1684, Roger de Piles

(2)Different perception of shadow in the history of painting

Filippo Baldinucci defined shadow in the language of painters in the other way. "Shadow: In the language of painters it is generally understood to refer to the more or less dark colour which serves in painting to give relief to the representation by gradually becoming lighter."³⁵ In other words, the gradation of light and darkness affects the way people perceive light, which is a very important character.

If we look into how painters depict cast shadow in history, one can understand the change of the shadow which is perceived differently through the time. "...some of the greatest observers of nature appear to have deliberately avoided the cast shadow... It looks indeed as if many of these masters had studiously avoided inserting such shadows, as if they regarded them as a disturbing and distracting element in an otherwise coherent and harmonious composition."³⁶ Take Leonardo da Vinci's Notes for an example, in the note which is known as the Trattato della Pittura, he said: "Light too conspicuously cut off by shadows is exceedingly disapproved of by painters."³⁷ Therefore, Da Vinci didn't utilise his observation of light and shadow into his drawings (Fig.2.4). The depiction of shadow seems to be unfashionable in the

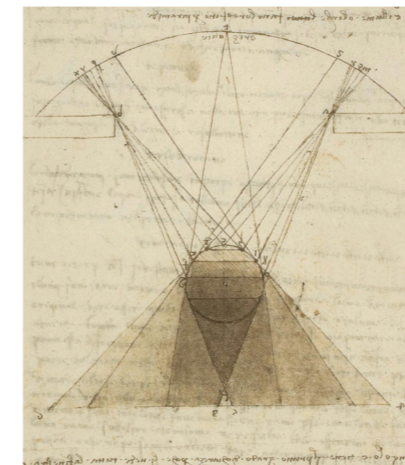


Fig.2.4, "Diagram of light falling on a wall opposite a window, indicating the arc of the horizon and the resulting shadow.", about 1490-2, Leonardo da Vinci



Fig.2.5, "The Supper at Emmaus", 1601, Michelangelo Merisi da Caravaggio

³³ Filippo Baldinucci, *Vocabulario Toscano dell'Arte del Disegno*, Florence 1681. Quoted from E. h. Gombrich, Neil MacGregor, and Nicholas Penny, *Shadows: the depiction of cast shadows in Western art* (Yale University Press, 2014), p.8.

³⁴ E. h. Gombrich, Neil MacGregor, and Nicholas Penny, *Shadows: the depiction of cast shadows in Western art* (Yale University Press, 2014), p.8

³⁵ *Ibid.*, p.8

³⁶ *Ibid.*, p.41

³⁷ *Ibid.*, p.42

first decades of the fifteenth century, and it became prevalent after the pioneer drawing-style of Caravaggio, whose paintings have been characterized with a dramatic use of light and shadow. (Fig.2.5) "... many artists of the seventeenth century were rapidly converted to Caravaggio's idiom, and the tenebroso (dark) style conquered not only parts of Italy but also whole regions of the north where it culminated in the art of Rembrandt."³⁸ Together with the trend of illustrating shadows in paintings, the colour of shadow had been recognized before the end of the eighteenth century. "Even before the end of the eighteenth century, observations of the variety of light effects in the open air had led to fresh interest in the colour of shadows which were particularly eagerly studied by the Impressionists."³⁹ Impressionists emphasis on accurate depiction of light and shadows in its changing qualities as a crucial element of human perception and experience. By depicting shadows and light both in the drawings, they portrayed overall visual effects and atmosphere of the space. It is remarkable that the technique of painting used by the Impressionist - complementary colours - is designed to approximate the state perceived by the human eye. "In painting, complementary colours are used for their vibrant contrasts and mutual enhancement when juxtaposed, for 'shot' or cangiante draperies, and for shadows tinged with the complementary of an adjacent highlight - a device imitating the physiological response of the human eye and much used by the Impressionists and Post-Impressionists."⁴⁰ The Impressionist are interested in the way in which the human mind processes what it sees. "When we look at a landscape, or a crowd of people, we do not instantly see every face, or leaf in detailed focus, but as a mass of colour and light. Impressionist painters tried to express this experience."⁴¹ Therefore, an overall visual effect of light and color seems to close to human's perception of the environment (Fig.2.6). However, by the end of the nineteenth century and twenty century, the role of shadows in paintings has changed from the observation of nature to the abstraction of decorative compositions, such as the role to guide and confuse the viewer in Cubism and creating the mood of mystery in Surrealists. The perceptions of shadows had been regarded as mystery, unquiet in twenty century in the paintings of Cubism and Surrealists (Fig.2.7).

In conclusion, the artist's intention of depicting shadows is to make the viewer feel the presence of light. Therefore, if one wants to perceive light, the existence of shadows is indispensable. The shadows depicted by different style of artists express various intention to bring perception to viewers. Among them, the manner in which the Impressionists painted, from my point of view, is close to the state of low-contrast shadowscape, which can provide people with the perception of the overall environment. On the contrary, shadows in the paintings of Cubism and Surrealists, aiming to give people a perception of mystery and unquiet in the paintings, thus depicting shadows in a decorative way, which is closer to high-contrast shadowscape in my point of view. This way of depicting shadows allows people to perceive the key objects in the picture rather than the whole space. Therefore, if one intends to be able to perceive the whole space, a low-contrast shadowscape is closer to achieving this purpose.

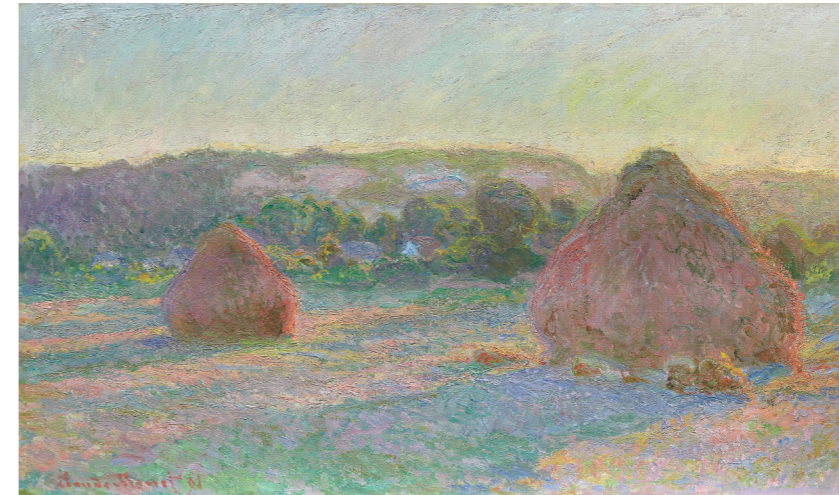


Fig.2.6, "Wheatstacks (End of Summer)", 1897, Claude Monet



Fig.2.7, "The Enigma of a Day", 1914, Giorgio de Chirico

³⁸ Ibid., p.47

³⁹ For coloured shadows see the letter of 1793 from the physicist Lichtenberg to Goethe that I cited in *The Image and the Eye*, Oxford 1982, p. 30. Quoted from *Shadows : the depiction of cast shadows in Western art* (Yale University Press, 2014), p.30

⁴⁰ Complementary colours, The National Gallery

⁴¹ Guide to Impressionism, The National Gallery

Architectural approach

Within the architectural realm, this study delves into the exploration of shadows, aiming to discern their potential roles in the utilization of architectural spaces. By comprehending the diverse applications of shadows in architecture, the knowledge acquired in this section can be effectively employed for analyzing shadowscape phenomena within housing case studies. Furthermore, this knowledge can be integrated into the initial design phase, serving as a demonstrative example of how shadows can be used in architecture.

In this section, I have learnt four main aspects of use of shadow in architecture. Firstly, the transition of brightness to darkness with light and shadow can enhance the experience of entering from exterior to interior. By the use of shadow to enhance the entering experience, it can give the occupants a sense of being inside, in the darker environment. Secondly, in the darkness of shadow, one tends to feel a self-centred and outwardly expanding domain. In a dark environment, the person is able to perceive his or her own sphere more than the intrusion of other matters. Thirdly, The use of dark colour and the curved shape could intensify the performance of shadow. Therefore, when considering to enhance the darkness of shadow in a space, these two tactics can be applied to the design of the space. Finally, in architecture, the performance of shadow has a great connection with the position of window openings, details, and folded walls. Moreover, in the case where window openings do not expose interior activities, the presence of the shadow reinforces the enclosed nature of the space. Therefore, when there is a demand for an enclosed space, we need to carefully consider the three elements of the space: the wall, the window openings, and the shadow.

(1) Enhance the sense of transition of spaces with brightness to darkness.

The darkness of shadow in architecture brings a strong and distinct feeling to occupants. Edmund Burke (1729-1797) wrote: "As the management of light is a matter of importance in architecture, it is worth enquiring, how far this remark is applicable to building. I think then, that all edifices calculated to produce an idea of the sublime, ought rather to be dark and gloomy..."⁴² He explained that the darkness is known by experience to a greater effect on the passions than light, and it can also make an object very striking. In other words, the darkness contains a dramatic force that is easy to perceive for occupants. To put this reasoning into the darkness of shadow in the sequence of entering interiors from exterior, the transition from light to dark is a way to recognize oneself entering an interior space. "... when therefore you enter a building, you cannot pass into a greater light than you had in the open air; to go into one some few degrees less luminous, can only make a trifling change; but to make the transition thoroughly striking, you ought to pass from the greatest light, to as much darkness as is consistent with the uses of architecture."⁴³ Such as one pass the limen (read as both threshold and lintel) to enter a building, the dramatic intensification of darkness is attended to strengthen the experience of entering spaces.

(2) Expansion of personal space in the darkness.

Shadows encompasses both visual and other sensory qualities. Within the shadowscape one feels the abundant layers of shadows, and thus the relationship between the space itself and the interior and exterior. Shadowscape allows one to feel the shifting boundaries between inside and outside through the other senses that are magnified in the darkness. To quote the explanation of the darkness by Fundamental Concepts of Architecture: "Indoor darkness ...creates its own experiential quality... The darker a room is, the more strongly it opens itself up to other levels of sensory perception. When spatial boundaries become diffuse and dissolve in the darkness, our own location in space becomes indistinct. In darkness, we experience the expansion of our personal space yet feel ourselves centred more strongly within our bodies."⁴⁴ Through the darkness of the shadows, one can feel the expansion of personal space and the ambiguity of boundaries, and this allows us to feel that we are merging with the interior space. I believe

that this is the contribution of the shadows to our perception of space, allowing us to feel integrated and protected in the blurred boundaries of space with different senses, thus creating a sheltered function.

(3) Enhance the intensity of shadow performance with colors and the shape of space.

Sir John Soane's Pitzhanger Breakfast Room is one of the examples which use the color in the interior to intensify the shadow performance. By seeing Joseph Michael Gandy's painting, interior perspective of the Breakfast Room (Fig.2.8), light and shadow is presented in the painting. Gandy drew the Breakfast Room as viewed from the east through a proscenium arch of deep subaqueous blue curtains. In the painting, "a low shaft of morning sun penetrates deep into the north-west corner of the room creating a mysterious halo-like light source, more like the lamps in his tomb chamber scenes, or those of the stage, than real natural light."⁴⁵ As a result of the shape of the space with a curved ceiling and the arched-shaped window in the Breakfast Room, it creates a mystery shape of light and shadow indoors. "From this spectral aureole originate the theatrical shadows cast by the chimney mantels, the urns, the great vase itself and the open doors to the library where Mrs Soane is seated. The canopy is a hovering ochre penumbra, borne upwards by the winged victories in its spandrels, whose dim cirque echoes the corona of light."⁴⁶

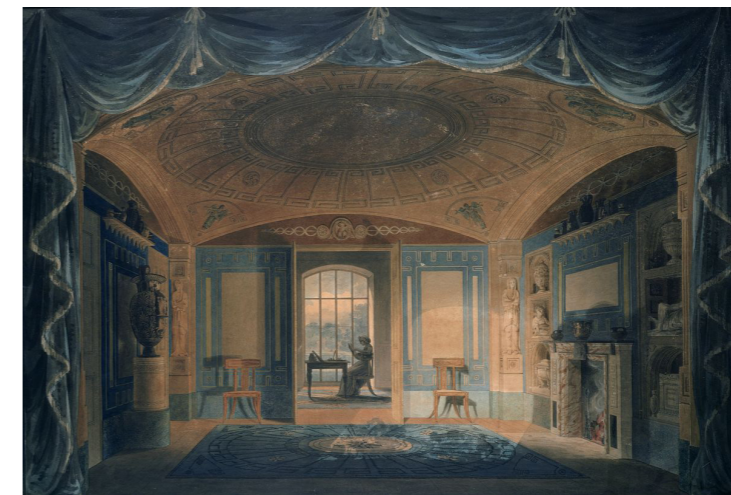


Fig.2.8, "interior perspective of the Breakfast Room, Pitzhanger Manor, looking towards the Library (1802- 3)"

⁴² Burke, *Sublime and Beautiful*, Part II, Section XIV, p. 122

⁴³ Ibid., p. 122

⁴⁴ Alban Janson and Florian Tigges, *Fundamental Concepts of Architecture: The Vocabulary of Spatial Situations* (Basel: Birkhäuser, 2014), p.81

⁴⁵ Stephen Kite, *Shadow-Makers: A Cultural History of Shadows in Architecture* (London, 2017), p.96

⁴⁶ Ibid., p. 96

“The colouring scheme is very important to the final atmosphere...”⁴⁷ The deepened tone of the color in the room produced an intensity of the darkness as the key details to occupants to perceive the striking change when walking from the breakfast room to the library. As Gillian Darley describes, “The picturesque interplay between the exterior and interior was continual’, between, for example, the ‘sternly classical’ Breakfast Room and the lighter Library ‘thrown open as if under a shady pergola at Pompeii...”⁴⁸ It is the intensity of “effect” Burke describes of “a quick transition from light to darkness, or from darkness to light”⁴⁹ which create the difference between the shadowed Breakfast Room and the light pergola library.

(4) Shadows as elements in architectonic compositions to create a sense of enclosure.

Louis I Kahn’s Margaret Esherick House (Fig.2.9) and Tribune Review Publishing Company Building are two examples which showcase how to use shadow as architectonic compositions to create a sense of enclosure, especially by the design of windows, folded walls, and furniture.

In the background of post-Enlightenment polarities of modernism which divided the world into ‘good-bad, bright-dark, light-heavy, or transparent-secret’, dissolving interior and exterior in the pursuit of evermore brightness to ever greater depths, Louis I Kahn was in the front line against the denial of the shadow in modern architecture. Light and shadow are both essential in Kahn’s architecture. There are many moments in his architecture when shadow becomes the predominant figure. Kahn treats shadows as coequal elements in these playful architectonic compositions.⁵⁰ To be noted, he strengthens the shadow by introducing ample natural light indoors. “...to be true to the argument that an architectural space must have natural light, I would say that it must be dark, but that there must be an opening big enough, so that light can come in and tell you how dark it really is – that’s how important it is to have natural light in an architectural space.”⁵¹ The perception of darkness of shadow in spaces is the intention of introducing light in Kahn’s architecture.

Kahn developed the way of performing shadow which inherent in thick walls or furniture with deep thickness. Take the shadow in Esherick House for example (Fig.2.10), “the shadows cast from the bookcases – from the upper horizontal glazed part of the keyhole – reinforce this feeling of protective enclosure. The vertical ventilation slot is unglazed, so to open its panels is a seasonal act that dramatically admits light, cross-ventilation and a glimpse of nature, into this withdrawn end of the living space.”⁵² The house itself becomes a container of the space and shadow by the enclosure of folded walls which described by McCarter as “building shadow and space with folded walls”⁵³. The other case which could demonstrate Kahn’s use of shadow by window setting is Tribune Review Publishing building (Fig.2.11). As the upper part of the Tribune Review’s keyhole windows facing north, it establishes a horizon of upper diffused light that utilizes the ceilings and walls as reflectors, while allowing the desk-worker a distinctly framed eye-level view within protective shade. According to Kite, the author of this article, this tonal balance in light and shadow in Tribune Review Publishing building is also portrayed in A man seated reading in the Dutch interiors, in which the window placement and shade play a crucial role for the behavior of occupants. (Fig. 2.12) All in all, the shadow and windows provide occupants a sense of enclosure and being contained.



Fig.2.9, “Perspective view of Margaret Esherick House, Chestnut Hill, Philadelphia”



Fig.2.10, “Living Room of Margaret Esherick House, Chestnut Hill, Philadelphia”, Keyhole window



Fig.2.11, “ground floor office space of the Tribune Review Building”



Fig.2.12, “A man seated reading”, Follower of Rembrandt, 1628–30

47 Ibid., p. 98

48 Darley, *Soane, Accidental Romantic*, p. 158–9.

49 Burke, *Sublime and Beautiful*, Part II, Section XIV, p. 121

50 Stephen Kite, *Shadow-Makers: A Cultural History of Shadows in Architecture* (London, 2017), p.238

51 Latour, Kahn. Writings, Kite’s emphasis, Quoted from *Shadows: the depiction of cast shadows in Western art* (Yale University Press, 2014), p.93

52 Stephen Kite, *Shadow-Makers: A Cultural History of Shadows in Architecture* (London, 2017), p.248

53 McCarter, *Louis I Kahn*, p. 160.

Conclusion

If one desires to attain intimacy by perceiving the space, what are the specific conditions for low-contrast shadowscape to achieve such a purpose, by considering the interior colour, the shape of the space, and the position of window openings, details?

Through the observational approach of shadow studies, I have learnt how to categorise shadows of different scales, materials and details, and I will systematically categorise the shadows observed in the housing case studies. Through the perceptual approach of shadow studies, I have learnt about the types of perceived shadows from the perspective of the perceiver. I will use the categorisation system I learnt to categorise the shadowscape observations in the housing case studies. In addition, by understanding what different styles of shadows depict to make the viewer perceive, I have learnt that if one wants to perceive the space as a whole and not just a specific object, it is more possible to achieve this through the depiction of the shadow and light overall distribution in the space and its level, which can be recognized as a gradual change of shadow or diffused light. This state of environment is dominated by gradual change of light and shadow instead of the individual light and shadow in the picture, which is close to the low-contrast shadowscape. On the contrary, if the shadow is simply strongly depicted by individual objects, which can be recognized as a sharp and clear shape of shadow/ direct light. This state is close to the high-contrast shadowscape, it will make the viewer feel the individual objects rather than the whole space. Through the architectural approach of shadow studies, I have learnt about the use of shadow in architecture. In the darkness of shadow, one can feel the expansion of one's own field and the feeling of being enclosed in a room. In addition, if one intends to enhance the expression of shadow, one can consider the colour of the interior, the shape of the space, and the position of window openings, details. Based on the idea that shadow can give a person the sense of enclosed in a space, low-contrast shadowscape seems to be more similar to allow people to perceive the overall state of the space. If one desires to attain intimacy by perceiving the space, what are the specific conditions for low-contrast shadowscape to achieve such a purpose, by considering the interior colour, the shape of the space, and the position of window openings, details?

2.3 Window in domestic space Studies

Historically approach

In this section, I mainly focus on the development of window in Danish domestic space, with attention to the mid-19th and late 20th to 21st centuries in Copenhagen. Why do I choose these two periods for window design? Firstly, because the window design in the mid-19th century was in the time of urban expansion in Copenhagen, when a large number of residential buildings were built outside of the rampart. The architectural styles at that time were between Classicism and Historicism, and the form of windows was deeply influenced by these two styles. Secondly, the period from the end of the 20th century to the present-21st century is also a period of great urban expansion in Copenhagen, and a large number of residential buildings were built, both in a newly developed areas and already developed areas. During this period, the styles of architecture has shifted from Modernism, Postmodernism, Minimalism to Contemporary⁵⁴. However, the window forms are mainly closely related to the revolution of construction technology and building regulations under the background of the these architectural styles. By exploring these two periods of mass housing construction in Copenhagen, I aim to understand the role of the window in the housing of these periods, especially to understand the relationship of the window to the urban texture and the interior living space. In addition, this exploration also explains the reason why I have chosen cases in each housing of these two periods, which are Kartoffelrække (1873-1889) and Dortheavej Residence (2018), to study the effect of the window on shadow and intimacy in the home interiors.

(1) Danish pier window architecture in 19th Century, from Classicism (1770-1830) to Historicism (1830-1900)

In Classicism (1770-1830)⁵⁵ in Denmark, the design of the windows usually responds to the compositional order of the facade and the use of daylight in the interior. According to Boje Lundgaard (1943-2004), who was a Danish architect and professor, co-founder of the design studio Lundgaard & Tranberg, "in Classical architecture, fenestration was usually rhythmic, modulated repetition of uniform elements, and if necessary, with certain variants to emphasize different building sections, or with respect for varying ceiling heights."⁵⁶ Under this order, there is the consideration of the light, and the different heights of the windows are varied. "It is this variation in ceiling heights, with the accompanying change in window heights, that often gives older buildings a supple, steeped rhythm despite the uniform window width. It also expresses the natural logic of employing larger areas of fenestration in the lower floors of the building, and small areas above where there is more light."⁵⁷ As the facades of Classical architecture broken down to brick piers between the windows and brick parapets while it appears as a smooth surface of uniform thickness, the orderly way of organizing a façade also reflects the building's structure. "Thus, the structure's measured rhythm of piers creates a similar order in fenestration and the resulting Danish expression: pille/vindue (pier/window) architecture."⁵⁸ When looking at Danish Classical architecture from this term, one can see the importance of windows in defining the external order of the façade and internal use of daylight in a building.

To look into the windows in housing in Classical architecture in Copenhagen, the characteristics of Danish pier window architecture can be seen in one of the examples which Boje Lundgaard had mentioned in the article.⁵⁹ The housing on Skindergade 34 in Copenhagen designed by CF Hansen (1756-1845), who was the leading architect of Danish Classicism⁶⁰, the fenestration of the façade has a rhythmic order with the consideration of daylight varied with different heights for indoors (Fig.2.13). This example showcases one of the Classical residential architectures in Copenhagen, and it demonstrates that the fenestration of the façade is not only for the exterior, but also for the different daylight conditions in the interior.

After Classicism, Historicism (1830-1900)⁶¹ took a great turn in the mid-19th century with the rise of the bourgeois and the context in which housing could be constructed outside of the ramparts of Copenhagen. "Towards the middle of the 19th century, the classics-inspired Historicism of the early Enlightenment was gradually abandoned for yet another new iconography, this time that of the nation state, in which the emphasis was a Historicism which could buttress the historical justification for the bourgeois nation state."⁶² Also, because housing can be built outside of ramparts, housing is growing rapidly to meet the situation of increasing urban population which cause the desperate need of residential space. In terms of housing styles at that time, the new Historicism borrowed imported styles from different countries around Europe. "Politically and artistically, there was a significant 'globalisation', coupled with an almost explosive urbanisation as the economy changed its focus."⁶³ Due to these imported styles in Historicism, it is rather difficult to describe the window designs of Historicism in a uniform style, but the background in which they were designed is worth noting. In particular, the context of urban expansion

54 History of the window, VILLUM WINDOW COLLECTION

55 Classicism, Realdania By & Byg

56 Boje Lundgaard, *Windows* (Copenhagen, 1996), p.7

57 Ibid., p. 7

58 Ibid., p. 9

59 Ibid., p. 6

60 C.F. Hansen, Den Store Danske Kunst og kultur Arkitektur Dansk arkitektur i 1700-tallet, Lex.dk

61 Historicism, Realdania By & Byg, <https://www.realdaniabyogbyg.org/historicism>

62 Ibid.

63 Ibid.

has led me to choose Kartoffelrækkerne to study the urban texture of its period of production (Fig.2.14). Kartoffelrækkerne was designed by Frederik Böttger(1838-1920), who was a Danish historicist architect. In this case, "light, air and modern installations were important program points."⁶⁴ Similarly, the focus on the light is persisted in the design in the case of housing on Skindergade 34 and Kartoffelrækkerne. By understanding Danish pier window architecture's focus on urban textural order and interior daylight, and Historicism's mass production of housing in the context of urban expansion, I aim to study Kartoffelrækkerne's windows to understand the impact of daylight to influence the design of the facade and the window, and how shadowscape affects the occupant's sense of intimacy, given the design focus on daylight.

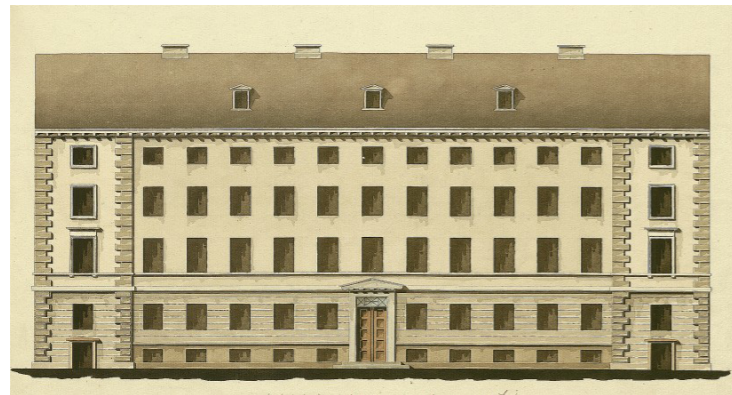


Fig.2.13, Skindergade 34, 1812-1815, Christian Frederik Hansen

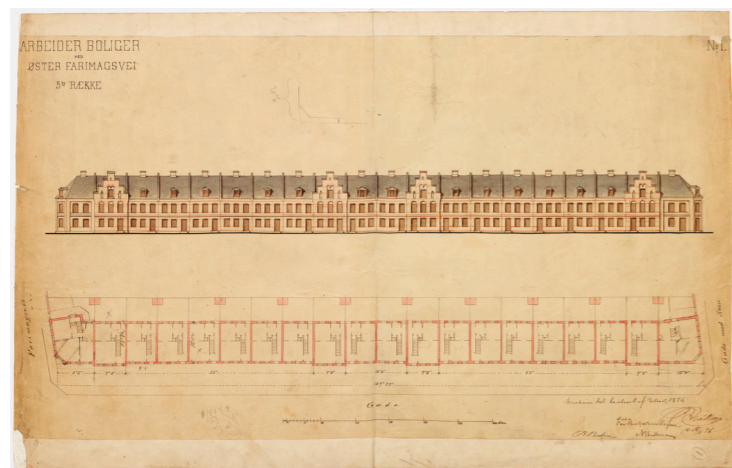


Fig.2.14, Kartoffelrækkerne

(2)Windows in Modernism Danish architecture, from Modernism (1930-1970)⁶⁵ to Energy crisis (1970s) Because of the change of construction technology and building regulation, the size and type of windows in Modernism Danish architecture have been drastically changed. The modern architecture movement altered the classical façade organization, according to Boje Lundgaard, because of the new ways of construction. "New building methods in concrete or steel allowed the creation of nonbearing facades, or facades with minimal bearing elements, which suddenly offered a greater freedom in fenestration."⁶⁶ Since the building method releases the restriction of windows' size, this resulted in new façade expressions with continuous horizontal bands of windows, corner windows or windows with varying proportions and placements according to free artistic compositions. At the same time, window areas increased considerably, and in some cases covered the entire façade.



Fig.2.15, SAS royal hotel, Copenhagen, 1955-1960, Arne Jacobsen (1902-1971)

64 Kartoffelrækkerne, Den Store Danske Kunst og kultur Arkitektur Arkitektur - Danmark Dansk arkitektur i 1900-tallet, Lex.dk

65 Modernism, VILLUM WINDOW COLLECTION

66 Boje Lundgaard, *Windows* (Copenhagen, 1996), p.9

In the context of the growth of glass architecture, the problem of overheating indoors, reflecting facades and unobstructed view to the interior was formed. This also shows that this type of window, if applied in housing, creates a potential external community environment and indoor living problems. The large glass façades are built in different functions of buildings in Denmark, including residential architecture. "In Denmark during the 1950's and 1960's, houses were also built with large glass facades."⁶⁷ The glass architecture in Denmark was manifested in Arne Jacobsen's Royal Hotel (Fig.2.15), according to Boje Lundgaard. Arne Jacobsen introduced this new international style to the Copenhagen urban scene. However, this glass architecture was not always well received. "In terms of the city structure, critics maintained that this concentration of glass surfaces created a shiny, cold and alienating urban environment. As for the indoor climate, the large glass facades often gave serious heat load problems in the summer and difficulties with cold and drafts during the winter." If this concern is put into a residential building, I argue that we need to consider more critically the impacts that large windows bring to the occupants at home.

In 1972, the design of the window in Danish architecture was changed by the building regulation which at that time became influenced by the Energy crisis. "In 1972, as a result of the so-called energy crisis, a radical rejection of glass architecture occurred... Calculations showed that almost half of a building's heat loss occurred at the windows, which in Denmark led to a significant revision of the building codes."⁶⁸ The size of window areas were reduced and the insulation was increased because of the regulation regarding to the avoid energy loss from the opening of building (Fig.2.16). This regulation has led to almost twenty years of building activity based on the window solution, with thicker walls and smaller windows. Also, the consideration of daylight from the window has also been subordinated to the energy agenda to nowadays. "First in an addition from 1979 to BR77 focusing on heat loss and thus allowing a maximum opening area of 15% of the building's gross floor area. This requirement had an immense impact on daylight intake and can be seen directly in architectural design, revealing a huge difference in having a minimum daylight intake of 10% of the floor area to a maximum of 15% of the building's gross floor area."⁶⁹ The different window size constraints in the regulations resulted in the valuing the priority of need for well-lit and less well-lit spaces, such as large windows in kitchen and living room and smaller windows in bedrooms, storage rooms and bathrooms. Architectural codes profoundly influenced window design during this period and continue at present.

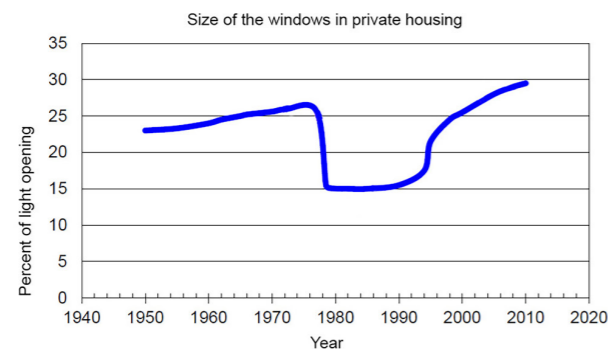


Fig.2.16, Permitted size of windows according to the Danish Building Regulations

(3)The window in Contemporary Danish architecture, from the 21st Century

The size of windows in 21st century architecture is once again being enlarged under the loosening of building codes while still being constrained by the need to avoid energy loss. In addition, due to the increasing demand for urban living space, 21st century residential buildings are being constructed in large numbers within the existing urban grain. With the revival of large windows and the complexity of the urban texture, the residential space is faced with a complex external space, and the interior living activities may be affected. This has aroused architectural scholars' concern about how residential architecture should respond to the increasing complexity of the external environment. In the second chapter of the case studies, I have chosen the Dortheavej Residence designed by BIG Design Team, which is known for its residential buildings with large windows (Fig.2.17), located in a former industrial area. I aim to investigate the relationship between the design of the windows and the urban texture, as well as the sense of intimacy felt by the occupants of the interior.



Fig.2.17, Facade of Dortheavej Residence, façade facing north(left), façade facing south(right)

⁶⁷ Ibid., p. 11

⁶⁸ Ibid., p. 15

⁶⁹ Nanet Mathiasen, Anne Kathrine Frandsen & Louise Grønlund, Daylight conditions in housing-Its role and priority in Danish building regulations, Architecture, Structures and Construction volume 2, pages23-37 (2022), p.33

According to Kristian Kristiansen, who was a researcher at the Norwegian Construction Research Institute, head of the secretariat for the Construction Development Council as well as associate professor and head of studies for DTU's master's postgraduate training for managers in the construction industry⁷⁰, "...The buildings [of the Copenhagen bridge districts] are basically the same, but also have many small variations, so that there is both harmony and life... the floor heights and depths of the buildings were the same. The houses were brick with (most often) tiled roofs. Everyone got Dannebrog windows." Compared to buildings of the Copenhagen building boom in the mid-19th century, the modern buildings are distinct. Kristiansen says about modern building construction: "...the buildings stand and shout at each other. Detailing is no longer used. The buildings appear as uniform surfaces with large glass sections."⁷¹ Under this circumstance, Kristian calls for the need for research and development on this issue. Perhaps things need to be built quite differently within the dense and complex urban fabric. Moreover, the boundary between public and private has to be redefined under this situation. The Danish Architect and writer, Jørn Ørum-Nielsen wisely said about housing: "Today, the greatest challenge in housing is to define the balance between the individual and the community, in the realm of management and organization, and within the framework of the daily lives of individuals and families."⁷² In this context, the research on residential architecture surrounded by complex external environments is particularly crucial. "The Copenhagen-based business Bjarke Ingels Group (BIG) is responsible for some of the most forward-thinking examples of modern architecture in the world - and that includes a lot of projects in Denmark."⁷³ Especially, BIG had designed numerous numbers of housing projects in Copenhagen, which shaped the city scene differently in the 21st century. By examining BIG's Dortheavej Residence - a residential building with large windows in a developed urban texture, I aim to investigate how the large windows of the home respond to the complexity of the external environment and how they respond to the intimacy which occupants needs in the interior.

Perception approach

In this section, I aim to study the atmosphere created by the cultural way of illumination/daylit environment in Danish domestic interiors. Also, I argue that the practice of a certain type of illumination/daylit environment could be connected to the Danish culture of hygge in the realm of domestic space. This cultural practice of hygge strengthen the motivation of maintaining the state of illumination/daylit environment. To understand the culture of maintaining a type of illumination/daylit environment at home is to bridge the connection between intimacy and shadow in domestic space.

Furthermore, I aim to understand the perception of the window in the room and the window itself in Danish domestic space, based on the comparison between the typical Danish casement window and the energy-efficient windows nowadays. This investigation lies in the background of appreciation of daylight in the context of Nordic countries. In the Nordic countries, there is a special awareness of light, and the changes in weather and season. The long, dark winter days bring a longing for the return of spring and sunlight. Therefore, there is a tendency for occupants to reach the daylight from the window at their home. However, I argued that the consideration of the potential problem of over-abundant daylight entering homes must be discussed further, not within the number of how much daylight should enter in the building regulation, but within the perception of the daylight condition from the window in the room. "Most people have experienced poor lit rooms, yet not many complain when there is excess light, and if they do it is more a question of overheating as a source of discomfort."⁷⁴ The overlook of excess daylight from the windows and the window itself may not only cause overheated indoor climate, but also cause the disturbance of indoor behaviour, which may influence the sense of intimacy. By comparing the perception of typical Danish window and energy-efficient windows

in this section, I aimed to compare how the window setting affects occupants' perception of the daylight condition of the window in the room and window itself in relation to the daylight condition in the room.

(1) Home atmosphere in low-level illumination/daylit interior

"Wolfgang Schivelbusch (1988) elaborates on how the nineteenth-century expansion of domestic gas and electric light was accompanied by reflexive endeavors to shape mood and atmosphere in the home. He explains many householders initially refused to use the newly supplied gas, for they preferred the warm glow offered by fires, candles, and paraffins and oil-lamps around which families gathered to converse or read, sources of light regarded as more conducive to a cozy domestic atmosphere."⁷⁵ Occupants' perception about the harshness of gas and electric light also stimulate them to modulate the pouring daylight indoors by diffusing and dampening the sun's rays with muslin and gauze curtains. Also, in the increasingly private bourgeois home, occupants tend to tone down the brightness of artificial and natural light and use color on walls and in stained glass to bestow a mild radiance on rooms to create kindled atmospheres. This act of reducing the glare of natural light in private bourgeois homes seems to provide a hint that privacy is connected to the lighting condition, with the characteristic of lighting as a tool to shape mood and atmosphere in domestic space. Due to the culture of toning down the brightness of artificial light and daylight in domestic space in 19th Century, the window plays a role to maintain the condition of low-level illumination/daylit interiors with its own setting and its surroundings.

(2) Hygge

According to Mikkel Bille, the practice of toning homespun atmosphere is a widely shared culture in Denmark, which is related to the culture of hygge. He exemplified this theory with the Danish practice of producing coziness through lighting, a practice that extends into public and commercial spaces but is especially pertinent in producing domestic aesthetics. As mentioned before in the former chapter, "this affective and aesthetic orchestration of space to maintain the condition of hygge, loosely translated as coziness but also connoting intimacy, conviviality, and enclosedness, by deploying hyggelys, or "cozy-light," is a key element of Danish national identity, widely practiced in the long, dark winter months."⁷⁶ The long dark winter weather in Denmark has deeply involved into the illumination culture which people are tend to be in a low-level illumination/daylit environment. The low-level illumination/daylit environment "tinctures the surroundings, blur the boundaries between things, and shapes a vague, enfolding, intimate space..."⁷⁷ To conclude, this shared light culture allows ones to utilize the light and shadow as a way to define spatial boundary, and to create atmosphere. Low-level illumination/daylit environment could blur the spatial boundary and create a sense of intimacy in relation to privacy.

According to Denmark.dk organized by Ministry of Foreign Affairs of Denmark, the various definition of hygge can be traced back to the Middle Age, where a similar Old Norse word meant "protected from the outside world."⁷⁸ It encourages its practitioners to shelter, cluster, and enclose. Also, according to Jeppe Trolle Linnet, he suggests that "the analytical metaphor of 'the shelter' captures central aspects of what hygge is all about."⁷⁹ Outsiders find it hard to get access to this kind of occasion because hygge are

70 Kristian Kristiansen and Realdania, Realdania, cities and construction

71 Kristian Kristiansen, *Expert: Modern construction is an insult to the eye* (Politiken, 2023), 10 APR 2023 AT 15.35

72 Jørn Ørum-Nielsen, *Denmark's Living Housing Tradition* (Avebury Publishing Limited, 1995), p.263

73 Ibid., p.263

74 Boje Lundgaard, *Windows* (Copenhagen, 1996), p.17

75 Wolfgang Schivelbusch, *Disenchanted Night: The Industrialization of Light in the Nineteenth Century* (University of California Press, 1988), Quoted from Tim Edensor, *From Light to Dark: Daylight, Illumination, and Gloom*. Minneapolis (University of Minnesota Press, 2017), p.156-157

76 Mikkel Bille, Peter Bjerregaard, Tim Flohr Sørensen, *Staging Atmospheres: Materiality, culture, and the texture of the in-between* (Elsevier B.V., 2015), Quoted from Tim Edensor, *From Light to Dark: Daylight, Illumination, and Gloom*. Minneapolis (University of Minnesota Press, 2017), p.158

77 Ibid., p. 158

78 Denmark.dk, People and Culture, What do we mean by "hygge"?, <https://denmark.dk/people-and-culture/hygge>

79 Jeppe Trolle Linnet, September 2011, *Social Analysis, The International Journal of Anthropology* 55(2):21-44, p.34

taken place mostly indoors with enclosure. In other words, in the context of Danish home, the enclosure and intimacy within family members and individuals in home are crucial elements based on the "hygge" characteristic. By understanding the spirit of "hygge" as part of Danish identity, I had an initial conclusion that the privacy within Danish domestic space is defined by these keywords which has been repeated depicted in the meaning of "hygge". "Intimacy", "enclosure" and "sheltered" by the means of low-level illumination/daylit. The boundary between exterior and interior is extremely crucial to accomplish the function of those three keywords, and we have to face the issues that modern dwellings may not provide these settings by large windows which expose occupants to outside world to a great extent.

(3)The perception of window in the room and the window itself, in the typical Danish window and energy-efficient windows

In regard to the typical Danish window, which is known as casement window or Dannebrog window (Fig.2.18), "the typical Danish window appear as a hole in the wall, surrounded by panels and terminated at the bottom by a window sill, a popular place for plants and other items to absorb and reflect light in a fashion we find pleasing."⁸⁰ To look into the window itself, the partition of the casement window itself also allows the light to change gradually by its slender dimensions. The traditional Copenhagen casement windows consist of a cruciform frame that carries four outward opening sashes with thin, puttied glass. "The frame, sash and muntin sections are finely profiled on the in-side, which gave slender dimensions and a beautiful, graduated change in light."⁸¹ The description of the traditional windows points at that the occupants receive a mixture of direct, blocked, transmitted and reflected daylight, according to the construction of the window and what is placed on the window sill. Also, the window's profile and slender partition provide the chance for occupants to perceive treated daylight on the window.

Since the window connects outside and inside, the placement of the window in the façade construction is also crucial in terms of how occupants perceive the window itself in the interior. "In the old Copenhagen area, they (casement window) are recessed about five centimeters."⁸² The setting on the façade surrounding the window is also significant. "The traditional Danish window in a brick outer wall usually has mortar joints on three sides and a protruding sill to lead off rainwater. The form of this can have a major aesthetical influence on the total façade expression."⁸³ The small retreat of the window from the outer wall is a crucial detail that shade the direct sunlight and give a sense of shelter for the occupants in the interior.

Compared to the window in housing nowadays, the window setting of interior and exterior usually varies from project to project. However, the window itself has played a role in the room to avoid heat loss, without so much consideration of occupant's perception of the window itself in relation to the daylight condition on the object. "The typical window of today is quite different. With double or triple thermal glazing, coated or gas filled, there are heavy muntins in aluminum, plastic or wood of a quickly grown, poor quality."⁸⁴ The partition of the window has become bigger without a small detailed shape on itself which may diffuse the direct sunlight when comparing to the ones in the old casement window. The focus on keeping as much as heat in the room has led the development of window with the evaluation of losing as few as possible heat. The heat loss through a window is indicated by the U-value. The lower the U-value, the less heat loss. "The first energy-efficient windows from the 1980s had a U-value of about 2. After the year 2000, Plus-energy windows halved that number."⁸⁵ The goal to let daylight enter and heat the room seems to have become the only one goal on the development of the window, but the perception of the window itself and how daylight interact with it is also important, when designing the

window. Many of the subtleties of the window have been replaced by a larger partition, which provides less opportunity to treat the sunlight, and the perception of the window itself receives fewer nuances of the gradual changes in daylight.



Fig.2.18, Dannebrog window, VILLUM WINDOW COLLECTION

80 Boje Lundgaard, *Windows* (Copenhagen, 1996), p.17

81 Ibid., p. 22

82 Ibid., p. 21

83 Ibid., p. 21

84 Ibid., p. 25

85 Energy-efficient window, VILLUM WINDOW COLLECTION, <https://en.villumwindowcollection.com/all-about-windows/types-of-windows/energy-efficient-window/>

Conclusion

By looking at the increasing number of factors that have been incorporated into window design, and the increasing complexity of the functions that windows must fulfil, do windows in domestic space create an interior environment that is able to provide desired intimacy for the occupant?

By understanding the development of the window at two key historical periods, I have learnt that Pier window Danish architecture has a consideration for the order of external space and the use of light in the interior. And in the context of urban expansion in the mid-19th century, one of the cases produced at that time - Kartoffelrækkerne - also carried the same emphasis on daylight. Focusing on modern window design, which has expanded in size due to advances in building technology and reduced in size due to energy loss and building code controls, I have been able to understand how windows have evolved through history. By looking at the increasing number of factors that have been incorporated into their design, and the increasing complexity of the functions that they have to fulfil, I extend this understanding of the evolution of the window to the question of whether the window still provides an interior environment that is able to provide sufficient intimacy for the occupant in the context of a code regulated and increasingly complex external environment. Therefore, I aim to address this issue by conducting housing case studies. By comparing the case of Dortheavej residence, which has large windows in the complex external environment, and Kartoffelrækkerne, which has traditional Dannebrog windows in the housing-functions external environment, I aim to understand the perceived intimacy behind the window by examining the difference of shadowscape (and the role of shadowscape) in the interiors behind the traditional Dannebrog window and behind a large contemporary window.

By understanding the perception that window brings to occupants in the living space and the cultural practice of hygge in Danish domestic space, I have learnt that occupants can obtain intimacy from the low-level illumination/daylit environment in the Danish domestic space. In addition, this environment will affect how people perceive the space in relation to the daylight condition because of the position, the surrounding settings, and the details of the windows in the space. The role of the windows not only affects the overall perception of the space, but also the windows themselves are an important element to perceive. Therefore, when considering the low-level illumination/daylit state of the interior, in addition to considering the impact of the windows on the daylight condition in the room, the way in which the windows themselves respond to the daylight condition also needs to be considered.

2.4 Theory Studies Conclusion

In the theory studies, I have learnt about the essential qualities of privacy/ intimacy, shadow and window in domestic space and how they are related to shadowscape. This has supported me in conducting housing case studies in a systematic and logical manner. Below I outline some key points that I have learnt from the theory studies, and these points guide and refine the scope and methodology I will use for researching the housing cases studies.

(1) Privacy / intimacy

a. Since occupants' needs for privacy/intimacy vary with time and situation, I will consider the different levels of occupants' needs for privacy/intimacy at certain times and situations in the housing case studies. In the interview, I will inquire whether there is a different level of need for privacy/ intimacy under specific circumstances.

b. Based on the weaker spatial structure of neighbourhood in the urban texture to maintain or enhance

the privacy/intimacy of homes, I will analyse the urban texture of the housing case studies. By comparing the distances between household and the functions of building in its surrounds, I aim to examine whether the homes are exposed to a more public state.

c. Based on the understanding that privacy/intimacy does not only exist in the family, but also in each family member. In the housing case study, I will focus on the independence of the family members and explore each member's perceptions of privacy/intimacy.

(2) Shadow

a. To understand how to observe shadow performance at different scales and to categorise the detailed performance of shadows, I will systematically categorise the performance of shadows in housing case studies. This categorisation will facilitate my understanding of the composition of the shadowscape and the detailed performance of shadows and will allow me to compare it to different case studies.

b. Given the different effects of different shadow performances on individuals, I can analyse what kind of shadowscape the shadow performances of the two housing case studies tend to be, and what kind of feelings such performances bring to the individual.

c. With an understanding of how shadow can be emphasised in architecture, especially on the walls, interior colours, and window composition. While observing shadowscape in housing case studies, I will also observe these significant elements to see how they are related to shadow performance.

(3) Window in domestic space

a. Historically, the design of windows has changed from focusing on the order of the façade and the interior daylight condition to the control of reducing energy loss, so that the focus of window design has shifted, and many complex considerations have been added. Therefore, I hope that in the housing case studies, the impact of window design on perception of intimacy under different focuses of window design will be investigated.

b. By selecting two periods in the context of the mass production of housing in Copenhagen, I aim to study the impact of windows on the shadowscape in selected housing case studies from these two periods, and to reflect on the impact of these two mass-produced windows on the interior with the results of this study.

c. By understanding the Danish hygge culture of low-level illumination/daylit, which is linked to the sense of intimacy, I intend to understand the state of low-level daylit that occupants desire through interviews in housing case studies. I aim to understand how to create the sense of intimacy through the low-contrast shadowscape affected by the window settings.

Chapter 3

HOUSING CASE STUDIES

In this chapter, there are two main purposes for conducting housing case studies. Firstly, housing case studies can be mutually verified with theory studies. I will apply the analysis methods learnt from theory studies to the analysis of housing case studies. By doing so, I aim to understand the relationship between shadowscape and privacy/intimacy in housing case studies, and to understand the feasibility of theory studies. Secondly, in the housing case studies, I have chosen two housing cases in Copenhagen as representatives of two common types of windows in residential buildings in the city. By studying these two cases in urban scale and interior scale, and studying in depth the performance of the shadowscape and the perception of intimacy of the occupants, I aim to understand the relationship between shadowscape and intimacy by comparing these two cases. I expect to understand what type of shadowscape provides more intimacy after comparing these two cases.

There are three main factors why I chose the two cases - Kartoffelrækkerne and Dortheavej Residence - and I have briefly mentioned them in the Methods section of chapter 1. I will explain the reasons in more detail below.

Firstly, both cases were built at a time when the city was facing a high demand for housing and urban expansion. However, the urban texture of the two cases is very different. Kartoffelrækkerne is placed in the same area of the city, where volumes of the same residential functions and geometrical shapes are grouped together, whereas Dortheavej Residence is planned in a developed area, so that there are many volumes of other functions and different geometrical shapes around the house. The two residences are different in terms of the way the city is planned, so the exterior of the residential buildings is also very different in terms of its environment. By comparing and analysing these urban textures within these two cases, I intend to discuss the spatial composition of the community in these two cases in terms of the spatial analysis that the urban texture provides to the exterior of the houses. This comparison can also be reflected in Copenhagen's future housing scheme, while Copenhagen reaching the goal of Mixed Cities by 2031, living condition in city will become more complicated. I aim that the comparison of the external community structures in these two cases will lead to a discussion about what future urban textures will provide for the external community environment of housing.

Secondly, these two housing models, and their windows, were reproduced in large quantities in the city. The large number of these two types of housing units in the city allows these two types of housing and their windows to be indicators of the urban housing architecture produced in certain periods. The Kartoffelrækkerne model is the traditional urban detached house, designed by architect Frederik Bøttger, and numbering up to 1202 houses in the city, all with Dannebrog windows. The Dortheavej Residence model is a modern housing, with 1346 apartments with full-height windows in the city, designed by the architecture team BIG. I expect that in analysing and comparing the windows of these two types of housing, I can also represent an understanding of the same type of windows in housing units in the city.

Thirdly, the massing, window orientation and sun paths of the two cases I have chosen are approximately the same. Both Kartoffelrækkerne and Dortheavej Residence have a linear massing, with the main windows facing south, with similar sunlight paths. This allowed me to compare the two cases by focusing solely on the relationship between the exterior and the interior under similar sunlight conditions, and how the performance of the windows affects the shadowscape. Under these conditions of consistent sunlight condition, I was able to focus on the spatial structure of the

building itself and the impact of the windows on the intimacy and shadowscape.

In order to understand how urban texture shapes community space, I will compare these two cases historically at the urban scale. I aim to understand the context in which the urban grain begins to change and how this changes the spatial structure of the neighbourhood. In addition, I will also look at daylight orientation of these two cases. To gain a basic understanding of daylight conditions is to understand how both the urban context and the building itself in these two cases respond to the sunlight.

Looking into the case studies at the interior scale, the focus will be on investigating the shadowscape dynamics and occupants' behaviour within the housing cases. This will be achieved through a combination of shadowscape observation and interviews with the occupants. Shadowscape observation is set on the date, time and the weather when the direction of sunlight has the possibility to enter the interior directly, in order to understand how the windows setting process the outside direct sunlight. The shadowscape observation consists of observing the overall interior shadowscape which is close to the occupants' perspective, as well as scrutinising the relationship between the texture of the shadow and the distance from the windows from the observer's point of view. These two ways of observing are instrumental in analysing the occupant's overall perception of shadows, as well as analysing the distribution of shadows in relation to the specific distance from the windows, and the details and materials of the shadows that are affected by the conditions of the windows. I also utilize the shadowscape drawing based on the observation on the site on the date and time of my visit, to try to understand the momentary relationship between shadowscape and interior spatial composition. The interview facilitated a clear understanding of the relationship between intimacy, shadow and window. By interviewing occupants about their perceptions and experience of applying these three elements, I expect to be able to establish a stronger relationship between these three elements.

By undertaking these case studies at both scales, a comprehensive understanding of the external and internal contexts will be attained. Specifically, the aim is to compare the traditional urban detached houses characterized by Dannebrog windows with modern houses characterized by full-height window features. This comparative analysis seeks to explore the implications of window design on shadowscape performance and occupants' perception of intimacy.

3.1 Urban-scale case studies

In urban-scale case studies, I will perform a historically background and daylight condition comparison. By analyzing these two main aspects, I aim to understand the spatial structure of the building in the urban texture, the neighbourhood context, and the relationship between the building and sunlight. This study will facilitate the understanding of the exterior space of the building in the interior-scaled case studies.

Urban-scale case studies Method

In the historically background comparison, I will learn about the construction background of these two cases, the planned urban development and context, the architect's design style in relation to the building types in the city, and how the geometry of the building responds to the external urban texture. In the daylight condition comparison, I will compare the direction of the building's response to the sunlight. Also, I examine the relationship between sunlight and the exterior of the building when sunlight has the possibility to enter directly into the house at specific times, date and weather when I visited the buildings. The residential units I investigate on two sites are both on the first floor, which the front façade is facing the similar direction- Southwest. By this examination, I aim to understand how the distance between the buildings and the exterior responds to the sunlight, and how the shape of the building itself responds to sunlight.

Historically background Comparison

Kartoffelrækkerne, Indre Østerbro, 1873-1889

Kartoffelrækkerne's background comes from the need for providing cheap and healthy housing for working people during the 1800s. At the beginning of the 1800s the city's population lived behind the ramparts. "It was only after a cholera epidemic in 1853 that the workers' movement in the 1870's using labour organisation to achieve political influence both at work and over living conditions."⁸⁶ As a result of this background, Kartoffelrækkerne was built outside the ramparts.

Kartoffelrækkerne was built with English terraced house as an ideal. The architect, Frederik Bøttger, who is an architect for Arbejdernes Byggeförening. His residential architecture has several similar modalities in the city, and Kartoffelrækkerne is his most representative work. (Fig. 3.4-8)

Kartoffelrækkerne consist of 480 houses built for workers, and it was being built when the Indre Østerbro was just newly developed. The residential blocks (of two floors and a top floor below the roof) are aligned with each other. (Fig. 3.2) Because of the same function for dwelling concentrated in these areas, it creates a spatial constructure of neighbourhood which neighbours are close to each other, with 7-meter wide of the street, 4-meter depth of front yard facing the street, and 4-meter depth of backyard facing neighbor's backyard. The division of human scale creates a spatial constructure of close neighbourhood. Compared to the 14m-wide street outside of the neighborhood, the smaller scale of street between neighboring buildings creates a transition between the public space and private home

Dortheavej Residence, Northwest, 2018

Dortheavej was produced in a background which comes from the mission of non-profit affordable housing association- Lejerbo's mission is to create "room for life", which one of the objectives is to build, rent out, manage, maintain and modernize housing for all groups in need.⁸⁷ "BIG was commissioned to design Dortheavej in 2013 by Danish non-profit affordable housing association Lejerbo, whose

mission is drafted by Danish urban space designer Jan Gehl."⁸⁸ Dortheavej Residence was built in 2018 in PROVSTEVEJKVARTERET, Northwest, which used to be an industrial area characterized by car repair shops, storage and industrial buildings from 1930-50s. (Fig. 3.3) "Over the past few years, the area has undergone a change, where former industrial buildings and older provincial housing have been demolished and replaced by new housing built as suburban housing."⁸⁹

Dortheavej Residence is designed by BIG team, who designed numerous housings in the new area and developed area of Copenhagen. (Fig. 3.1) To quote the description of Dortheavej Residence from the President of Lejerbo, "Our ambition was to create affordable apartments by the world's leading architects. Together with BIG, we have succeeded in creating sustainable, safe and functional homes that see eye to eye with the people who live in them."⁹⁰ The buildings designed by BIG is characterized by its full-height windows. (Fig. 3.9-13) The Dortheavej Residence, which is located in the multicultural north-west area of Copenhagen, is worthy of study as a model for the future Mixed City of Copenhagen.



Fig.3.1, "Potential for addition social housing- Selected options until 2031 for more social housing in existing urban areas", Copenhagen Municipality- 'More Social Housing in Copenhagen', 23 June 2022

⁸⁶ Kartoffelrækkerne, THE HISTORY OF THE ROWS, Husejerforeningen at Øster Farimagsgade, Kartoffelrækkerne.dk

⁸⁷ Mission and visions, lejerbo.dk

⁸⁸ Homes for All - Dortheavej Residence / Bjarke Ingels Group, ArchDaily, <https://www.archdaily.com/903495/homes-for-all-dortheavej-residence-bjarke-ingels-group>

⁸⁹ PROVSTEVEJKVARTERET, LOKALPLAN 619, københavn kommune

⁹⁰ ArchDaily, "Homes for All - Dortheavej Residence / Bjarke Ingels Group", <https://www.archdaily.com/903495/homes-for-all-dortheavej-residence-bjarke-ingels-group>

Dortheavej Residence is a 5-story building, and it offers 66 new homes to low-income citizens. "Located in the multicultural northwest area of Copenhagen, the building winds through the neighborhood characterized by industrial buildings from the 1930s-50s."⁹¹ Inherited by the characteristics of industrial buildings, the façade expressions of each building in this area are different from each other, which creates a complex cityscape in this area. Furthermore, the curved geometry of Dortheavej Residence creates a public area on the front with a pedestrian passage going through the building to the garden and parking lot on the back. The context of the building location creates an opened character with a distance of 9-27 meters between itself and the other buildings across the street, with a park on the front, and a distance of 42-80 meter between itself and the other buildings across the park on the back side. Compared to the 14-meter and 30-meter wide of the street outside of the neighborhood, the scale of street between neighboring buildings doesn't form a smaller scale of spatial structure for neighborhood. Furthermore, after the urban regeneration in 2013 in this area, there are still some different function-use spaces scattered in this area. For example, offices, workshops in the neighborhood. In the future, there will be a new five-story residential building in the neighborhood, and there are a number of additional stories currently being added to the neighborhood. To see the future context of Dortheavej Residence, there will be more residential buildings in the neighborhood, with several existed industrial buildings. However, from the perspective of spatial organization of neighborhood, the distance between the household forms a weak structure of neighborhood.



Fig.3.4, 1870-72, 45 houses Gernersegade, Krusemyntegade & Sankt Pauls Gade
 Fig.3.5, 1874-77, 49 houses Olufsvvej
 Fig.3.6, 1873-1889, 480 houses Kartoffelrækkerne
 Fig.3.7, 1886-1891, 235 houses Humleby
 Fig.3.8, 1892-1903, 393 houses Strandvejskvarteret

Kartoffelrækkerne / Frederik Böttger



Fig.3.9, 2005, 230 apartments VM Houses
 Fig.3.10, 2008, 80 apartments The Mountain
 Fig.3.11, 2010, 475 apartments 8 House
 Fig.3.12, 2017, 495 apartments Kaktus Towers
 Fig.3.13, 2018, 66 apartments Dortheavej Residence

Dortheavej Residence / Bjarke Ingels Group: BIG

1870s
"Workers' movement"

2013
"room for life"

2022
"More social housing in Copenhagen"

2031

1873-1889
Kartoffelrækkerne, Indre Østerbro

2018
Dortheavej Residence Northwest

approx. 2,000 new social housing through densification on existing public land registers in Copenhagen

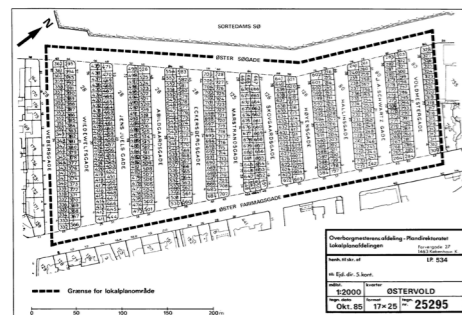


Fig.3.2, Lokal plan of Kartoffelrækkerne

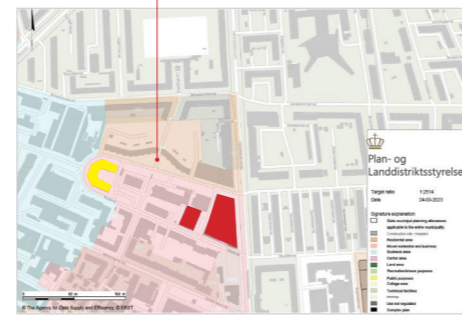


Fig.3.3, Situation Plan of Dortheavej (red dot), construction site (red area), and added floor on original building (yellow area)

91, Dortheavej Residence, EU Mies Award/YTAA, Danish-architecture, <https://miesarch.com/work/3924>

Daylight condition Comparison

Kartoffelrækkerne

(1) Sunlight Orientation

Kartoffelrækkerne's buildings are orientated in a north-east and south-west direction. (Fig. 3.15) In summer the sunlight path moves from the north-east to the north-west of the blocks, so that both the front and the back side of the buildings are receiving sunlight. In winter, the sun's path moves from the south-east to the south-west of the complex, so that the north-facing side of the building receives less sunlight, but with skylight most of the time.

(2) Distance between buildings in relation to sunlight, skylight and shadow (Section drawn based on the daylight condition of Kartoffelrækkerne - J.A Schwartzgade 18, 1st floor, 11.00-13.00, 16th March as an example)

The 7-metre street between the buildings of Kartoffelrækkerne is lined with 4-metre-deep front yards for the houses and 4-metre-deep back yards at the back of the buildings. The distance between the buildings allows sunlight to reach both sides of the building. At higher angles, sunlight can enter the house, but at lower angles it is blocked by the building on the opposite side. This prevents the glare that would occur at lower angles. In addition, because of the front and backyard settings, the landscape can also diffuse excessive direct sunlight.

(3) Building geometry and layout in relation to sunlight, skylight and shadow (Section drawn based on the daylight condition of Kartoffelrækkerne- J.A Schwartzgade 18, 1st floor, 11.00-13.00, 16th March as an example)

The building volumes in Kartoffelrækkerne are linear (Fig. 3.14), the building heights are the same, and the buildings are placed parallel to each other. This building volume and arrangement allows each occupant in each row of buildings to receive sunlight in a more uniform manner, and at the same time to be equally shaded by the opposite row of buildings, which shades out the low angle of the sunlight, and evenly receives the shadows. (Fig. 3.18-19)

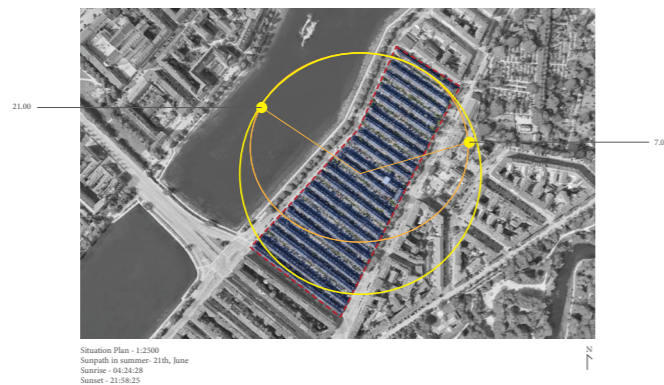
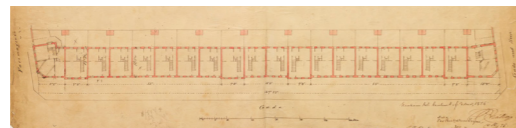


Fig.3.14 (above), floor plan of Kartoffelrækkerne
Fig.3.15 (below), sunlight orientation of Kartoffelrækkerne

Dortheavej Residence

(1) Sunlight Orientation

Dortheavej Residence is orientated in a north-east and south-west direction (Fig. 3.17). In summer the sunlight path moves from the north-east to the north-west of the blocks, so that both the front and the back side of the buildings are receiving sunlight. In winter, the sun's path moves from the south-east to the south-west of the complex, so that the north-facing side of the building receives less sunlight, but with skylight most of the time.

(2) Distance between buildings in relation to sunlight, skylight and shadow (Section drawn based on the daylight condition of Dortheavej 2C 1. tv., 16.00-18.00, 26th March as an example)

On the front of Dortheavej Residence, with a distance of 9-27 metres between itself and the other buildings across the street, the buildings are not able to shield each other from the low angle sunlight. In addition, because the landscape in the front park is not dense and not close to the buildings itself, the landscape has no means of shielding the buildings from direct sunlight. On the back side of Dortheavej Residence, with a distance of 42-80 metres between itself and the other buildings across the park, the back side of the building also receives sunlight from various angles, but because it faces north-east, it mostly receives skylight.

(3) Building geometry and layout in relation to sunlight, skylight and shadow (Section drawn based on the daylight condition of Dortheavej 2C 1. tv., 16.00-18.00, 26th March as an example)

The building mass of the Dortheavej Residence is linear but curved (Fig. 3.16), resulting in a non-parallel alignment with the neighbouring buildings, coupled with inconsistent heights of the neighbouring buildings. This building mass does not receive consistent shading from the sunlight through the neighbouring buildings, instead, the building itself receives rather different levels of sunlight and shadows due to the changing angle of the sunlight over time, as the sunlight reaches the different buildings on the opposite side of the building. (Fig. 3.20-21)

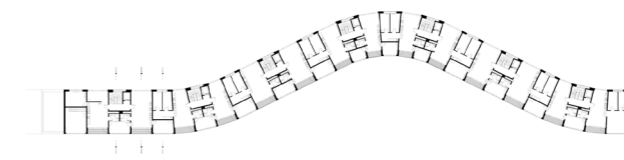
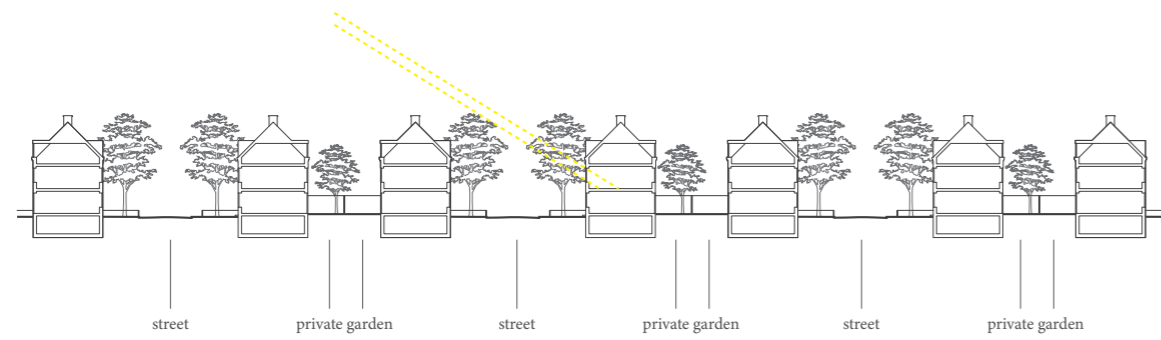


Fig.3.16 (above), floor plan of Dortheavej Residence
Fig.3.17 (below), sunlight orientation of Dortheavej Residence



Section - 1:500

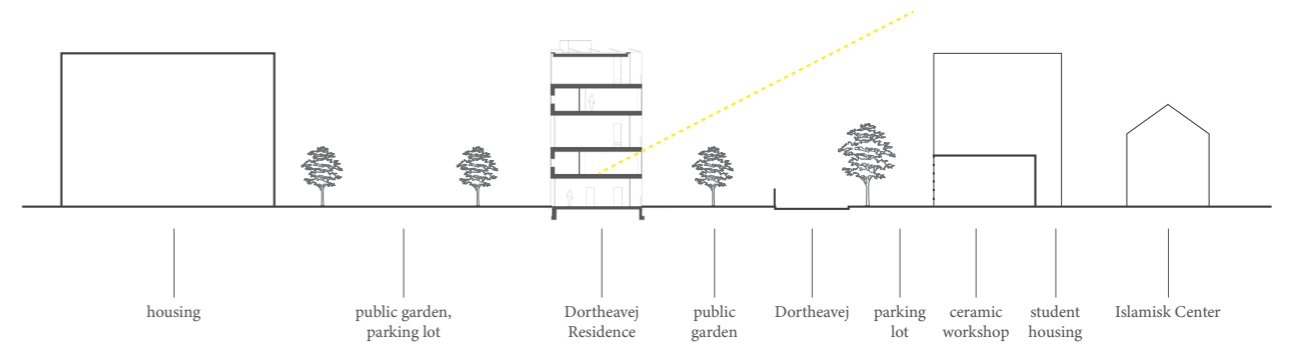


Elevation - 1:500

Fig.3.18 (above),
Section of Kartoffelrækkerne

Fig.3.19 (below),
Facade of Kartoffelrækkerne

J.A Schwartzgade 18, 2100 Kobenhavn Ø, Indre Østerbro
16th March, 11.00-13.00



Section - 1:500



Elevation - 1:500

Fig.3.20 (above),
Section of Dortheavej Residence

Fig.3.21 (below),
Facade of Dortheavej Residence

Dortheavej 2C 1. tv., Northwest
26th March, 16.00-18.00

Conclusion

With external environmental conditions determined, what are the factors that can be adjusted in the interiors of a building to affect the performance of the shadowscape, in order to provide an indoor environment, which enables occupants to feel intimate.

By analysing these two cases at urban scale, there are two main findings that reveal the main differences between these two cases.

Firstly, the function of the external space of the housing results in a stronger or weaker neighbourhood structure; Kartoffelrækkerne, because of its concentrated urban planning, is situated within the same housing foundation; Dortheavej Residence, because of its planning in an industrial area of early development, is situated amongst buildings with different functions. In addition, because the distance between the buildings in Kartoffelrækkerne is closer than the distance between Dortheavej Residence and the other buildings, it creates a small-scale spatial structure of the neighbourhood. These two different urban textures give Kartoffelrækkerne a stronger spatial structure of neighbourhood than Dortheavej Residence.

Secondly, despite the same sunlight orientation in both cases, the curved, linear shape of the Dortheavej Residence's own massing, its long distance from the other buildings, and the fact that the landscape (trees) does not block the buildings, results in the buildings themselves receiving a variety of angles of sunlight. In addition, Dortheavej Residence also receives very different shapes of shadow through the sunlight trajectory of the buildings of different shapes and heights on the opposite side of the building. On the contrary, because the linear building volumes of Kartoffelrækkerne are of the same height and are arranged parallel to each other, the volumes are closer to each other, which results in the building itself being evenly shaded by the neighbouring buildings with a more uniformly shaped shadow, and the low angle of sunlight is blocked out by the opposing building volumes. Also, because the front and rear of the building have sufficient landscape to block the building, some of the direct sunlight is blocked by the landscape (trees).

In conclusion, through the urban-scale studies of these two cases, I have learnt that the function of the surrounding buildings, the distance between the buildings, the arrangement of the buildings, the shape of the surrounding buildings and the surrounding landscape not only affect the strength or weakness of the spatial structure of the community, but also affect the sunlight conditions that the interior of the house may receive. This also allows me to review the practicality of this understanding in interior-scale case studies. In addition, after understanding the potential impact of the exterior on the shadowscape of the interior, I raise the question: With external environmental conditions determined, what are the factors that can be adjusted in the interiors of a building to affect the performance of the shadowscape, in order to provide an indoor environment, which enable occupants to feel intimate.

3.2 Interior-scale case studies

In interior-scale case studies, I will undertake an investigation into the shadowscape dynamics through observational analysis. Additionally, I will explore the subjective perception of intimacy by conducting interviews with the occupants residing in the interiors of Kartoffelrækkerne and Dortheavej Residence. These case studies aim to provide valuable insights into the interplay between shadowscape and intimacy within these specific residential contexts.

Interior-scale case studies Method

(1) Shadowscape Observation

In the observation of shadowscape, I utilize the methodology of observing shadow and documenting shadowscape with "The Four Shadows" and "The Shadow Types" which I learnt from the theory studies. To utilize the method to observe the shadowscape, I aim to understand the variation of the shadow performance in the interiors.

The shadowscape observation process comprises five key stages.

Firstly, in order to understand how the shadowscape is affected by direct sunlight, I use Suncal- a sunlight direction data source to understand the computation path of the sun, and select the date and time when the sunlight has the chance to enter into the house directly, and conduct the shadowscape observation. Also, when visiting the house on that day, I documented the weather conditions outside the house, as well as the sunlight and skylight conditions affected by the sunlight, in order to understand how the shadowscape is affected by the outside environment. Moreover, in order to understand the difference between the sunshine hours on that day and other days of the month, I learnt about the sunshine hours of March in DMI's Weather archive at the time of documenting the shadowscape in March.

Secondly, 360° panoramic pictures and four-directional interior elevations will be captured using a camera positioned at a height of 160cm, approximating human eye level. This photographic documentation aims to provide an overview of the shadow performance within the entire space, capturing the overall shadowscape.

Thirdly, close attention will be paid to big and small object shadows to analyse the colour, softness/sharpness and intensity of the shadow on the ball and from the ball in specific locations related to the position of the window and daylight condition. Also, by placing a ball at a height of 100cm and positioning it at one-meter intervals from the window, the intention is to discern the details and texture of shadow performance in relation to the distance between the object and window.

Fourthly, detailed photographs of windows will be taken to investigate their profiles, compositions, and their relationship to the shadowscape within the window area.

Lastly, the shadowscape documented by floor plans and sections to establish connections between momentary shadow performance, spatial organization, furniture placement, and window configurations (Fig. 3.23-24). Additionally, prior to conducting on-site observations, this method of documentation had been thoroughly tested in the school's light lab to learn the tools and refine the process. (Fig. 3.22, 3.25)

Through the documentation of shadowscape, I conclude the findings from the observation of weather conditions outside, 360° panoramic pictures, interior elevations, big and small object shadows, ball shadow observation, in the categories of spatial organization, interior colors, furniture and objects arrangement, and window settings and details. The system of categorizing is learnt from the theories study which I understood that these elements are the main keys to shape shadowscape differently. Therefore, by concluding the findings from the shadowscape observation with my

shadowscape drawings. (Fig. 3.26) The drawings serve and enforce my understanding of shadowscape, and it also reflects the learning of theories study to this observation. Besides of the manner of observation I learnt from theory studies, I put my on-site observation of occupants' behavior in the observation of shadowscape. By observing and analyzing the connection between the behavior of occupants and shadowscape, I aim to connect the desired level of behavior with the performance of shadowscape, before the understanding of how the occupants attain intimacy indoors in the interview.



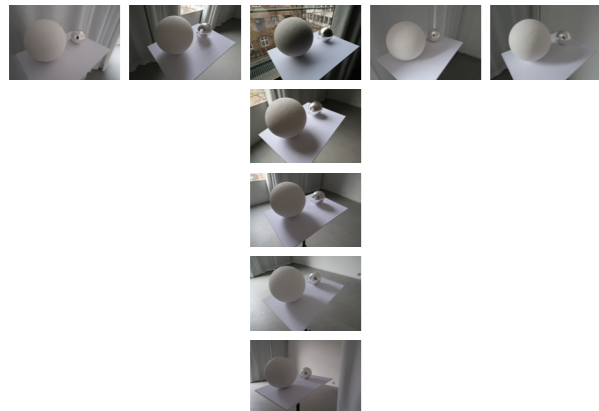
360° Panoramic picture, camera height:160cm



interior elevation, camera height:160cm



details of windows



small object shadow, ball height:100cm texture of shadow- sharp/soft by meters away from window

Fig.3.22, LightLab Test, Lightlab, 155 2. sal, Lysstudio A, Fabrikmestervej 5, 1437 København, Building F 14th March, 9.00-14.00

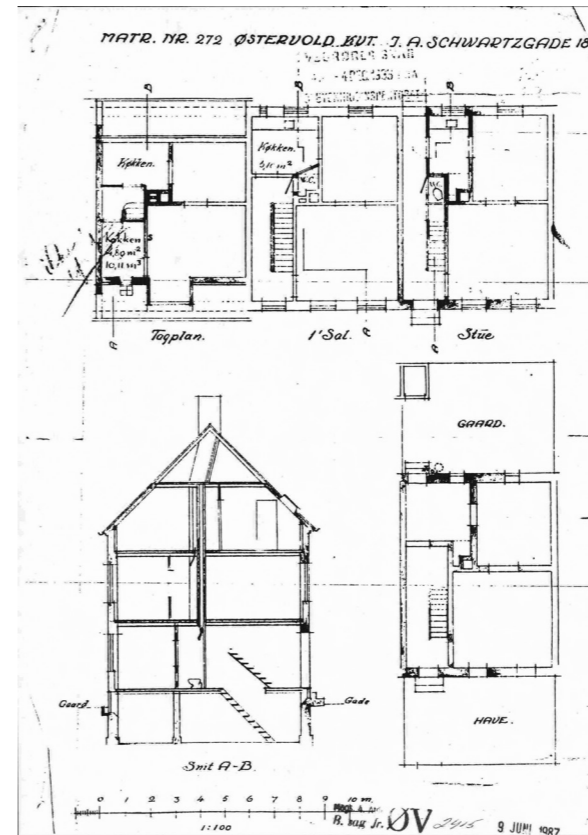


Fig.3.23, Floor Plan and section of Kartoffelrækkerne- J.A Schwartzgade 18, 2100 Kobenhavn Ø

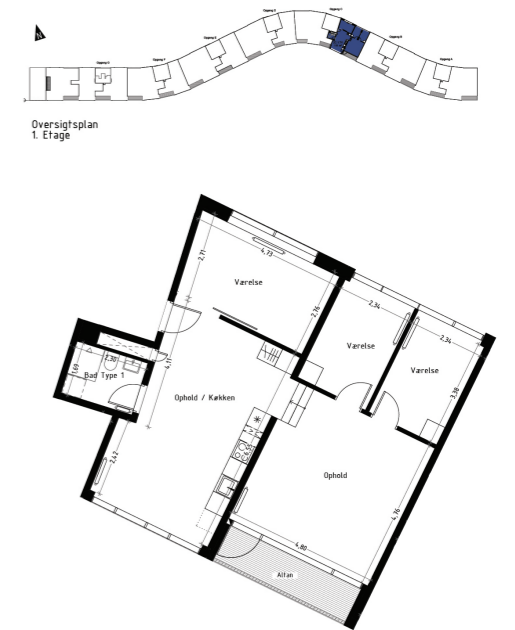


Fig.3.24, Floor Plan of Dortheavej 2C 1. tv., 2400 København NV



Fig.3.25, on-site shadow observation

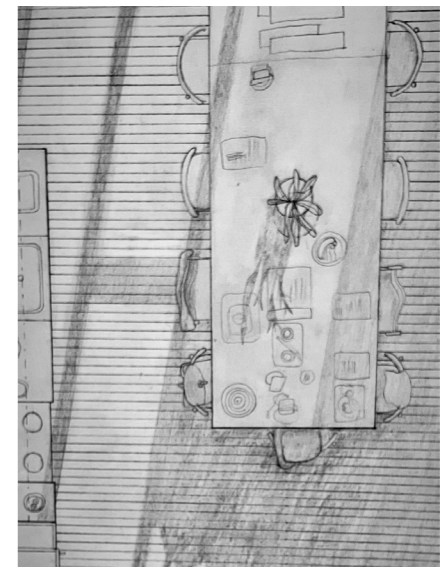
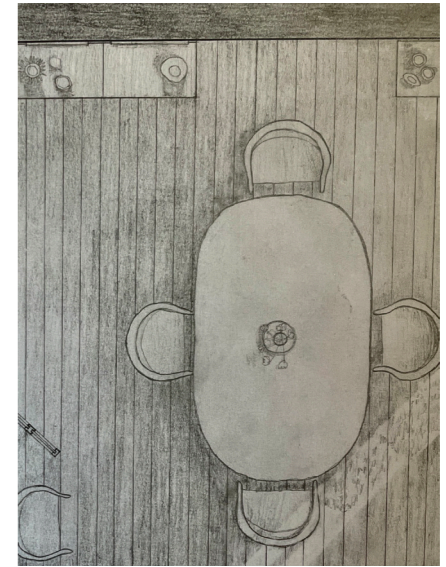


Fig.3.26, shadowscape drawing

(2)Interview method:

Interview situation: interviewer in the interior with interviewees

According to Sarah Pink, conducting on-site interviews offers a unique opportunity to gain a deeper understanding of occupants by immersing oneself in their home environment. "Interviewing in the home indeed involves entering into the mundane, intimate and private sphere of participants' lives. It can be a research encounter that goes beyond being verbal."⁹² She mentioned that some everyday life biographies, experiences and activities that are stored or enacted in home are often best encountered in home tour, by extending the interview to include things and activities, rather than just words.

Interviewees: ideally with all the family members

The interview is ideally set in the situation that all the family members can be interviewed in order to understand how each individuals feel intimate in the space. "Not all interviews are with single participants, and in the context of doing research in households, it is important to seek to engage some participation of the wider household as a group, even if not all household members are able to continue to engage in the research process throughout the whole project."⁹³

One of the things that is noteworthy about the way the interviews were conducted is that I visited the occupants in each cases twice before the interviews were carried out, and on each occasion, I brought some small treats to both the occupants who were present and those who were not present at the time. This behaviour not only established a relationship with the occupant who was at home at that time, but also allowed other occupants who were not present to establish a connection with me. This allowed me to connect with them more easily during the interview. It is significant to note that on the day of the formal interviews, occupants in both Kartoffelrækkerne and Dortheavej Residence spontaneously prepared refreshments, which allowed for everyday behaviours to take place during the interviews, in addition to the behaviours of interviewing and being interviewed. The activities of having refreshments made the interviews more integrated into the daily activities of the occupants. This method is also applied in the LEEDR project led by Professor Sarah Pink, in the form of the 'Getting to Know You' (known as GTKY interviews) stage of the research. "A shared meal around the dining room or kitchen table provides a familiar context for inviting others into the home and for the participants to engage with the researchers."⁹⁴

Interview tool: camera and voice recording tool

Below I will list the reasons why I use these two tools for my interviews.

a.Camera

Camera is used to supplement their descriptions with pictures, and to record the relationship between their behavior and the momentary shadowscape.

b.Voice recording tool

The voice recording tool enables researchers to conduct interviews naturally in conversation with family. Take an interview conducted by Professor Sarah Pink with a family at home as an example, "the time together, with the family's permission, was voice-recorded using a small Dictaphone. This allowed conversation to flow naturally among family members and researchers, providing an opportunity to begin to understand the interplay between family members."⁹⁵

Interview Space: In these two cases, I will conduct the interview both on the first floor, and both in the living and dining room in order to understand the behaviour of the family as a whole and also family members as individuals. Moreover, the space is also where I conducted the shadowscape observation. By interviewing them at the same space, I aim to understand the relationship between my observation of shadowscape and occupants' perceived intimacy.

Interview time: 1.5-2 hours

"Research undertaken in other people's homes tends to be short term for various reasons: it is difficult to spend extended periods of time in homes..."⁹⁶ Therefore, the research methodology employed for interviews will involve the utilization of short-term and intensive research methods, with the interview session lasting approximately 1.5 to 2 hours.

Interview questions:

In order to investigate the interplay between intimacy, shadow, and windows, a carefully prepared set of questions will be employed, categorizing them into these three distinct themes. By posing questions within each category separately, the aim is to comprehend the connections between these subjects objectively, without unduly influencing participants' responses with preconceived assumptions.

Moreover, within each category of questions, careful consideration has been given to explore various aspects such as psychological factors, desired level of behavior, situational contexts, and temporal dimensions. These categories draw upon insights gained from the theory studies of privacy, aiming to grasp the occupants' desired levels of behavior in relation to intimacy under specific circumstances. This approach enables a comprehensive understanding of the occupants' nuanced needs and preferences concerning the desired intensity of individual's interactions within their living spaces.

a.Intimacy

- Psychology: When you stay at this room, do you feel intimate? Why and how?
- Location: Which area in this room do you like to stay for more intimacy? Why and how?
- Time: What time will it be when you stay at that area? Does it change through the time? (A year or a month)
- Situation: What do you usually do in that area and at that time?
- Desired Levels: Will you want to have more or less intimacy in this area? Why?

b.Shadow

- Psychology: What is the feeling that shadow brings to you?
- Desired Levels: Will you want to have more or less shadow in the room? Why?
- Time: What time will it be when you want to have more or less shadow? Does it change through the time? (A year or a month)
- Location: Which area in this room do you want to have more or less shadow? Why and how?
- Situation: What do you usually do in that area and at that time?

⁹² Sarah Pink, Kerstin Leder Mackley, Roxana Moro,sanu, Val Mitchell, Making Homes : Ethnography and Design. (Bloomsbury Academic,2017), p.100

⁹³ Ibid., p. 101

⁹⁴ Ibid., p. 104

⁹⁵ Ibid., p. 104

⁹⁶ Ibid., p. 98

c.Window

- Condition: Are you satisfied with the windows in this room? Why?
- Situation: How do you usually use or adjust the window?
- Time: What time will it usually be when you adjust the window? Does it change through the time? (A year or a month)
- Levels: How do you wish to adjust the windows in order to have more or less light or darkness? Why?

(3)Interview Data Display

“As researchers we are also responsible for creating a connection between the private world we encounter and the lives participants in research experience in them, and public domains of academic and more accessible or popular publications (like the websites and videos associated with this book).”⁹⁷ Therefore, researchers should build a more deeply moral and ongoing relationship with research participants, whereby when possible, occupants are given the choice of seeing images or text about themselves if they wish before it is made public and to have a power of veto over the image of them that are ultimately released into a public domain. After conducting the interviews, I obtained consent from the participants regarding anonymity and publication. Both interviewees from Kartoffelrækkerne and Dortheavej Residence have granted permission for the publication of their interviews, including the use of their names, the photos and drawings of the interiors including the occupants.

Shadowscape Observation

(1)Observation location, date, and time

Kartoffelrækkerne:

living/ dining room and kitchen, 1st floor, J.A Schwartzgade 18, 2100 København Ø, 11.00-13.00, 16th March.

Dortheavej Residence:

living room and dining room, 1st floor, Dortheavej 2C 1. tv., 2400 København NV, 16.00-18.00, 26th March.

(2)Weather conditions outside (Fig. 3.27)

Kartoffelrækkerne (Fig. 3.28):

The weather conditions for the shadowscape observation were sunny and the sunlight was at a point in time where there was a chance of direct sunlight from the front of the building into the interior, and the skylight could enter the back of the building. Since the shadowscape observation was conducted in March, I compared the date of the observation with other dates in March, and the sunshine hours on that day was 7.1 hours, which is relatively high compared to other days in March this year.

Dortheavej Residence (Fig. 3.29):

The weather conditions on the day of the shadowscape observation were unstable, occasionally overcast, occasionally sunny, but at a point in time when there was a chance of direct sunlight coming into the room from the front of the building. I compared the date of the observation with other dates in March. The sunshine hours on that day were 2.3 hours, which is relatively low compared to other days in March this year.

**Københavns kommune marts 2023
Solskin (timer)**

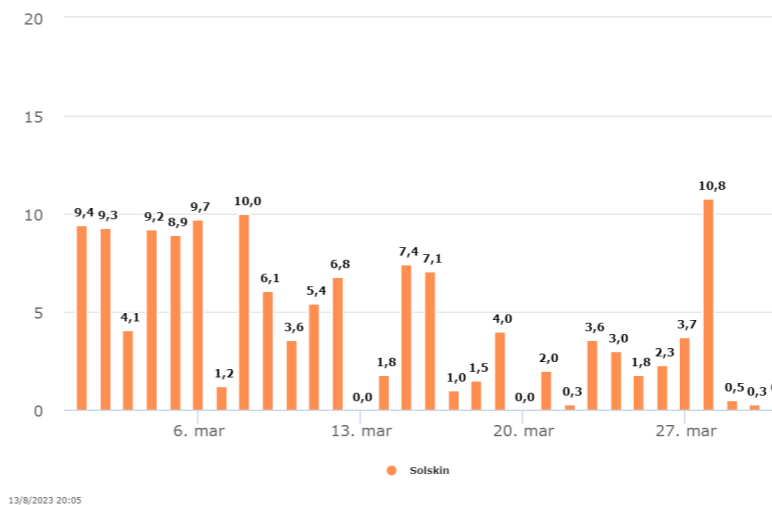


Fig.3.27, Sunshine hour, Copenhagen, March, DMI

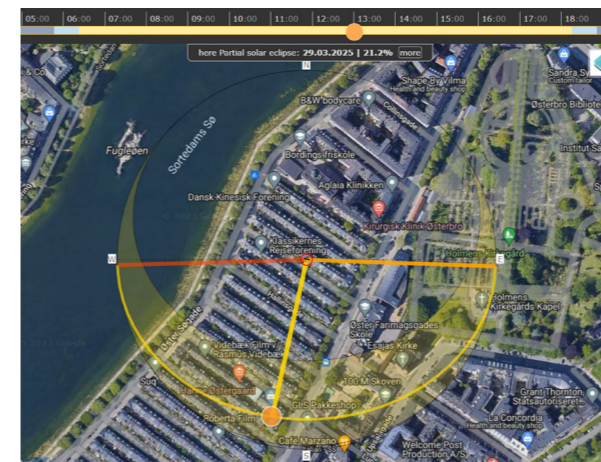


Fig.3.28, SunCalc, J.A Schwartzgade 18, 2100 København Ø, 13.00, 16th March



Fig.3.29, SunCalc, Dortheavej 2C 1. tv., 2400 København NV, 16.30, 26th March

97 Ibid., p. 95

(3)360° panoramic pictures (Fig. 3.30-31)

Kartoffelrækkerne

From the 360° panoramic pictures, I observed that in the interior of Kartoffelrækkerne, the shadow types were mainly Shadow A - the big room shadow and Shadow B - the big object shadow. These two types of shadow dominated the interiors, the shadows are distributed uniformly, and the overall distribution of the shadow in the room can be felt more than the shadows of the individual objects.



Shadow A.
the big room shadow

Fig.3.30, 360° Panoramic picture of 1st floor Room A
J.A Schwartzgade 18, 2100 København Ø
16th March, 11.00-13.00



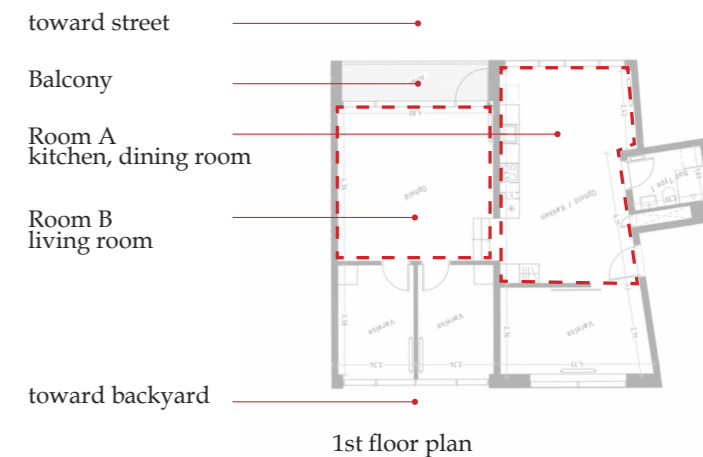
Shadow A.
the big room shadow

Shadow B.
the big object shadow

Fig.3.31, 360° Panoramic picture of 1st floor Room B
J.A Schwartzgade 18, 2100 København Ø
16th March, 11.00-13.00

Dortheavej Residence (Fig. 3.32-33)

In Dortheavej Residence, Shadow B- the big object shadow and C-small object shadow are dominated. In these two types of shadows in the interior, one can focus on the shadow silhouettes that are particularly obvious, and feel that the overall sense of the space is disrupted by the explicit darkness and brightness and silhouettes of the sharp shadows.



Shadow B+C.
the big object shadow
small object shadow

Fig.3.32, 360° Panoramic picture of kitchen, dining room Room A
Dortheavej Residence, Dortheavej 2C 1. tv.
26th March, 16.00-18.00



Shadow B+C.
the big object shadow
small object shadow

Fig.3.33, 360° Panoramic picture of living room Room B
Dortheavej Residence, Dortheavej 2C 1. tv.
26th March, 16.00-18.00

(4)Interior elevations

Kartoffelrækkerne (Fig. 3.34-35)

In the living/dining room of Kartoffelrækkerne, I observed low-contrast shadowscape with only a few clear shape of shadow cast by sunlight from the south which blocked by leaves and windowsills. In the kitchen, I observed a low-contrast shadowscape cast by the skylight from the north. Looking at the shadowscape of the living/dining room and the kitchen together, even though they are exposed to different sources of daylight, one is skylight and the other is sunlight, the shadowscape doesn't differ drastically. On the contrary, the two spaces as a whole present a low-contrast shadowscape.



Fig.3.34, Room A interior elevation
J.A Schwartzgade 18, 2100 Kobenhavn Ø
16th March, 11.00-13.00

Fig.3.35, Room B interior elevation
J.A Schwartzgade 18, 2100 Kobenhavn Ø
16th March, 11.00-13.00

Dortheavej Residence (Fig. 3.36-37)

In the dining room and living room of Dortheavej Residence, I observed both high-contrast shadowscape. Looking at the shadowscape of the living room and dining room together, they both face south and both created great differences in light and darkness, which can be regarded as high-contrast shadowscape.



Fig.3.36, Room A interior elevation
Dortheavej Residence, Dortheavej 2C 1. tv.
26th March, 16.00-18.00

Fig.3.37, Room B interior elevation
Dortheavej Residence, Dortheavej 2C 1. tv.
26th March, 16.00-18.00

(5) Big and small object shadows

Kartoffelrækkerne (Fig. 3.38-39)

In the living/dining room and kitchen of Kartoffelrækkerne, the shadows of window sills, interior furniture, and small objects are blended into the big room shadows. Even though some of the shadows are more prominent due to the sunlight, for example, the shadows of leaves, the small size of the shadows compared to the overall indoor area and the broken shape of the shadows due to the shape of the plants make the shadows less noticeable in the whole space. Overall, in the environment dominated by big room shadow, the shadows of individual objects do not stand out.

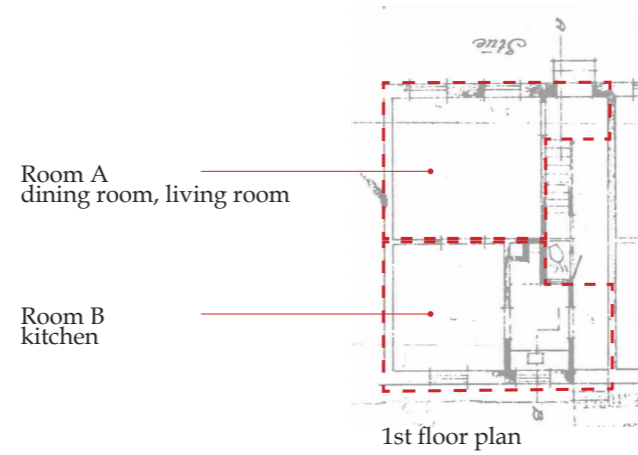


Fig.3.38, Room A interior elevation
J.A Schwartzgade 18, 2100 København Ø
16th March, 11.00-13.00



Fig.3.39, Room B interior elevation
J.A Schwartzgade 18, 2100 København Ø
16th March, 11.00-13.00

Dortheavej Residence (Fig. 3.40-41)

In the dining room and living room of the Dortheavej Residence, I observed distinct shadows of windows, small objects, and exterior objects. The shadows of objects are clearly shown individually, and with the changing intensity and direction of sunlight, shadows of objects occasionally spread to almost the entire room, which give a changing image of the rooms with peculiar shapes of different object shadow. In an environment where big room shadow is not apparent, the shadows of objects are more prominent, and their shapes and shades can affect the whole room considerably.

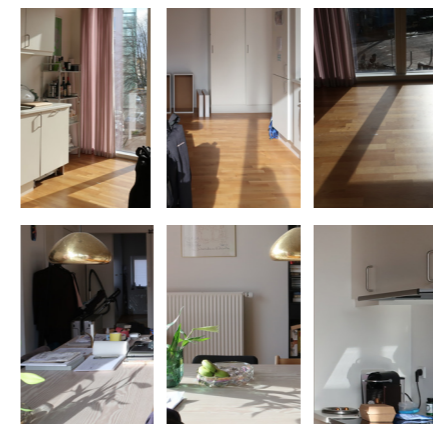


Fig.3.40, Room A interior elevation
Dortheavej Residence, Dortheavej 2C 1. tv.
26th March, 16.00-18.00

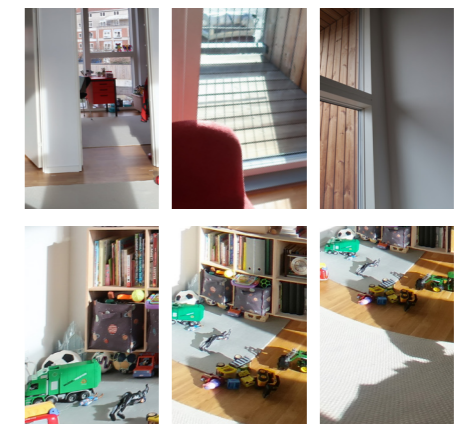


Fig.3.41, Room B interior elevation
Dortheavej Residence, Dortheavej 2C 1. tv.
26th March, 16.00-18.00

(6) Small object shadows- ball shadow observation

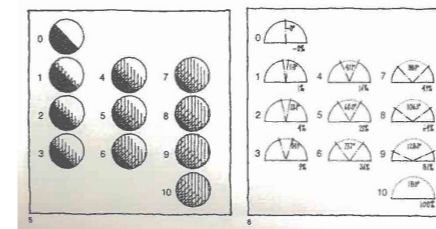
Kartoffelrækkerne (Fig. 3.42-43):

In the living/dining room and kitchen in Kartoffelrækkerne, I observed that the texture of the shadow of the ball changed gradually by meters away from the windows. From living/dining room to kitchen, the texture of shadow changed from soft (shadow type-9) to sharp (shadow type-1) within the distance of 1 meter away from window. The relatively sharp shadow only existed in the area of 1-meter away from the window facing south. The other texture of shadow changed gradually through the increasing distance from windows. In the ball shadow which is 4-meter away from the window facing south, it is clear to see the ball receive both of the skylight and sunlight, and there is almost no cast shadow from the ball, only with the shadow on the ball itself. The receiving sunlight and skylight from both sides of the room create a subtle and gradual change of texture and direction of shadow on the ball, without striking change of texture of shadow.

All in all, the shadow on the ball gradually becomes darker and softer as the distance between the ball and the window increases. The only more obvious contrast shadow occurred when it was located at the distance of 1 meter away from the window facing the south.



Fig.3.42, shadow test- perspective
low-contrast shadowscape,
soft texture of shadow



“Scale of shadows”,
the individual shadow-types are character-
ised by the size of the shade middle zone.

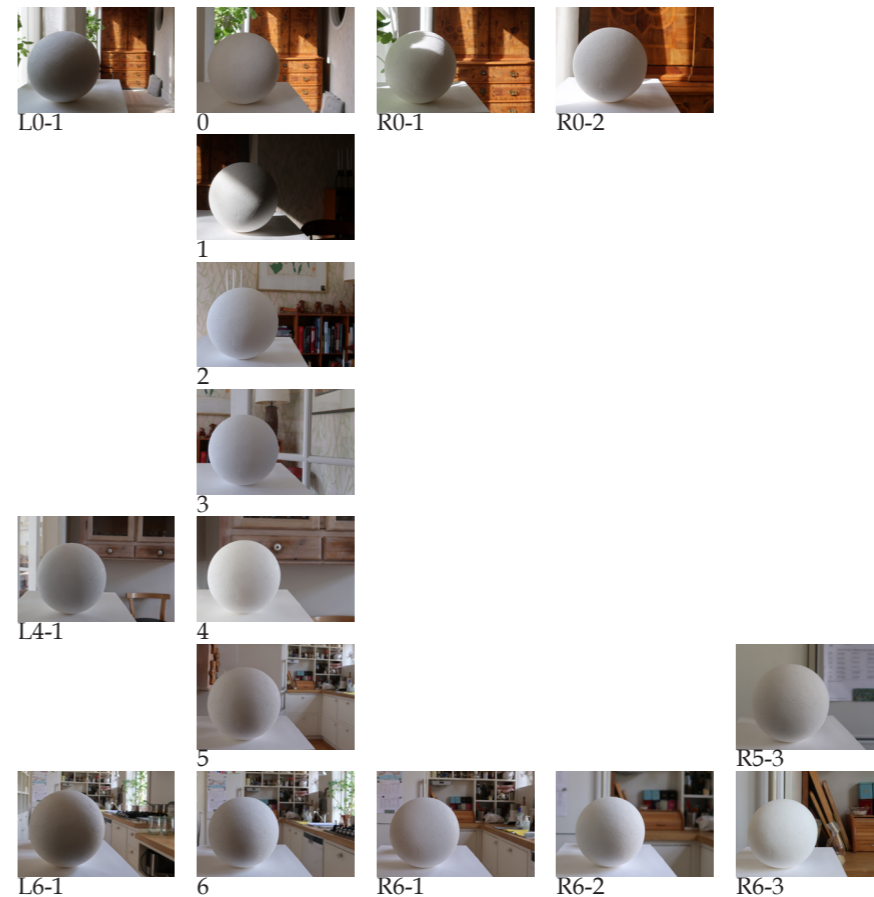
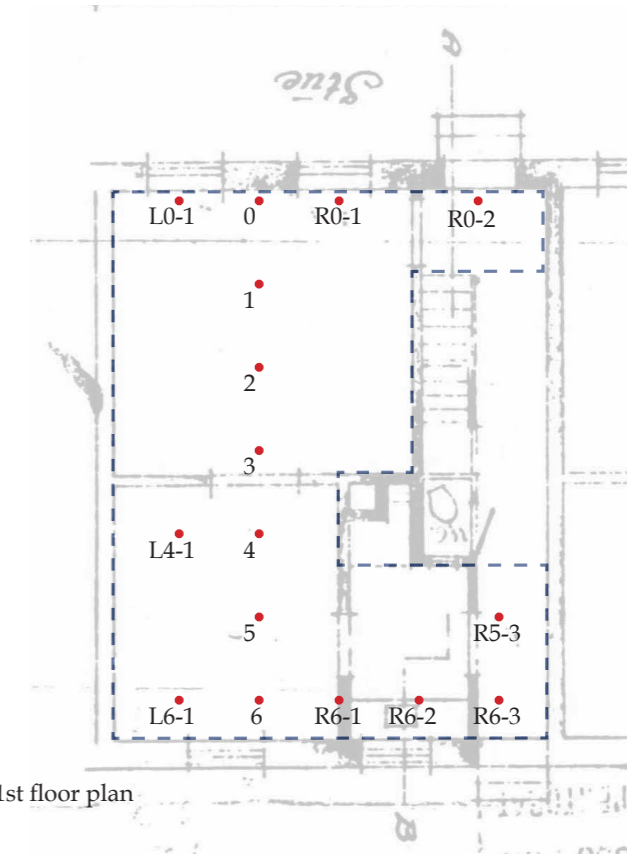


Fig.3.43, shadow test- section
clear shape of shadow only existed within the distance of 1 meter



1st floor plan

Dortheavej Residence (Fig. 3.44-45):

In the dining room and living room of the Dortheavej Residence, I observed that the shadow texture of the ball was changing drastically. When the weather is sunny, as can be seen in the shadow from position A-0 to A-0, the texture of the shadow on the ball remains sharp up to a distance of 3 to 4 metres from the window (shadow type-1 to 3). In the process of documenting the shadows, I attempted to document the performance of the shadows under a clear sky to get closer to the state when there is a direct sunlight into the room. However, under unstable weather conditions, the shadow on the ball can also be seen to be very unstable, and affects a very deep part of the room, which is one of the findings of observing the shadow at the moment.

All in all, the shadow becomes darker as the distance from the window increases. Inside the room, which has a depth of almost 6.55 meters, shadow on the ball shows considerable variations of light and dark. When the sunlight entered the interior without overcast sky, the apparent contrast between dark and light shadows exists within the distance of 3-4 meters away from windows.

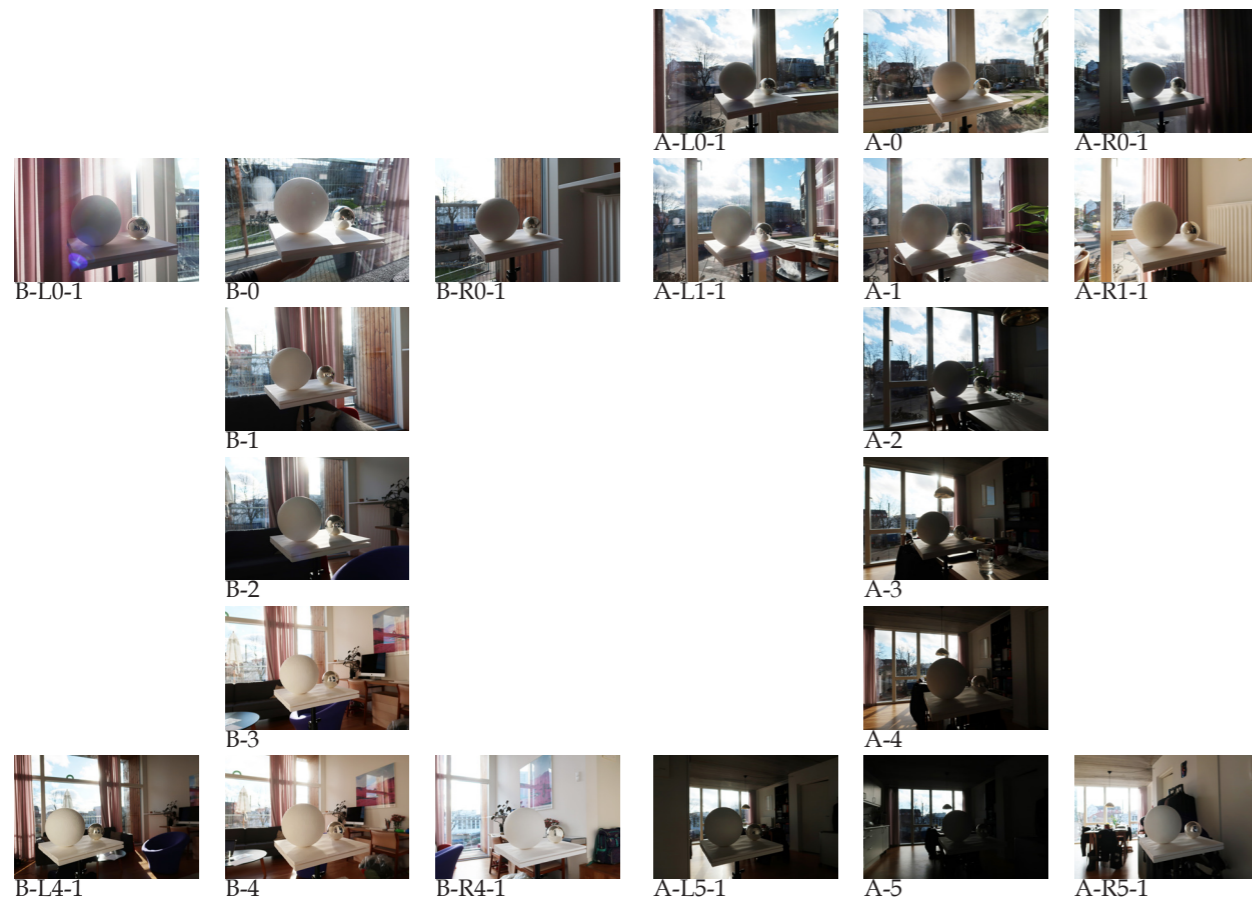
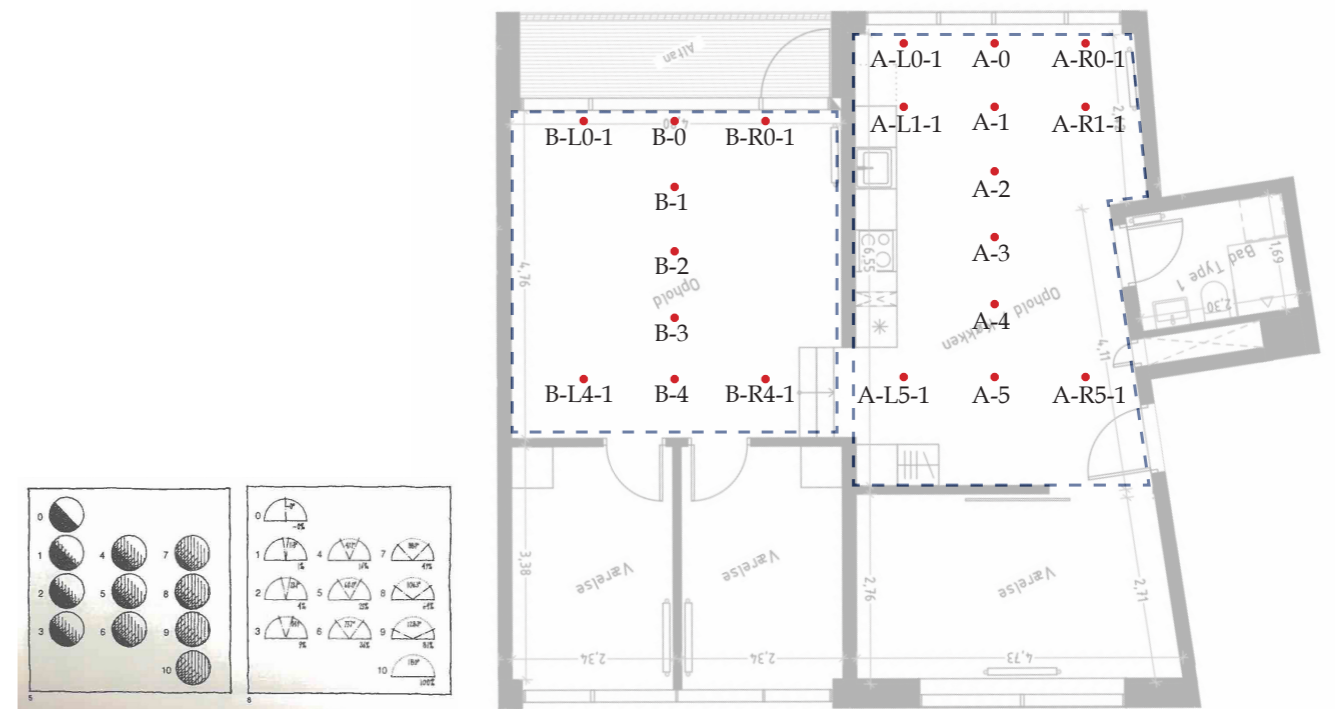
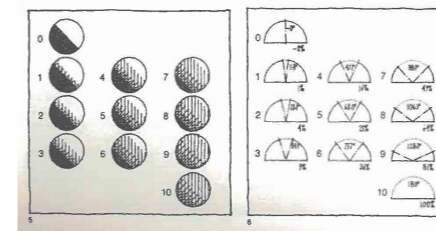


Fig.3.44, shadow test- perspective high-contrast shadowscape, sharp texture of shadow



1st floor plan



"Scale of shadows", the individual shadow-types are characterised by the size of the shade middle zone.



Fig.3.45, shadow test- section clear shape of shadow existed within the distance of 3-4 meter

(7)shadowscape drawings (Fig. 3.46-51)

a.Spatial organization

From my observation of shadowscape in the aspect of spatial organization, I find that the depth of the room and how it connects to different spaces are two essential elements that contribute to the different types of shadowscape. If the depth of the room allows sufficient daylight to penetrate, reflect, and be treated in the room, and if there are daylight sources on both sides of the room, the room will have a better chance of having more uniform performance of light and shadow. Therefore, if both conditions are met, the room will have a higher possibility of performing low-contrast shadowscape. The depth in the interior of Kartoffelrækkerne is 6.5 meters, with a glass door in between living/ dining room and kitchen. When the sunlight lit up the living/ dining room, the kitchen received skylight from the other side. Also, the glass door allows these two different light sources lit up both of the rooms, which provided a balanced daylight interior. The shadowscape is low-contrast in these two rooms because of the balanced daylight environment.

On the contrary, the depth of interior of Dortheavej Residence is 9.5 metres. The dining room alone is 6.55-meter deep, which is already deeper than the whole depth of the interior of Kartoffelrækkerne. In addition, the door to the bedroom, which lead to the other side of the dining room, does not let in any daylight with its opaque material. Also, the size of the windows on that side of the bedroom is relatively small, so if the door were opened, it would not be sufficiently affecting the shadowscape in the dining room. Therefore, the shadowscape in the dining room receives daylight from almost one direction, and the contrast between light and darkness is more obvious than in the room in Kartoffelrækkerne, because there is no sufficient daylight coming in through the opening from the other side of the dining room and the depth of the room.

b.Interior colors

By comparing the interior colours of the two cases, especially through the observation of interior elevations, I understand that darker interior colours are more likely to absorb light, making the whole room darker and softer, while lighter colours are more likely to reflect light, making the whole room brighter and stronger. If the room facing direct sunlight is set to a relatively dark interior and the room facing skylight is set to a relatively bright interior, the shadowscales of the two rooms will be similar, and will not have high-contrast shadowscape due to the different types of light they receive. The living/ dining room of Kartoffelrækkern is where mostly receive direct sunlight. However, because of the green and milky white colour of the wallpaper, the dark wood cabinets and tables, the dark wood floor absorbs some of the direct sunlight, making the whole room feel darker and milder. In the kitchen area, except for the darker flooring, the walls and most of the cabinets are white, which can easily reflect daylight and brighten the room, making the overall room feel brighter and stronger. By setting the colours of these two rooms, the shadowscape of the kitchen, which has a mild skylight, is made stronger and brighter, while the shadowscape of the living/ dining room, which has a strong direct sunlight, is made softer and darker. As a result, the different light sources introduced into the two rooms were balanced, resulting in a low-contrast shadowscape in both rooms.

In Dortheavej Residence, the interior colours of the living room and dining room are dominated by bright colours, with only the light grey of the ceilings being darker. "...materials are all kept very simple with wood and concrete in light colors dominating inside and outside."⁹⁸ The walls of the living room and the dining room are white, and the wooden floors are light-coloured. In the dining room, the kitchen cabinets and worktops are white, the centre table is a light wood colour, and only one storage shelf and one high cupboard are dark. In the living room, only the table and sofa in the centre are dark, while the cabinets and tables on both sides of the room are light wood. In both rooms, white is the dominant colour, coupled with the south-facing windows, allowing direct sunlight to be received, and the dominant colours in both rooms tend to reflect the light source, resulting in a more intense and contrasting perception of light and dark, which can be regarded as a high-contrast shadowscape.

c.Furniture and objects arrangement

The relationship between the desired behaviour of occupants and shadowscape can be seen in the observation of how the furniture and objects arrangement responds to light and shadow. In the kitchen at Kartoffelrækkerne, the main volume of the rectangular kitchen work counter is parallel to and close to the window, and a table is placed in the corner of the space. The configuration of the space, because it is parallel to the window and at the same height as the window sill, results in the space being orientated towards the outdoors. I observe that the kitchen counters and the more commonly used utensils and vessels are located near the areas with light, and the more commonly used items - the plates - are placed in the neighbouring white cupboards, while the table is placed in the corner of the kitchen where there is less skylight. This arrangement of furniture and objects seems to represent an environment where occupants need a sufficient level of daylight to work in the kitchen, but in the sitting area the table and chairs do not need so much light and can be used in a relatively shaded state. In the living/ dining room, the dark wood dining table is the main volume in the space, with cabinets for books and decorations on both sides. This symmetrical spatial configuration results in a symmetrical orientation of the space - either towards the outside viewing or towards the inside viewing direction of the activity. The table is placed in the centre of the space and receives part of the direct sunlight most of the time when there is no overcast sky. The cabinets with books and decorations are placed on either side of the space, receiving less direct sunlight as the direction of the sunlight changes. This represents the occupation's use of the table in a well-lit environment, whereas the books and decorations in the cabinets can be used in relatively shaded conditions. It is worth noting that both the dining/ living room and the kitchen have sufficient indoor sunlight, and because there are many plants on the windowsill, the light felt in the room is mostly a softer light that is reflected by the plants.

In the living room of Dortheavej Residence, the round table in the middle of the room is the central configuration of the space, the long sofa next to the table is parallel and adjacent to the window, the side wall of the room is placed with a TV and storage cabinets, and next to the other side of the wall is a long table, the configuration of the furniture guides the direction of the view towards the interior of the room. Because the sofa faces the interior, its volume obscures parts of the direct sunlight from the exterior, creating more shadows in the centre of the space, with occupants occupying either on the sofa seating height or floor height - sitting on either the floor or the sofa. In the process of documenting the shadowscape, I observed that the occupant was sitting on the floor to use the computer and watch TV, and during the activities, she was sheltered by the shadows of the sofa and could use the computer, but due to the change of the light from the outside over time, it still occasionally shone directly on her face, which resulted in the need for her to move the direction of the activities.

⁹⁸ Dortheavej Residence, BIG, <https://big.dk/projects/dortheavej-2-residences-2442>

d. Window settings and details

In the kitchen of Kartoffelrækkerne, there are two Dannebrog windows and one fixed window. In the living/dining room, there are two Dannebrog windows and one glass door toward the balcony outside, at a distance of about one metre from each other on the wall. The profile of the Dannebrog windows is the same- "The two lower casements are about twice the height of the top sashes. Mullion and transom forms a cross."⁹⁹ With windows placed at the same distance and with the same profile, the shadowscape is evenly shaded by the light from the windows at a fixed distance. In addition, because of the size and position of the Dannebrog window, which is placed at a height of about one metre, and the division of the profile into mullion and transom, the opportunity for the direct sunlight to be brought in over a large area is reduced, and the opportunity for the forming of a high-contrast shadowscape is reduced.

Apart from the profile of the Dannebrog window itself, the settings around it also affect the performance of the shadowscape. There are side panels on three sides of the Dannebrog window, and its anlg and details provide a setting to redirect the direct sunlight. The direct sunlight is guided by the panel and details, which turns it into a multi-angle light and reduces its intensity. In addition, about one metre high windowsill be placed underneath the window, so that the plants can block part of the direct sunlight, also weakening the intensity of the light. Lastly, the curtains also play a role in absorbing and diffusing light around the windows, so as to reduce the intensity of light.

In Dortheavej Residence, windows in dining room and living room are full-height windows and energy-efficient windows with 3-layers of glass. In the living room, the windows are divided vertically into three parts and horizontally into upper and lower parts at a height of about 2m, and one of the lower part of the windows is a terrace door, which can be used to reach the balcony outside. The windows in the dining room are vertically divided into four parts, two of which are divided into a side hung window (above one metre) and a fixed window (below one metre) at a height of about one metre.

It is noteworthy that the frames of the side hung window and the terrace door of the living room and the dining room are hidden in the widths of the mullion and the transom, resulting in the profile of each window and door being the same when the windows are viewed from the inside or the outside. The manufacturer of this window also emphasised that there were two intentions for this design, the first consideration being: "In VELFAC 200 ENERGY, the frame in fixed and movable opening functions is the same, which gives an elegant and uniform facade expression."¹⁰⁰ The second consideration is: "The narrow frame profile and large glass area increase the incidence of light."¹⁰¹ In such a consistent profile, the window's partitions are composed of simple rectangular shapes without complex geometry, and there is no windowsill around the window, making it impossible to place objects to block some of the light from the outside, and only the internal curtain can be used to block light. The windows are almost like a transparent independent volume, and do not have any concave or convex shape with the interior or exterior around the windows, which completely introduces the sunlight conditions given by the exterior environment, resulting in the performance of the shadowscape being severely affected by the exterior environment. In the on-site observations and records, on sunny weather, the interior features a high-contrast shadowscape.

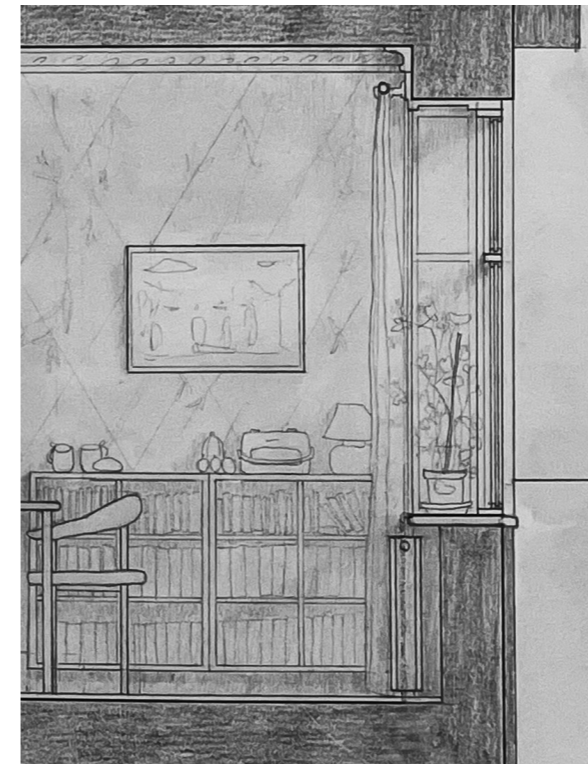


Fig.3.46, shadowscape section drawing
J.Å Schwartzgade 18, 2100 København Ø
16th March, 11.00-13.00

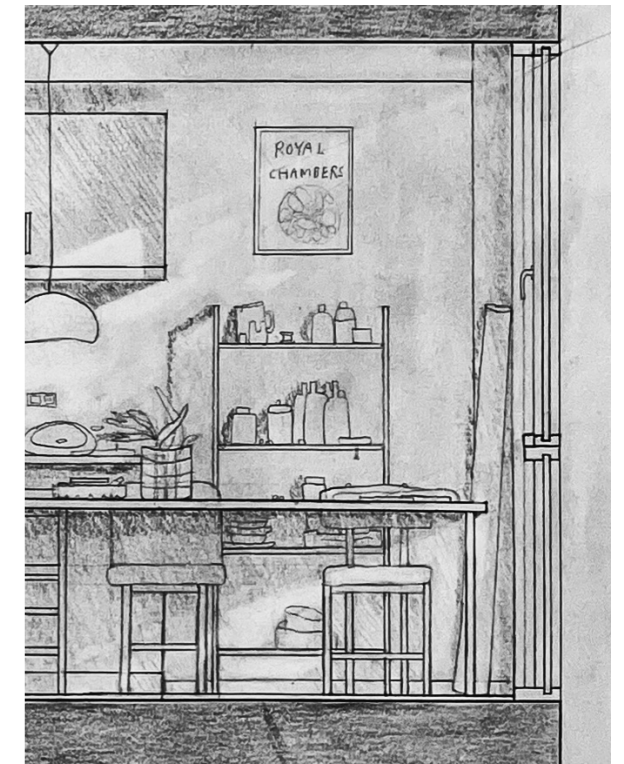


Fig.3.47, shadowscape section drawing
Dortheavej 2C 1. tv.
26th March, 16.00-18.00

98 Dortheavej Residence, BIG, <https://big.dk/projects/dortheavej-2-residences-2442>

99 Casement window, VILLUM WINDOW COLLECTION, <https://en.villumwindowcollection.com/dictionary/c/>

100 Side hung window, VELFAC Product Database, <https://produkter.velfac.dk/products/18764/18781/19580>

101 Ibid.

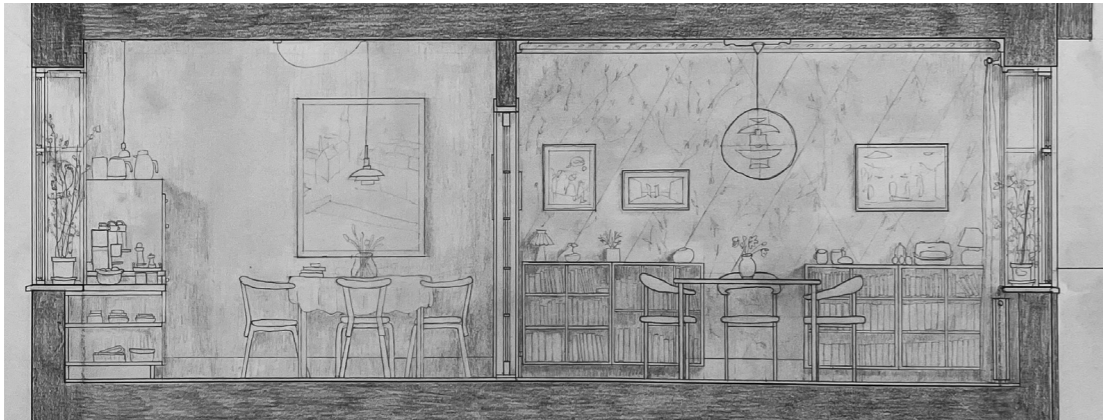


Fig.3.48, shadowscape section drawing
 J.A Schwartzgade 18, 2100 Kobenhavn Ø
 16th March, 11.00-13.00

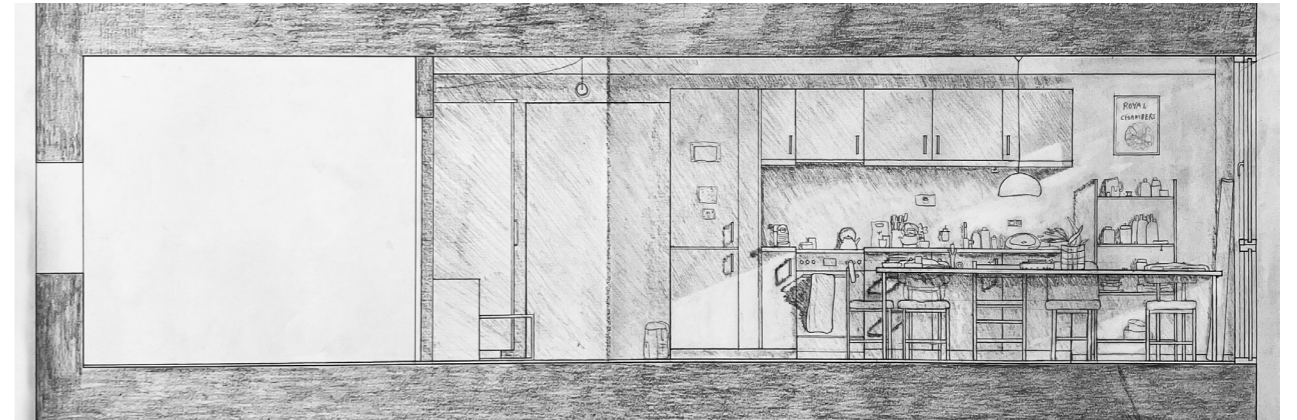


Fig.3.50, shadowscape section drawing
 Dortheavej 2C 1. tv.
 26th March, 16.00-18.00

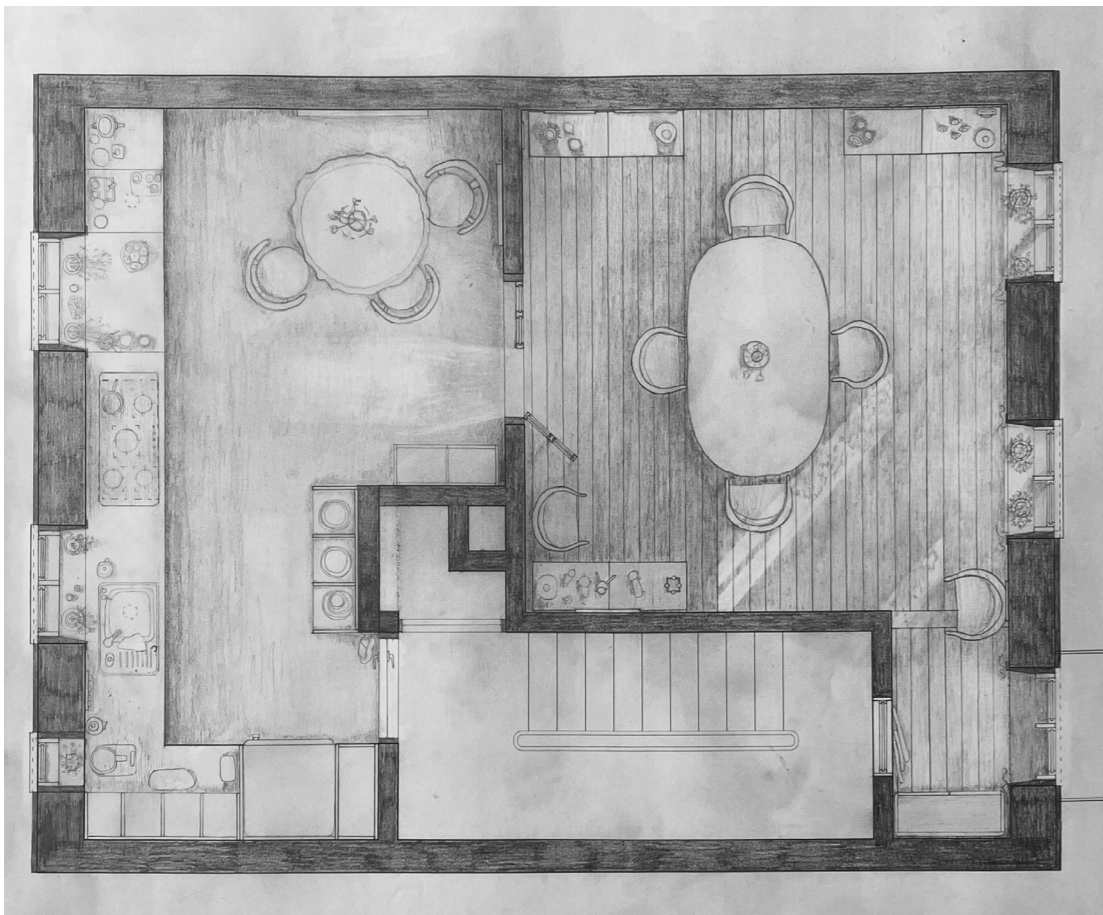


Fig.3.49, shadowscape floor plan drawing
 J.A Schwartzgade 18, 2100 Kobenhavn Ø
 16th March, 11.00-13.00

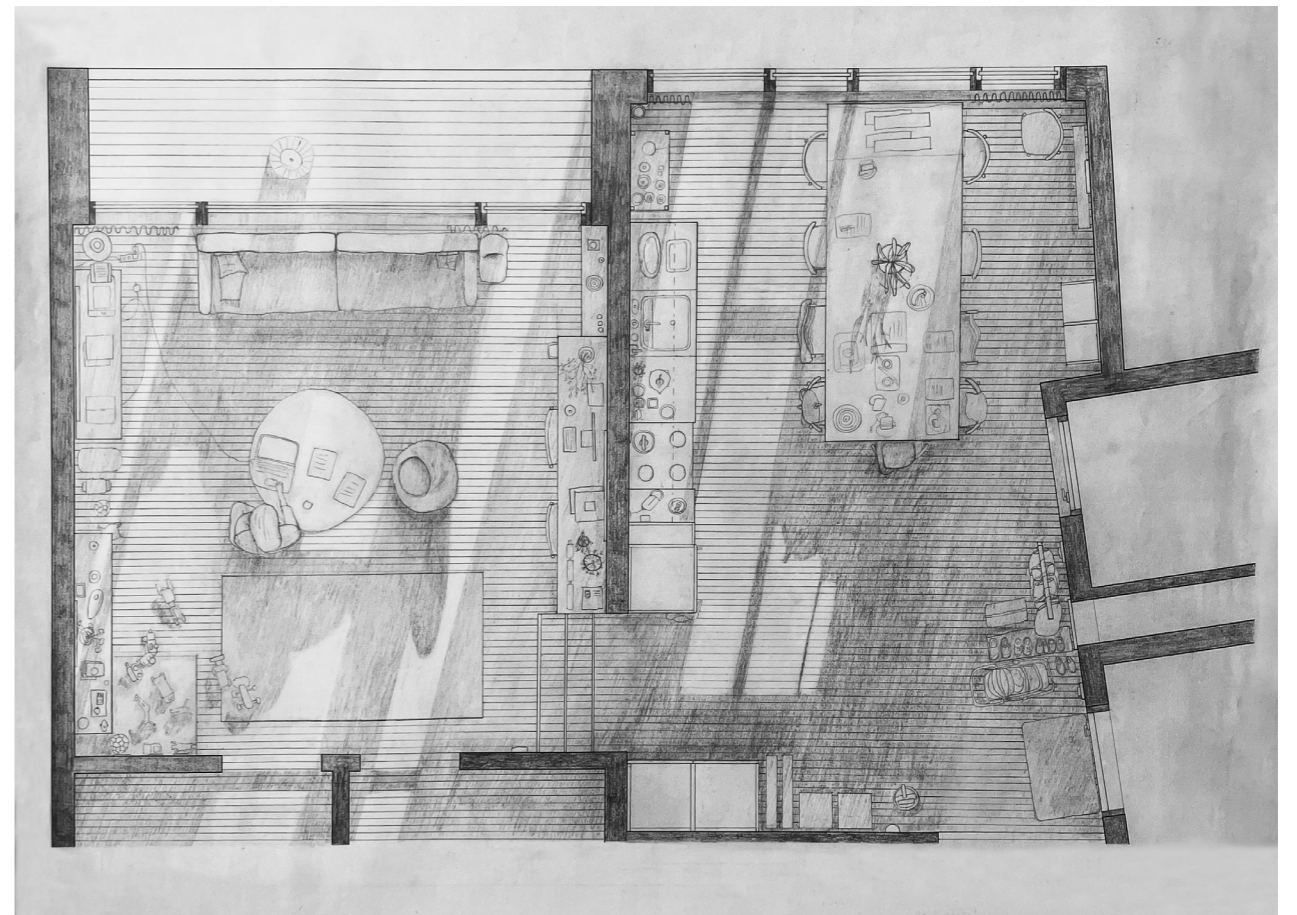


Fig.3.51, shadowscape floor plan drawing
 Dortheavej 2C 1. tv.
 26th March, 16.00-18.00

Interview

Kartoffelrækkerne

Occupants: Birgitte (74 years old) , Jakob (77 years old)

Interview location: in the dining room, 1st Floor, J.A Schwartzgade 18, 2100 København Ø

Interviewee: Birgitte (74 years old)

Interview time: 7th June, 14.00-16.00

Interview tools: camera and digital voice recorder

Daylight condition (Fig. 3.52-54): Because of the time of day and the weather conditions outside the room, the interview can be conducted under conditions where the sunlight has a chance to enter directly into the room.

a.Intimacy (Fig. 3.55)

1.Intimacy is related to privacy, and it can bring you a sense of sheltered, enclosed. When you stay at this room, do you feel intimate?

Yes, I feel intimate because of the window. The window with its height without from floor to ceiling height. The size of window makes me feel private. Also, we keep the original division of the wall between the dining room and kitchen. The space is small and close to us. We feel enclosed.

2.Which area in this room do you like to stay for more intimacy? Why and how?

I can feel intimate anywhere in the room. I usually sit on the chair which close to windows and face to the direction of kitchen. Jacob is the chef, so he has to sit close to the kitchen and serve the dishes. The cookbook is near to his side, and the dictionary is near to my side. There are also some books about traveling. When we want to have some reference or discuss where we want to travel, we can easily reach to the books.

3.What time will it be when you stay at that area?

We usually eat here, and host the event for visitors and family here. As a routine, we enjoyed the morning with reading 4 different newspaper (5 on the weekend).

4.Will you want to have more or less intimacy in this area? Why?

No, I think there is enough intimacy for us.

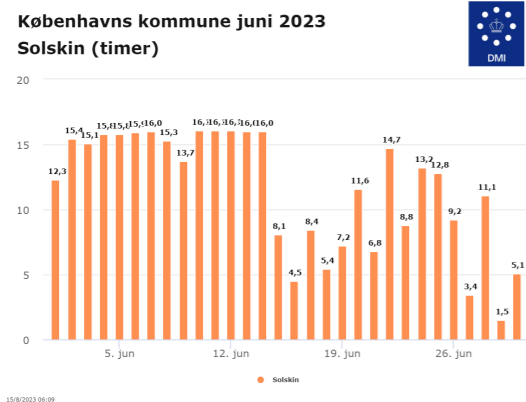
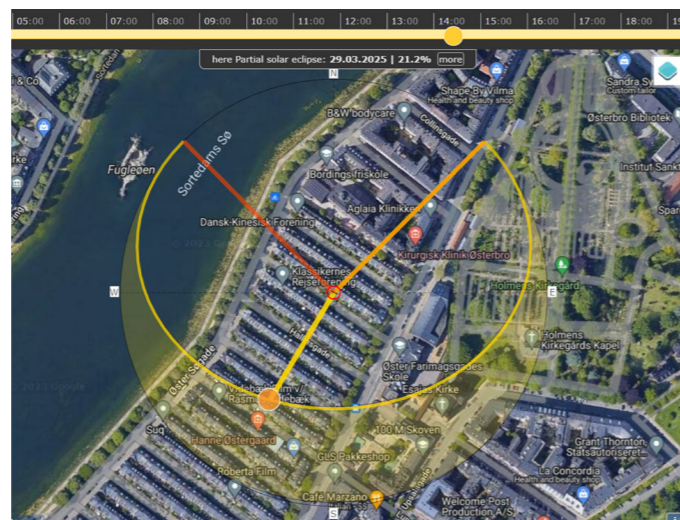


Fig.3.52, Sunshine hour, Copenhagen, June, DMI

Fig.3.53 (above), exterior of the house
Fig.3.54 (below), SunCalc, 14.30, 7th June

Fig.3.55, the size of rooms, occupant;s behaviour in relation to the perception of intimacy

b.Shadow (Fig. 3.56)

1.What is the feeling that shadow brings to you?

We like the light, but Jacob sometimes will have tears when the sun is shining from the window. He doesn't want to change the seat with me. Sometimes we will draw the curtain to avoid direct sunlight.

2.Will you want to have more or less shadow in the room? Why?

No, we like the light. We can draw the curtain when we need more shadow. It can be flexible, especially depends on where the direct sunlight is. The curtain is made with cotton, and it can block some levels of the sunlight.

Also, the door between the kitchen and dining room is made by Jacob. It was a sliding wooden door, but we changed it into a bigger glass door to let the light go inside each room.

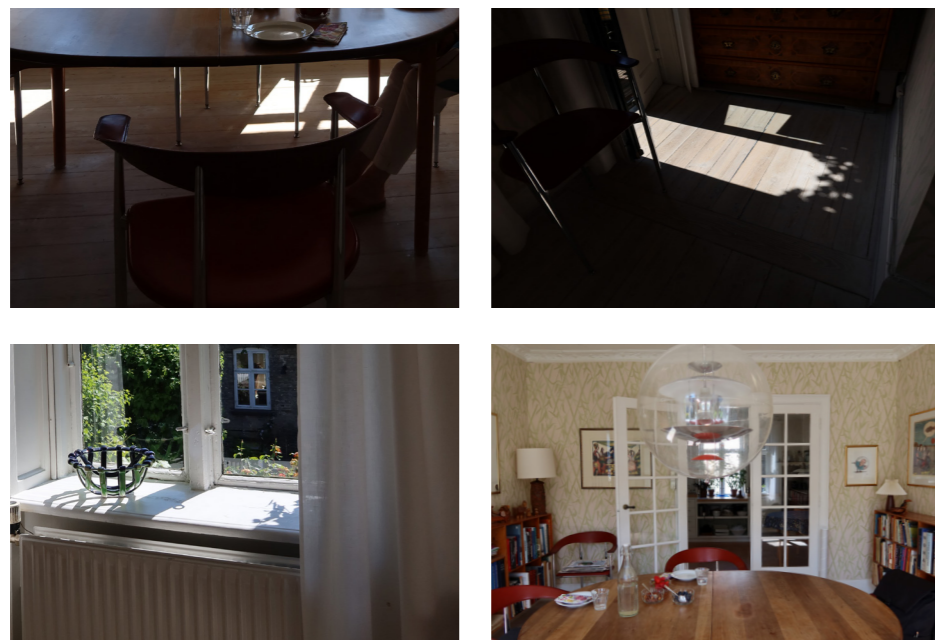


Fig.3.56, shadow in the room

c.Window (Fig. 3.57)

1.Are you satisfied with the windows in this room? Why?

Yes, we are satisfied with the windows. The window frame is well made with dry wood, and we want to keep it. As I have mentioned, the reasons why we want to keep it is also because of its profile provide us enough privacy and light.

2.How do you usually use or adjust the window?

We usually open the door to balcony for ventilation. When we want to have more air, we usually open the upper window. We have added the other layers of window. During winter, it can prevent the cold from outside, and we can still keep the original window in this condition.

3.What time will it usually be when you adjust the window? Does it change through the time?(A year or a month)

It depends on when the summer and winter is. We add the second window last October, and we took it off around this March. It changed every year. During summer, when the neighbors are usually out for vacation, we will go to the summerhouse in Dragør which near to the seaside. When our grandchildren visit us in summer, we will stay here for hosting them.



Fig.3.57, the use of windows

Dortheavej Residence

Occupants: Diana (young adult), Mads (young adult), Viktoria (Elementary school- third grade), Hektor (Elementary school- first grade), and Oskar (kindergarten)

Interview location: in the living room for a while, but mainly in the dining room, Dortheavej 2C 1. tv., 2400 København NV

Interviewee: Diana, Viktoria, Hektor, and Oskar

Interview time: 13th June, 16.30-17.30

Interview tools: camera and digital voice recorder

Daylight condition (Fig. 3.58-60): Because of the time of day and the weather conditions outside, the interview was conducted under conditions where the sunlight had a chance to enter the room directly. It is worth noting that the temperature in the room is very high during the interview because of the direct sunlight, so the occupants had to move around in the space in order to resolve the discomfort of staying in the same space. Therefore, during the interview, the occupants stayed in the living room for about 10 minutes before moving to the dining room where the main interview was conducted. Because of the discomfort brought by the indoor conditions to the occupants, I shortened the duration of the interview to one hour so that the occupants could leave the discomfort of the indoor environment as soon as possible. Thus, most of the questions for the children were obtained through on-site interviews, while some of the questions for Diana and Mads were collected through Diana's written feedback from email.



Københavns kommune juni 2023
Solskin (timer)

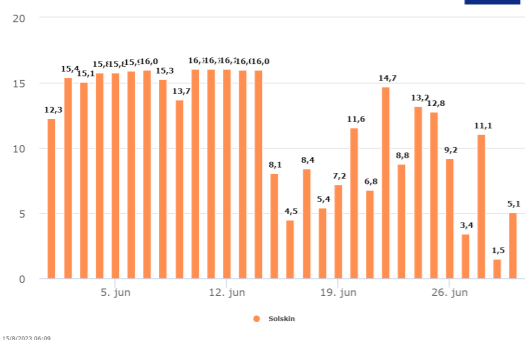


Fig.3.58, Sunshine hour, Copenhagen, June, DMI

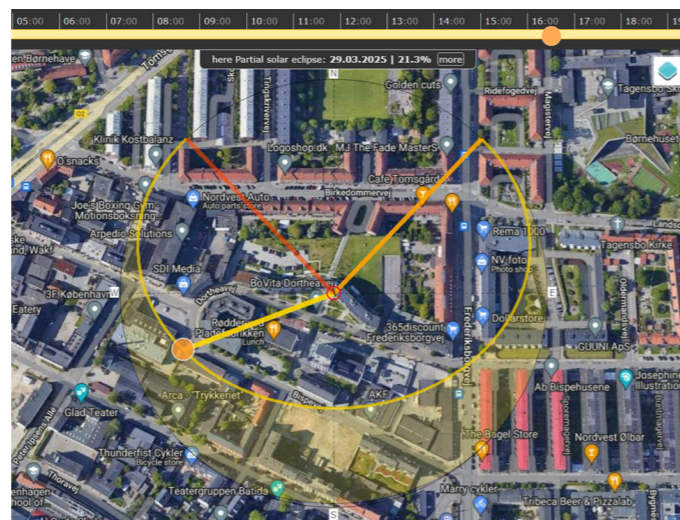


Fig.3.59 (above), exterior of the house
Fig.3.60 (below), Sunscal, 16.30, 13th June

a.Intimacy (Fig. 3.61)

1.Intimacy is related to privacy, and it can bring you a sense of sheltered, enclosed. When you stay at this room, do you feel intimate?

Hektor: When I go out from my bedroom, I feel myself become small because the living room and bedroom are so big. The different ceiling height and floor height make me feel a bit weird.

Viktoria: The stairs are strangely small compared to the size of the living and dining room. The space is big to me, and it is very deep. I don't feel enclosed.

Diana: We feel that we have an enclosed space in our dining room in regard to the activities that we do. The area is a meeting place where we gather, which makes this a personal space for great talks, dining and playing.

2.Which area in the dining room do you like to stay for more intimacy? Why and how?

Diana: The bedroom side of the apartment is more private, but we still prefer to be together as a family in our living room and kitchen/dining room.

3.What time will it be when you stay at that area? Does it change through the time? (A year, a month or a day)

Diana: We stay in the kitchen/dining room in the morning before school and work and in the afternoon when we return for around an hour. Then we split up and use different spaces for individual activities. Around 6 PM, we gather for dinner in the kitchen/dining room. And after dinner, we usually spend time in the living room together before going to sleep.

In the summertime, we are more outside and out visiting others. Both because we seek more social relations in the summer but also due to the high temperatures in the apartment.

4.Will you want to have more or less intimacy in that area? Why?

We can feel a little exposed in the room due to the big windows in our dining area. We love the view, but it would be nice if people couldn't look directly into our apartment.

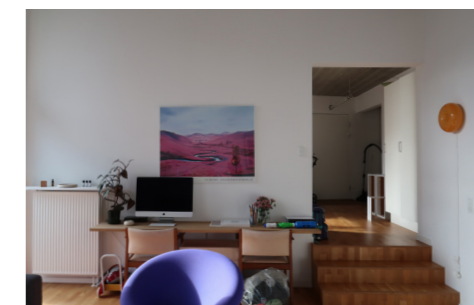
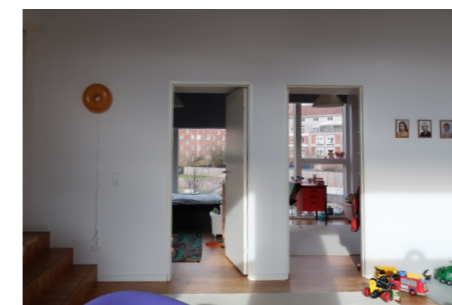


Fig.3.61, the size of rooms in relation to the perception of intimacy

b.Shadow (Fig. 3.62)

1.What is the feeling that shadow brings to you?

Hektor: I like to sit in the shadow because it is too hot when I sit in the sunlight.

Viktoria: I like to have some light on my paper, and I can read and write. The curtain is good because it can filter some light, and it will be also not too hot.

Diana: We only have shadow in the dining room before noon and late when the sun is down or it's cloudy. We like keeping the space cool, and we often block the sun with our curtains.

2.Will you want to have more or less shadow in the room? Why?

Hektor: Yes. Maybe more shadow from the window to the middle of the table (point out where he sits) will be great.

Viktoria: Yes. More shadow near the window would be great. Then I can sit here.

Diana: We usually draw the curtain in the evening when we are all together at dining room. Then people cannot watch us all the time. In the morning, we will open the curtain to get some light, but if it is too hot in the summer we will draw the curtain. We eat, draws on the table. Most of time we play on the floor because we can sit in a circle, and Oskar can also join our game. We would love to have more shadow, because the room gets very heated, especially in the summer but also in winter.

3.What time will it be when you want to have more or less shadow? Does it change through the time? (A year, a month or a day)

Diana: We would prefer more shadow in the afternoon between noon and 4 pm.

4.Which area in the dining room do you want to have more or less shadow? Why and how?

Diana: We would like less direct sunlight in general.



Fig.3.62, shadow in the room

c.Window (Fig. 3.63)

1.Are you satisfied with the windows in this room? Why?

Hektor: It will be better if the lower part of the window is covered because it is too hot and too much light inside during summer. We also don't need the sunlight from below.

Viktoria: I usually have headaches from too much light and heat from the window, and I cannot concentrate on my homework. It will be better if the glass is replaced by the one with color to filter the sunlight.

Diana: We like a lot of light from outside during winter, but in the summer, it is too hot inside so we cannot stay at home for a long time. The kids usually want to go out and play. We would love the windows to be smaller actually. They could start a meter from the floor and up for example. It would provide more privacy and a less heated space.

2.How do you usually use or adjust the window?

Diana: The kids usually ask us to open the windows most of the time. During the daytime in the summer, they are almost always wide open. Me and Mads usually open the windows in the morning to get some fresh air after sleep. In the evening we will close the window because Viktoria fears spiders coming in.

3.What time will it usually be when you adjust the window? Does it change through the time? (A year or a month)

Diana: During summer we usually open the windows because it is very hot, and in winter, we usually close the windows. We can only open the windows on one side of the apartment to avoid drafts. We usually close them before we go to sleep in the summer. In the winter we only open them up for a couple of hours during the day to let fresh air in.

4.How do you wish to adjust the windows if it can be changed? Why?

Diana: It would be great if we could open it even more up to cool down the space.

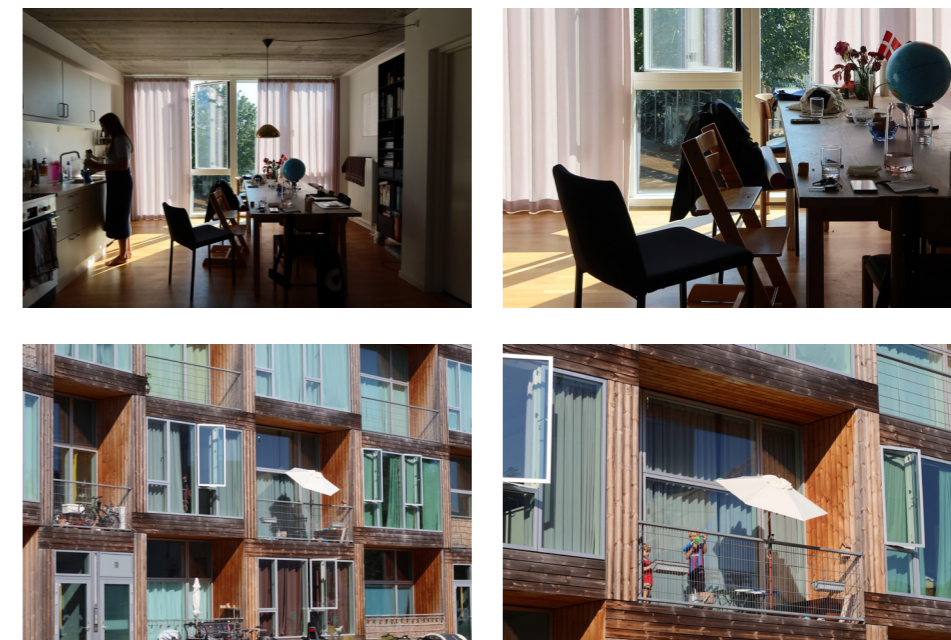


Fig.3.63, the use of windows

Conclusion

low-contrast shadowscape usually occurs when occupants attain intimacy by performing their desired level of behavior, without too much outside gaze, glare and heat, especially during the months when there is over-abundant daylight outside.

Through Interior-scale case studies, I gained an in-depth understanding of the relationship between shadow, window and domestic interior space through shadowscape observation. Through the interview, I learnt about the relationship between occupants' feelings of intimacy and shadow and window. These two investigations gave me a comprehensive understanding of the role of shadow and window in shadowscape and the relationship between these two elements and intimacy.

From the observation of shadowscape, the performance of shadowscape is closely link to window and interior settings. In Kartoffelrækkerne, the window settings- Dannebrog window with windowsill and details - block some of the direct sunlight, and create a considerable amount of treated daylight. The quality of treated daylight introduced by the windows is enhanced by the use of darker interior colors and spatial organization with its depth which let both of two different light sources meet in the interior. The interior is dominated by treated light without too much direct sunlight. Therefore, a state of low-contrast shadowscape is performed in the interior, with softer texture of shadow and nuanced change of light and dark.

In contrast, the window settings of Dortheavej Residence- windows with fewer details, simple compositions, and full-height size- let the direct sunlight enter more easily and abundantly. The quality of direct sunlight introduced by the window is enhanced by the bright-color interiors and spatial organization with its great depth, and the character of only allowing only one side of the room toward south to lit up the space with fewer opportunities to have two light sources from two sides of the room. The interior is dominated by direct sunlight, and the change of light and darkness is drastically from the side of window to the other side of the room. Therefore, a state of high-contrast shadowscape is performed in the interior, with sharper texture of shadow and more extreme change of light and dark.

Through the interview survey, I learnt that window settings are directly related to occupants' perception of intimacy and shadowscape. Window settings affect the occupants' interior behaviour and the way they interact with the outside world, including the daylight condition, temperature, and outside gaze. In addition, due to the distinct season changes, occupants will adjust their windows in relation to the adjustment of indoor climate, which also influences the performance of shadowscape in a great level. Therefore, the flexibility of the windows is very significant to meet the need for a different indoor environment, and the shadowscape is performed based on the varied needs. To connect the relationship between the shadowscape and the perceive intimacy by interior-scale studies of Kartoffelrækkerne and Dortheavej Residence, I understand that low-contrast shadowscape usually occurs when occupants attain intimacy by performing their desired level of behavior, without too much outside gaze, glare and heat, , especially during the months when there is over-abundant daylight outside. Lastly, the problem of gaze, glare and heat causing the lack of intimacy in the large window house is a crucial issue, which I recognized from the conducting of shadowscape observation and interview.

3.3 Housing Case Studies Conclusion

(1) Urban-scale case studies:

Different volumes and function of buildings, wider street outside of Dortheavej Residence which could let the gaze enter the interiors lead to a weaker spatial structure of neighborhood compared to the external environment of Kartoffelrækkerne, which is located in the neighborhood with more narrow streets and with same dwelling functions buildings. The geometry of the housing is also crucial, which mostly led to differnt daylight condition indoors.

(2) Interior-scale case studies:

The spatial organization, interior colors, furniture and objects arrangement, and window settings and details are all the factors to contribute to the different performance of shadowscape ,especially windows. With floor-to-ceiling window, bright-color interior and the great depth of the space led to a high-contrast shadowscape at Dortheavej Residence, which the daylit state can be contributed by the dominance of direct sunlight. With Dannebrog windows, darker-color interior, and the access to attain two different light sources led to a low-contrast shadowscape in Kartoffelrækkerne, which the daylit state can be contributed by the dominance of treated daylight without too much direct sunlight.

Through the interview survey, the window settings can affect the shadows and perception of intimacy indoors. These are closely related to occupants' behaviour and have very varied needs depending on the season, so the needs for window settings also vary greatly depending on the season. Among the varied needs for windows settings, the main ones are avoiding too much gaze from the outside world, avoiding too much direct sunlight, and avoiding too much heat in the months when the daylight is over-abundant. After these three needs are met, occupants will be able to perform their desired behaviours indoors and obtain sufficient intimacy.

Chapter 4 CONCLUSION

4.1 Comparison of theory studies and housing case studies

a. privacy/ intimacy

In theory studies, I learnt that intimacy is a phenomenon that changes with time and situation. In addition, in order to maintain the privacy of the family in the weaker spatial structure of the modern community, the intimacy within the family and individual family members is relatively crucial. Although the enhancement of intimacy cannot compensate for the protection of the external community space, it can maintain the intimacy within the household.

In the housing case studies, I observed that the perception of intimacy has a great relationship with the setting of the windows. In addition, during the interview process, I found that intimacy is related to the occupants' perception of the size of the interior of the space and the visibility of the interior space from the outside. Experience of whether the space is close to the occupants and whether the view from the outside interferes with the activities in the interior space are two other essential elements in allowing the occupants to feel intimate.

b. shadow

In shadow studies, I learnt that different levels of shadow are a way of depicting light. Also, low-contrast shadowscape is closer to human's perception to the whole environment. I can observe shadowscape systematically by learning how to observe shadows. By learning how to observe shadowscape systematically, I can observe shadows of different scales and textures to categorise different kinds of shadowscape and understand how different kinds of shadowscape affect human perception.

In the housing case studies, I found that a low-contrast shadowscape can be contributed by the dominance of treated daylight without too much direct sunlight in the interiors. To apply the understanding of the use of the terms to describe the perceived shadow and observed shadow from theory studies, the low-contrast shadowscape is dominated by the big room shadow, which usually occurs in a normal-lit room without too much direct sunlight.

c. window in domestic space

In the study of window in domestic space, I learnt that the window's size, placement and its detail will affect the indoor light and shadow distribution, and the shadowscape created by the window has the opportunity to make people feel different levels of intimacy. Especially in Copenhagen's climate background, the long period of overcast-sky climate has made the interior of the residential building accustomed to maintaining the indoor intimacy by the low-level illumination/daylit environment. With this understanding, the large windows in modern houses, with their settings to introduce within a certain amount of light into the interiors based on the building regulation, the settings of large windows seem to affect the maintenance of intimacy.

In housing case studies, I observed that the window not only influences the performance of shadowscape, but also af-

fects the visual connection from outside and the indoor climate, which leads to varying feelings of intimacy. Therefore, in addition to the consideration of the window's size, position, and its details on the shadowscape performance, it is also necessary to consider the relationship with the outside world. There is significant to understand that the placement of the windows in Kartoffelrækkerne is close to the window settings of pier window architecture, which consisted with modulate distance between windows and doors, with the same width of the windows, except the fixed window on the back side of the building. To reflect the finding from the case studies to theory studies, I found that the rhythmic placement of window not only contributes to the order of the façade, but also contribute to creating a low-contrast shadowscape, with low-level daylit environments.

In case studies I have observed that the performance of shadowscape is very much related to the outdoor weather, windows, and indoor environment. Low-contrast shadowscape allows occupants to perform their desired activities in the space due to the milder indoor climate, especially during the months when there is over-abundant daylight outside. High-contrast shadowscape, on the other hand, causes occupants to move around their living space due to the need to avoid direct sunlight and excessive heat, and results in a lack of intimacy in the domestic space.

4.2 Conclusion

Summarizing the findings of the theory studies and the housing case studies, I came to the conclusion that intimacy in the Copenhagen domestic space is strongly related to the following three elements: the relationship between the window and the exterior, the shadowscape created by the window, and the way in which the interior space itself is constructed. I will list these three elements as follows.

(1) Relationship between windows and the exterior

Windows that expose occupants' activities to outside gaze and direct sunlight are two important conditions that contribute to the lack of the occupants' intimacy. The section of the window in relation to the external surroundings is a significant factor.

Firstly, the view from the street to the interior of the house through the window is mostly a low (street) to high (interior of house) section. If the windows are set above a certain height, such as windowsill, and if there are other settings around the windows that allow the windows to have a certain level of retreat from, such as retreating from outward walls, there will be less interaction with the view from the street when performing indoor activities, and some direct light will also be avoided. On the contrary, when the full-height window is fully opened and evenly placed with the outer wall, the street's gaze can clearly intrude the interior activities, which also directly introduces direct light, and further affects the maintenance of intimacy.

Secondly, if the space between the window and the external environment is wide and open, and if the windows are large, it also means that the view from the external environment into the interior space is also larger. In this case, the opportunity to introduce direct sunlight in the summer is also greater, for example, when the street is wider and there is no trees, the indoor activities of the residents on the ground floor to the other floor can be seen from the street, and the low angle of the direct sunlight can

be introduced directly into the room. When the street is narrower, one can only see the indoor activities of the lower floors, the other floors are more difficult to see. The low angle of direct sunlight will also be shielded by the buildings across the street.

Thirdly, regarding the relationship between windows and direct sunlight, if a window of a household faces south, it can bring in sunlight from midday to afternoon, that is, the warmer sunlight of the day. In addition, the orientation of the windows provides a heated room through the sunlight, but it also provides an opportunity to introduce too much heat and direct sunlight, which in turn affects the living behaviour of the room, and thus affects the feeling of intimacy.

(2) Shadowscape created by the window

Window settings critically affect the performance of shadowscape, including its size, location, composition, and detailing. Window settings further affect the occupants' intimacy; the size and location of windows contribute to the size and location of shadows, and the composition and detailing of windows affects the texture of shadows, which contributes to the occupants' perception of indoor temperature, light and shadow, and therefore their ability to carry out their desired activities in the space. If the size, location and composition of the windows introduce too much direct sunlight, it will result in a high-contrast shadowscape that will affect the occupants' activities. If less direct sunlight is introduced, the interior shadowscape will have a low-contrast shadowscape, resulting in a more stable environment for occupants to perform their activities, and thus more intimacy. In addition, the arrangement of objects around the window is also an important factor in the distribution of shadows in the interior, such as the placement of vases or plants.

(3) Windows and composition of the room

The way the interior is constructed includes the depth of the interior, the colours, the furniture, the furnishings and other details, which will affect the performance of the shadowscape, which in turn will affect the occupants' perception of intimacy. The depth of the interior will affect the occupants' perception of whether the space is enclosed, and thus whether the space is intimate; in addition, if the depth of the space is deep, coupled with the introduction of light from large windows only on one side of the room, a high-contrast shadowscape will be more likely to perform in the room. Darker interior colours absorb direct light and reflect it to other areas of the room in a gentle manner compared to lighter interior colours, which in turn affects the occupants' perception of shadows. Furniture and furnishings also take part in affecting the distribution of shadows, with their size, position in the room and texture.

To summarise these three points, the relationship between windows and indoor intimacy is very profound, with three important considerations affecting: whether there is too much outside gaze, heat and direct sunlight. If these three factors can be adjusted through the window settings, adjusted according to the climate, and the low-contrast shadowscape is maintained steadily, the occupants have a greater possibility of carrying out their activities in the indoor space and obtaining adequate intimacy.

Lastly, after understanding shadowscape in different ways, I have a deeper understanding of the role of low-contrast shadowscape in Danish domestic space. Low-contrast shadowscape is a phenomenon that mostly occurs when too much outside gaze, heat and direct sunlight is avoided. Moreover, in the Danish cultural practice of *hygge* with

low-level illumination/daylit environment at home, low-contrast shadowscape is a phenomenon that are more commonly perceived as a state that could enhance the sense of intimacy. If we only pursue the performance of low-contrast shadowscape, there is no way to guarantee that we can obtain intimacy in the domestic space. For example, in an over-cast sky weather, low-contrast shadowscape may be formed in the interior due to the relatively mild skylight, but if the window can directly allow the outside gaze to enter, even if there is a low-contrast shadowscape in the interior, it will not bring the occupants to perceive the intimacy.

Throughout my studies, I have recognised that there has been a significant amount of research on daylight in academia, but relatively little on shadow. Daylight and shadow are perceived in a nearly complementary manner, and I have learnt in the course of my studies that these two elements are closely related. However, it is obvious that there are more terms that can be used to describe the different traits of light, such as: diffused light, reflected light and so on. On the contrary, there are not so many terms that can be used to define the different sources and textures of shadow, which leads to the need to use the term of light to describe the performance of shadow in the process of research. performance. Therefore, if there are more research on shadow, maybe we can achieve a mutually reinforcing relationship with the study of light, and shadow.

Chapter 5 DESIGN

5.1 Design Strategies

In the initial design, in order to understand how the window setting affects the shadowscape of the room, and the possibility that this improvement can be implemented in other households in Dortheavej Residence, I focused on the adjustment of the windows themselves to gain a better understanding of how the windows can be adjusted to create a low-contrast shadowscape in the interior of the households.

I aim to improve the following three main issues within Dortheavej Residence by improving the windows themselves, listed in descending order of duration and need: excessive external gaze, excessive external heat, and excessive direct sunlight from the outside.

(1) Excessive external gaze- long term issue

Because the full-height window exposes the indoor activities to the outside, if the occupants don't draw the curtains, as long as they have activities in the space, they will have the problem of too much gaze from outside. Therefore, blocking the excessive gaze will be the main issue to be solved by the window.

(2) Excessive external heat- seasonal Issue

During the summer and partly during the winter months, excessive heat from the outside can be transmitted into the room through the windows, making it impossible for occupants to stay indoors. How to cope with this seasonal problem by providing variable shading to keep out excessive external heat is a task that must be addressed in the design.

(3) Excessive direct sunlight- seasonal Issue

Usually in the summer time, too much direct sunlight from the outside can cause discomfort to occupants and make it impossible for them to perform activities indoors. How to partially block and filter the excessive direct light as well as to diffuse the direct light is a task that I need to address in the design.

5.2 Design development

Based on the need to address long periods of external gaze, seasonal excessive heat, and seasonal excessive direct light with window settings, I have focused on collecting references to improve the window settings in my design development.

First, I will make a physical model and observe the interior daylight condition in the lightlab at school to derive the shadowscape at different times of the year. Secondly, I will deduce my initial design from the methods of solution that I have learnt from theory studies and housing case studies. Finally, I visit curtain manufacturers and window museum in Copenhagen to understand the practicality and feasibility of different window settings. After these three stages, I analyse the various opportunities of window settings and develop the initial design.

Physical model daylight test in Light Lab

Based on the fact that the main part of the window design that I need to adjust is related to the consideration of daylight, I placed the model in lightlab the school to understand the shifting daylight condition and shadowscape in different seasons and the duration of direct sunlight inside the room, in order to understand how to adjust the window. (Fig. 5.1-2) During June, the direct sunlight will enter almost the two third of the room. During March, the direct sunlight will enter almost whole room with low angle.

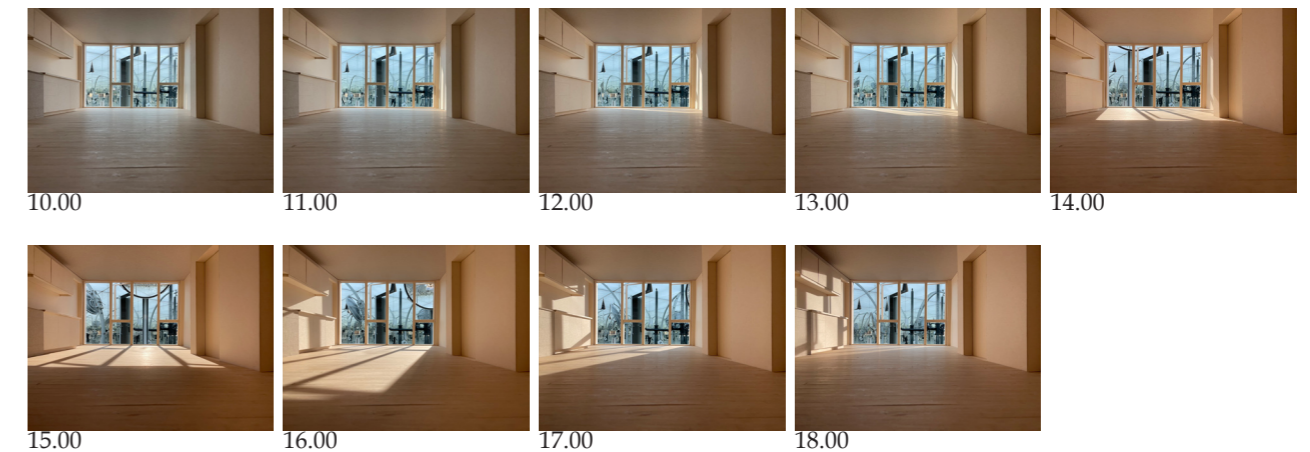


Fig.5.1, daylight condition in the dining room in 21th, June

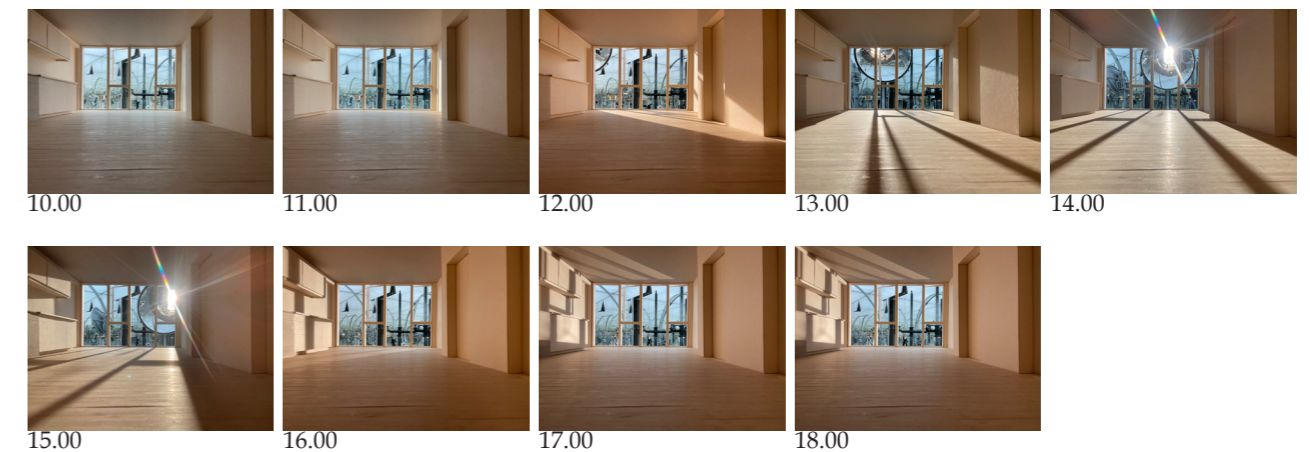


Fig.5.2, daylight condition in the dining room in 21th, March

Theory studies and Housing case studies

Based on my theory and housing case studies, I learnt that window setting and detailing can avoid direct light, such as the window's mullin, window frame and windowsill can diffuse and block the direct sunlight. In the design, I will experiment with adding detailing and shading around the window, based on a combination of long term and seasonal improvements, and discussions with relevant suppliers of window settings.

(1) Excessive external gaze- long term issue

The gaze is usually through the window below to penetrate into the room. I learnt from housing case studies that you can add a windowsill with a height of about 100cm to block the view from below. The lower part of the windowsill can be made of translucent or opaque material to block the view. In this way, the windows below can be blocked for a long period of time to avoid excessive views from the outside, and to allow the residents to have a countertop to use and place their belongings on. If there is a horizontally level view, for example, the windows below can be blocked for a long period of time to allow the residents to have a countertop to use and place their belongings on. If there is a horizontal view, such as that of immediate neighbours on their other side of the street, items can also be placed on the countertop to block the horizontal view.

(2) Excessive external heat- seasonal Issues

As the problem of overheating occurs mostly in summer and partly in winter, there is a need for variable shelters that can absorb heat from different angles of sunlight and can be opened and stored when not in use.

(3) Excessive direct sunlight- seasonal Issues

This problem occurs mostly during the summer months, when sunlight intensity is high and there are more opportunities for occupants to experience discomfort from direct sunlight in the eyes. There is a need for shelters that can block the direct horizontal sunlight coming into the room and can be folded when not in use.

Reference from curtain manufacturers and window museum

In the process, I also visited the window museum and curtain manufacturer (Fig.5.3-4), and I understand if we only adjust materials for windows and curtain, the need for adjustments of windows and curtains due to seasonal change will be constrained within the large division of windows. Therefore, I try to divide the composition of the windows and curtains with the flexibility of different ways of drawing curtains.

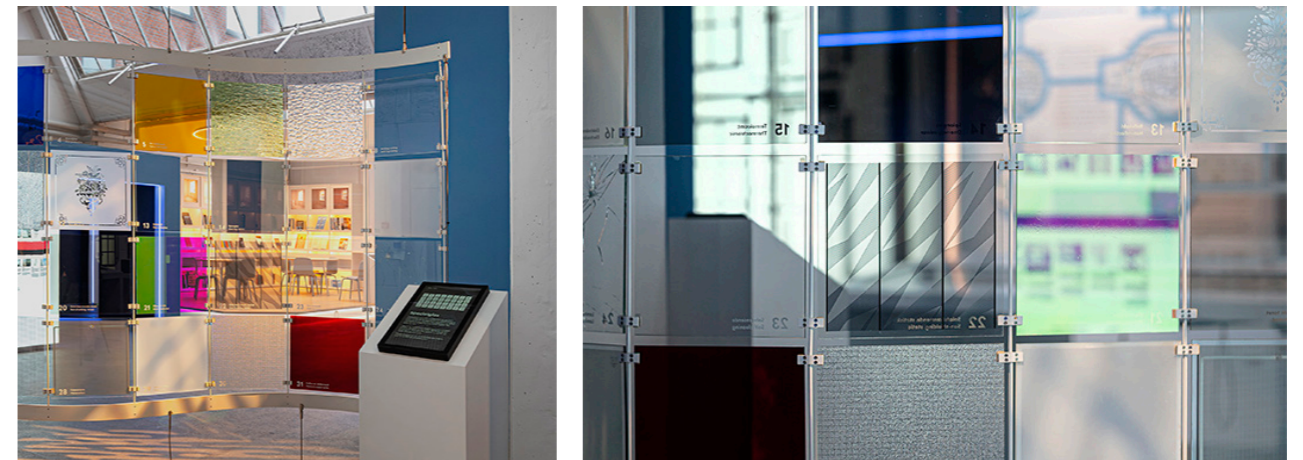


Fig.5.3, glasses samples in VILLUM Window Collection

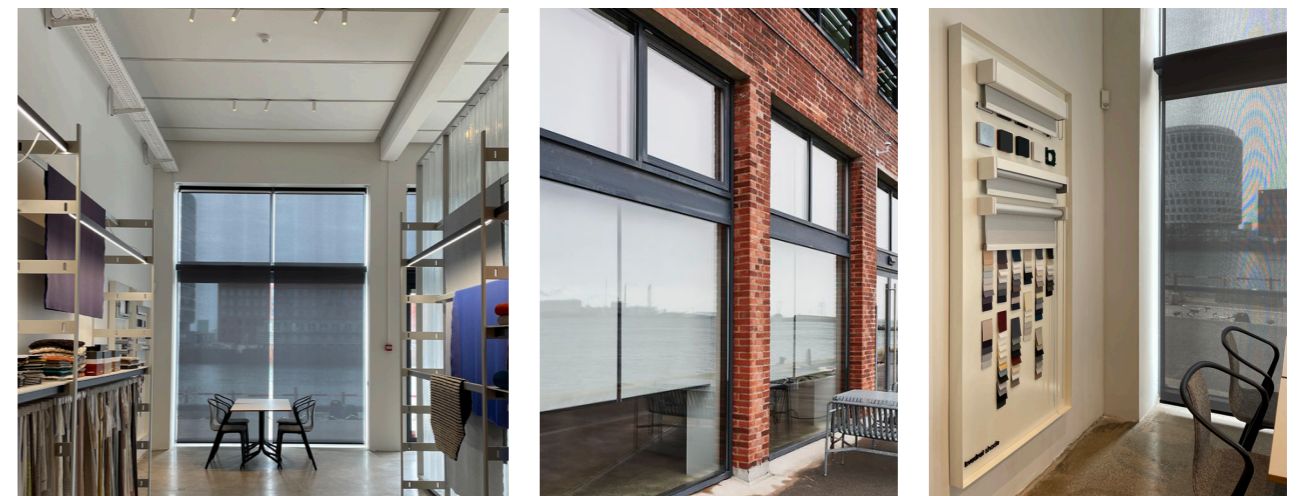


Fig.5.4, curtain products in kavadraft showroom in Copenhagen

Sketch models and sketches

Base on the different use and need to close/open the curtains and windows in different seasons, I try to divide the composition of the windows and curtains with flexibility. (Fig.5.5-7)



Fig.5.5, division of window according to different need of use



Fig.5.6, sketch models

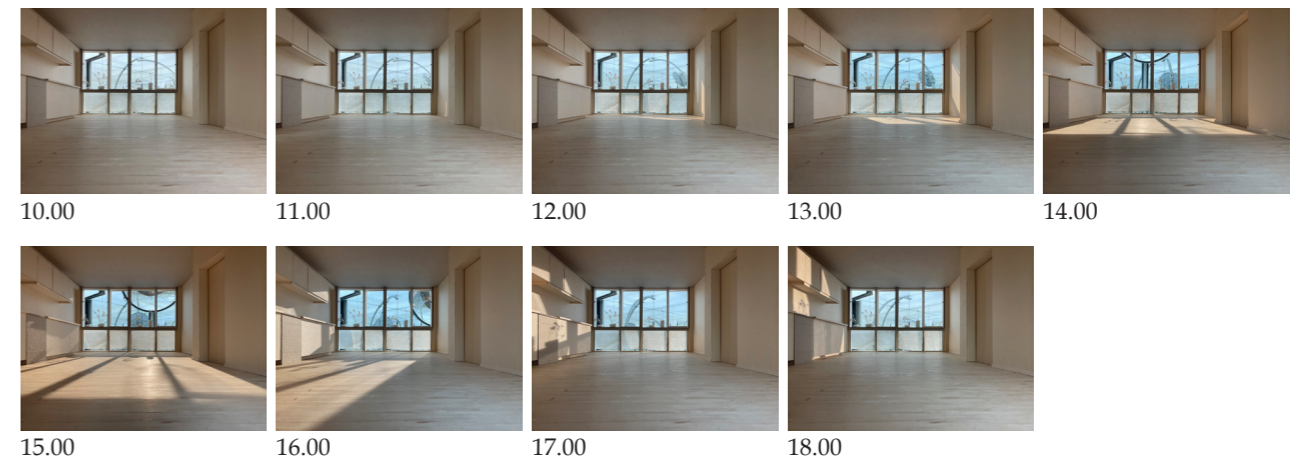


Fig.5.8, daylight condition in March, below part of the window covered

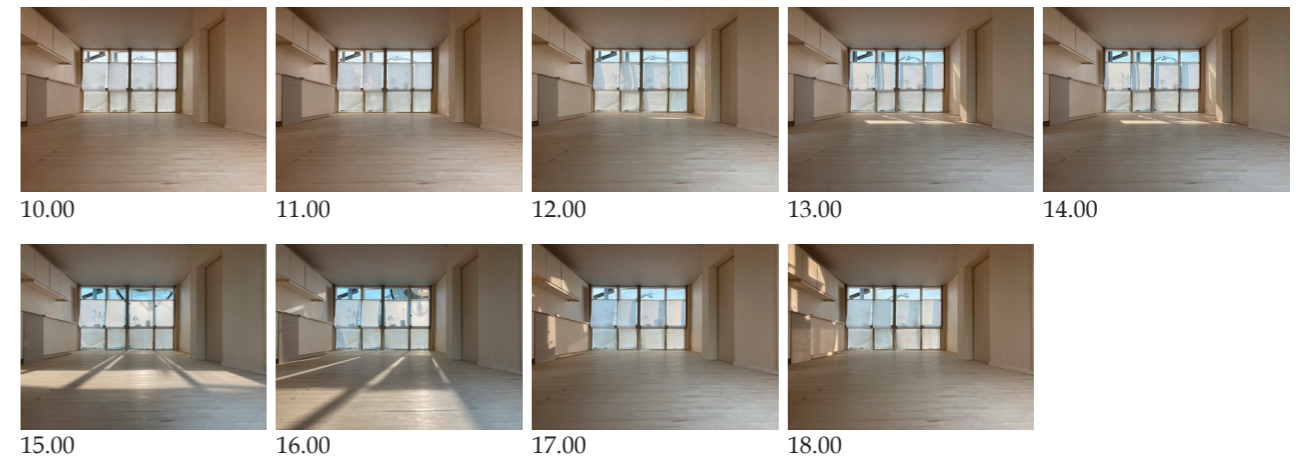


Fig.5.9, daylight condition in March, below and middle part of the window covered

5.3 Design

Design model

Lastly, I created a flexible systems in window settings:

The upper part of the window can be opened in different angle based on the different angle of sunlight outside, and the area in the interior occupants aim to have more daylight. When there is no need of adjusting the angle from the upper part, the panel can be folded to the height level of ceiling.

In the middle part of the window, the windowsill and roller blind is to avoid direct sunlight and gaze from neighboring building. When there is no need of blocking, the roller blind can be withdrawn into the curtain box underneath the windowsills.

The below part of the window is to avoid the street-level gaze and heat from outside with the curtain drawn from the side. When there is no need of blocking, the curtains can be drawn to each side of the division.



Fig.5.10, flexible adjustment in window settings, the upper part of the window is half-opened



Fig.5.11, flexible adjustment in window settings, the upper part is divided into two components that it can be adjusted base on the direction of sunlight



Fig.5.11, flexible adjustment in window settings, the upper part of the window is totally closed



Fig.5.12, middle part of the window-windowsill and roller blind to avoid direct sunlight and gaze from neighboring building



Fig.5.13, below part of the window- avoid the street-level gaze and heat from outside with the curtain drawn from the side



Fig.5.14, middle part of the window- windowsill with two functions of placing objects and curtain box to store the roller blinds



Fig.5.15, middle part- windowsill with the function of putting objects



Fig.5.16, below part of the window- avoid the street-level gaze and heat from outside with the curtain drawn from the side



Fig.5.17, upper part of the window- reflect sunlight to the area where occupants need light



Fig.5.18, below and middle part of the window

Bibliography

Privacy

- Altman, Irwin. Privacy Regulation: Culturally Universal or Culturally Specific?, *Journal of Social Issues* 33, no. 3 (Summer 1977): 66–84.
- Dario, Castiglione. *Shifting the Boundaries: Transformation of the Languages of Public and Private in the Eighteenth Century*. Edited by Lesley Sharpe. Exeter: University of Exeter Press, 1995.
- Green, Michaël, Lars Cyril Nørgaard, and Mette Birkedal Bruun, eds. *Early Modern Privacy : Sources and Approaches*. Leiden; Boston: BRILL, 2022.
- King, Peter. *Private Dwelling : Contemplating the Use of Housing*. London ; New York: Routledge, 2004.
- Madanipour, Ali. *Public and Private Spaces of the City*. London: Routledge, 2003.
- Prost, Antoine, and Gérard Vincent, eds. *A History of Private Life: Riddles of Identity in Modern Times*. 5. Cambridge, Mass: Belknap Press of Harvard University Press, 1991.
- Rengel, Alexandra. *Privacy in the 21st Century*. Leiden: Martinus Nijhoff Publishers, 2013.
- Robin, Evans. *Figures, Doors and Passages, In Translations from Drawing to Building*. Cambridge: MIT Press, 1997.
- Samuel D., Warren, and Louis D. Brandeis. *The Right to Privacy*. *Harvard Law Review* 4, no. 5 (December 15, 1890): 193–220.
- Solove, Daniel J. *Understanding Privacy*. Cambridge, Mass.: Harvard University Press, 2008.
- Vincent, Goldhammer. *A History of Private Life : Passions of the Renaissance*. Edited by Chartier Roger. 3. Cambridge, Mass.: Belknap Press of Harvard University Press, 1989.

Shadow / Light

- Corrodi, Michelle, Klaus Spechtenhauser, and Gerhard Auer. *Illuminating : Natural Light in Residential Architecture*. Basel, Switzerland: Birkhäuser Verlag AG, 2008.
- Dubois, Marie-Claude. *Daylighting and Lighting: Under a Nordic Sky*. Lund: Student literature, 2019.
- Edensor, Tim. *From Light to Dark: Daylight, Illumination, and Gloom*. Minneapolis: University of Minnesota Press, 2017.
- Frandsen, Sophus. “The Scale of Light.” *International Lighting Review*, ILR, 1987.
- Gombrich, E. H. (Ernst Hans), Neil MacGregor, Nicholas Penny, and National Gallery (Great Britain). *Shadows: The Depiction of Cast Shadows in Western Art*. New Haven: Yale University Press, 2014.
- Heschong, Lisa. *Visual Delight in Architecture: Daylight, Vision and View*. Abingdon, Oxon; New York: Routledge, 2021.
- Kite, Stephen. *Shadow-Makers: A Cultural History of Shadows in Architecture*. London: Bloomsbury Publishing, 2017.

Window in domestic space

- Lajer-Burcharth, Ewa, and Beate Söntgen, eds. *Interiors and Interiority*. Berlin: De Gruyter, 2016.
- Tsukamoto, Yoshiharu, Fuminori Nousaku, Chie Konno, and Tokyo kogyo daigaku. *WindowScape : Window Behaviorology*. Tokyo: Firumuatoshia, 2011.

Kartoffelrækkerne

- Bech-Danielsen, Claus, and Marie Stender, eds. *Et Lille Hus i Byen: Fortællinger Om Arbejdernes Byggeforening – Nostalgi Eller Fremtid?.* Kbh: Gad, 2015.
- Harsløf, Olav, Anne Røssell, and Husejerforeningen ved Øster Farimagsgade. *Kartoffelrækkerne*. Kbh: The Homeowners Association at Øster Farimagsgade Arbejdernes Byggeforening, n.d.
- “Kartoffelrækkerne : En Livsstil for Børn.” 1989.

Uncategorized

- Alban, Janson, and Tigges Florian. *Fundamental Concepts of Architecture: The Vocabulary of Spatial Situations*. Basel: Birkhäuser, 2014.
- Samuel, Flora. *Le Corbusier and the Architectural Promenade*. Basel: Birkhäuser, 2010.
- Wang, David, and Linda Groat. *Architectural Research Methods*. 2nd ed. Wiley, 2018.

Figures

Fig.1.1: Hammershøi, Vilhelm, *Interior in Strandgade, Sunlight on the Floor*, 1901, 46.5 x 52 cm, Statens Museum for Kunst

Fig.1.2: Corbusier Le, Pierrejeu De, *Home of Man*, 1948, *Privacy and Publicity-Modern Architecture As Mass Mediadomain*

Fig.1.3: *Samarbejdsaftale mellem regeringen (Socialdemokratiet) og Københavns Kommune om: Flere almene boliger i København*, 23. juni 2022, p.7.

Fig.1.4: *Guidelines for Master's project at the architectural degree programme – Academic Regulations 2017*, Royal Danish Academy – Architecture, Design, Conservation

Fig.1.5: Böttger, Frederik, *Kartoffelrækkerne- Øster Farimagsgade, byggeforeningshus*, 1880, The Royal Library's picture collection

Fig.1.6: *Dortheavej Residence*, 2017, Lejerbo

Fig.2.1: Sophus, Frandsen, *The Four Shadows, The scale of light, International Lightning Review, ILR* (Philips Lighting, Luminaire Group, 1987), p. 111

Fig.2.2: Sophus, Frandsen, *The Shadow Types, The scale of light, International Lightning Review, ILR* (Philips Lighting, Luminaire Group, 1987), p. 111

Fig.2.3: Piles, Roger de, *Eléments de la Peinture Pratique*, 1684, Detail of an engraving, Paris

Fig.2.4: Da Vinci, Leonardo, *Diagram of light falling on a wall opposite a window, indicating the arc of the horizon and the resulting shadow*, about 1490-2

Fig.2.5: Merisi da Caravaggio, Michelangelo, *The Supper at Emmaus*, 1601, 141 cm x 196.2 cm (56 in x 77.2 in), National Gallery, London

Fig.2.6: Monet, Claude, *Wheatstacks (End of Summer)*, 1897, 60 cm x 100.5 cm (23.6 in x 39.5 in), Art Institute of Chicago , Chicago

Fig.2.7: de Chirico, Giorgio, *The Enigma of a Day*, 1914, 83 cm x 130 cm, Fondazione Giorgio e Isa de Chirico, Rome

Fig.2.8: Michael Gandy, Joseph, *interior perspective of the Breakfast Room, Pitzhanger Manor, looking towards the Library*, 1802- 3, the Trustees of Sir John Soane's Museum, London

Fig.2.9: I. Kahn, Louis, *Perspective view of Margaret Esherick House, Chestnut Hill, Philadelphia*, 1959- 62, May 1960. Louis I. Kahn Collection, The University of Pennsylvania and the Pennsylvania Historical and Museum Commission, Philadelphia

Fig.2.10: *Living Room of Margaret Esherick House, Chestnut Hill, Philadelphia, Keyhole window*

Fig.2.11: Ebstel, John (photograph), *ground floor office space of the Tribune Review Building''*, Courtesy Keith de Lellis Gallery, New York

Fig.2.12: Follower of Rembrandt, *A man seated reading*, 1628- 30, The National Gallery, London

Fig.2.13: Frederik Hansen, Christian, *Skindergade 34*, 1812-1815, Danmarks Kunstmuseum, Copenhagen

Fig.2.14: Böttger, Frederik, *København, Arbejdernes Byggeforening/B & W arbejdernes boliger - Farimagsgadekvarteret / Kartoffelrækkerne - Farimagsgade, Øster Farimagsgade, Voldmestergade*, 1880, The Royal Library's picture collection

Fig.2.15: seier+seier(photograph), *SAS royal hotel*, Copenhagen, 1955-1960

Fig.2.16: Permitted size of windows according to the Danish Building Regulations, Logadottir A et al. (2013) *Dagslys i boliger*. SBirapport 2013:32. Copenhagen: Statens Byggeforskningsinstitut, Aalborg Universitet

Fig.2.17: BIG, *Facade of Dortheavej Residence*, Floornature.com

Fig.2.18: Dannebrog window, VILLUM WINDOW COLLECTION

Fig.3.1: *Samarbejdsaftale mellem regeringen (Socialdemokratiet) og Københavns Kommune om: Flere almene boliger i København*, 23. juni 2022, p.7.

Fig.3.2: KØBENHAVNS KOMMUNE PLANORIENTERING, *Lokal plan of Kartoffelrækkerne*, Lokalplan nr.115, Marts 1988, Bygge- og Teknikforvaltningen • Plan & Arkitektur

Fig.3.3: Lokal plan of Dortheavej, Plan-og Landdistriktsstyrelsen,

Fig.3.4: Chung, Payton(photograph), *GernersgadeKrusemyntegade & Sankt Pauls Gade*

Fig.3.5: Olufsvvej, RundtiDanmark

Fig.3.6: Kartoffelrækkerne, kartoffelraekkerne.dk

Fig.3.7: Jørgensen, Leif (photograph), Humleby

Fig.3.8: Jørgensen, Leif (photograph), *Strandvejskvarteret*

Fig.3.9: VM Houses, big.dk

Fig.3.10: The Mountain, big.dk

Fig.3.11: 8 House, big.dk

Fig.3.12: Kaktus Towers, big.dk

Fig.3.13: *Dortheavej Residence*, big.dk

Fig.3.14: Böttger, Frederik, *København, Arbejdernes Byggeforening/B & W arbejdernes boliger - Farimagsgadekvarteret / Kartoffelrækkerne - Farimagsgade, Øster Farimagsgade, Voldmestergade*, 1880, The Royal Library's picture collection

Fig.3.15: sunlight orientation of Kartoffelrækkerne, suncalc.org

Fig.3.16: floor plan of Dortheavej Residence, EU Mies Award/YTAA, miesarch.com

Fig.3.17: sunlight orientation of Dortheavej Residence, suncalc.org

Fig.3.18: by the author of this article

Fig.3.19: Böttger, Frederik, *København, Arbejdernes Byggeforening/B & W arbejdernes boliger - Farimagsgadekvarteret / Kartoffelrækkerne - Farimagsgade, Øster Farimagsgade, Voldmestergade*, 1880, The Royal Library's picture collection

Fig.3.20: by the author of this article

Fig.3.21: section of Dortheavej Residence, EU Mies Award/YTAA, miesarch.com

Fig.3.22: by the author of this article

Fig.3.23: COPENHAGEN MUNICIPALITY · BUILDING CASE ARCHIVE, VV2985

Fig.3.24: "Dortheavej- New homes in Copenhagen NW", 2017, Lejerbo København

Fig.3.25: by the author of this article

Fig.3.26: Ibid.

Fig.3.27: Sunshine hour, Copenhagen, March, DMI

Fig.3.28: Sunca, J.A Schwartzgade 18, 2100 København Ø, 13.00, 16th March

Fig.3.29: Sunca, Dortheavej 2C 1. tv., 2400 København NV, 16.30, 26th March

Fig.3.40-51: by the author of this article

Fig.3.52: Sunshine hour, Copenhagen, June, DMI

Fig.3.53: by the author of this article

Fig.3.54: Sunca, J.A Schwartzgade 18, 2100 København Ø, 14.30, 7th June

Fig.3.55-57: by the author of this article

Fig.3.58: by the author of this article

Fig.3.59: Sunca, Dortheavej 2C 1. tv., 2400 København NV, 16.30, 13th June

Fig.3.60-63: by the author of this article

Fig.5.1-2: by the author of this article

Fig.5.3: glasses samples, VILLUM Window Collection

Fig.5.4-18: by the author of this article