# Aalborg University Copenhagen

Aalborg University Copenhagen

Frederikskaj 12,

DK-2450 Copenhagen SV

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- Lighting design for the new Gadehavegård

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**Supervior:**
Ellen Kathrine Hansen
Mette Hvass

**Semester Coordinator:**
Georgios Triantafyllidis

**Group Members:**
Sidsel Abrahamsen &
Dimitra Hadji-Popovski

**Abstract:**

This project is a lighting design proposal for the urban renovation of Gadehavegård done by Arkitema. Gadehavegård is a socially deprived housing area in Høje Tåstrup and with the urban renovation it is the intention to change this. As a part of the urban renovation Arkitema is establishing a new street with mixed mobility through the neighborhood that should give Gadehavegård some of the flow from the surrounding city and create a more extroverted neighborhood. This is the street we are designing light for.
With the lighting design we aim to strengthen the street during the dark hours providing it with a recognizable character. Furthermore it is the aim to increase the perceived safety and the feeling of community on the street. Through the analysis of the street we found that the light from the windows of the surrounding buildings has the effect of increasing the feeling of safety and community because the lived life is visible in the image of the city, in our design we try to amplify this notion on the street.

We have created a lighting design that increases this effect of the window. This is done through two elements. First by introducing projected dynamic light windows onto the ground and second leaving the facades of the buildings to be dark making it possible for the light from the windows to become very noticeable in the image of the street.
This creates an innovative lighting design solution where the street light is used for making an impact on the social housing areas, and strengthening the community on and around the street.

# THE WINDOWS OF GADEHAVEGÅRD

## LIGTING DESIGN FOR THE NEW GADEHAVEGÅRD

MAY 2021 - MASTER THESIS

MSC LIGHTING DESIGN - AALBORG UNIVERSITY

SIDSEL ABRAHAMSEN & DIMITRA HADJI-POPVSKI

IN COLLABORATION WITH

Arkitema

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# 1 INTRODUCTION

Light is an essential part of people's life, as it is allowing you to see your surroundings, especially in modern peoples life. Lighting is what creates the frame for how you perceive your surroundings. During the daytime the light source is the sun, embracing the surroundings in a global illumination. During the dark hours of the day the light source is the electrical light. It is the soft light that you put in your bedroom, it is the pendel light that collects people around the dining table and in the public space it is the light along the street. The light along the street helps you to navigate home, it helps you to feel safe, it helps you to identify the spaces and the people around you. In this thesis it is the last thing we are going to investigate. The street lighting that we will be investigating and designing is for the social housing area Gadehavegård.

Gadehavegård is a social housing neighborhood in Høje Taastrup and it has an important history, a history that is very similar to many other neighborhoods with social housing in Denmark. Gadehavegård like many other neighborhoods from the 60's to 70's is built after modernist principles. The ideal was to create affordable and nice housing for all. The new urban spaces were created with the rational principles that form should follow function. Functions were divided into zones with equal access for all residents, zones for living, zones for traffic and parking, zones for walking, etc. (Bjørn, 2008). Even though the housing areas were created with the intention of creating a better and more equal life for its residents, soon after they were built a lot of social issues started to occur. Unemployment and crime started to increase more in these areas compared to the surrounding areas and the neighborhood started to become socially deprived (Bjørn, 2008).

In 2012 the Danish government published the first Ghetto list pointing out the most socially deprived neighborhoods around Denmark, this list also included Gadehavegård. Following that in 2018 the parallel society agreement (Parallelsamfund Aftale) was approved (Økonomi- og Indenrigsministeriet, 2018), with the aim of removing all neighborhoods from the Ghetto list by 2030. One of the points for action is to do urban renovations, here Gadehavegård was selected to be renovated.

Arkitema is the architecture studio that won the competition for the urban renovation of Gadehavegård. This is where we got connected to the project in Gadehavegård, as Dimitra did her internship in the 9th semester with Arkitema. Here she worked on analysing the current lighting in socially deprived areas as Gadehavegård and additionally Hedemarken, which set the foundation for this thesis. Arkitema explains that their aim with the urban renovation is:

> "Vi sigter højt og går efter at skabe et attraktivt boligområde med høj grad af tryghed, varieret boligudbud, værdiskabende zoneopdeling af by- og landskabsrum, identitsbærende og oplevelsesrig arkitektur, opløsning af den monofunktionelle by og radikalt forandret infrastruktur." (p. 4, Arkitema, 2020)

This will be done through the approach they call “More street, More garden, More yard” (“Mere gade, Mere have, Mere gård”), which includes many different initiatives. In this project our focus has been on the approach called “More street”. Arkitema suggested establishing a new street in Gadehavegård and describes that it should work like a zipper that helps to connect the surrounding buildings and the surrounding city. Making the new street function as a natural connection point, where buildings and people meet in a rich urban environment that activates the community in the neighborhood (see figure 1.5).

Fig 1.1 & 1.2 Pictures from the current Gadeahavegård night time

Fig 1.3 Rendering of Gadeahavegård (Arkitema, 2020)

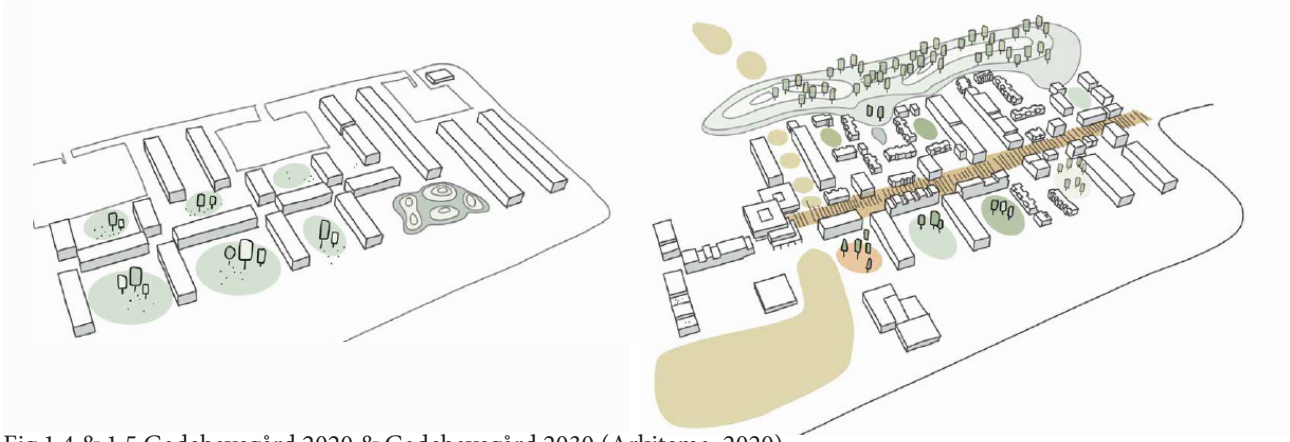


Fig 1.4 & 1.5 Gadehavegård 2020 & Gadehavegård 2030 (Arkitema, 2020)

As lighting designers our focus has been on transferring these intentions for the new street in Gadehavegård into the dark hours. To find a lighting concept that fits with Arkitemas intentions for Gadehavegård, but also to find a lighting concept that could be applied in similar cases.

Socially deprived housing areas have many interesting aspects that can be explored through lighting design and investigate what effect lighting can have in such an area:

- **Not feeling safe:** A lot of these areas are struggling with the issue that the outdoor areas do not feel safe during the dark hours; this is something that will be addressed in our project.

- **Feeling lost:** Furthermore a lot of the areas that are built after modernist principles also encounter the issue of people having a hard time navigating and feeling comfortable in the neighborhood. This has of course also been addressed through the plan that Arkitema has made. However with lighting we need to also help the neighborhood to be recognizable and comfortable during the dark hours of the day.

- **Lack of outdoor areas that encourage social life:** Lastly because the neighborhoods built with modernist principles separated everything according to function, there is a lack of areas that are inviting for social engagement. It is clearly the ambition from Arkitema that the street should be a solution to this issue. Our lighting design will also address how to extend these meeting points in the street into the dark hours of the day.

In the process we have found it relevant to apply the concept of social lighting by Slater et al. (2018) to the case of Gadehavegård as this provides us with some tools that help us work with the aspects presented above and create a lighting design that is centered around the human experience of the city.

Therefore we have made our **initial research question** to be:

> *What if lighting design could be used as a tool for supporting an urban transformation of a socially deprived housing area into a new neighborhood that feels safe, offers space for social life and is appealing to a diverse group of users?*

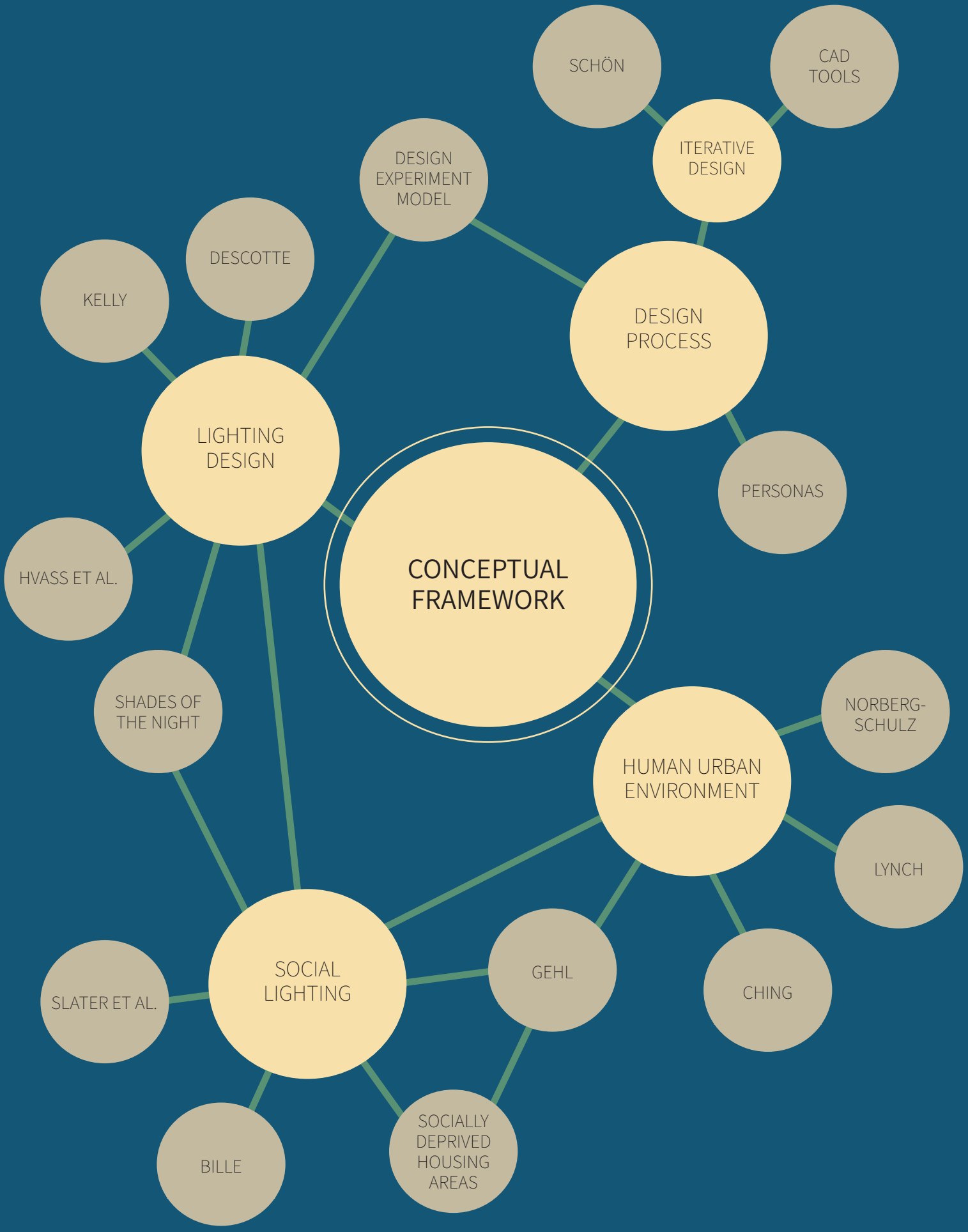



Fig 2.1 Above is our conceptual framework presented. It is created to provide an overview of the various theories and methods that shape this project.

# 2 METHOD

In this chapter we are going to provide an overview of the methods used in our project. The method is separated into two sections: Design process and Designing light and space. The design process is clarifying the methods used when developing our lighting design. The section includes Design experiment model and Iterative design. The Designing light and space section is presenting the methods we have used for informing our design. Hereunder Social lighting and Personas, containing also knowledge from the traditional theories by Descottes and Kelly. The theories explained in this chapter are used for establishing the vocabulary for communicating the design intentions.

## 2.1 DESIGN PROCESS

### 2.1.1 DESIGN EXPERIEMENT MODEL

Lighting design is a transdisciplinary field as it includes natural science, social science and the humanities and arts. The approach for working in this field is presented through the design experiment model by Hansen & Mullins (2014). It directs towards generating new knowledge based lighting design within the three fields (see figure 2.2). Natural science will focus on collecting technical knowledge

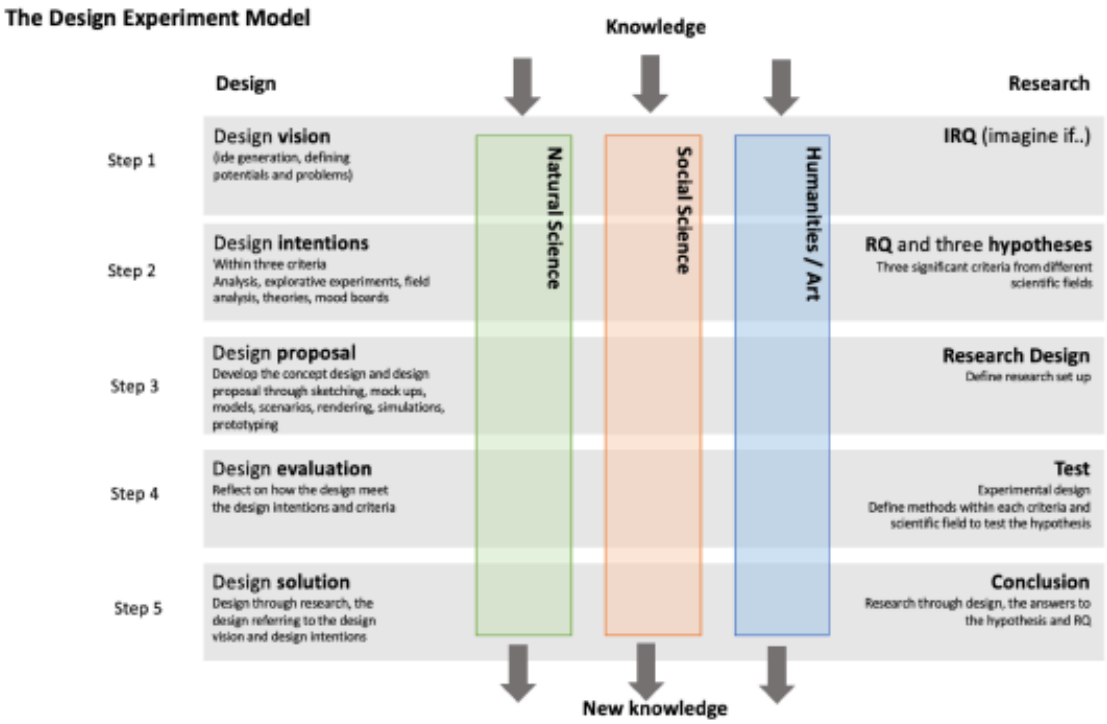


Fig 2.2 Design experiment model (Hansen & Mullins, 2014)

about light. Social science emphasizes the relationship between the people and the social effect of light. Humanities and art focuses on creating aesthetic experiences through light.

This thesis naturally is created with its foundation in this model. Including these three different fields and the design steps. However the three hypothesis haven't been created through the Design Experiment, but rather considered through the design criteria the Social Lighting concept by Slater et.al (2018)

### 2.1.1 ITERATIVE DESIGN

The development of the lighting design for the street in Gadehavegård will be an iterative design process. Iterative design is a circular process. You first establish the problems you need to solve with the design and what the problems require in order to be solved. Next step is to create the first design proposal and then evaluate the design in relation to the established requirements. In this step you are able to identify the part of the design that meets the requirement and the part of the design that needs further improvement (Rogers, Sharp, & Preece, 2011).

The iterative process has also been investigated in more detail by Schön (2016). Schön defines three different approaches for the reflective practice: knowing in action, reflection in action and reflection on action. Knowing in action is where the practitioner has enough knowledge in their field to an action without having to reflect upon the action. Reflection in action is where the practitioner is reflecting upon the particular action while they are doing it. Lastly reflection on action is where the practitioner is reflecting after performing an action. Here we would like to highlight reflection in action as our primary way of working in this project, about this Schön says: "When the practitioner reflects-in-action in a case he perceives as unique, paying attention to phenomena and surfacing his intuitive understanding of them." (p. 147, Schön, 2016).

The initial part of the iterative process will be done through sketching out the lighting design concepts. This is an effective method in order to get a fast understanding of the spatial character of the lighting (Chu et al. 2017). Creating these sketches will help to present the lighting concept in a visual manner before transfering the concept into different CAD programs.

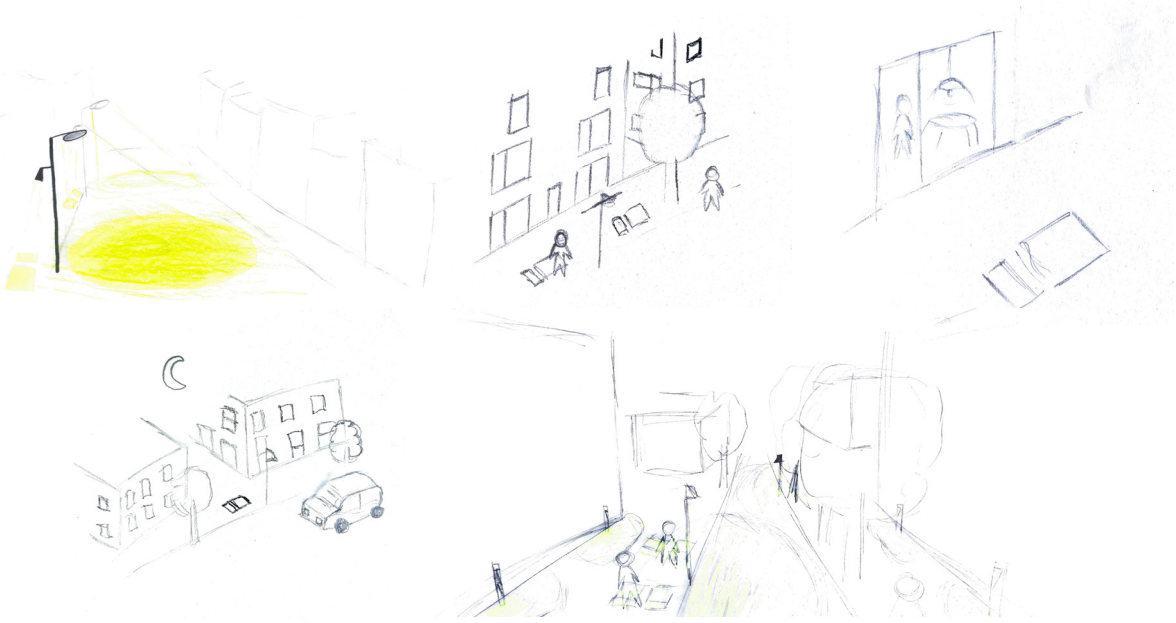


Fig 2.3 Sketches from iterative design process

The CAD (computer-aided design) programs are a profitable tool to use when creating a design that is difficult or expensive to test in real life. Bryden says "CAD allows designers to explore multiple concepts in 3D more quickly, visualize more accurately and eliminate error from engineering drawings" (p. 16, Bryden, 2014). The programs we will be using are DIALux, SketchUp, Enscape and Adobe Illustrator. DIAlux is used for creating calculations of the light and to retrieve photometric data. SketchUp is used to present a 3D version of the urban space and the context of the lighting design. The urban environment in the SketchUp file that we are using is created by Arkitema. Enscape is the visual tool that uses Sketchup as a base. Enscape is providing us with real time renderings of the lighting design, and creates a visual representation of the lighting in the urban space. Working with real time renderings is an efficient way to adjust the light characteristics as you design. Adobe illustrator is used in order to gain a general overview of the design through illustrations in the right dimensions.

Fig 2.4 Illustration from Enscape

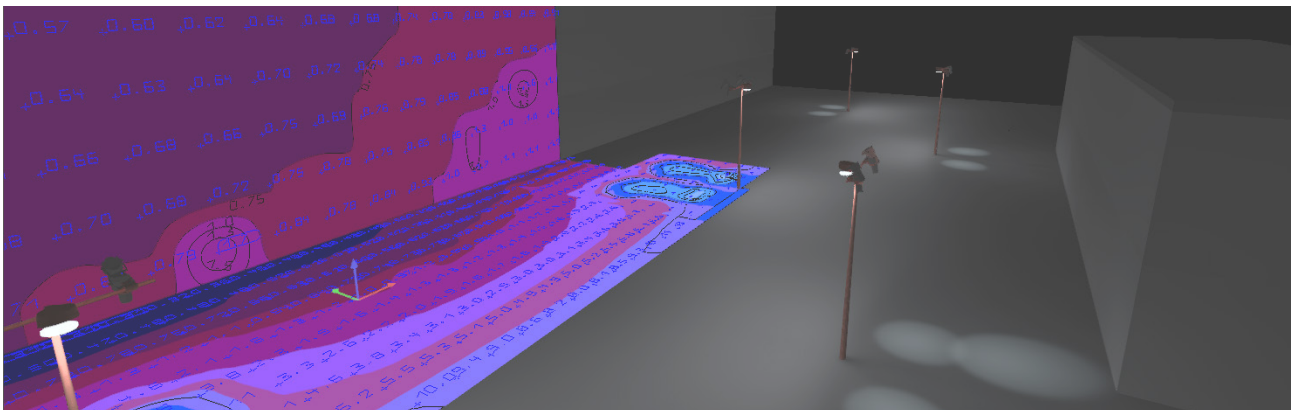


Fig 2.5 Illustration from DIALux

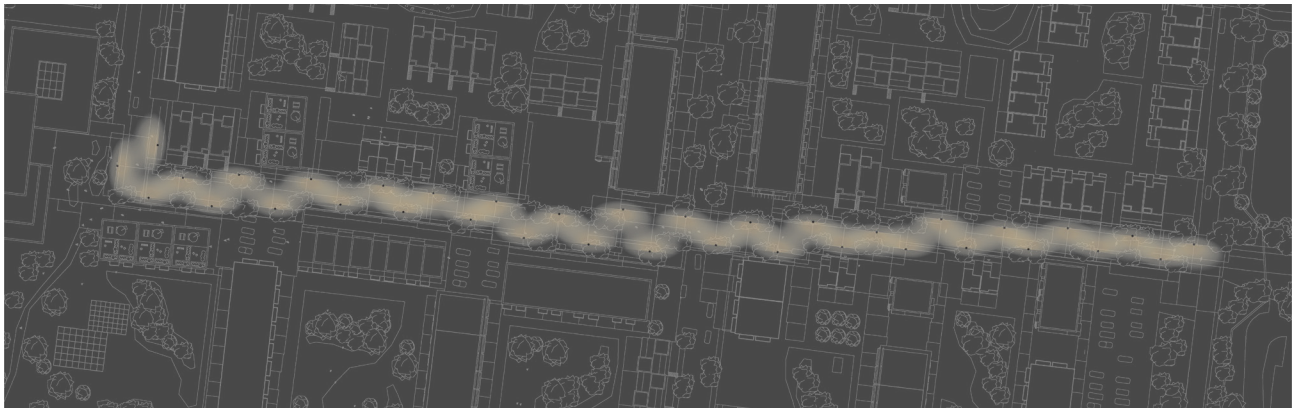


Fig 2.6 Illustration from Adobe Illustrator

## 2.2 DESIGNNING LIGHT FOR HUMANS

### 2.2.1 SOCIAL LIGHTING

The concept of social lighting in its core is concerned with the social effect of lighting, and the way that lighting has the power to define how a space is being experienced and how it shapes the way that humans interact with the space during the dark hours. In this project the methodology is used as a framework for the project and base for the analysis.

Slater et al. establishes four social complexities for lighting designers, recommending it to be used when identifying light in relation to the social character of the urban space. The social complexities are used to get an extensive understanding about the urban space, how it is being used, what is being valued and the interplay between different elements and social actors. Slater et al. argues:

> "We believe we have demonstrated that serious social research and understanding can and should be integral to lighting design, that social and spatial thinking can be brought together for more creative and more responsible design" (p.7, Slater et al., 2018)

Taking this social perspective when looking at urban spaces it is helping to identify the issues of the socially deprived areas, providing designers with a better understanding of the social context. Helping designers to create a lighting design that supports people's use of the urban space. Slater et al. explains about the effect of lighting in the urban space:

> "This is because light is an extraordinary tool, able to enhance the beauty of things, but also to improve people's lives, both individually and as part of a community. Light is deeply social, having a crucial role in determining the socio-cultural dimension of places throughout past, present and future." (p.5, Slater et al., 2018)

This method consists of four kinds of social complexities: **Connections, Places, Practises** and **Diversity**. Each explores and considers all the interconnected elements of the urban space and its complexity.


Fig 2.7 Illustration representing the four social complexities by Slater et al. (2018) (own illustration)

**Connections** - Here you establish an understanding of the location of the area in relation to its outer surroundings. Providing you with an understanding of how the neighborhood is perceived in relation to its context. How is it connected to the rest of the city and is it connected to a historical context?

**Places** - Here you consider what kind of identity the space has and how that creates value for the users in the space. The identity is defined by the spatial structure of the space, creating the frames for the atmosphere and the understanding of the space.

**Diversity** - The people are social actors in the urban space, play a big role in shaping the character of the space. Here you need to be aware of the different people in the space and who is going to use it. Exploring the user group and analyse their potential needs and and understandings of the space.

**Practices** - Here you take a closer look at how the space is being used in regards to different activities, movements and functions and how these can support or conflict with each other. It means that you need to understand how the users are going to use the space and what functionalities should be emphasized through lighting.

### 2.2.2 PERSONAS

When working with the concept of social lighting it becomes necessary to investigate, on a closer scale, the people who live in the neighborhood, who are we designing the light for? Here we have been utilizing the method of creating personas. This method is very common to use in product design as a way for the designer to gain an empathic understanding of the user and their behaviour (Nielsen, 2013). A persona is a fictional, but realistic, portrayal of the user you are designing for. The personas created for a project is a representation of a person you will find within your target group. The process with creating and working with personas can be put into three main steps (Nielsen, 2013):

**Data collection and analysis** - Here you collect a detailed understanding of your user group, and form a general understanding of who the users are and how they are different from each other.
**Persona description** - Next step is the description of the persona. Here you describe the persona with focus on the knowledge you need to gain in order to make your design. This is details about the personas lifestyle, interests, values, education, behavioural patterns, needs, desires and so on. Furthermore you give the persona a name and an image of the persona, in order to make the persona more realistic.
**Scenarios** - Create realistic situations and scenarios where the personas would be using your design. Here you would gain a further understanding of what could be potential benefits and problems for the user.

Having the fact that Arkitema's project about Gadehavegård is a vision project, there was a lack of knowledge for the potential users of the new-built housing. This method was very relevant for our design as it is providing us with more information about the potential users, how they will use the space, their needs, activities and events in the space, to be able to design the light accordingly.

## 2.2.3 KELLY - THE THREE ELEMENT OF LIGHTING DESIGN

The three elements of lighting design by Kelly (1952) are being used as a method for describing and understanding the layers of light in the urban space. Kelly's method is being used as a guideline for creating an interplay between these three tenets, where throughout the process the lighting designer needs to find the right balance on how to combine them. When these tenets are placed in a good balance, in regards to the functions and elements in the space, then enhancing the beauty and value of the urban space will be achieved.

**The focal glow** - is being defined as a functional light, where a specific task is being performed, or as Kelly defines it: "separates the important from the unimportant, helps people see". (p.25, Kelly, 1952) This element is used for defining a defined task in the urban space and it is used so that it is easier to see.
**The ambient luminescence** - is used for reassurance and establishing a safe urban environment. Kelly describes it as: "The ambient luminescence procuses shadowless illumination." (p. 25, Kelly, 1952)
**The play of brilliants** - is the layer of light that stimulates the spirit and enriches the human experience. It is the light that makes space come to life. Kelly writes: "Play of brilliants excites the optic nerves and in turn stimulates the body and spirit, quickens the appetite, awakens curiosity, sharpens the wit." (p. 25, Kelly, 1952)

These light layers by Kelly are being used as a vocabulary for describing the effect of the layers of light in the final design.

## 2.2.4 DESCOTTES - SIX VISUAL PRINCIPLES OF LIGHT

2.2.4 Descottes' six visual principles of light
The six visual principles of light presented by Descottes (2013) are created as parameters for lighting design. The principles are setting visual factors which should help us to understand the spatial characteristics of light. These principles are helping us in the process of designing light, to set the parameters and understand how to apply the characteristics of light, with an intention of highlighting the beauty of architectural spaces. Descotte argues "As architectural lighting designers, our role is to utilize light as a medium through which architectural intentions can be heightened and experiential spaces transformed." (p.8, Descottes, 2013).

It is our intention to use the six principles of light as a vocabulary for when we talk about the characteristics of light throughout this project. Descotte explains: "By defining the six principles, we aim to establish a common vocabulary through which the visual and experiential aspects of lighting design can also be properly addressed." (p.13, Descottes, 2013).

**Illuminance** - The illuminance is being understood as an important element that provides visibility and reassurance and when used at an appropriate level. With appropriate use of the illuminance level it can help to create a safe environment
**Luminance** - Luminance is the term for the intensity of light emitted from a surface. Descottes explains that brightness is a very similar concept to luminance. The difference between the two is that

luminance is objective, it is the light that is measured and brightness is subjective, it is what the viewer perceives when experiencing light from an object or surface. Here the surfaces in the space play a big role because they reflect the light and define the luminance being reflected into the space.

**Color and temperature** - The color and temperature of the light is influencing the perception of objects in space. This is because their colored appearance is dependent on the characteristic of the material of the object that absorbs or reflects the light. Taking this in consideration the color and temperature of light needs to be designed to highlight the appearance of the architectural space and create a recognizable memory.

**Height** - When designing with light it plays a very big role at which height the light is placed. As the spatial relationship between the light source, the ground and the ceiling is what helps us place our body into the surroundings and perceive the environment in regard to that. This knowledge about the height has helped in the design process to determine the space and visually create a balance that helps the user to immediately relate to the space, which through the height of the light can be expanded or make it more intimate.

**Density** -

> "Like the percussion section of an orchestra, the density of light in tandem with existing architectural patterns can establish the tempo of a space, giving a rhythm and movement to the overall architectural composition." (p.60, Descottes, 2013)

In the urban space density is defined as the rhythm that creates the spatial distribution and illustrates the dynamics of the space. The essential parameters for creating the spatial composition are divided into: the number and the organization of grouping the light fixtures.

**Direction and distribution** -

> "The form of light is governed by the principle of direction and distribution, which concerns the aim, shape, and beam characteristics of a light source." (p.70, Descottes, 2013)

For shaping the light in the lighting design, the direction and distribution of light are important to be considered as it is creating the beam characteristics of the light source. The wider beam angle can illuminate a greater area and expand visually the space, whereas the narrow beam is made so that it can highlight and concentrate the light in a specific area.

# 3 ANALYSIS

## 3.1 INTRODUCTION TO ANALYSIS

As a framework for the analysis of the street in Gadehavegård we are following the social lighting method with the four social complexities - **connection, place, diversity** and **practices** - presented by Slater et al. (2018). Creating the analysis within this framework will help us to highlight some of the issues that can be present in a socially deprived neighborhood and ultimately help us to gain an understanding and be able to create a lighting design that meets the potentials of the street.

Accordingly, we have chosen to start the analysis with the social complexity Connections, in order to first collect knowledge on a larger scale and be able to understand the location in the wider context and its relation to the surroundings. The next phase in the analysis is the complexity of Places, where we will be zooming in on the street and work to understand and define the public space and its identity. In the complexity Diversity we will collect and observe the different actors of the street. Further on the Practises should help in exploring how the public space is being used during the dark hours, which activities are happening and how people move in the space, in regard to the functions and needs.

Lastly at the end of the analysis our research question will be established.

## 3.2 CONNECTION

In this section we are going to take a closer look at the neighborhood from a wider perspective. Slater et al. (2018) presents that this complexity is concerned with how the neighborhood is connected to its surroundings and how it is understood in the context of the surrounding city.

In relation to Connections the case that we are working with is extremely interesting, because there will be a huge structural change in the neighborhood after the urban renovation. As mentioned earlier the structural change will happen by establishing a new street going through the neighborhood. A structural change like this is intended to create a positive impact on a socially deprived neighborhood like Gadehavegård.

Bjørn & Holek (2014) found that from 27 cases of socially deprived neighborhoods where physical changes would be made, it resulted in a positive impact on the residents' satisfaction and the residents feeling more safe in the neighborhoods. However they found that there was a clear difference between the positive effect in neighborhoods where only physical changes were made, compared to neighborhoods where structural physical changes were made. Bjørn & Holek explains:

> "Strukturelle fysiske forandringer i samspil med sociale indsatser forandrer et udsat område socialt ved at medføre positive effekter for arbejdsløsheden, uddannelsesniveauet, indkomst-

> niveauet, kriminaliteten, andelen af beboere på overførselsindkomst, tryghed, tillid, samfundsengagement og øget tilfredshed med at bo i området, samt løfter de oprindelige beboeres indtægtsniveau, tryghed, tillid, stolthed og livskvalitet og medfører en imageforbedring." (p. 28, Bjørn & Holek, 2014)

In order to find out how we can support this structural change with our lighting design the next step in the analysis of Connection is to dive deeper into the structural change proposed by Arkitema.

As it is now Gadehavegård is connected to the surrounding city through its three large parking spaces, as seen on figure 3.1. The effect of this can be that from the outside the neighborhood seems almost like a barricade and becomes very unpredictable and can be hard to navigate in and around (Bjørn & Holek, 2014). But as seen on the figure 3.2 with the proposal from Arkitema, establishing and leading streets into Gadehavegård will help to give the neighborhood some of the flow from the city, and will help to create a neighborhood that is more extroverted and integrated in its surroundings. From our perspective as lighting design designers the problem that needs to be solved is to figure

Fig 3.1llustration of the roads around Gadehavegård (own illustration combined with screenshot from google maps)

Fig 3.2 Illustration of the roads around Gadehavegård after the renovation (Illustration from Arkitema, 2020)

### 3.2.1 SUB CONCLUSION TO CONNECTION

out how we can support the structural change in Gadehavegård. We find that here it is important to work with a lighting design that addresses the newly established street going through the middle of Gadehavegård, as the street is going to have a huge influence on how Gadehavegård is connected and experienced in relation to the surrounding city. Through the lighting design this can be addressed, by using the light to highlight the street as being an important place and help the street to take the role of being the main connection point of the neighborhood, not only during the daytime but also throughout the dark hours of the day.

## 3.3 PLACE

In this section about places we are going to analyse the spatial identity of the street in Gadehavegård. Investigating the spatial structure of the street and how this is experienced and furthermore investigate what role different elements of light can take on in a street like this.

Slater. et al (2018) presents the complexity with asking this question about the public space: "What is the identity of this space for its different stakeholders?" (p.11). This question creates a favorable place for us to start, in order to analyse the street as a place by asking what is its identity and how is this identity experienced and understood by its users.

To unpack the topic of a places' identity we look to the concept of Genius Loci presented by Norberg-Schulz (1979). Genius loci is an old roman concept that is translated to the spirit of the place. The concept can help us to understand what elements define the identity of a place, in our case what will define the identity of Gadehavegård after the renovation. Norberg-Schulz explains that Genius Loci is present in an environment when you are able to dwell there and it "consists in a correspondence between outer and inner world, and between body and psyche" (p. 21, Norberg-Schulz, 1979). The dwelling in the environment, as Norberg-Schulz is referring to, is explained in relation to the concepts "orientation" and "identification", two concepts that are dependent on each other. Norberg-Schulz describes:

> "When man dwells, he is simultaneously located in space and exposed to a certain environmental character. The two psychological functions involved, may be called "orientation" and "identification". To gain an existential foothold man has to be able to orientate himself; he has to know where he is. But he also has to identify himself with the environment, that is, he has to know how he is a certain place." (P. 19, Norberg-Schulz, 1979)

Orientation is dealing with the physical environment, how you find your way and navigate through your surroundings. Here Norberg-Schulz refers to Lynch (1960) and his way of analysing the spatial elements in the urban outdoor environment through the five city elements (path, edge, district, node, landmark, nodes). For the concept of identification, Norberg-Schulz describes that you have to become friends with the environment you are in, the feeling of belonging and the notion of somehow being home. In Norberg-Schulz' words:

> "Identification and orientation are primary aspects of man's being-in-the-world. Whereas identification is the basis for man's sense of belonging, orientation is the function which enables him to be that homo viator, which is part of his nature." (p.22, Norberg-Schulz, 1979) (homo viator translates to man on the journey)

In order to design an environment that affords for people to dwell there, both of these concepts need to be present. In the following sections we are going to analyse how both orientation and identification is experienced in the street of Gadehavegård, and define how light can be an important factor in facilitating the two concepts.

### 3.3.1 THE STRUCTURE OF THE STREET

In this part the orientation perspective of the street in Gadehavegård will be investigated. It is the ambition from Akritema to create a dynamic and rich street, where there is space for many different activities. Arkitema describes:

> "Bygaden samler alle trafikformer i et langt og varieret byrum, hvor bilerne og cykler triller langsomt, og fodgængerne har masser af plads. Bygadens solbeskinnede side er bredere, og møbleres med siddeplinte, træer, blomstrende regnvandsbede, bænke og klatreskulpturer, som giver gode opholdsmuligheder, pauser på gåturen og plads til de tilfældige møder mellem kvarterets beboere." (p.12, Arkitema, 2020)

In this part of the Places section we will analyse the structure of the street, in order to figure out how these ambitions can come to life during the dark hours with the help of lighting.

In order to understand and analyse the space and to be able to support the architectural intentions, we have to take a closer look at the legibility of the urban space by Lynch (1960). The various structural elements that make up an urban space are divided into five city elements. These elements evoke the emotional connection with the urban context, and highlights the memory and identity of the place. Creating these memorable connections and mental images to the urban context define the legibility (Lynch, 1960). When designing a reassuring urban environment the lighting design should focus on making these elements visible and distinct. Lynch describes: "A distinctive and legible environment not only offers security but also heightens the potential depth and intensity of human experience." (Lynch, 1960)

The above mentioned five city elements are defined as: **path, edge, district, node** and **landmark**. They are used in the process of analysing the new street in the renovation project of Gadehavegård to reveal the various spaces and highlight the ones relevant in relation to the vision of the project.

Lynch defines a **district**, as an element in the urban space, that is being recognized as one area of the city that has a common character of the space. He explains that it is somewhere that the observer can mentally be "inside of". For our case the neighborhood Gadehavegård is being understood as a district, due to the similar character that is in the neighborhood. The knowledge about the area being defined as a district also comes from the analysis of the Connection (see chapter 3.2).

The **path** in the urban context is understood as a defined route that the observer experiences while moving through the urban environment. In the new Gadehavegård, this path, as an element,

is recognized where the new street will be established. The street is planned to appear in the center of Gadehavegård, continuing throughout the whole neighborhood. During the dark hours the street should lead users though Gadehavegår like it does during the daytime. Therefore the street should be highlighted and distinct in the nightscape.

The **edge**, as an element in the urban space, is being found when a boundary from one area to the other appears to be having different character or it can be marked as a break in continuity in the urban space. In the area Gadehavegård there are no distinct edges that create a distinct boundary, but what is understood as an edge on the street has been identified as the surrounding buildings. The surrounding facades that are shaping the space where the street is placed are dividing the street from the housing area and in that way the boundary is being created. During the dark hours the facades should also be able to define edges in the street. It is important that we let the identity of the facades stand out.

The **node** in the urban context is understood as a meeting place where various paths meet. For the user it can represent an activity center within the space. In our context, throughout the street there are many activity centres that are created, mostly these spaces are designed for people to meet and interact. At the different nodes that are being created, people conduct activities and pass through when heading to the desired destination. Following the ambition from Arkitema of creating a street full of life, the nodes in Gadehavegård should be indicated in the dark hours with the lighting design. As these are the spaces where the users' routes are crossing, creating a space that invites for social interaction.

The **landmark** is a point reference, as an external physical object, that strengthens the identity and helps create the character of the space. Since Gadehavegård is not yet a built environment there are not any distinct elements in the space that could be identified as a landmark. The one element in the space that could be recognized as a landmark is the new building for the Campus, noticeable because of its architectural characteristics and placement in the context.

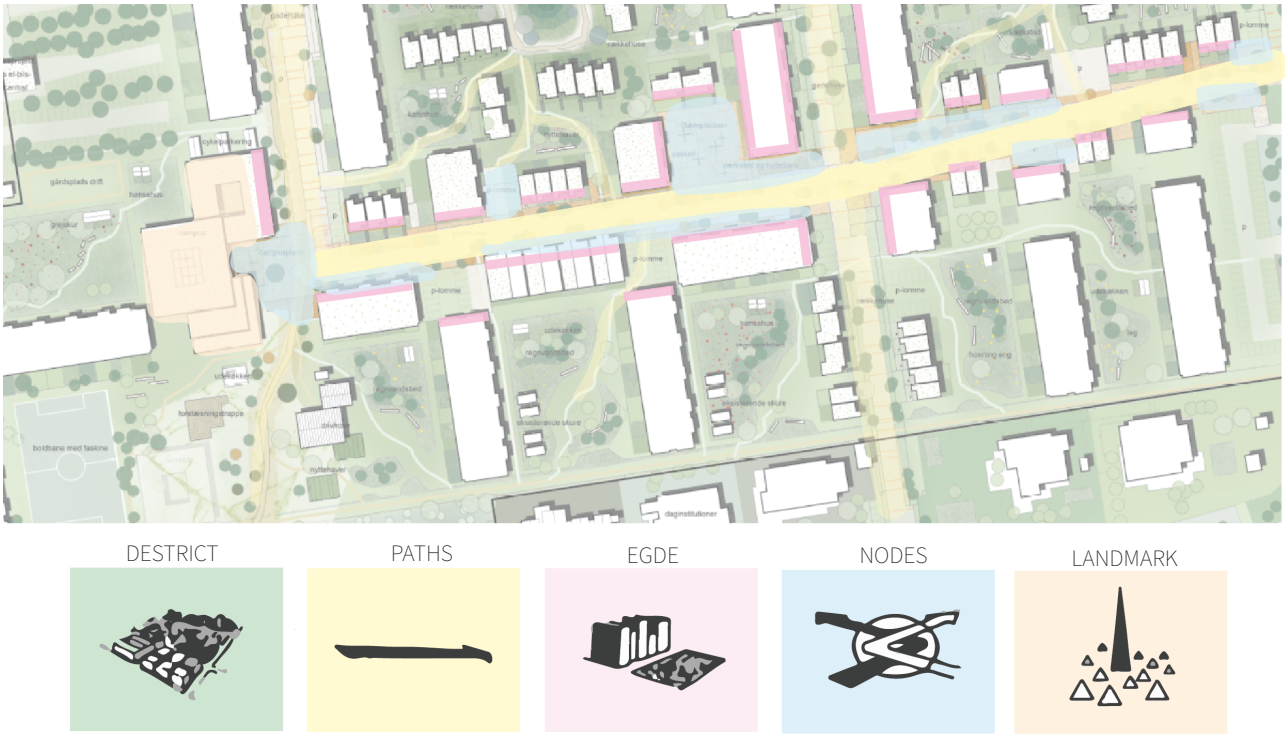



Fig. 3.3 Lynchs five city elements marked on the street in Gadehavegård (Own illustration, with map from Arkitema 2020)

After identifying the elements of the street according to Lynch, we find it relevant to investigate further what effect the elements have when they are combined and how they are understood when using the street. What effect does the surrounding elements have on the human experience of the street? For understanding this we use the architectural principle of circulation presented by Ching (2014). Circulation is a principle that informs us about how the flow of the street is in relation to the body. Ching describes:

> "Since we move in Time through a Sequence of Spaces, we experience a space in relation to where we've been and where we anticipate going." (p.252, Ching, 2014)

Through a path of movement that creates the perception of how we are seeing the spatial elements around us, Ching is linking the series of spaces in the exterior environment (Ching, 2014). Analysing the space according to its circulation we will be able to design the space according to how the elements of the space are linked. The relationship between the body and the space that we are interested in investigating are understood as a basis for creating a spatial feeling when experiencing the buildings and urban public spaces. Through getting a closer understanding of what the users will perceive in the space it will help in strengthening the relation between the spatial surroundings and the people. In that way, we will be able to create a design that responds to creating legible urban environments (Lynch, 1960) and continuous dwelling in the space.

> "...The interplay between the world of our bodies and the world of our dwelling places is always in flux. We make places that are an expression of our haptic experience even as these experiences are generated by the places we have already created. Whether we are conscious or innocent of this process, our bodies and our movement are in constant dialogue with our buildings." (p.251, Ching, 2014) (retrieved from Body, Memory and Architecture by Charles Moore and Robert Yuddell, 1977)

The following principles are imagined to be analysed as a walk throughout the street, reminiscent of the serial vision by Cullen (Cullen, 1995) with focus on the relation of the spaces and the street and what we experience when walking through (see figure 3.4). Since the street has not yet been built, the walk through will be done with the help of Enscape, as here we can get the notion of the space being three dimensional. The circulation principle consists of the following approaches: Approach, Configuration of the Path, Path-Space Relationships.

**(1) Approach - The distant view**

The distant view is the first phase of the circulation principle. It is providing information about how we, as users, are prepared to see, experience and use the space. This is being used in regard to establishing knowledge on how the space is experienced from a distance, what we experience when we are getting close to a space, what we get prepared and excited to see. Before we actually arrive at the space we need to observe it from a distance to be able to create a predictable picture in our head, to know in advance what to expect to experience and perceive.

When approaching the street in Gadehavegård the distant view provides you with the initial knowledge about the space. Approaching the street you are provided with information about the di-


Fig. 3.4 Illustrations from 3D model of Gadehavegård, the new street experienced from human perspectives

rectionality of the street. In Gadehavegård this is defined by the placement of the trees and how the pavement is shaping the space. During the dark hours the lighting should help to maintain a rhythm that emphasizes the initial directionality of the street.

**(2) Configuration of the Path - The sequence of Spaces**

For figuring out the type of space that we are analysing there is a need of defining the path of movement in the context. Ching is explaining the path of movement that has a starting point which is guiding us through the series of places, the space has to offer. Throughout this process of movement, different mobilities are experiencing these spaces in a different way, due to their needs and the freedom of movement. Ching describes: "While we as pedestrians can turn, pause, stop, and rest at will, a bicycle has less freedom and a car even less, in changing its pace and direction abruptly." (p. 276, Ching, 2014).

This has to be taken into consideration when designing for creating a better human experience of the street. For that reason we are looking at the configuration of the street and what type of movement it offers. This will help for understanding the needs of different mobilities in a space and through that express the character of the street.

When we are looking at the needs of different mobilities, we are investigating how much space these mobilities need on the path and how we can support those needs through lighting. Considering the Arkitemas vision for Gadehavegård the character of the street should promote a slow paced street with a lot of space for the pedestrians (Arkitema, 2020). In relation to this, the knowledge about the different mobilities in the street is explored and the surrounding spaces and functions to different mobilities. The street is planned for pedestrians to be able to stay more in the wider pedestrian zones. (see figure 3.5). These spaces are also being identified as spaces for staying. In our analysis of Lynch's city elements these are identified as Nodes. The area that belongs to the road for cars and bikes is marked to be in the middle of the street, having the trees as their boundary to the pedestrian path (see figure 3.6).

Putting all these spaces clearly visible through our lighting design should help in creating a mind map of the configuration of the path and organization of the spaces so that we can memorize them, recognize and be able to orientate in the surroundings, in dark hours.

Fig. 3.5 & 3.6 Illustration of the pedestrian area (red) and the road for cars and bikes (blue)

**(3) Path-Space Relationships - Edges, Nodes and Terminations of the Path**

The link between the path and the space is very important in regard to how we experience the spatial surroundings. Ching has divided the relationship between the path and the space into three principles: Pass by Spaces, Pass through Spaces and Terminate in a Space. For the case of the street in Gadehavegård we refer to the Pass through Spaces principle, where "the path may pass through a space axially, obliquely, or along its edge."(Ching, 2014).

Through this organization of spaces along the street, the user is being invited to take a break, rest, relax or meet other people. The street passing through a series of spaces is providing it with more functions and activities, which are creating more opportunities for the users on the street, that helps in making the life and character of the street more dynamic. The lighting should help in highlighting these spaces as qualities during the dark hours as well, and make the space memorable, easy to understand and navigate.

### 3.3.2 THE ROLE OF LIGHT ON THE STREET

When investigating the street it is interesting to take a look at the contrast between the public and private life around the street. Bjørn & Holek (2014) is describing the impact that different zones/levels of privacy can have in a social housing area. When there are no half private and half public zones, the space can be experienced as "no man's land" ("ingenmandsland") In comparison to when there are layers of privacy, then a better social infrastructure can be experienced. These different zones in the public space are shaping the character of the street and how the street is understood by its users.

Based on the vision from Arkitema it is clear that they want to define these half private half public spaces throughout the street in Gadehavegård. However during the dark hours if these spaces are not lit up it can still result in the experience of "no man's land" as the environment will be perceived as dark and uninviting.

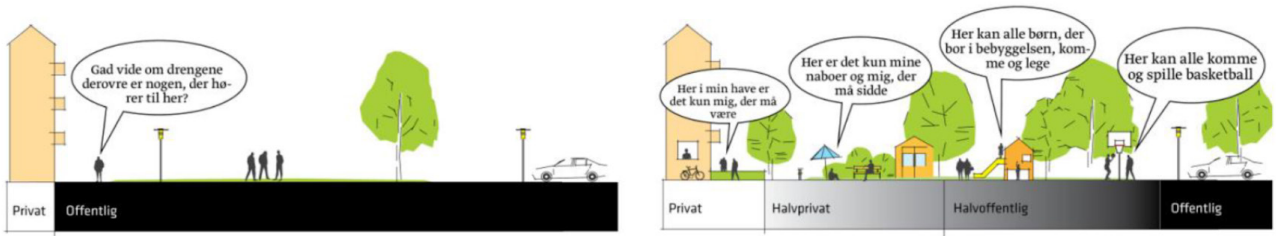



Fig. 3.7 & 3.8 Illustration of improvement of public and private zones in social housing (Bjørn & Holek, 2014)

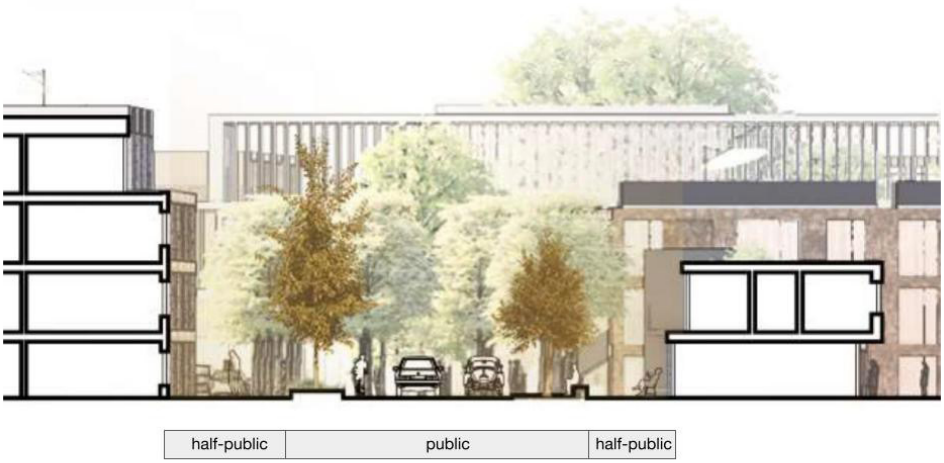



Fig. 3.9 Illustration of public and private zones in Gadehavegård (edited version of illustration from Arkitema, 2020)

In relation to lighting, Descottes (2013) is explaining the height of the light can also help to determine the degree of intimacy in the public light space, see figure 3.10. Descotte (2013) explains that the proximity between the body and the light source are important when defining how intimate a space is perceived. Descotte describes:

> "As we humans are inclined to adjust the height of a light source to correspond to a desired level of intimacy, we can create different readings of public and private space through the variation of light height." (p. 55, Descottes, 2013)

These intimacy levels need to be considered when creating the lighting design for the street in Gadehavegård, in order to create a smooth transition from the public street to the private houses and apartments.

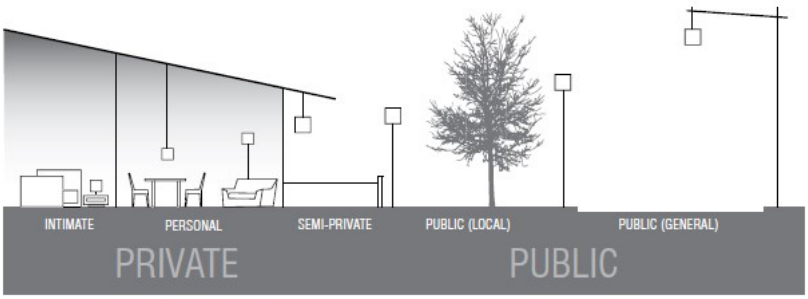



Fig. 3.10 Height of light relative to degree of intimacy (Descottes, 2013)

Additionally to the proximity between human and light source, it is also worth investigating, before creating a lighting design, what effect the intensity of the light sources and the contrast between them can have in the urban space. Hvass et al., (2021) investigated, through a lab experiment, how the atmosphere would be perceived in relation to the intensity of light in the local space compared with the intensity in the surroundings. The findings are showing that the participant perceived the scenarios with high intensity of light to be more tense and public. Additionally when the local area had a high intensity of light the scenario would be perceived as non-harmonious and glary. However in the findings about the scenarios with low light intensity the space was generally perceived to be more relaxed, private and harmonious. Hvass et al., (2021) explains that the values expressed in relation to the low intensity of light "... can support a livable and safe outdoor public environment." (p. 8, Hvass et al., 2021). The low light level and a balanced light level in the surroundings lead to general positive feedback. These findings provide us with an understanding of how we can work with the identities of light in Gadahavegård in a way that would make users perceive it to be safe and suited for life to unfold on and around the street.

### The lived life in and around the street

In order to analyse the identification, we have looked at the features that can help identification during the dark hours in the urban environment. When looking at the concept of identification presented by Norberg-Schulz (1979) we have been interested in identifying what these features can be during the dark hours in an urban space. As mentioned previously the features that help identification between

human and environment, are the features in a place or environment that make you feel like you belong and are able to fully dwell in an environment. Norberg-Schulz explains:

> "In our context "identification" means to become "friends" with a particular environment. … For modern urban man the friendship with a natural environment is reduced to fragmentary relations. Instead he has to identify with man-made things, such as streets and houses." (p. 21, Norberg-Schulz, 1979)

As lighting designers it is crucial to reflect upon what role light has in this identification between humans and their environment. Light is what enables us to see our surroundings and thereby identify with the environment we are in, as we know daylight is a factor that is ever changing, as Norberg-Shulz explains:

> "Light is not only the most general natural phenomenon, but also the less constant. Light conditions change from morning to evening and during the night darkness fills the world, as light does during the day." (p. 32, Norberg-Schulz, 1979)

The electrical light that is present during the dark hours in the urban environment is also helping to define what we are able to see, and highlight the elements in the space we are able to identify with, as it is the frame for how we are seeing the environment. A question that can be raised is also to investigate, whether the presence of electrical light in the urban space can be an element that you can use for this identification. In relation to this question we want to investigate further what role windows can have in a street like the one in Gadehavegård and if they can be used as a factor when identifying with the environment.

As we know, during both daytime and nighttime, windows can be a very defining factor in the appearance of the facade of a building, however we also know that windows can have a role in the social context of a space as well.

Bjørn (2020) explains that the so-called "dead" facades in the socially deprived urban areas can cause the public space to feel unsafe. He defines "dead" facades as being without windows from the surrounding apartments facing towards the public space. Bjørn explains that from the perspective of the user staying in the public space, the fact that there are no windows can cause it to feel abandoned and unprotected, like there are no other people to help you if an unsafe situation would occur. Gehl (2013) also talks about this effect of windows in the urban space during the dark hours, he explains:

> "Life in the street has an impact on safety, but life along the street also plays a significant role. Urban areas with mixed functions provide more activities in and near buildings around the clock. Housing in particular signifies good connections to the city's important common space and a marked reinforcement of the real and perceived safety in the evening and at night. So even if the street is deserted, light from windows in residential areas send a comforting signal that people are nearby" (p. 99, Gehl, 2013)

Here Gehl explains that the light from the windows has an important signaling value in showing that

even though there are no other people in the public space, there are people in the buildings around you. The light from the windows then becomes both a signal of that you are not really alone in the public space and a signal of life and the life being lived in the surrounding space.

Fig 3.11 The lived life in the buildings in Gadehavegård

This exact notion is something that anthropologist Bille (2015) has investigated in Islands Brygge in Copenhagen, where he looks at how light from windows affects the atmosphere in a residential area. Bille (2015) uses Böhmes (2013) theory of atmospheres to explain how the light from the windows affects the overall atmosphere in the area he is researching. Böhme calls this the ecstasies of things, the ecstasies radiates into the surroundings and influences the atmosphere according to the context that it is present in. Bille (2015) explains how the ecstasies of the light inside the apartments radiates and influences the atmosphere perceived on the street and from the surrounding apartments. In Billes own words:

> "Light, and the atmospheres it co-shapes, extends beyond the borders of the apartments and shines its ecstatic nature onto the neighbourhood, bathing the surroundings in a gleam of hygge; Light offers 'a sense of secureness (tryghed) and community (fællesskab)' ... In that way, the ontological vagueness of atmospheres, ... becomes the medium for expressing and unfolding social and emotional life through the varied visibility that light and darkness offers." (p. 62, Bille, 2015)

In this quote Bille also talks about what type of atmosphere the light from the windows is creating. The study showed that the light had a social power both in feeling safe in the street, like described previously but also that the light and its visibility that it creates of the homes is creating a sense of community. Bille describes:

> "Most informants, ... highlighted how there is a sense of community shaped through visibility and lighting practices, but it is a community in which they may see their neighbours but do not know them. They are kept at a distance, albeit close enough to create a sense of community." (p. 61, Bille, 2015)

In the context of Gadehavegård it becomes very relevant for us to include this effect of the windows into our lighting design, as they provide an effect that would support the ambition of strengthening the community presented in both the development plan for Gadehavegård (Trafik-, Bygge- og Bolig-styrelsen, 2019) and from Arkitema (2020). Furthermore it is also the ambition from Arkitema to use the facades in the neighborhood as a factor in creating a more inviting urban space, they explain:

> "Vi tror, at det vil gøre en afgørende forskel for områdets image og selvopfattelse hvis vi giver Gadehavegård et ansigt, bestående af et åbent og inviterende gaderum, som er klart defineret med varierede smukke facader, som henvender sig mod gaden" (p.12, Arkitema, 2020)

It would make sense to use the windows and the fact that they create a sense of safety and community, as an active element in the design in order to create this varying and inviting facades also during the dark hours of the day.

### 3.3.4 SUB CONCLUSION

Through the Places section of the analysis we have been taking a closer look at what element of orientation there is on and around the street using the spatial analysis theory presented by Lynch (1960) and Ching (2014). Here we have found that the mixed traffic and series of spaces for people to stay, make the street dynamic. The analysis has shown that many structural elements have contributed to making the street appear dynamic. However important elements that should be highlighted are the surrounding spaces that are creating space for the lived life to be going on on the street. These spaces are the varying sizes of areas for pedestrians, where there is great potential for social life to be facilitated through a lighting design and create good orientation in the area.

Furthermore the spaces for staying in Gadehavegård also create great potential for creating elements of identification. In addition to these spaces the window in the street is a luminous element that holds a lot of potential. Designing with the intention of highlighting the windows in Gadehavegård can help to increase the perceived safety in the street and also help to create this sense of community and belonging in the space.

## 3.4 DIVERSITY

In this section of Diversity we will investigate the users of the street in Gadehavegård. Slater et al. (2018) describes that it is important to know who are the people you are designing light for and where their conflicts and commonalities can be found. For this we will look into the demographic of the people living in Gadehavegård before the renovation (year 2021) and the target group of new residents that will move in after the renovation (year 2030). This information of the present and new residents will be used as a departure point for shaping the personas of the new Gadehavgård.

### 3.3.4 PERSONAS

As mentioned in the 2 Method chapter the creation of personas is in three steps: 1. Data collection and analysis, 2. Persona description and 3. Scenarios (see section 3.5).

**Data Collection and Analysis**

In order to develop the personas for Gadehavegård we need to investigate who are the residents currently living in Gadehavegård and who are the residents that are going to move into Gadehavegård after the renovation? This will help us to provide an understanding of what type of personas that needs to be created.

Firstly we look at the demographic of the people living in Gadehavegård. Because Gadehavegård has been on the ghetto list, we have access to data on the five criteria that define when a neighborhood appears on the list. The newest publication of the list (Transport- og Boligministeriet, 2020) was from December 2020 at that point Gadehavegård had 2192 residents.

- 57,0% of the residents are immigrants and second generation immigrants with a non-western backgrounds.
- 33,9 % of the residents in the age range between 18-64 are unemployed or not under education.
- 71,1% of the residents in the age range between 30-59 have not finished higher education than primary and secondary school (danish: Folkeskole/grundskole).
- 2,21% of the residents have been convicted for violation of the penal code, gun law or law on euphoriants within the last two years.
- 56,0 % of the tax-paying residents in the age range between 15-64 have a gross income less than 55% of the average gross income for the same group in the region.
- (Transport- og Boligministeriet, 2020)

This data of course only provides us with limited information about the residents, however there are still some valuable points to be taken from here. We are provided with rough knowledge about what type of ethnic background the residents have, their type of education and work life.

The next piece of information we can look at is the target group of the new residents in Gadehavegård. Here the aim is to get a more diverse group of residents, in order to create an area that is socially sustainable (Arkitema, 2020). The development plan of Gadehavegård states that the amount of social housing units should be brought down to 40% out of the housing in the neighborhood,

in that way different types of housing will become available after the renovation (Trafik-, Bygge- og Boligstyrelsen, 2019). In Arkitemas proposal there are 105 units for student housing (almene ungdomsboliger), 446 units for social housing (almene familieboliger), 54 units for senior housing and 75 privately owned housing (ejerboliger). Arkitema states: "Fremtidens Gadehavegård er et mangfoldigt sted: Blandede beboere og ejerformer, blandede familietyper og livsformer" (p. 28, Arkitema, 2020).

Furthermore Arkitema states that with the renovation they wish to encourage alternative ways of living together and creating more shared spaces

> "Derfor foreslår vi, at der fra starten planlægges eksperimenterende boligformer både når det gælder nybyg og renovering. Vi tænker i retning af opgangsfællesskaber, kollektiver, bofællesskaber og deleboliger. Og vi ser muligheder i at gentænke boligernes fællesfaciliteter, så de bliver mere end blot servicefaciliteter, men nærmere end forlængelse af boligen." (p. 31, Arkitema, 2020).

Looking at the type of housing available after the renovation provides us with a lot of information about what type of people lives in this certain type of housing, which gives us a good foundation for the different types of personas we need to create.

### Persona Description

We have decided to create six different personas in that way we are able to have at least one from each type of housing. The personas are created to be reflective of the new residents and the previous residents of Gadehavegård. In the following section the personas will be described in relation to their occupation, activities, mobilities, when and why they moved to Gadehavegård and their personality type.

Fig 3.12 Personas (Skalgubbar, 2021)

**Name**: Erica
**Age**: 23
**Occupation**: Student at the Campus Gadehavegård
**Ethnic background**: Italian
**Family situation**: Single
**Psyche (introvert or extrovert)**: Introvert
**Hobbies/spare time activities**: Running, spending time in nature
**Mobilities:** Walking, public transport and biking
**Type of housing**: Student housing (Ungdomsboliger)
**Resident status**: Post-renovation

Erica is 23 years old and is studying to be an engineer at the Campus in Gadehavegård. She is originally from Italy but moved to Denmark in order to get her education. Erica lives in one of the student housing apartments. Since she lives very close to campus her main mobility is walking or biking. But when she needs to go to other places that are further away she takes public transport.Erica spends most of her day studying or going to class, but in her spare time she likes to spend time with her close friends, going out in nature or going for a run.

**Name**: Henrik
**Age**: 52
**Occupation**: Canteen assistant at Dansk Teknologisk Institut (without education)
**Ethnic background**: Danish
**Family situation**: Married to his wife Jette for 25 years
**Psyche (introvert or extrovert)**: Introvert
**Hobbies/spare time activities**: Reptiles
**Mobilities**: Walking and car
**Type of housing**: Social housing (almene boliger)
**Resident status**: Pre-renovation

Henrik is 52 years old and works as canteen assistant at Dansk Teknologisk Institut at the other side of Roskildevej, he has worked there for five years. Henrik has been married to his wife Jette for 25 years, together they have one child who has moved out. They have lived in social housing in Gadehavegård since the 90's. Henriks main mobility is walking since he lives very close to his workplace and his wife has to use the car when she needs to go to work. When he needs to go to other places he will use the car. Henrik starts work early in the day which gives him a lot of time to spend in the afternoon. During that time he likes to spend time on his pets and watching TV. Henrik is not a super social person and likes to spend time alone or with his wife, despite that he likes to know the faces of his neighbors and to keep up with the social activities in Gadehavegård. Henrik is not interested in arranging the social events but he will always come to check out what is going on.

**Name**: Marianne
**Age**: 45
**Occupation**: Teacher
**Ethnic background**: Danish
**Family situation**: Divorced
**Psyche (introvert or extrovert)**: Extrovert
**Hobbies/spare time activities**: Theater/drama, volunteer work, her dog, Gardening
**Mobilities**: Walking, biking and public transport
**Type of housing**: Private owned housing (Familiehus) in a 'kollektiv' with other adults
**Resident status**: Post-renovation

Marianne is 45 years old and five years ago she was divorced from her husband and now she has moved into a house with other adults because she really likes and enjoys the little community that they can have together. Mariannes main mobility is walking, biking and public transport, this is because she is very conscious about the environment. Like with the environment Marianne is also very conscious about her local community, she will happily take on the role as the organiser for social activities, it comes to her very naturally because she has a background as a teacher.

**Name**: Halid
**Age**: 19
**Occupation**: Student (Høje-Tåstrup Gymnasium)
**Ethnic background**: Second generation immigrant from Turkey
**Family situation**: Living with mum and dad and sister
**Psyche (introvert or extrovert)**: Introvert
**Hobbies/spare time activities**: Plays football, hang out with friends
**Mobilities**: Walk and Bike
**Type of housing**: Social housing (Almene boliger)
**Resident status**: Pre-renovation

Halid is 19 years old and lives with his parents in Gadehavegård, he was born and raised in Denmark, but his parents are originally from Turkey and have lived in Gadehavegård since they moved to Denmark in the late 90's. He is a student at Høje-Tåstrup Gymnasium. Halid' main mobility is walking and biking. In his spare time he likes to spend time with his friends, they like to play football together. After football practice he and the team will usually have some beers. Halid likes to be involved in the social activities in the neighborhood if his friends are also joining.

**Name**: Malene
**Age**: 38
**Occupation**: Graphic designer
**Ethnic background:** Dane
**Family situation**: Married with Alex (40) together they have Karl (3 years)
**Psyche (introvert or extrovert)**: Extrovert
**Hobbies/spare time activities**: Knitting, doing yoga with females from the neighbourhood, going to the playground with the kid, barbecuing with her husband.
**Mobilities**: Walking, car and Christiania bike
**Type of housing**: Private owned housing (Familiehus)
**Resident status**: Post-renovation

Malene is 38 years old and works as a graphic designer in Copenhagen. She lives in a house in Gadehavegård with her husband Alex and together they have three year old Karl. They bought a house in Gadehavegård because it had a convenient location close to the train station. Malenes main mobility is public transport and biking, she has a Christiania bike so she can easily transport Karl to the places they need to go. When Malene is not working, she likes to spend time with her family and to spend time with other families in the area. Her and Alex love to host barbecues during summer time. Together with some of the other women in the neighborhood she has a small yoga group, if the weather is nice they practice yoga outside in the green areas or else they do it in Gadehavegårds community house.

**Name**: Jamal
**Age**: 74
**Occupation**: Pensionist (used to be a janitor).
**Ethnic background**: Immigrant from Yemen
**Family situation**: Single
**Psyche (introvert or extrovert)**: extrovert
**Hobbies/spare time activities**: Bees (making honey), Voluntarily helping fælleshus
**Mobilities**: El scooter and walking
**Type of housing**: Senior housing (Almene seniorboliger)
**Resident status**: Post-renovation, has lived in Gadehavegård for 30 years.

Jamal is 74 years old and has lived in Gadehavegård for 30 years. Before the renovation he lived in social housing, but has now moved into one of the new senior houses. Jamal has never had a family, but he really enjoys spending time with his friends in the neighborhood, and is always up for engaging in conversation and small chats with new people. Jamals main mobility is his el scooter since he is not super good at walking anymore. He is really happy with his el scooter as he is mostly only going around the neighborhood. Jamal is very involved in the social activities in Gadehavegård. His main interest is to take care of the bees near the community house.

### 3.4.2 SUB CONCLUSION

Using the method of Personas, the potential users of the new Gadehavegård have been establishing the personas, describing the mixture of different types of people who are going to live in the area. This knowledge of the personas will be used further on in the Practises section, where we look more into scenarios with their movement and activities in the space.

## 3.5 PRACTICES

The persona's characters have been determined in the previous section about Diversity (see section 3.4) and this section we will take a closer look on the practises of these personas. As the project is still a not built environment this analysis is relevant in the design process to predict how people would use the space at different times of the day, what are the activities that are being conducted and which mobilities have been used, throughout the area, with focus on the street. Through mapping the diverse movements, activities and events throughout the space, we get knowledge on how the space is being used and "how these different practises intersect and conflict, and relate to the functionality and identity of this place" (Slater, et al, 2018). Having this analysis will help us shape the light according to people's needs and practises in the space, and be able to reduce potential conflicts and create an urban environment that reflects upon the functional needs of the space.

This analysis is helping us to create a lighting design that belongs to the people. Having this information is a basis on designing light that supports people practises. For this purpose the concept of Shade of Night by Arup (Hargrave et al., 2015) will be introduced together with the recommendations from the Danish Standard and the lighting requirements.

### 3.5.1 ACTIVITIES OF THE PERSONAS

The personas with their daily activities will be elaborated in this section, with focus on the space of interest, the street. The knowledge about the daily activities will be used to understand which activities light needs to support in the public space.

For each persona we have created a scenario of a day in their life, to find out what are the activities that people carry out outdoors and near the street during the dark hours. This day is fall equinox the 22nd of September with sunrise at 06:55 (dawn starting at 06:19) and sunset at 19:09 (dusk ending at 19:46) ("SunCalc", 2021). This will give us an average view of the persona's activities during the dark hours. The marked activities are the ones happening during the dark hours (see figure 3.13).

**A day in the life of Erica:**
08.00 Wake up
09.00 Classes
12.30 Lunch and talks on the phone with mum
13.00 Coffee and walk around the neighborhood in the sun with a fellow student
14.00 Reading at the campus
16.00 Goes shopping in Netto
17.00 Cooks and eats dinner
19.00 Goes for a run
19.30 Watches TV and goes to bed

**A day in the life of Henrik:**
05.30 Wake up
06.15 Walking to work (Teknologisk institut)
06.45 Starts working
14.00 Finished working
14.30 Walks from work to Netto for shopping
15.00 Shopping
15.30 Walk from netto to home
16.30 Drive to Buy food for his pet/reptile and come back
18.00 Dinner
19.00 Watch TV + Spends time on his phone
23.00 Goes to bed

**A day in the life of Marianne:**
06.00 Wake up
06.30 Make breakfast
07.00 Walks her dog
07.30 Leaves in car for work
15.30 Arrives home from work
16.00 Takes care of the community urban garden
17.00 Walks her dog
18.00 Makes dinner for the collective (weekly event)
21.00 Takes her dog on an evening walk and meets a friend for a short chat
23.30 Goes to bed

**A day in the life of Halid:**
07.00 Wake up
07.45 Biking to school
08.00 School
16.00 Done with school
16.30 Going home to take a nap
18.00 Dinner
18.45 Meeting friends for football
19.00 Football practice
21.00 Going for drinks with friends in the neighborhood
23.30 Going home
24.00 Watch TV
01.00 Sleep

**A day in the life of Malene:**
06.00 Wake up + Breakfast + Play with Carl
08.00 Bring Carl to børnehave + socializing with neighbors
08.45 Bikes to the train station Høje Tåstrup and goes to Copenhagen
09.15 Arriving at work
16.00 Finished working + Taking the train back
17.00 Goes to green hills for Yoga class with females from neighbourhood
18.00 At home: Dinner and hygge
20.30 Put Karl to sleep
21.00 Knitting
23.30 Goes to bed

**A day in the life of Jamal:**
7.00 Wake up + Having breakfast and coffee
8.30 Watches morning TV and read newspaper
10.30 Grabs morning coffee with friends outside in the yard
12.00 Eats lunch
13.00 Drives to the community house to help the community (doing some voluntary work)
15.00 Drives to the elderly home and meet some people
16.00 Watches TV + naps
18.30 Dinner
19.30 Drives to buy cigarettes at Kiosk/Netto with a detour through the neighborhood
22.00 Goes to bed

Fig 3.13 Activties of the personas during the dark hours


Fig 3.14 Map of movement during dark hours

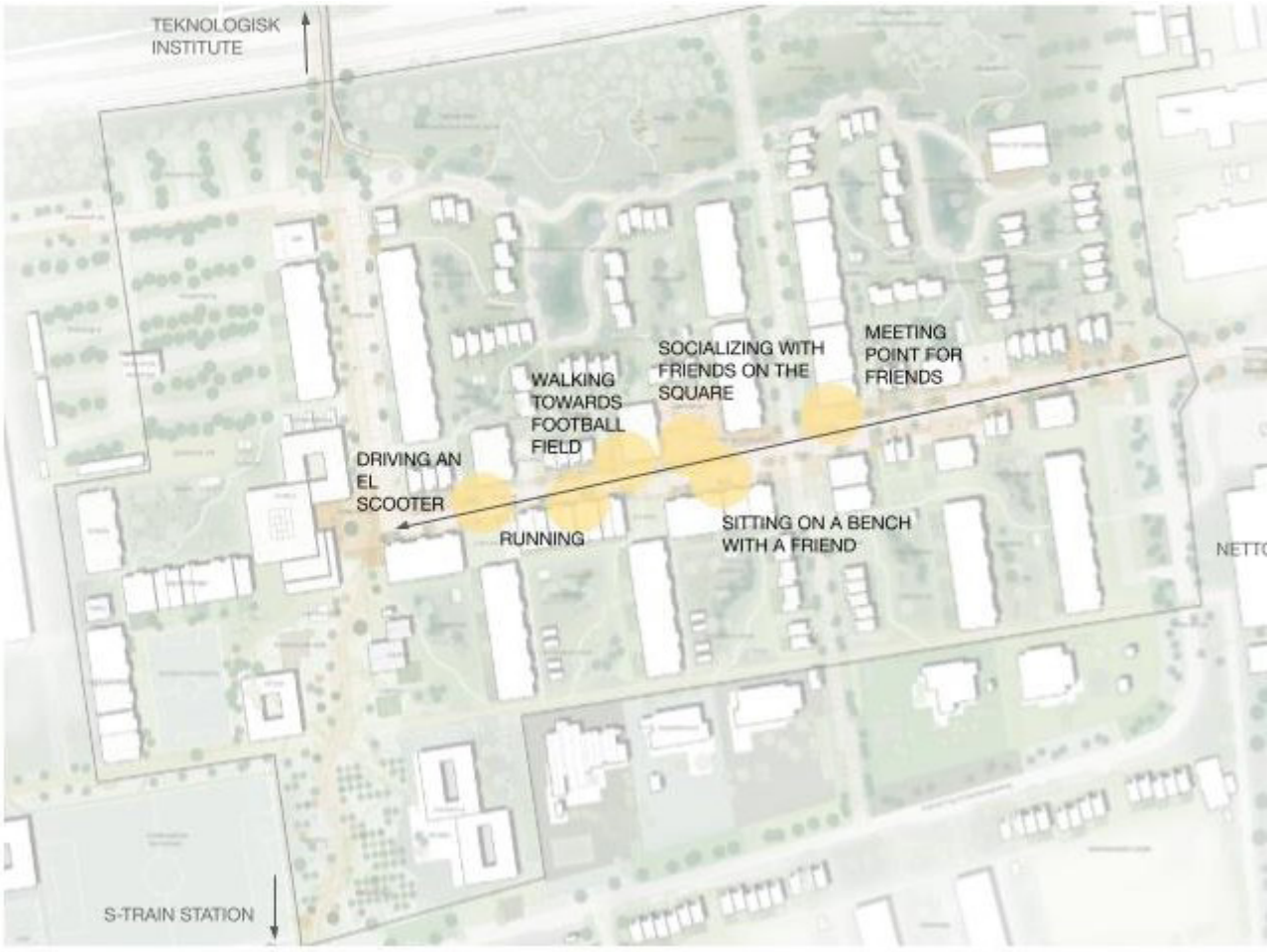



Fig 3.15 Activities on the street during the dark hours

**Activities and movement on the street at dark hours**

Based on the information about the personas activities during the dark hours, we are able to map out how they move in the space and what activities are happening on the street. In figure 3.14 the personas movements though Gadehavegård are highlighted and in figure 3.15 the personas activities on the street are highlighted and described. It should be noted that this is the actives and movements of only six residents, however this still provides us with a general view into the activities and movement on the street.

## 3.5.2 THE ROLE OF LIGHT ON THE STREET

**The shades of night (Dynamic lighting)**

In Arup's booklet Rethinking the Shades of the Night (Hargrave et al, 2015), they are investigating how lighting can be designed for a diverse user group and activities within different times of the dark hours in the city. They talk about the city as a 24 hours city with a 24 hours cycle. A cycle where people's needs and desires are constantly changing. When the lighting is able to support the 24h cycle, people can get the chance to experience the city during the dark hours as a more inclusive and livable environment (Hargrave et al, 2015).

> "Current developments towards 24h cities tend to blur our perception of day and night. As we start to understand the importance and distinctiveness of the different shades of night—from

dusk till dawn—we shift away from seeing light as a purely functional element." (p. 13, Hargrave et al., 2015)

With this knowledge we are learning that for creating the lighting design on the street, the people's needs and practises have to be considered and facilitated by the lighting design accordingly. The Shades of the Night Arup have developed a framework that they call shades of the night. The shades describe the different activities and usage of the city during the different times of the night, see figure 3.16.

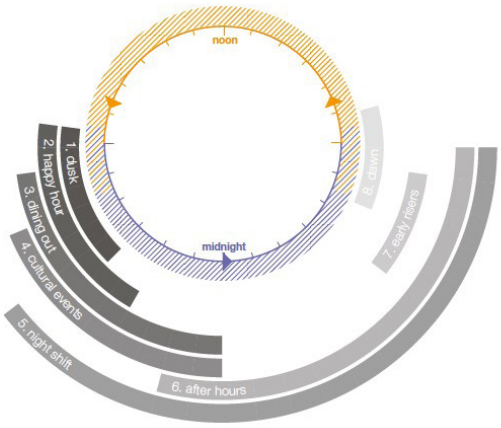



Fig 3.16 Shades of the Night by Arup "The eight shades above typify an urbanised area in the Western hemisphere such as New York." (Hargrave et al., 2015)

The Shades of Night will be used as a concept for the lighting in Gadehavegård. For reflecting the various activities at different times of the night, and according to that layers of light will be activated or deactivated to create an urban environment, that we call dynamic.

There is a need to understand and explore the different Shades of the Night around the street, through identifying the activities of the personas (see chapter 3.4.1) within different times of the night. The Shades of Night are being framed in regard to the personas practises on the street and in regard to the change and level of activities. The Shades of the Night created for Gadehavegård can be seen in figure 3.17. For each frame of activities a new light scene is being applied. We have identified these four light scenes: light scene 1, light scene 2, light scene 3, light scene 4.

**Light scene 1** - High activity is created to capture the dusk period in the dark hours, which has a high activity. Referring to the rush hour after work, where the personas conduct many activities before and after dinner time. Starting at 16.00 and ending at 21.00.
**Light scene 2** - Winding down stands for the period of the day when the activities in the neighborhood start to slow down, where most of the personas are at home and some of them are socializing outdoors. Starting at 21.00 and ending at 00.00.
**Light scene 3** - Night time is created for the period in the dark hours when most of the personas are at their homes, sleeping, and the neighborhood is quiet. Starting from 00.00 ending at 05.00.
**Light scene 4** - Morning rush hour is created for the period of the dark hours when the day starts,

capturing the sunrise. The personas are waking up and going to work, exercise or walk their dog. Starts at 05.00 and ends at 09.00.
The intention of aligning the lighting design with the activities that are being conducted in the space at dark hours should help to create a better experience of the urban environment in Gadehavegård.

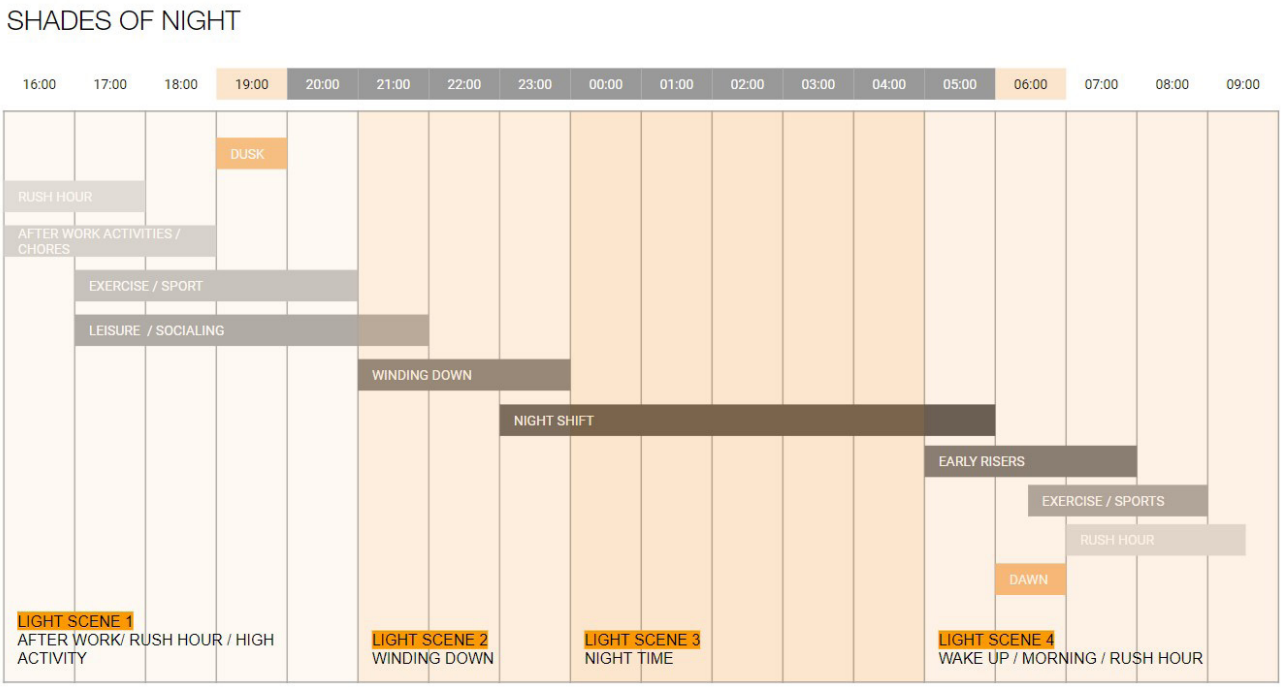


Fig. 3.17 Shades of the night based on the activities of the personas (own illustration)

## Lighting standards

For the lighting design to be able to support the vision for the new street in Gadehavegård the functional needs of the diverse practises and mobilities need to be considered. To be able to support the lighting needs, we look to the lighting requirements from the Danish standard (Dansk Standard, 2014) to get a better understanding of the local requirements that need to be applied when creating a new lighting design solution.

In our case, the mobilities on the street is identified as: a street for cars and bikes and a pedestrian path. These areas on the street need to be considered according to their purpose. The lighting design should align with the requirements from the standard and respond to the needs of the different mobilities through providing appropriate light levels on the street and help to create a safe urban environment. By the Danish Standard we found out that the street in Gadehavegård belongs to the M4, C3 and P4 lighting classes. The lighting class M4 (see Appendix), is categorized as motorized traffic, the lighting class C3 is used to identify the degree of conflict between mobilities (see figure x), and P4 is used for pedestrians and low speed areas (see Appendix), in our case applying to the pedestrian path. M4 and C3 require an average of 15 lux on the surface of the street and the P4 requires an average of 5 lux on the surface of the pedestrian path.

### 3.5.3 SUB CONCLUSION

From the Practises analysis we find that the lighting design should meet the different functional needs of the space and be able to support the different activities and mobilities conducted by the personas on the street throughout the different times of the night. The concept of Shade of the Night was introduced to categorize the different activities in regard to the night time hours, dividing them into different light scenes for certain times during the dark hours. These light scenes will be applied to the design, and in that way the dynamic of the activities throughout the night will be supported. Furthermore, the relevant lighting requirements by the Danish Standard should be applied following lighting classes appropriate for the street.

## 3.6 CONCLUSION OF ANALYSIS

Based upon the analysis of the street in Gadehavegård through the four social complexities, Connections, Places, Diversity and Practises we are able to conclude the following findings:
From the section about Connections we found that it is important that we, through our lighting design, support the structural change that is going to take place in Gadehavegård. We found that the street is going to function both as the place that is connecting Gadehavegård to the surrounding city, but also take on the role as an identifying and recognizable element of Gadehavegård. Making the street the main connection point in the neighborhood.

From the section about Places we found through the spatial analyses that the street has a very dynamic structure. There are many places on the street with great potential for the lived life to unfold, we need to support that through our lighting design. We have found these spaces to be the large sidewalks along the street designated for staying and meeting. Highlighting these areas should create good overall orientation on the street. Furthermore, we have found that elements of identification through light can be the light from the windows during the night time. By using the light from the windows as an element in the design, research has shown that perceived safety and the feeling of community can be increased, on and around the street.

From the section about Diversity knowledge about the users of the space has been expressed through creating personas. The personas have shown us the diverse combination of present and potential users of the space.

From the section about Practices we were able to dive deeper into the activities of the users of the street. The activities of the personas have been analysed in relation to  when and how they are using the street during the dark hours. This knowledge made us capable of creating a Shades of the Night framework for Gadehavegård. In the Shades of the Night framework we are able to define activity and movement in the space at certain times of the day in a more general manner. Based on this framework four light scenes were identified that will be used in the lighting design. Furthermore in Practices we also found the appropriate amount of light that is recommended by the Danish Standard for a slow paced street with diverse mobilities like the one in Gadehavegård.

### 3.6.1 RESEARCH QUESTION

The conclusions from above has led us to the following research question:

> *How can we use lighting design to enhance the lived life for people walking or socializing in the new connecting street element in Gadehavegård, maintaining a balanced light that creates a pleasant and safe experience of the street for its users?*

# 4 DESIGN

In the following chapter we will present our lighting design for Gadehavegård. First the design criteria based on the analysis will be defined. Based on the design criteria the design concept will be presented, here we will go into detail with the characteristics of the lighting design and how we aim for the light to behave. Based on the design concept we are going to explain how some of the lighting elements will be realized in the project and what will be explored further in the 5 (Design) Test chapter.

## 5.1 DESIGN CRITERIA

The design criteria has been created with foundation in the social lighting complexities that the analysis also were structured after. For the design criteria the Places and Connections has been combined into one criteria as they both have foundation in the space and the spatial structure of Gadehavegård. Likewise, the Practices and Diversity has been combined into one in order to make a criteria about the people in Gadehavegård and how the light is reflective of their behavior.

**DESIGN CRITERIA for Places & Connections**

*The lighting design should support the street in being the main connection point of Gadehavegård providing a recognizable, safe and inviting character, through using windows as an luminous element, both from the facades and in the lighting design, which emphasizes the lived life and helps the orientation indicating the spaces for staying and meeting.*

<u>Main connection point & recognizable character</u>

In order to highlight the newly established street as being the main connection point and as an important feature in connecting Gadehavegård to its surroundings, we want to use lighting to introduce a recognizable luminous element that will only be present on and around the street. That should provide the street with its own certain identity.

Fig. 4.1

Reflecting the lived life from the facades

Since the neighborhood is a residential area it provides us with an opportunity to work with the lived life and the community in the area. As mentioned in the analysis the light from the windows is a special feature that creates the feeling of community by reminding both, the people who are living in the buildings and the people who are using the street, of the life being lived in the surrounding homes. Furthermore, the windows also provide the feeling of safety on the street.

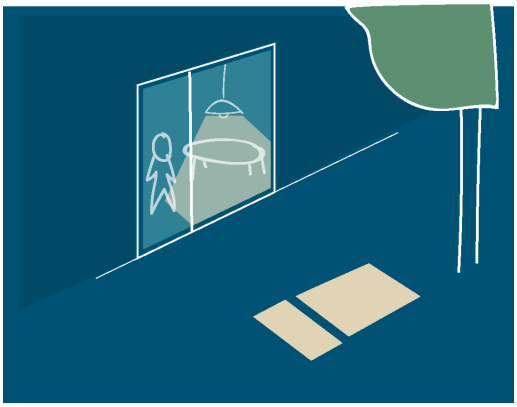


Fig. 4.2

Indicating the spaces for staying and meeting

Through the spatial analysis we have found a series of spaces that are interconnected and define the character of the street. These spaces hold the potential to facilitate the users meeting and staying on and around the street. Through lighting we wish to highlight these spaces for the users to pay attention to them and use them throughout the dark hours. By highlighting these spaces it should also improve the overall orientation of the street.

Fig. 4.3

**DESIGN CRITERIA for Practises & Diversity**

*The lighting design should support people's use of the street by having appropriate and well balanced street light that is dynamic in order to support and reflect the structure of people's daily lives during the various shades of the night.*

Dynamic street lighting

The lighting design for the street will be dynamic in the sense that it aligns with the people's needs and practises through the different light scene found through the Shades of the Night framework, presented in the analysis. The lighting will create a composition that supports the light scenes through working with the intensity and density of the light in the lighting design on the street, with the intention of creating a street that enhances places and times for meeting.

Fig. 4.4

Well balanced light & appropriate light levels

In order to create a street that is safe to stay on and move on, it is important that we meet the danish standard for this type of road, as it allows us to know what is needed for the light to be sufficient for the different types of mobilities. Furthermore the lighting should be well balanced as this will create a more pleasant experience when using the street. Here we will pay attention to the contrast between the light on the street and the density of light on the street.

Fig. 4.5

## 5.2 DESIGN CONCEPT

In the following section we will be describing the lighting elements of our design concept. Going into detail with the characteristics of the light and how the characteristics have been developed. The section has been separated into two parts, one where we describe as the element of the light windows and one for street lighting.

### 4.2.1 LIGHT WINDOWS

**Intention**

As it was stated in the analysis and in the design criteria we will be using windows as an essential luminous element in our design. We know from the research that the light from people's homes has the effect of increasing the perception of safety and community. In order to achieve this it is important that we create darkness around the facades for the light from the windows to stand out and be a noticeable element in the image of the street.

The luminous element of the window will also be present on the horizontal surface of the street. On the ground/floor of the street light figures shaped like the windows in Gadehavegård will appear. Reminiscent of when a reflection from window glass hits the surface of the street on a sunny day. (see figure 4.6). Creating a layer of "play of brilliants" (Kelly, 1952) in the lighting design. Like the light from the windows on the facades, the light windows on the ground should also be dynamic by following the different light scenes presented through the Shades of the Night framework. In this way the light windows on the ground will be reflective of the level of activity and the life happening on the street, appearing and disappearing with the flow of life. Here we will work with the density and intensity of the light. Through the change in density and intensity the four light scenes will be showcased, indicating the spaces on the street that allows the users to meet and stay during the dark hours.

The first light scene, placed between 16.00 and 21.00, will have more intense and dense light to reflect the high level of activity. The second light scene, placed between 21.00 and 00.00, is the winding down period and will have less intense and dense light compared to the first scene. The third light scene, placed between 00.00 and 05.00, will have even less intense and dense light than the previous scene, to reflect the low level of activity during the night time. Lastly the fourth light scene, placed between

05.00 and 09.00, is the waking up time, when the activities are slowly starting, where the intensity and density of the light will be increased compared to the previous scene. See figure 4.8 for visual explanation.

When creating a lighting design for a residential area it has been very important for us to design something that is subtle, which is why we need to be careful when introducing the light windows as an element on the street. In order to make it a coherent part of the lighting design the color temperature of the light windows and the street lighting should be the same. Even though the intensity of the light windows will be changing to fit the light scenes, the light windows should not create too large of a contrast in relation to the street light.

Fig 4.6 & 4.7 Reflection of windows on the street

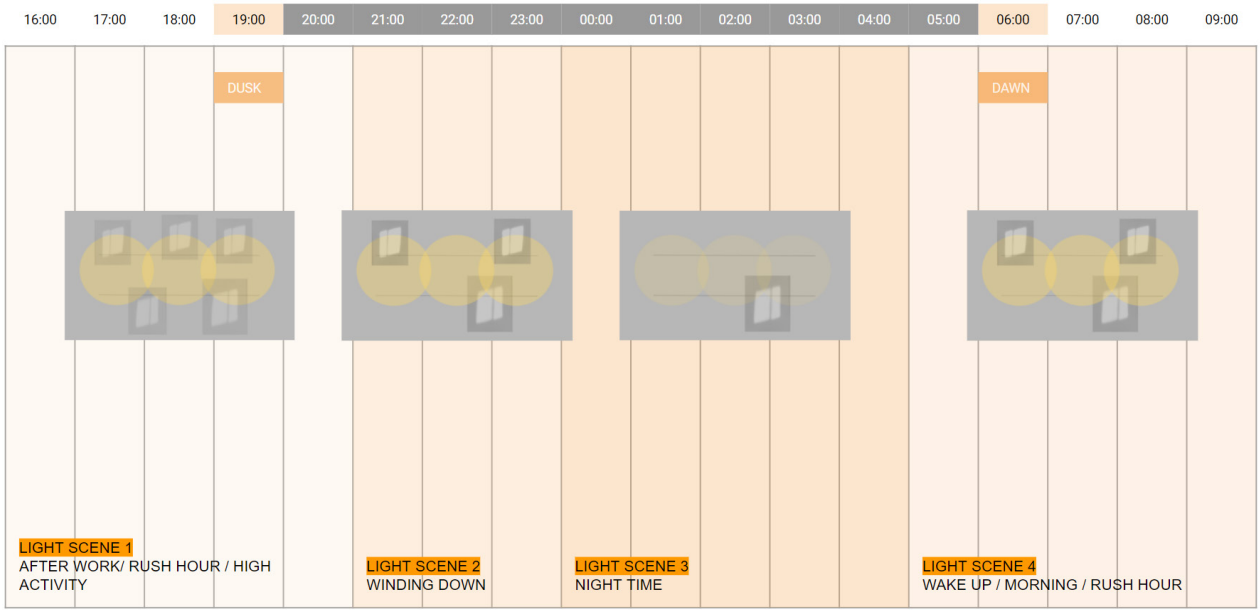



Fig 4.8 Light windows on the street following the Shades of the Night

## Shape of light window

The light windows on the ground will be created from a spot light with a gobo in front of, the gobo will have the shape of a window.

In order to create the shape of the window we tested different shapes through quick shapes cut out from cardboard (see figure 4.9). However it became apparent that in order to create the shape of the

light windows that will be on the street, we had to look at the actual windows in Gadehavegård (see figure 4.11). The windows in the renovated Gadehavegård look very typical for a newly built place. Almost all of them have in common that they use a smaller section of windows and put multiple together in order to create one bigger. Also a general shape of the windows is that they are long and rectangular, starting already at the floor. We want to use these characteristics for the shape of the light window on the ground in order for it to fit in with the surroundings. See figure 4.10 for the final shape of the light window.

The size of the light window will of course be defined by the distance between the ground and the spotlight, but also by how the spot is angled. We aim for the size of the light window to be around 1m x 1,5m.

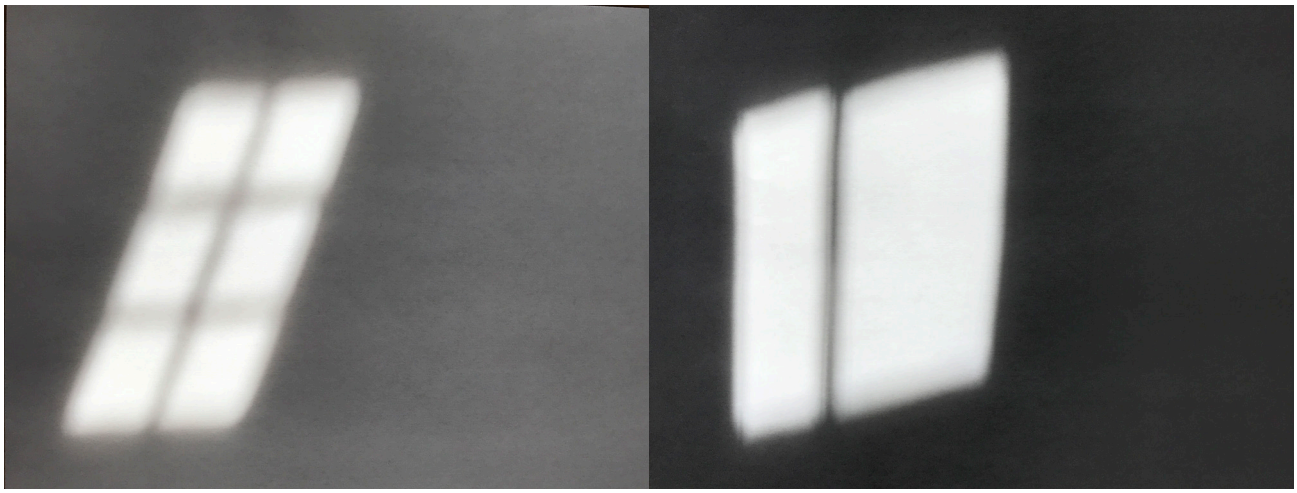


Fig. 4.9 & 4.10 Sketches of light and different window shapes (The one on the right side is chosen as final shape for the light window

Fig. 4.11 The shape of the windows in Gadehavegård

## 4.2.2 STREET LIGHT

### Intention

The intention with the street lighting is to create "ambient luminescence" on the street, creating a street that is visible and safe. Furthermore, the street light should create a "focal glow" as functional light for the cars, bikes and pedestrians. The street lighting should meet the required light levels from the Danish Standard (2014), with an average of 15 lux on the street for cars and bikes and an average of 5 lux on the pedestrian path.

The spatial characteristics of the street light is defined by using the vocabulary of the Six visual principles of light by Descottes (2013). The direction of the street light should be pointing away from the buildings along the street because of two reasons: to reduce the risk of glare from the street light into the buildings and to create a dark zone towards the facades of the buildings. The dark zone should help the light from the windows of the facades to be more visible, as explained earlier (see figure 4.12). The distribution of the light source is planned to be expressed as a wide light beam illuminating both the street for cars and the pedestrian path. Where the street for cars will have a higher intensity of light and lower intensity of light on the pedestrian path (see figure 4.13). As we would like to create a warm and inviting feeling on the street, we imagine the color temperature of the light to be 3000 kelvin, providing a warm white hue. The density of lighting on the street should fit with the rhythm of the street. This will be explored further in the 5 (Design) Test chapter. As seen in figure 4.14 the windows and the street lighting are going to coexist on the street.

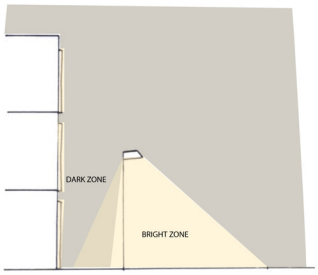



Fig 4.12 Conceptual sketch of the dark zone

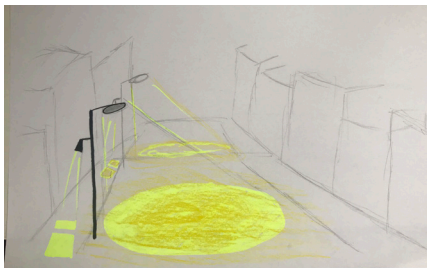


Fig. 4.13 First initial concept sketch

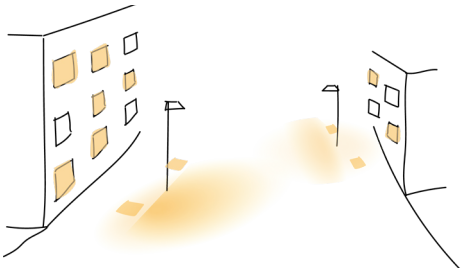


Fig. 4.14 Conceptual sketch of lighting design concept

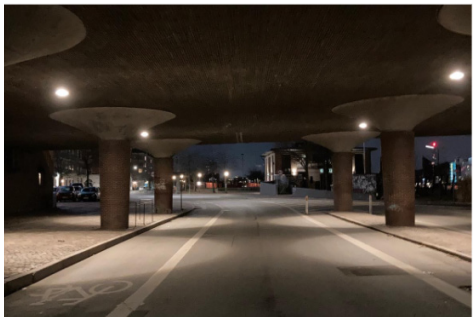
### Inspiration

For shaping the characteristics of the street light, there were visits conducted at few locations in central Copenhagen, to gather knowledge from the field. Three of them will be presented as most relevant to our case. Different characteristics of light (Descottes, 2013) were explored and analysed, in regard to the glare, height of the light, its direction and distribution, type of the street and placement in regard to the context they are placed in.

Fig 4.15 - Is an image from Frederiks Brygge in Sydhavnen. This is a street that is very similar to the street we are designing light for in Gadehavegård. Here the recognized characteristics were that there was only one type of lighting, that illuminates both the road for cars and the walking path. The height of the light was approx. 6m and the walking path approx. 1.5m wide.

Fig 4.16 - Is also an image from Frederiks Brygge in Sydhavnen but at a different location. Here the light's distribution and direction were directed towards the path for reducing the potential glare that could enter into the apartments in the building on the ground floor.

Fig 4.17 - Is an image from under the bridge Langebro, at Islands Brygge. Here the direction and the beam of the light are being investigated, on what effect is being created when the light beam is falling on both the walking path and the road for cars. The light beam has very distinct borders, making it visible where the beam starts and ends, creating a theatrical appearance.



## Chosen fixture

After looking at the light fixtures in urban spaces in the city of Copenhagen and their spatial characteristics of light in the urban space. We selected a luminaire that was the most relevant in regard to the characteristics that the light needs to have for our design. This light fixture is found in the example no.2 at Frederiks Brygge, presented in the previous section. In our design it is used as an example of a light fixture that is not creating glare to the apartments because of its distribution, it has a light beam that suits the space we are designing for, as well as the color temperature (see figure 4.18).

| Specifications |
| --- |
| Brand: Focus Lighting AS<br>Luminaire: Nyx 330<br>Total luminous flux: 3576 lm<br>Colour temp: 3000<br>CRI: 80<br>Watt total: 28,8 W |

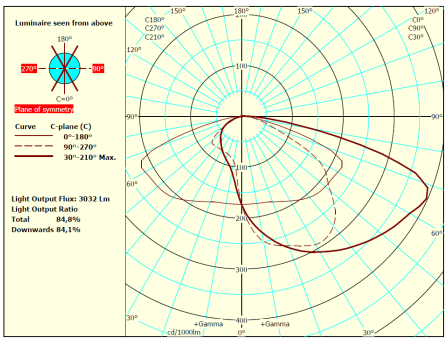



Fig. 4.18 & 4.19 Illustration of throw pattern and exterior of luminaire

# 5 (DESIGN) TEST

In this chapter our iterative design process will be presented. Here we will explore the elements of the lighting design concept that were presented in the previous chapter. Through the iterative process we will explore what effect the different elements have on the street in Gadehavegård, and how they can be adjusted and improved in order to meet our design criteria. During the design testing process we will be practising the "reflection in action" that Schön (2016) is describing, where we will be reflecting upon the iterations as we go along in the iterative process.

## 5.1 ITERATIVE DESIGN TESTING

Through the iterative process each iteration will be presented through three tools. The three tools are presented in the 2 Method chapter. The tools are:

- The illustrations, created in Illustrator, are used to present an overview of the placement of the lighting and the rhythm of the light on the street.
- The knowledge about the light measurements is calculated in Dialux.
- SketchUp and Enscape are used for visualizing the design and experiencing the design from different 3D perspectives. As Enscape is the closest we can come to evaluating the iterations from a human perspective, renderings will be done from three perspectives you will experience the street from. First perspective is walking down the street, second is from a connection point, approaching the street and the third is the view you have of the street from an apartment.

The aim with the iterative process is to create a design that realises the two design criteria. To do so, we have created five evaluation points similar to the subpoints from the design criteria. These evaluation points are:

- **Main connection point & recognizable character**
  Here we will evaluate whether the lighting design elements are helping to highlight the street as a main connection point in Gadehavegård. Additionally, evaluate if the light is providing the street with a recognizable character.
- **Reflecting the lived life from the facades**
  Here we will evaluate whether the light from the windows in the facades towards the street can be experienced.
- **Indicating the spaces for staying and meeting**
  Here we will evaluate how the lighting elements are helping to indicate and highlight the spaces on the street that are for staying and meeting.

- **Supporting the dynamic street lighting**
  Here we will evaluate the dynamic effect of the light windows, and how they are contributing in realizing the light scenes from the shades of the night framework.
- **Well balanced lighting & appropriate light levels**
  Here we will evaluate if the lighting is meeting the Danish Standard for this specific type of street. Additionally, evaluate how the composition of lighting elements are affecting the overall appearance of the street to be perceived as well balanced.

We are aware that some of the evaluation points will be more relevant than others, in relation to some of the light elements.

### 5.1.1 FRAMEWORK FOR THE TEST

The following framework, presented below, is the structure that we will be following during our test. Each of the points will be described in relation to each iteration, to provide an overview and make the iterations easier to compare with each other.

1. **Define what elements in the lighting design that should be worked with in this iteration of the design.**

2. **Design the iteration with the aim of meeting the design criteria using the three tools.**
   - Illustrations
   - Dialux
   - Enscape
     - "From walking point" perspective
     - "From apartment" perspective
     - "From connection point" perspective

3. **Evaluate the design according to the design criteria. Underneath is a list of each evaluation point retracted from the design criteria, the evaluation points are as following:**
   - Main connection point & recognizable character
   - Reflecting the lived life from the facades
   - Indicating spaces for staying and meeting
   - Dynamic street lighting
   - Well balanced lighting & appropriate light levels

4. **Review how the iteration can be improved and move on to the next iteration.**

## 5.2.1 ITERATION 1

**1. Define what elements in the lighting design that should be worked with in this iteration of the design**

In this iteration we will investigate the placement of the light poles. We will place the light poles opposite of each other along the street. The light poles are placed along the edge of the street for cars and bikes, directed onto the street. With the highest intensity of the light where the cars and bikes are going to drive, and with lower intensity of light where the pedestrian zone is. The distance between the light poles is around 21m. In this iteration the light window element will not be included.

**2. Design the iteration with the aim of meeting the design criteria using the three tools**

The images and dokumentation for this iteration can be found on page 55 and in Appendix, iteration1.

**3. Evaluate the design according to the design criteria**

Main connection point & recognizable character

The placement of the light poles across from each other is creating "islands" of light in the street. Suddenly it is very bright (35,7lx) and suddenly it is very dark (7,23 lx). This does not help to show the user the directionality of the street. Creating an uninviting street, and is not helping the street to be experienced as a main connection point.

The direction of the light pointing toward the center of the street is helping to create darker areas along the facades where the light from the windows can appear. This light from the windows helps to give a recognizable character to the street.

Reflecting the lived life from the facades

As mentioned in the previous evaluation point, the lower light levels on the pedestrian path enables the light from the windows to become more noticeable on the street, which helps the lived life in the buildings to appear more in the image of the street.

Indicating spaces for staying and meeting

The street light poles intention is not to emphasize these areas, but the element light window will address these spaces in the further iterations.

Dynamic street lighting

This criteria can not be evaluated in relation to this iteration as it is not working with the dynamics of the light scenes.

Well balanced lighting & appropriate light levels

Through the DIALux report we can see that the part of the street for motorized traffic is meeting the requirements of the Danish Standard with an average lux of 19,3 lx (minimum 15 lx is required). As it was established in the analysis the pedestrian paths in Gadehavegård are of varying sizes. This iteration shows that when the path is under 4,5 m wide it meets this with an average of 5.1 lx. If the path is wider than this the pedestrian path needs supplementing light.

The light is perceived to be really dense in the spaces where the light poles are placed and creates dark pockets where the light is not placed, which establishes a rhythm that becomes rigid. Because the light beams overlapping dark pockets are created through the street, the lighting can be perceived to be filled with contrast and the intensity of light is not consistent which creates a lighting design that is not well balanced. The conclusion is that there is no need for two lights to be placed on opposite sides.

**4. Review how the iteration can be improved and move on to the next iteration**

We have found that this placement of the light poles is creating an unbalanced experience of the light in the street. The placement creates  a rigid rhythm and inconsistent light level and therefore creates dark pockets in the middle of the street resulting in the layer of light that should help you to see, making this exact thing difficult.

We found that the direction of the light in the light poles helps the light from the windows in the facades to stand out.

We found that when a pedestrian path is under 4,5 m the light from the light pole is meeting the requirement. However when the path is wider than 4,5 m there is a need for more lighting in the path. In further on we will use the projected light window as a supplementing light source to solve this issue.

### 5.2.2 ITERATION 2

**1. Define what elements in the lighting design that should be worked with in this iteration of the design**

For improving the previous iteration here we would like to improve the unbalanced appearance of the previous iteration. In this iteration we will place the lights alternating along the street and by that hopefully create a more balanced appearance of the street. The distance between the light poles will remain the same (around 21m).

**2. Design the iteration with the aim of meeting the design criteria using the three tools**

The images and dokumentation for this iteration can be found on page 56 and in Appendix iteration 2.

**3. Evaluate the design according to the design criteria**

Main connection point & recognizable character

The change in the placement of the light pole has helped to eliminate the “islands" of light and the dark pockets throughout the street. This helps the user to understand the directionality of the street, and create a more inviting appearance. Making the users be more likely to identify the street as a main connection point of the neighborhood.

As the light is still pointing towards the middle of the street, the light from the windows of the facades will still be apparent in the image of the street. Making the light from the windows a part of the recognizable character.

Reflecting the lived life from the facades

In relation to this criteria the evaluation also remains the same as in the previous iteration, as the light from the windows will still be visible.

Indicating spaces for staying and meeting

The street light poles intention is not to emphasize these areas, but the element light window will address these spaces in the further iterations.

Dynamic street lighting

This criteria can not be evaluated in relation to this iteration as it is not working with the dynamics of

the light scenes.

Well balanced lighting & appropriate light levels

When analysing the placement of the light in DiaLUX it shows that the light is providing the appropriate level of light in relation to the Danish Standard for this type of road and the pedestrian path. Having the same values as in Iteration 1. Like in the previous iteration when the pedestrian path is above 4,5 m wide the requirements from the Danish Standard are not met.

In this iteration the placement of the light poles is following the rhythm of the street, through its alternating pattern. It is perceived to be more dynamic since it is following the nature of the street. Compared to the previous iteration, the density of the light avoids creating dark pockets along the street and the lighting appears to be more evenly distributed throughout the space. This creates a more comfortable and appealing overall appearance of the street, it becomes very harmonious and predictable. Resulting in a more well balanced lighting design.

**4. Review how the iteration can be improved and move on to the next iteration.**

We have found that this placement of the light poles is creating a pattern of light that follows the nature of the street, making it appear more well balanced and predictable compared to the previous iteration. Creating a street that can naturally become the main connection point of a neighborhood.

As it was present in the previous iteration the placement of the light poles creates space for the light from the windows in facades to be noticeable.

Compared to the first iteration this iteration did not improve the light levels on the pedestrian path when it is above 4,5 m wide. This should be addressed in the following iterations.

### 5.2.3 ITERATION 3

**1. Define what elements in the lighting design that should be worked with in this iteration of the design**

In this iteration we will be designing the dynamic light for the light windows projected on the ground. The dynamic light is based on the four light scenes from the Shades of the Night framework. In regard to the scenes the light windows will be dynamic, by adjusting the density and intensity of the light.

As it was apparent in the previous iteration, the light on the pedestrian path needs to be improved. Which is why we place the light windows on the pedestrian path. They will be attached onto the street light poles - two light windows for each pole.

As the shape of the light windows is a uniquely shaped light we are not able to find a light source in the same shape to import into DIALux. Which is why the shape used for the light windows is different from the design. In Dialux we have used a regular spot light, where the light beam can not be shaped into the shape of a window.

**2. Design the iteration with the aim of meeting the design criteria using the three tools.**

The images and dokumentation for this iteration can be found on page 57 and in Appendix Iteration 3. In this iteration we will divide the light windows into two types, in regard to their placement on the street (see figure 5.1).

1. Primary light windows - located on the pedestrian path close or on to the places for staying and meeting
2. Secondary light windows - located on the pedestrian path throughout the street

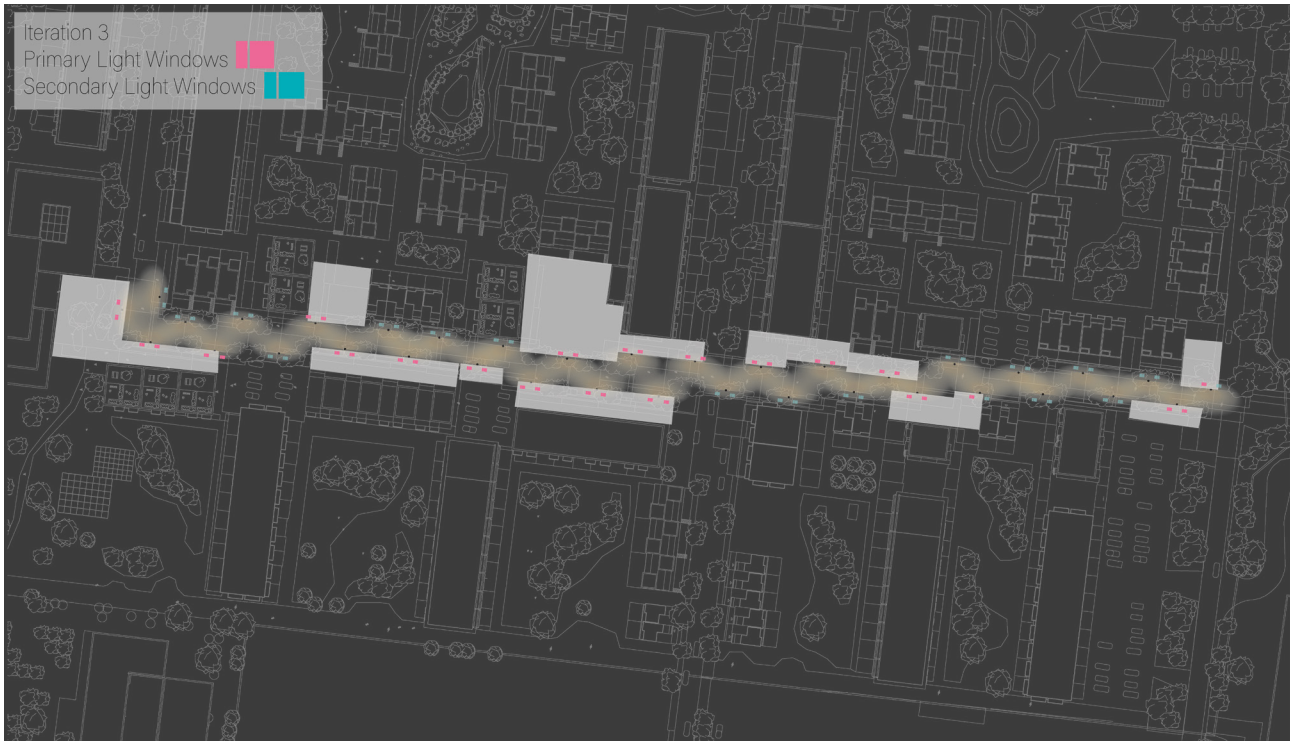



Fig. 5.1 Illustration of the two types of light windows (primary marked with red, secondary marked with blue)

We work with the intensity of the light windows through three levels of light. The light levels will be matched with the level of activity happening on the street:

- High (average of 47lx in the light window)
- Medium (average of 25lx in the light window)
- Low (average of 18lx in the light window)

| LIGHT SCENES | INTENSITY OF LIGHT | |
|---|---|---|
| **Light scene 1**<br>After work rush hour<br>16.00 - 21.00 | High | Medium |
| **Light scene 2**<br>Winding down<br>21.00 - 00.00 | Medium | Low |
| **Light scene 3**<br>Night time<br>00.00 - 05.00 | Low | Off |
| **Light scene 4**<br>Wake up rush hour<br>05.00 - 09.00 | Medium | Low |

To be able to experience the dynamic characteristics of the light windows, we will present them through illustrations of the four light scenes.

**3. Evaluate the design according to the design criteria**

Main connection point & recognizable character

Adding the light window to the street has helped to provide it with a more distinct character as the light window acts as a recognizable element. Even though the light windows change character during the night, as they are more intense or less intense, they are present in the street all throughout the night. Having a recognizable element in the street like the window, is helping the user to identify the street in its surroundings, working as a form of a landmark. This will help the user to see the street as being a main connection point.

Reflecting the lived life from the facades

Since this was found to be realized in iteration 2, it is not relevant to evaluate here.

Indicating spaces for staying and meeting

In this iteration there are light windows present all the way along the street (with the exception of light scene 3, where the secordary are turned off) with various intensities. As shown, the primary light windows always have the highest intensity of light, with the intention to indicate the space for staying and meeting. After reviewing the Enscape images we can conclude that the primary light windows are not indicating the spaces for staying and meeting as much as intended. This is because when all the light windows are turned on, they do not appear as distinct on the spaces for staying but rather uniform throughout the street. With this iteration spaces for staying are not being highlighted, but rather experienced as a space that is part of the pedestrian path. This should be improved in order to highlight the difference between the two spaces.

Dynamic street lighting

In this iteration the changing light scenes are helping the street to appear dynamic and the users will be able to detect a slight change in appearance of the light windows throughout the dark hours. As mentioned in the previous evaluation point the light windows can appear very similar throughout the street, which can cause the light windows to not be perceived as very dynamic.

Well balanced lighting & appropriate light levels

For this iteration we wanted to improve the light levels when the pedestrian path is wider than 4,5 m. Here we created a calculation plane that is the equivalent of being a 10 m wide pedestrian path, like the widest pedestrian path in the street is.

Through the calculations from Dialux we have found that by implementing the light windows in the design, with high intensity, it creates an average of 4,15 lx on the pedestrian path with 10m width. With this finding we can conclude that the light level for the pedestrian path is not sufficient enough and does not meet the requirement from the Danish Standard, as the required light level is an average of 5 lx. For this to be improved further development of the light windows element will be done.

**4. Review how the iteration can be improved and move on to the next iteration**

In iteration 3 it was found that the light windows placed did not indicate enough where the spaces for staying and meeting are in the street. This needs to be improved in the next iteration.

Furthermore the light windows did not help to achieve the required light level on the pedestri-

an path wider than 4,5 m. This also needs to be improved in the next iteration.

### 5.2.4 ITERATION 4

**1. Define what elements in the lighting design that should be worked with in this iteration of the design**

Iteration 4 is focusing on the placement of the primary light windows on the places for staying, with the intention to highlight them in the design. The light windows will remain the same dynamic characteristics from iteration 3. In this iteration the primary light windows will be doubled, meaning that for each light window on those areas will have one more light window added. These new primary light windows are being added to improve the light level with wider pedestrian paths, as the previous iteration did not meet the required light level from the Danish Standard.

**2. Design the iteration with the aim of meeting the design criteria using the three tools**

The images and dokumentation for this iteration can be found on page 58 and in Appendix Iteration 4.

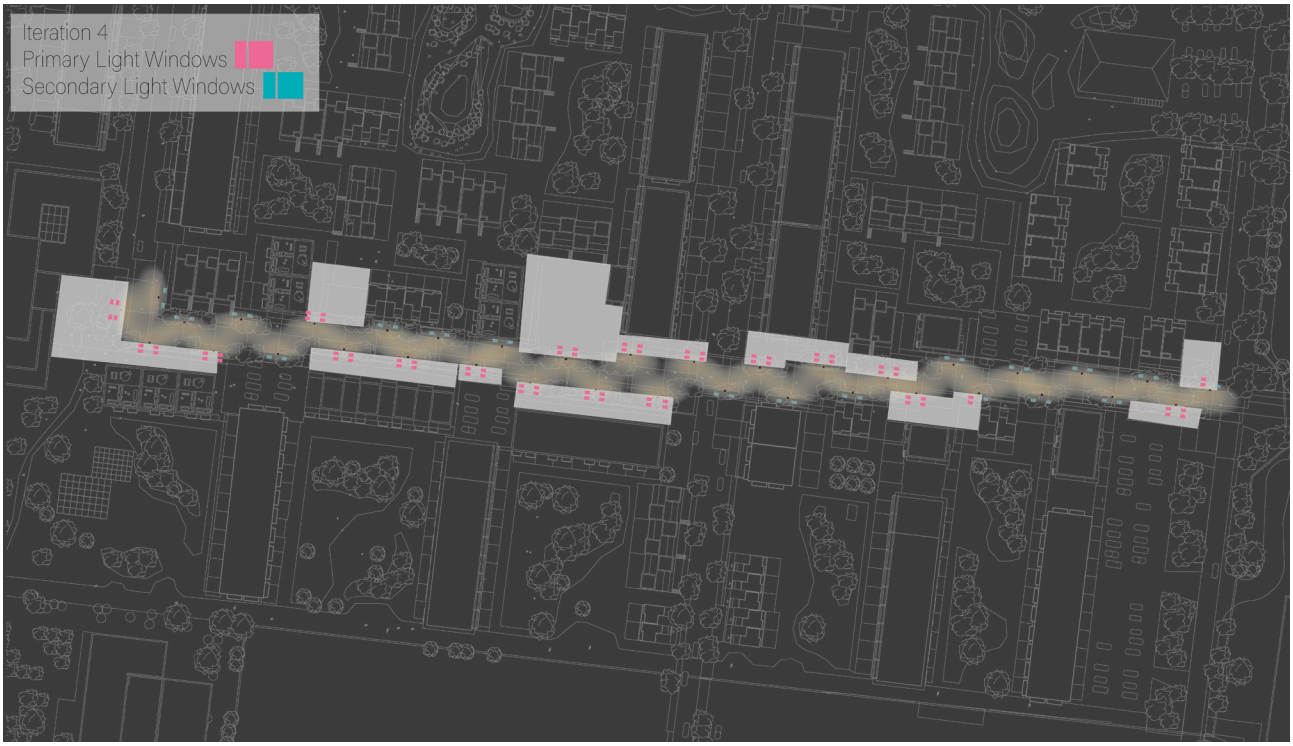



Fig. 5.2 Illustration of the two types of light windows including the new light windows (primary marked with red, secondary marked with blue)

**3. Evaluate the design according to the design criteria**

Main connection point & recognizable character

In this iteration we are referring to the same findings as in iteration 3, whereby by having the light windows with its dynamic characteristics as a recognizable element in the space, a recognizable identity of the area is being facilitated. The one more light window added in these areas in this iteration, is

found to be even more contributing to the identity as it allows the window element to be present more on the street.

Reflecting the lived life from the facades
Since this was found to be realized in iteration 2, it is not relevant to evaluate here.

Indicating spaces for staying and meeting
In this iteration the light windows on the spaces for staying are double the amount in comparison to iteration 3. The effect of having more of the primary light windows is defining and emphasizing the spaces for staying and meeting better than in iteration 3. Additionally the spaces for staying and meeting are more distinct compared to the rest of the pedestrian path. More light windows on these spaces makes the spaces to be more appealing on the pedestrian path and shows that they are promoting the function of staying and meeting. However when reviewing the renderings from Enscape the secondary light windows are taking up too much space in the image of the street. Here it can be concluded that for best experience of the spaces for staying, the secondary light windows need to be eliminated in the next iteration 5.

Dynamic street lighting
The dynamic street lighting from iteration 3 applies also to this iteration. The dynamic feature of the light windows makes these spaces to become more appealing, as their amount is increased.

Well balanced lighting & appropriate light levels
Here we have found that by doubling the amount of the primary light windows on each space for staying, these spaces reach the sufficient light level by the Danish Standard, but only when high intensity. The required value is 5lx, where the light windows at high intensity reach 5,99lx. Whereas, when the intensity of the light windows is low, the average lx on the pedestrian path is measured as 4,9 lx. From here we can conclude that an additional light needs to be added in the spaces for staying and meeting.

Furthermore, we found through reviewing the renderings from Enscape that the secondary light windows are taking a lot of space in the image of the street. Creating the effect that occurance of the light windows can feel too dense throughout the street.

**4. Review how the iteration can be improved and move on to the next iteration**

Through this iteration we found that we managed to improve the evaluation point for indicating spaces for staying and for meeting by adding a second light window, to the primary light windows. However, in order to enhance the spaces for staying even more, the most optimal solution would be to exclude the secondary light windows. Taking out the secondary light windows will help to make the spaces stand out even more, and would create a more attractive composition of the light windows, as they would not appear so regularly.

We also found that the requirements from the Danish Standard for the pedestrian path are not reached when the light windows have low light levels. To solve this we have to add additional light on the paths that are wider than 4,5m.

## 5.2.5 ITERATION 5

**1. Define what elements in the lighting design that should be worked with in this iteration of the design**

In this iteration there will be additional light added on the spaces for staying and for meeting. This will emphasize these places even more and help the wider pedestrian path to not be as dark as previously. Additionally adding extra light along the wider pedestrian paths should help to meet the requirements from the Danish Standard. The additional light will be a small bollard placed along the facades pointing towards the pedestrian path (see figure 5.5).

The primary light windows in this iteration are remaining the same characteristics from iteration 4, whereas the secondary light windows will be removed from the design.

**2. Design the iteration with the aim of meeting the design criteria using the three tools**

The images and dokumentation for this iteration can be found on page 59 and in Appendix Iteration 5. The new additional lighting will create a layer of ambient light on the street. When implementing this additional light it is important to avoid glare and light directed towards the facades of the buildings. With the notion of remaining the facade identity, reflecting on the lived life in Gadehavegård. The placement of the ambient light is along the facades of the surrounding buildings, in the wider parts of the pedestrian path to further emphasize the places for staying and meeting.

We have picked the Flindt Garden bollard by Louis Poulsen. This fixture was picked because of the small size (34,5cm tall), as this can be placed next to the buildings in Gadahavegår without being too intense, in relation to the facade it will be placed against.

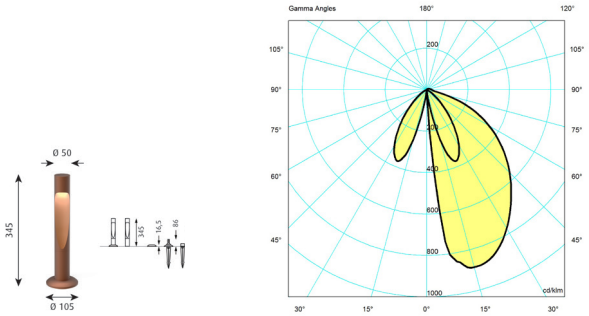



Fig. 5.3 & 5.4 Flindt Garden bollard by Louis Poulsen and light distribution of bollard (Louis Poulsen, 2021)

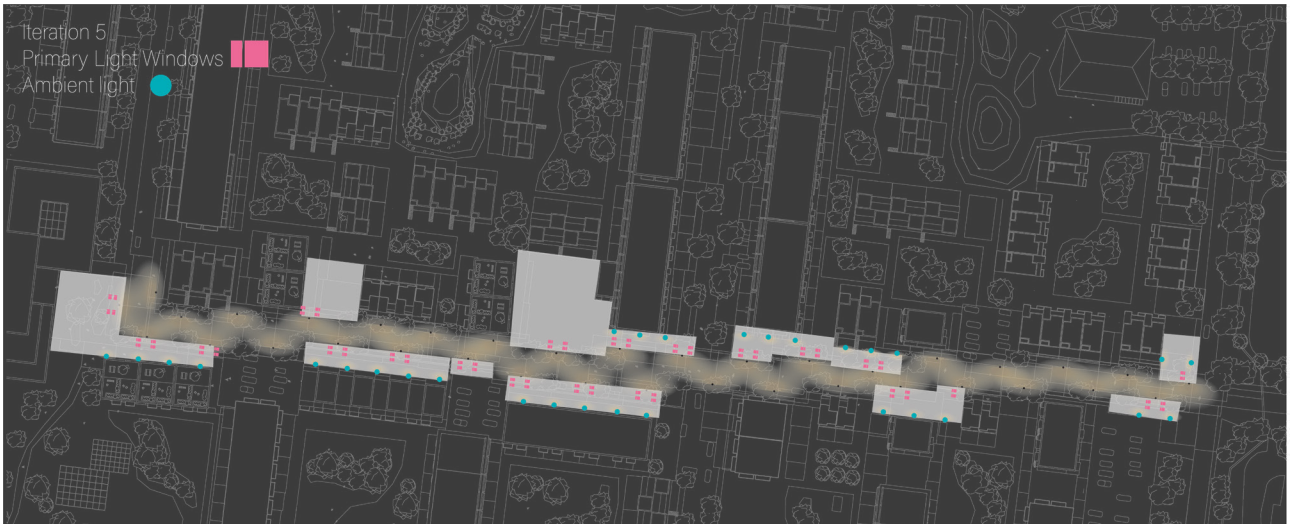



Fig. 5.5 Illustration of the primary light windows and ambient light (primary marked with red and ambient with blue)

**3. Evaluate the design according to the design criteria**

Main connection point & recognizable character

For this evaluation point we have found that the new light source is contributing to creating a recognizable character. As the spaces for staying are more distinctive after the secondary light windows are taken out, contributing to creating a recognizable identity on the street.

Reflecting the lived life from the facades

When designing the iteration 5 there was a specific attention paid on the characteristics of the light and its placement in regard to the spaces for staying and meeting. The new ambient light is placed next to the facades and the spaces for staying and meeting. Where the design of the chosen fixture allows the direction of the light to be distributed only towards the path, which in our case adapts very well to the context and the intention of presenting the facade identity reflecting the lived life in Gadehavegård. When the ambient light is placed next to the facades, the amount of light distributed on the surface of the facade is around 2 lx in the area near the light source. Even though this is creating some light on the facades this still aligns with the intention of having dark facades.

The new ambient light will be added only on the places for the staying, where the pedestrian path is above 4,5m. On all the pedestrian paths with width of 4,5m or less there will be no ambient light, which creates dark pockets where the light from the windows of the facades really get the opportunity to stand out.

Indicating spaces for staying and meeting

After we have added one more pair of the primary light windows these spaces were better marked as an actual space with a function, rather than being experienced as a part of the pedestrian path. In this iteration the light windows are placed in a group of four light windows and in combination with the bollard, it makes the spaces stand out compared to the rest of the street. By excluding the secondary light windows, the primary light windows are becoming more distincting on the street. It helps to show the user that these places are for staying and meeting.

Dynamic street lighting

The dynamic street lighting from iteration 3 applies also to this iteration. The dynamic feature of the light windows in this iteration works very well both in highlighting the function for staying and meeting on the street and creating a dynamic urban environment. However after the amount of the light windows in the spaces for staying and meeting is doubled and the secondary light windows are excluded, the dynamic feature becomes less noticeable. But since the light windows are following the light scenes the user will still be able to detect a change in the street throughout the dark hours.

Well balanced lighting & appropriate light levels

By adding the bollard to the wider pedestrian paths (wider than 4,5m) the calculations from DIALux shows that an average of 6.53 lx is present on a path that is 10 m wide. This is meeting the requirement from the Danish Standard.

Furthermore after excluding the secondary light windows from the design and adding the bollards the wider pedestrian path (spaces for staying and meeting) are highlighted. This creates dark zones where the pedestrian path is smaller because there are no light windows or no bollards. Based

on the readings from Enscape we see that this is helping to open up the street in the wider areas, and meet the full potential of the space.

**4. Review how the iteration can be improved and move on to the next iteration**

In this iteration we took away the secondary light windows. The primary light windows were kept in the places for staying and meeting, additionally bollards were also added along the facades in these spaces.

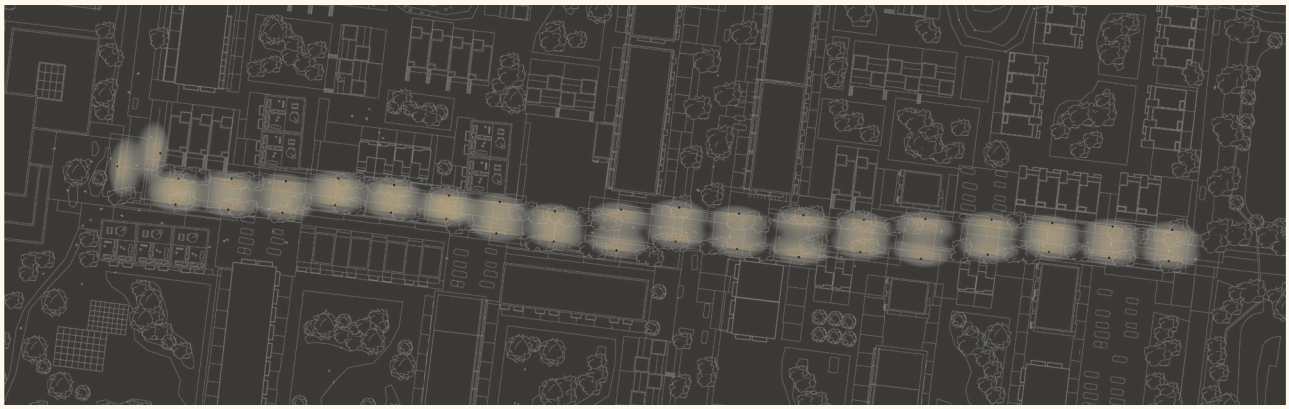
From this iteration we found that by having bollard and light windows in only the wider pedestrian areas we highlighted the spaces for staying and meeting. This also helped to open up the street in wider areas. Furthermore it created darker spaces where this street is not so wide, this helped the light from the windows in the facade to stand out.

By taking away the secondary light windows, it reduced the dynamic effect experienced on the street, however the changing character can still be experienced throughout the dark hours. If we were going to make further iterations this is where we would try to improve the lighting design.

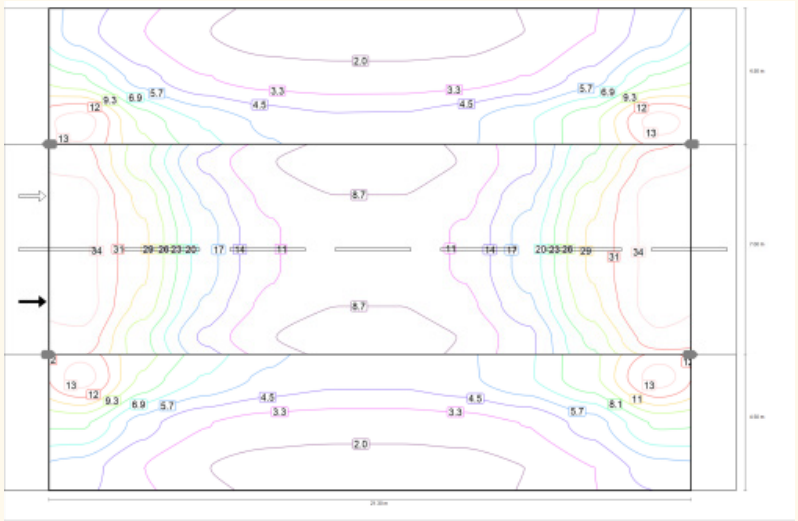
By adding the bollard to the lighting design the requirement of 5 lx on the pedestrian path was met with an average of 6.53 lx on a 10m wide path.

# ITERATION 1

## ILLUSTRATIONS

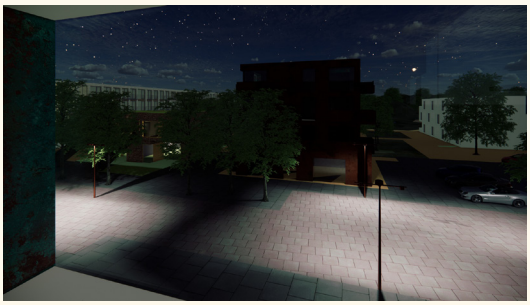


## DIALUX



| | Finding | Danish Standard |
|---|---|---|
| Pedstrian path (4,5m wide) | 5,01 lx | 5 lx |
| Street for cars and bikes | 19,3 lx | 15 lx |

## ENSCAPE



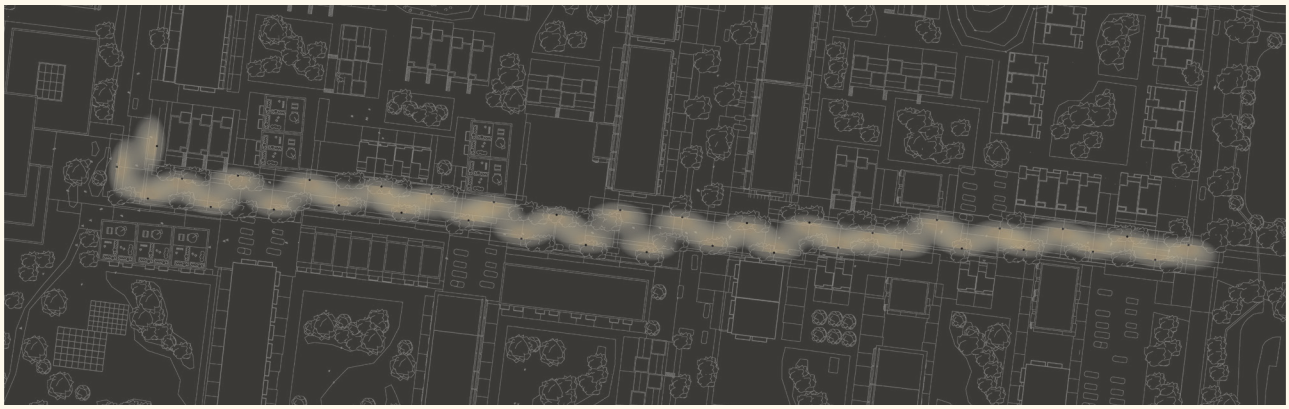
View from apartment

View from connection point

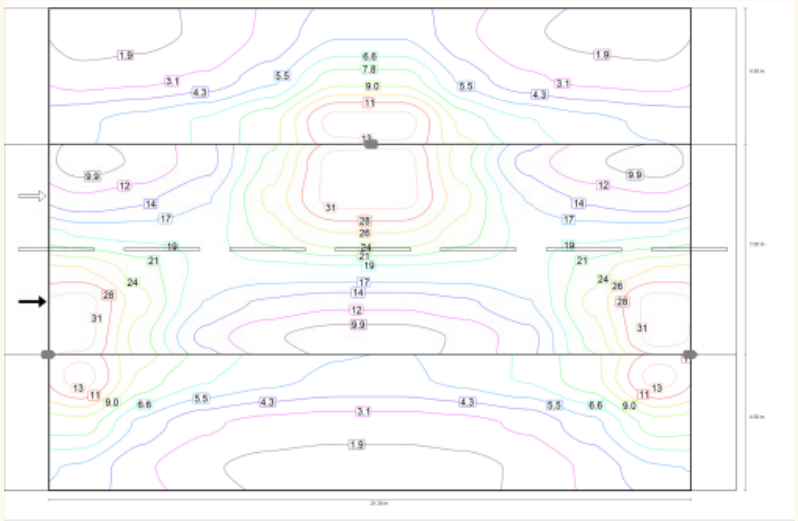
View when walking down the street

# ITERATION 2

## ILLUSTRATIONS

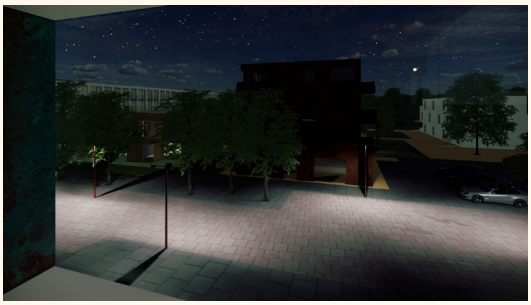


## DIALUX



| | Finding | Danish Standard |
|---|---|---|
| Pedstrian path (4,5m wide) | 5,01 lx | 5 lx |
| Street for cars and bikes | 19,3 lx | 15 lx |

## ENSCAPE



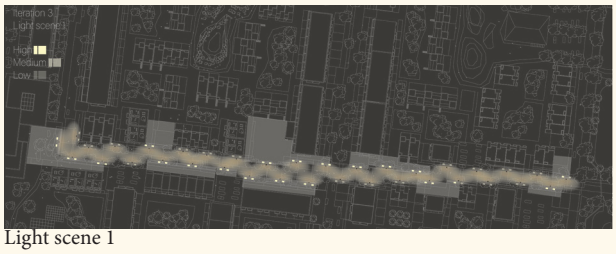
View from apartment

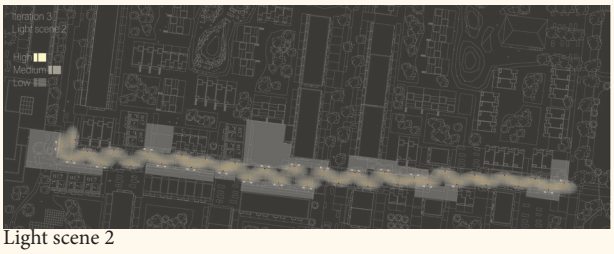
View from connection point

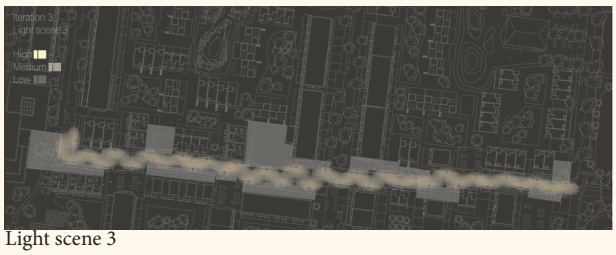
View when walking down the street

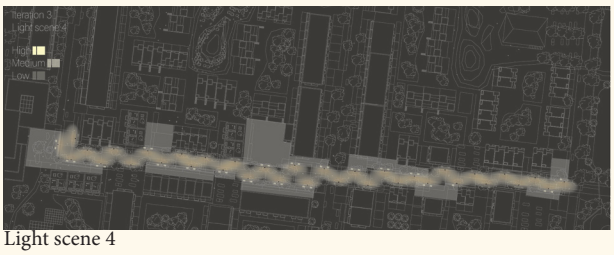
# ITERATION 3

## ILLUSTRATIONS

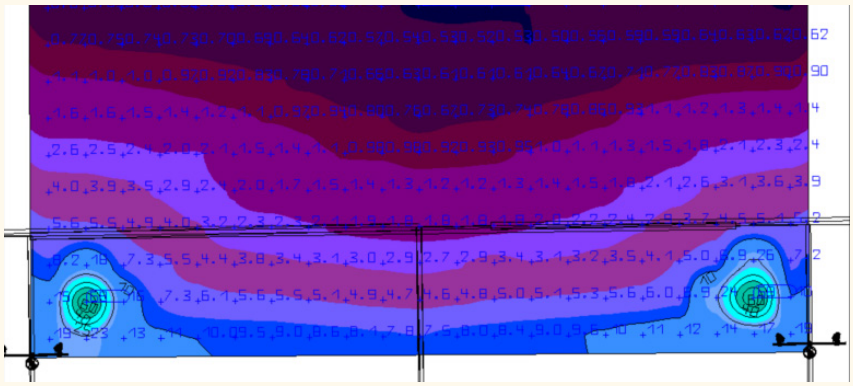

Light scene 1


Light scene 2


Light scene 3


Light scene 4

## DIALUX



| | Finding | Danish Standard |
|---|---|---|
| Pedstrian path (10m wide) | 4,15 lx (high intensity light windows) | 5 lx |

## ENSCAPE

View when walking down the street

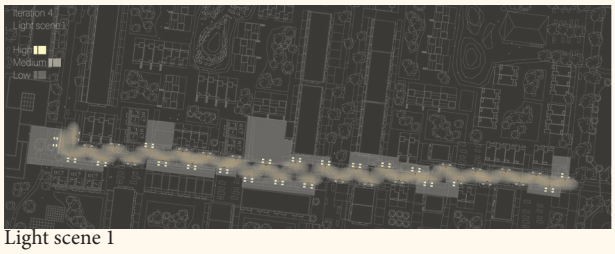

Medium intensity light windows

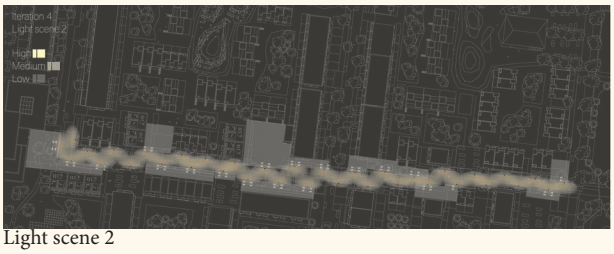

Low intensity light windows

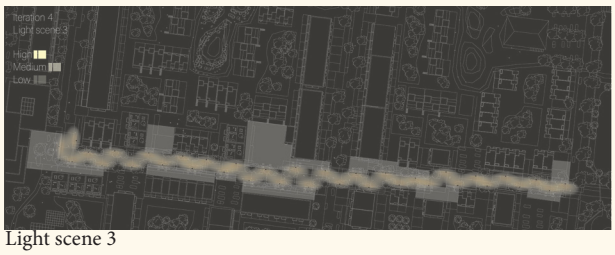

High intensity light windows

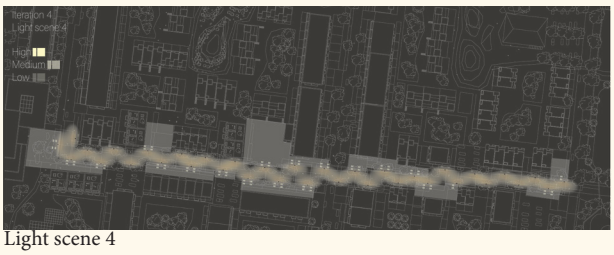
# ITERATION 4

## ILLUSTRATIONS

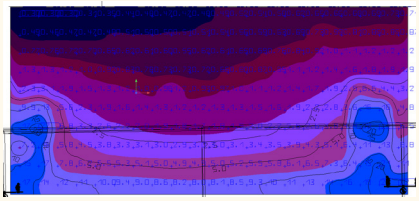

Light scene 1

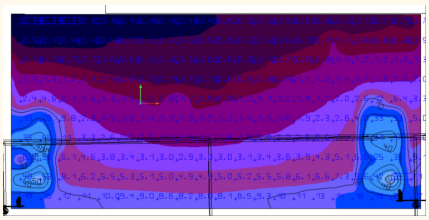

Light scene 2


Light scene 3


Light scene 4

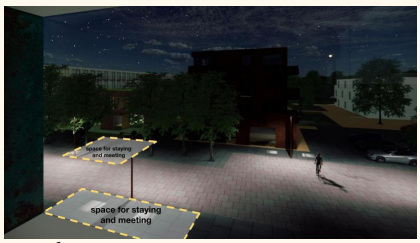
## DIALUX


Low intensity light windows

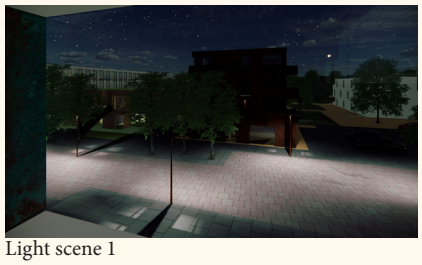

High intensity light windows

| | Finding | Danish Standard |
|---|---|---|
| Pedstrian path (10m wide) | 4,19 lx (low intensity light windows) | 5 lx |
| Pedstrian path (10m wide) | 5,99 lx (high intensity light windows) | 5 lx |

## ENSCAPE

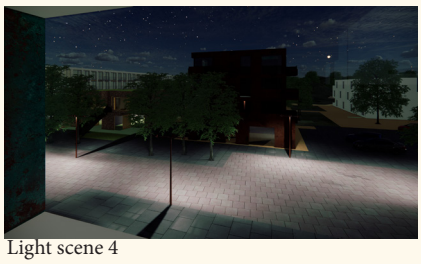


View from apartment


Light scene 1

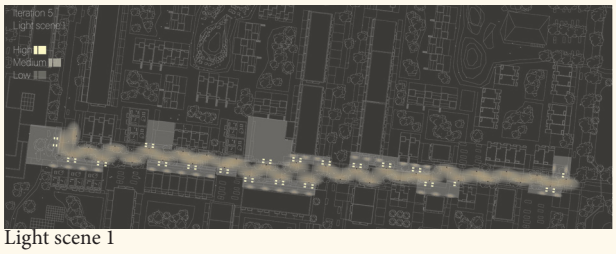

Light scene 2


Light scene 3

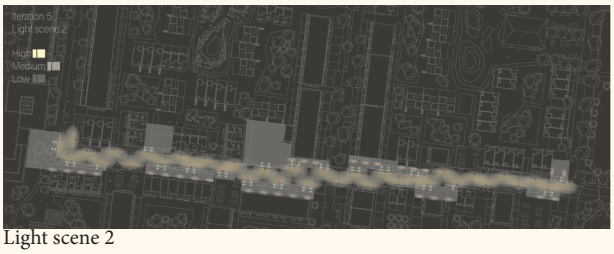

Light scene 4

# ITERATION 5

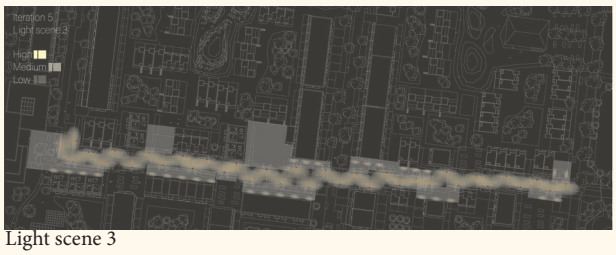
## ILLUSTRATIONS



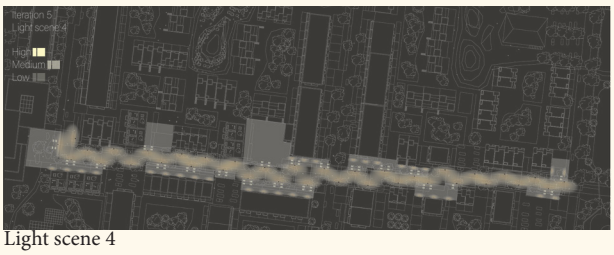
Light scene 1



Light scene 2

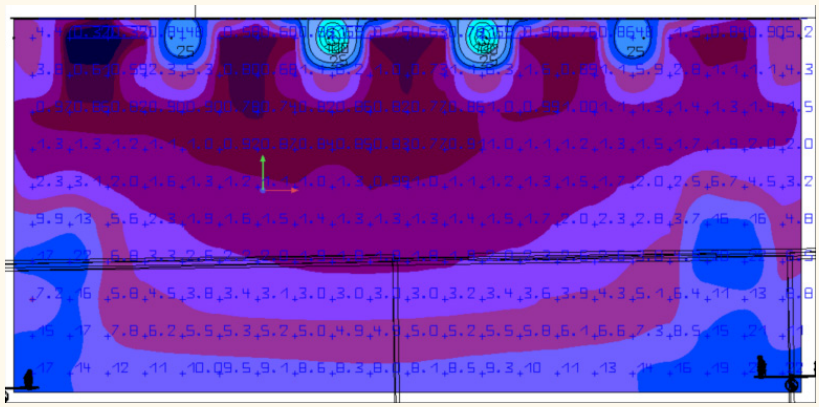


Light scene 3



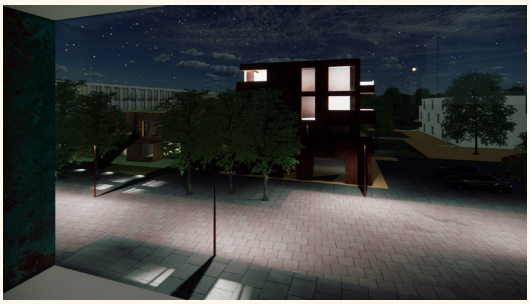
Light scene 4

## DIALUX



| | Finding | Danish Standard |
|---|---|---|
| Pedstrian path (10m wide) | 6,53 lx (low intensity light windows) | 5 lx |

## ENSCAPE


View from apartment


View from connection point


View when walking down the street

## 5.3 FINAL DESIGN

In the iterative design process we have been working with evaluating the design elements in relation to the evaluation points. Throughout the process five iterations were evaluated in order to achieve a lighting design that would meet the two design criteria created for the lighting design in Gadehavegår.

For presenting the final design elements we are referring to the three elements of the lighting design by Kelly (1952) and the way he understands the layers of light in a lighting design. As he elaborates, the three elements should be in good balance, to enhance the beauty of the architectural space and value.

Taking that as a departure point, our final design is created with a combination of the following three elements and further on we will elaborate what is their function and how are they combined in order to achieve a well balanced lighting on the street.

- Street light pole ("focal glow" layer)
- Light windows ("play of brilliants" layer)
- Ambient lighting ("ambient luminescence" layer)

Fig. 5.6, 5.7 & 5.8 Illustration of the final design with the three elements: street light pole (1), light windows (2) and ambient lighting (3) (own illustration)

**Street light pole**

The street light pole is designed with the intention of providing a focal glow creating a functional layer of light for cars, bikes and pedestrians on the street. The fixture used for expressing the characteristics of this light pole is NYX 330 by Focus Lighting.

The placement of the light poles will be in an alternating pattern throughout the street in GHG, which creates a well balanced and uniform lighting. This placement is designed for emphasizing the architectural space and creating a harmonious and predictable experience of the street (see figure 5.6, 5.7 & 5.8).

As mentioned in the analysis section, on the street there are different mobilities and this layer's role is to support their needs. The light distribution of the light is expressed as a wide light beam designed to illuminate the street for cars and bikes and the pedestrian path and provide appropriate light levels to both functions. This light source creates sufficient light levels for when the pedestrian path has a width of 4,5m, where everything above that size will have to be supported by the ambient layer. This type of street lighting is designed with the intention to place the focal glow on the street for cars and bikes, and at the same time provide a dark area towards the buildings. This way the light windows of the facades can appear stronger in the space and promote the lived life of Gadehavegård.

**Light windows**

This layer of light is going to function as the "play of brilliants" layer (Kelly, 1952) with the aim of stimulating the spirit and making the street come to life. It is being created with the intention to reflect upon the lived life and the community in GHG, which responds to the design criteria about diversity and practices. The light windows are designed to be working as window projections on the street (see figure xx), with the aim to emphasize the spaces for staying and meeting and create a pleasant and safe experience of the street. The light windows with their shape are reflecting on the lived life in the area, presenting that people are at home and are using that as a narrative in creating the sense of belonging to the space, touching upon the social aspect in lighting.

The light fixtures projecting the light windows are being mounted on the street light pole, with the intention to have only one pole on the pedestrian path. Where each light fixture projects two light windows. The light windows will be projected on the pedestrian path, where the path is wider than 4,5m. Defining these wider paths as spaces for staying and meeting on the street. This will help to provide more light on the spaces for staying and meeting, determine them as spaces with a different function on the pedestrian path and make them become more appealing on the street.

The light windows will have a dynamic feature as a characteristic, which is designed in relation to the Shades of the Night framework with four light scenes. This framework is used to promote the level of activity in Gadehavegård in regard to different times of the dark hours. This dynamic characteristic in the light windows will work with the intensity of light in order to emphasize the time when these functions for meeting and staying on the street can be utilized. The intensity of the light in the light scenes will be adjusted in three levels of intensity (high, medium and low), depending on the activity level on the street.

Throughout the (design) test, it was found that the light windows and their dynamic nature did not help to meet the requirement of the Danish Standard for a pedestrian path, revealing that there was a need for additional light in the wider parts of the street.

Ambient lighting

The ambient light is being added to the design with the intention to maintain balanced light levels on the pedestrian path wider than 4,5m, referring to the spaces for staying and meeting.
For this layer of light it is important that the height of the light is kept low and the distribution of light to be directed towards the path, to avoid spill light onto the buildings. This ambient light will support the two other layers and create a balanced lighting design that is creating a safe and reasuaring urban environment and pleasant walking experience on the street.

**A combination of the three layers**

All the three layers, presented above, are defining our final lighting design. The street light poles (focal glow) and the ambient light (ambient luminescence) will be present at all times in the design, remaining the same intensity. Whereas, the light windows will also be present at all times, designed with intensity that is changing according to the four light scenes reflecting the level of activity. The combination of the three layers is created referring to the concept of three elements of lighting by Kelly (1952), in which the layer play of brilliants is used to shape this project, focusing on the social aspect, providing the user with an extraordinary experience that reflects on the lived life and helps the user identify with the environment which contributes to the notion of belonging in the space

# 6 CONCLUSION

## 6.1 DISCUSSION

In this project we have been exploring how to create a lighting design that can support the urban transformation of Gadehavegård. Throughout the project the aim has been to create a lighting design that aligns with Arkitemas vision for the urban transformation of Gadehavegård. Here the street was a crucial element in order to create a more extroverted neighborhood. From Arkitema it is the ambition to create an inviting, safe and appealing street full of life, having various meeting spaces and mixed traffic. From our perspective it has been the aim to use lighting design in order to create such a street during the dark hours as well.

We have analysed the street through the social lightscape framework (Slater et al., 2018) with the four social complexities: connections, places, diversity and practices. This method was developed in order to have a social perspective on working with lighting design, which is especially important when working with improving a socially deprived area like Gadehavegård. In our case structuring the analysis after the social complexities gave us insight into several essential viewpoints of Gadehavegård. However at times the method proved to be challenging to apply to our project. As the street has not been built yet and as there will be a big change in the type of residents in Gadehavegård, it created a lack of possibility to involve the everyday users of the street in the process of creating the lighting design. Here the method of using personas was applied in their place. Even though the creation of the six personas could have been founded in more research, they were a helpful tool to view the design with six pairs of different eyes. Despite this we managed to use the concept of social lighting as a stepping stone to investigate the potential life on the street during the dark hours.

One of the most important findings through the analysis was the effect of the light from windows as it became a central element in the development of our lighting design. As explained in the analysis the light from windows has the ability to make a space come to life during the dark hours. It signals other people being around and in this way improves the perceived safety on the street. Furthermore it also increases the sense of community in the neighborhood, as it creates an insight into your neighbor's daily life and habits. Using the light from windows as an element in lighting design is an innovative approach to the topic of safety in the urban space. Here we have found a gap in knowledge which creates great potential for further investigation into the topic, this will be touched upon in 6.3 Future work.

This notion of the light from the windows was carried into the design of the street light in the shape of a window of light being projected onto the ground. This projected window is created with the intention to be dynamic, following the daily rhythm of the lived life in Gadahevgård. In the presented final design the dynamic function is only working with different intensities of light, here we also find

great potential to explore this more in order to create a more rich dynamic effect of the light.

Based on our design concept we developed our design in greater detail through an iterative process. Here we evaluated the design based on overview illustrations, renderings from Enscape and calculations from DIALux. Five evaluation points were made in order to review the iterations in relation to the design criteria. The evaluation points were: main connection point and recognizable character, reflecting the lived life and the community, indicating the spaces for staying and meeting, dynamic street lighting and well balanced light and appropriate light levels. Viewing this method with critical eyes there are a few points to be made.

The process of creating and reviewing each iteration proved to be very slow. It took a lot of time to put the design into the programs (Enscape and DIALux) and to get the result to a state where we were able to do evaluation based upon them. Despite this we managed to get valuable data from the programs. The data from DIALux proved to be especially useful when reviewing if the light level on the street met the requirements.

Furthermore the framework and the evaluation point proved to be problematic when put in relation to each iteration. As there were some iterations where some of the evaluation points were not relevant, and could not be evaluated. Additionally the evaluation points were too broad, reaching towards too many different topics which made it difficult to create a narrative through the iterations that were streamlined. For another time the evaluation points should be decreased into one or two questions instead of five evaluation points with multiple sub questions.

The evaluation method should also be discussed. Despite evaluating the iterations with critical eyes, the evaluations were done with basis in our own opinion and how we see and understand the lighting design. Furthermore, we as designers, work with the intention of creating a lighting design that is successful. Naturally this creates a bias when looking at how reliable the findings from the iterations are. The next natural step would be to include other stakeholders and current and potential residents of Gadehavegård into the evaluation process.

The iterations were done with the aim of realizing the two design criteria. The first one being the criteria in relation to connection and place and the second one in relation to diversity and practices. They are as following:

**Design criteria - connections & places:**
*The lighting design should support the street in being the main connection point of Gadehavegård providing a recognizable, safe and inviting character, through using windows as an luminous element, which emphasizes the lived life and helps the orientation indicating the spaces for staying and meeting.*

**Design criteria - diversity & practices:**
*The lighting design should support people's use of the street by having appropriate and well balanced street light that is dynamic in order to support and reflect the structure of people's daily lives during the various shades of the night.*

The big question is: did we manage to create a lighting design that fulfilled the design criteria? Starting with the first criteria about connection and place. Here it was the aim to use the windows a luminous

element that could improve the experience of the street during the dark hours with a recognizable, safe and inviting character. We managed to create a lighting design where windows were a central feature with both the light from the facades and the light windows projected onto the ground. By this image of a window being present both on the facade and on the ground it will create a recognizable element in the space, hopefully this will also lead to the street being understood as the main connection point of the neighborhood. The light from the windows and the dynamic light in the windows on the ground should also help to increase the feeling of safety when using the street during the dark hours. As this is showcasing the activity and the lived life on and around the street.

For the second design criteria about diversity and practices it was the aim to create a street that was suited for and reflective of the lived life. We managed to create a lighting design that met the required light level from the Danish Standard for a street like the one in Gadehavegård. Additionally we managed to make the light windows dynamic following the four light scenes found through the Shades of the Night framework. However this still has potential to become even more dynamic. We worked with the overall image of the street to have more light in the wider parts of the street, creating the illusion of opening up the street inviting the users to stay and meet.

## 6.2 CONCLUSION

In this project we have engaged with the fields of urban lighting design, social lighting, socially deprived housing (ghetto), safety and iterative design in order to create a lighting design for the new street being established in Gadehavegård.

In the analysis we looked at Akitemas vision for Gadehavegård in relation to the four social complexities, connections, places, diversity and practices. This provided us with an understanding of the street in relation to the surrounding context, the spatial structure of the street and its potentials, the users of the street and their life and activities on the street. In the analysis we investigated the potential of the light from windows. It was found that the light from could increase the perceived safety on the street and the feeling of community. This became a central element in our lighting design. Based on the analysis the following research question were raised:

*How can we use lighting design to enhance the lived life for people walking or socializing in the new connecting street element in Gadehavegård, maintaining a balanced light that creates a pleasant and safe experience of the street for its users?*

In order to answer this, our lighting design was developed through an iterative process, where we went through five iterations of the lighting design. This resulted in a lighting design with various facets.

The light on the street is meeting the required standard for the spaces for motorized traffic and spaces for pedestrians. This is achieved with the light from light poles and additional bollard along the facades where the street is very wide.

The windows that appear in the street, creating a recognizable element and providing the street with identity in the dark hours as well. With the light poles pointing in toward the middle of the street it creates darkness along the facades for the windows to appear in the image of the street. Furthermore the dynamic light windows on the ground are indicating the spaces for staying and meeting through

the street. The dynamic effect in the light windows following the four light scenes are emphasizing and reflecting the level of activity on the street. By implementing the windows (both that facade windows and the light windows on the ground) will increase the perceived safety and the feeling of community on the street.

In conclusion the final lighting design is supporting the functions and elements in the space and enhancing the lived life and the places for socializing. We believe that the lighting design is meeting both our own intentions and is aligning with Arkitemas overall vision for the urban renovation project.

## 6.3 FUTURE WORK

After concluding the project we see that there are some aspects of the project that have great potential to be investigated further.

**Physical testing** - Due to the pandemic it has not been possible to conduct physical testing with participants. While working on the iterations, it was noticed that in the evaluation process there was a lack of knowledge when evaluating, as the way of evaluating the design has only been looked at through our eyes as lighting designers, which has the potential of creating a bias. Potentially, in the further work, we would like to create a physical test with participants involved, to be able to evaluate the perceived safety on the street with the light windows added. This knowledge is very valuable in regard to this new approach of using the light windows element to create safety in the urban environment. Also to be able to explore how the street lighting is being perceived in the pedestrian area, and if the lighting used for creating a dark pocket for strengthening the facade identity is being highlighted.

**Dynamic lighting** - The dynamic feature of the light windows was created to be dynamic, through following the daily rhythm of the people in Gadehavegård, which is only working with different intensities of the light. Here there is a lot of potential for dynamic lighting to be explored in the future, and be able to design a more rich environment through the dynamic effect of the light. We would like to explore the dynamic effect even more. A suggestion could be that each light scene would have their own distinct character to indicate the different shades of the night. A potential solution could be to create a program for each light scene that would have foundation in peoples lighting habits in their homes, within the certain time frame that the light scene is happening in. Potentially this should build up a new remarkable experience of pedestrian paths and create a more rich urban environment.

**Different seasons** - As the lighting design is created for a street in Denmark, where the summer nights are short and the winter nights are long, it is evidently the next step in the process to consider the different seasons. In the lighting design the light windows are being designed to change the intensity of light in regard to the light scenes that are being created for only one season of the year, autumn. This was created for the reason that autumn and spring have similar dynamics in regard to the people's activities. Potentially there could be ways of exploring the other seasons as well, where the light scenes should be revisited and adjusted accordingly, to be able to support the activities of the space in regard to different times of the day during the different seasons. Taking the summer months, as an example,

due to the limited amount of dark hours in Denmark, the light scenes need to be adjusted. As well as in the winter months, due to the long dark hours, the light scenes have to be adjusted.

**Light windows for the community** - Another thing we want to explore in the further work is if people could use the light windows in a different way, that benefits the community. In relation to that this lighting element can be utilized for a communication tool in diverse events and activities of the community of Gadehavegård. With that in mind, this lighting element can become an urban element that belongs and strengthens the community, which is something very valuable when working with social lighting.

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# FIGURE LIST

veg%C3%A5rd
Fig 3.15 own illustration based on 2  Arkitema. (2020). Gadehavegård - Mere gade, mere have, mere gård - Konkurrenceforslag 10453. Retrieved from https://arkitema.com/dk/projekt/gadeha-veg%C3%A5rd
Fig 3.16 Hargrave, J., Lam, F., Luebkeman, C., & Schwendinger, L. (2015). Cities Alive: Rethinking the Shades of Night [Ebook]. London: Arup. Retrieved from https://www.arup.com/perspectives/publications/research/section/cities-alive-rethinking-the-shades-of-night
Fig 3.17 own illustration
Fig 4.1 own illustration
Fig 4.2 own illustration
Fig 4.3 own illustration
Fig 4.4 own illustration
Fig 4.5 own illustration
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Fig 4.18 Focus Lighting. (2021). NYX 330 [Image]. Retrieved from https://www.focus-lighting.dk/produkter/nyx-330/nyx-330-lygte/
Fig 4.19 Focus Lighting. (2021). NYX 330 [Image]. Retrieved from https://www.focus-lighting.dk/produkter/nyx-330/nyx-330-lygte/
Fig 5.1 own illustration
Fig 5.2 own illustration
Fig 5.3 Louis Poulsen. (2021). Flindt Garden Pullert [Image]. Retrieved from https://www.louispoulsen.com/da-dk/catalog/privat/udendoerslamper/flindt-garden-bollard?v=91811-5747402542-01&gclid=Cj0KCQjwhr2FBhDbARIsACjwLo1fdW8ySxZE9V5Esm04zix14wTSmYsJCjfvy99DhujSSNlJ1WsiaTsaAq1PEALw_wcB&t=about
Fig 5.4 Louis Poulsen. (2021). Flindt Garden Pullert [Image]. Retrieved from https://www.louispoulsen.com/da-dk/catalog/privat/udendoerslamper/flindt-garden-bollard?v=91811-5747402542-01&gclid=Cj0KCQjwhr2FBhDbARIsACjwLo1fdW8ySxZE9V5Esm04zix14wTSmYsJCjfvy99DhujSSNlJ1WsiaTsaAq1PEALw_wcB&t=about
Fig 5.5 own illustration
Fig 5.6 own illustration
Fig 5.7 own illustration
Fig 5.8 own illustration