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Abstract: The aim of this master´s thesis is to study the influence of lighting on atmosphere perception in Privately Owned Public Spaces. This new urban typology is often regarded as uninviting or exclusive and for this reason, ends up being underused. Lighting could then be implemented to improve the pedestrian´s perception of P.O.P.S. to encourage them to spend more time in them. For this purpose, a literature review of relevant papers and bibliographical material on P.O.P.S., urban lighting, and urban atmospheres was performed. To get an insight into the state of these spaces, their use, and lighting solutions in the city of Copenhagen, a case study of 3 projects were done using K. Lynch´s theory and the Project for Public Spaces Urban Quality evaluation tool. Finally, a field test on Sund Nature Park was set using discussion groups and atmosphere metrics to evaluate how different light intensities affected the atmosphere perception of this urban space during the night-time. Due to different limitations, despite having results in line with the initial hypothesis and previous research, the results of the test were not conclusive but instead, show how atmospheres and lighting are inherently cultural and social and should always be put into context by incorporating all the involved actors into the design process. As a conclusion of this thesis, from all the collected material a series of recommendations to make P.O.P.S. be perceived as more inviting and inclusive, highlighting the importance of research as well on our professional practice as a continuous process to develop better urban spaces no matter their ownership.

URBAN ATMOSPHERES

PRIVATELY OWNED PUBLIC SPACES

LIGHTING DESIGN MASTER THESIS

MSC LIGHTING DESIGN - AALBORG UNIVERSITY

MARIA FLORENCIA STURLA

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ABSTRACT

This master´s thesis aims to study the influence of lighting on atmosphere perception in Privately Owned Public Spaces. This new urban typology is often regarded as uninviting or exclusive and for this reason, ends up being underused. Lighting could then be implemented to improve the pedestrian´s perception of P.O.P.S. to encourage them to spend more time in them. For this purpose, a literature review of relevant papers and bibliographical material on P.O.P.S., urban lighting, and urban atmospheres was performed. To get an insight into the state of these spaces, their use, and lighting solutions in the city of Copenhagen, a case study of 3 projects were done using K. Lynch´s theory and the Project for Public Spaces Urban Quality evaluation tool. Finally, a field test on Sund Nature Park was set using discussion groups and atmosphere metrics to evaluate how different light intensities affected the atmosphere perception of this urban space during the nighttime. Due to different limitations, despite having results in line with the initial hypothesis and previous research, the results of the test were not conclusive but instead, show how atmospheres and lighting are inherently cultural and social and should always be put into context by incorporating all the involved actors into the design process. As a conclusion of this thesis, from all the collected material a series of recommendations to make P.O.P.S. be perceived as more inviting and inclusive, highlighting the importance of research as well on our professional practice as a continuous process to develop better urban spaces no matter their ownership.

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V. FIELD STUDY

I. INTRODUCTION

The topic for this thesis is based on my 9th-semester project. During it, through a collaboration with SLA architects, I worked on the relation between lighting and urban atmospheres based on a local urban space, Sund Nature Park. Together with this, I explored different methods to learn from the user experience and apply this knowledge to creating more welcoming urban spaces and increasing their use during nighttime.

Sund Nature Park is an urban space located in Nørrebro, Copenhagen. One of the particularities of this park is that it belongs to the University of Copenhagen and the Maersk Foundation, and it was built with the aim of providing a new green area to be enjoyed not only by the university community but by the surrounding neighborhood too.

Despite its initial intentions and the scarcity of green spaces in the neighborhood, as a result of several observations and a throughout analysis, it was evident Sund Nature Park was being underused. This issue is even more noticeable during nighttime when the area became nearly deserted. Following some literature research on the topic, I found that this is a common problematic between this new space typology, known as Privately Owned Public Spaces, which was worth exploring.

Privately owned public spaces or P.O.P.S., is a concept originally proposed to describe the spaces that were born from the floor area bonus system in New York City during the 60s. Nowadays this model has extended all over the world and covers a whole range of nuances between the “public” and “private”. While in theory, P.O.P.S. should create a win-win solution, they are often accused of being perceived as exclusive for a specific group, uninviting and artificial.

While not being the only factor affecting the perception of the space, urban lighting plays an enormous role in the creation of nocturnal atmospheres and in consequence, could contribute to the improvement of P.O.P.S. to make them feel more inclusive and inviting after dark. While P.O.P.S. share some similarities with traditional public spaces, they additionally present individual challenges that have not yet been explored in detail inside the lighting design field.

The methodological approach for this thesis is very much based on M. Hvass´s Ph.D., “Sensing Shared Space in Balanced Lighting”. In her

,Hvass studied the architectural and social potential of light and how brightness levels have an influence on the sensory experience on tram stations by combining ethnographic tools and a phenomenological approach. It is my aspiration to build upon this work, expand her findings to other fields of urban lighting design and gain more knowledge on how we can improve the nighttime experience in our cities beyond the ownership of the space.

I.I. CONTEXT

As mentioned before, lighting design plays a vital role in our urban experiences after dark. This point is particularly relevant in the Danish context where most of these experiences happen in darkness through the winter months. As days get shorter and nights colder and longer, the use of outdoor spaces significantly decreases.[1]

Searching to revert this behavior, cities like Copenhagen, propose different activities and initiatives like the Light Festival to encourage citizens to make full use of the opportunities for exploration that the city offers after nightfall. This event which takes place every February since 2018, is the perfect example of how lighting can transform the urban experience after dark by creating unique atmospheres.[2] With a series of light interventions in different public and private open spaces, light works as a medium to ignite curiosity and wonder that animate people to use and live the city in a different way defying the weather and special circumstances.

One of these was Covid-19 which had a great impact on the way we use urban spaces. Especially during the peak of the pandemic, parks and squares played a key role in helping people feel connected in physically distanced times.[3] With a higher demand for open spaces, private initiatives gained whole new importance as they represent a huge potential of green areas to be enjoyed by citizens. In these terms, lighting design can play a crucial role to help in the integration of privately owned public spaces into the city woven.

I.II. VISION

"Imagine if light could help transform the atmosphere of privately owned public spaces at night"

,As a result of this body of work, I intend to study the possibilities that lighting design offer to affect the perception of urban atmospheres in accessible areas that are not in public hands. This search will be supported by an exploration of specialized literature, the analysis of different case studies, and finally b a field test on Sund Nature Park.

This will result in the end in a series of recommendations/guidelines that can be taken and applied in the whole spectrum that covers from public to private urban spaces. It is worth mentioning that the particular characteristics of each space are an important contributor to the design process, but this thesis does not address a specific space but rather urban spaces with similar properties to the ones described in chapter 5. While designing for a specific site, particular characteristics such as location, users, and social and cultural background need to be addressed to create a successful design. However, there are certain characteristics investigated in this present work that are common to these hybrid spaces and even to traditional public spaces which will be the focus on which the final proposal will be based.

I.III. INITIAL RESEARCH QUESTION

Based on the vision, findings presented in the literature research and case studies together with the outputs this thesis aims to produce, the initial research question that will guide the literature review and case studies is:

"How does lighting affect atmospheres in P.O.P.S. and how can lighting make these spaces inviting for pedestrians?"

II. METHODOLOGY

This section presents a brief description of the approach and methods engaged throughout this thesis with the aim of robustly answering the initial research question.

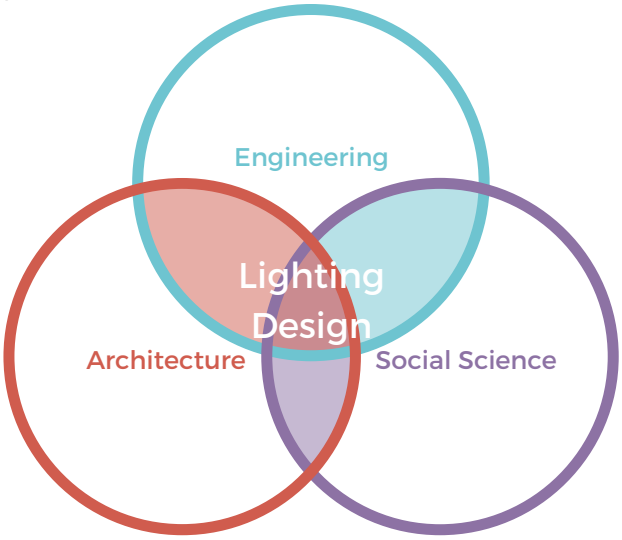


Figure 2.1

Light is a multidimensional design element and because of this, it needs to be approached through different disciplines.[4] For this reason, in this work, I aimed to combine a variety of quantitative and qualitative tools with a strong emphasis on the Social field. While standards and design guidelines are useful in technical matters; when it comes to "soft" issues such as atmosphere perception and user interaction they tend to fall short and cannot reflect the complexity of the light experience.[5]

Without neglecting the other fields, the human experience was at the center of this work and for it, the most logical way to work on it has been a combination between social lighting, phenomenology, and an ethnographic approach. Lighting design must be understood as a major social intervention that impacts people and their ways of life. With this statement as a starting point, social lighting design goes against standardized information and instead, incorporates tools from other fields with the aim to develop site-sensitive designs based on detailed social knowledge.[6]

Hand by hand with this comes ethnography, comprehended as learning about other people's emplacement and experiences through participation in specific practices and environments.[7] Some of the usually ethnographic methods that will be included in this work are [5]:

-Interviews/Group discussions: in situ conversations with individuals or groups searching to raise and explore themes on participants'own terms.

-Observation: watching, listening, experiencing,

and participating in the social scene to learn the implications for the ones involved with the space.

-Photography: to document the relationship between the social and physical, the lighting, and how it changes and affects this relation.

Finally, closing our methodological trilogy, phenomenology is an intrinsic part of lighting design as light is a phenomenon experienced by the senses. According to G. Bohme, this approach studies "the way objects are illuminated to create a specific atmosphere during the sensual, bodily experiencing of the space".[8] Through it, we will explore how light intensity, distribution, and direction can lend a certain atmosphere to an environment.

Based on this methodological approach, the proposed structure for this thesis is:

1. Literature review

Based on the vision and initial research question, three major topics of interest were identified to investigate more in-depth.

1.1 Privately Owned Public Spaces:

What are Privately Owned Public spaces?
What role do Privately Owned Public Spaces play in the Danish context?

1.2 Urban Lighting - Public vs Private:

What is the current role of urban lighting?
What are the differences between Public and Private Lighting?
How do Public and Private Lighting interact in the cityscapes?

1.3 Urban atmospheres

How can we define atmospheres in the city context?
What is the relationship between lighting and the atmospheres?

An extensive list of scientific papers from international journals was discussed together with the work of G. Böhme and M. Hvass as foundations for this chapter.

A full list of the reviewed material is attached at the end of this thesis in the "Bibliography" section.

2.Case Study

Three examples of privately owned public spaces in Copenhagen were chosen to study their relationship with the city, their urban qualities, and the role lighting plays in their experiences after dark. This analysis was based on a macro level on Kevin Lynch´s theory [9] and on a micro level, on the Project or Public Space´s Place Diagram [10].

3.Field Study

To test all the information compiled from the literature review and case studies into a real-life setting, a field test was performed to evaluate how different light intensities can affect the atmosphere perception on a privately owned public space in Copenhagen.

4.Recommendations

Finally, a series of recommendations based on how lighting design can help create more inviting and inclusive privately owned public spaces will be proposed. These suggestions are presented as a flexible framework and should be adapted according to the particularities of each space.

III. LITERATURE REVIEW

III.I PRIVATELY OWNED PUBLIC SPACES

Traditionally cities had a clear distinction between public and private spaces, the public versus the private sphere. In this context, the classic definition of public space refers to the one accessible to all citizens for their use and enjoyment while private spaces are those opened to a group determined by law or custom.[11]

In modern cities, public space´s importance has been recognized as they:

-Serve as a setting for public life, community organization, and activities

-Reinforce the sense of belonging

-Relieve congestion and crowding

By the end of the 20th century with the change from traditional manufacturing economies to service activities, the cities suffered a radical transformation in terms of use of land. Many former productive areas became vacant, and the possibility of adaptive reuse and redevelopment became a reality.[11] For example, harbor areas suddenly became attractive potentials for new public spaces and urban developments that often ended in a gentrification process.

Simultaneously, some city governments started to feel the burden of the provision and maintenance of public space and began to search for ways to relinquish responsibility to other sectors. The most iconic case is the 1961 New York zoning resolution which gave developers benefits such as special permissions to exceed densities regulations in exchange for opening and maintaining new open spaces in the lots. From this experience, J. Kayden forged the term Privately Owned Public Spaces or P.O.P.S., as will be referred to from now on. [12]

Figure 3.1.1 - Domino Park on the old docks in Brooklyn. NYC.

Since the ‘60s, 503 privately owned public spaces have been built in Manhattan under the zoning provisions which evolved and started

including specific requirements such as trees, seating areas, and specific hours of accessibility.[13] Many of these changes were the result of W. Whyte´s work, "The Street Life Project". Whyte was a pioneer in the study of pedestrian behavior and city dynamics. Through observations and film analysis of corporate plazas, small parks and other open spaces contributed to a new way of designing spaces starting from understanding the way people use them.[14]

Despite being born in the United States, the concept of privately owned public spaces quickly spread all over and are not only limited to small plazas under office buildings. For example, the King Cross Estate, one of the most important redevelopment projects in the history of London and the largest open and publicly accessible space, is in fact a Privately Owned Public Space. [15] The mix-uses project covers an area of over 80 acres and includes a variety of plazas, parks, open-air theaters, and markets, becoming an extremely popular destination for locals and tourists. [16]

Even its popularity, for some specialists this new concept has been controversial due to a supposed prioritization of the corporate over the civil character in these spaces and excessive control over uses and activities.[17] In this matter, a paradoxid case was when in 2011 a group of protesters tried to rally in the open space outside the London Stock Exchange in Paternoster Square and were removed by the police on grounds that they were trespassing on private land.[15] Besides this, they often are regarded as over-designed, sterile, and unauthentic, or in other words, a counterfeit of 'real' public spaces. [18]

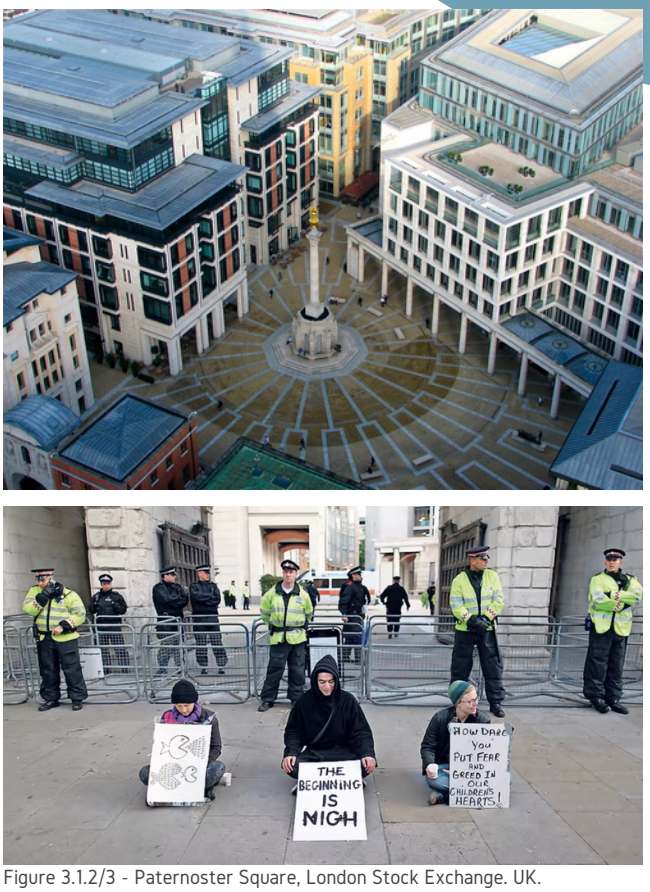


Figure 3.1.2/3 - Paternoster Square, London Stock Exchange. UK.

To understand the real impact of these accusations, we must first define the concept of publicness in the current context. The essence of publicness depends on how users are permitted to experience, evaluate, negotiate, and appropriate the space to meet their own needs. In most cases of POPS, there is no community involvement during the process of planning, development, and design and neither does on the management of the space. There is usually an imposition of restrictions and prohibitions which translates into a lack of freedom and possibilities for its

users. In terms of design, there is a strong emphasis on architecture and physical and visual order that is sometimes perceived as intimidating and as result, invites a limited range of users and uses.

Private spaces do not mean 'bad' and public spaces do not mean 'good'. In fact, it is not the purpose of this work to judge or condemn the existence of P.O.P.S. As active participants in the construction of the city, designers must acknowledge that such spaces are a reality that is present in most of the major cities around the world and in a growing tendency. For such reason, there is a need for tools to secure the grant of access to all and the integration to the city network.

P.O.P.S. in Copenhagen

Compared to the amount of American and British literature on P.O.P.S., the research on the topic in the Nordic context is quite limited. On this matter, S. Bjerkeser and J. Aspen [19] studied the case of the Tjuvholmen waterfront development in Oslo, Norway. They concluded that there are some shared characteristics with the US and UK examples such as closed planning and development process and a lack of diversity of uses and users. But at the same time, control and sanctioning are less strict and aspects such as physical enclosure, inward orientation, and hostile architecture are less frequent in the Nordic context. Reasons for these differences might be based on the Nordic idiosyncrasy and social model against

Figure 3.1.4 - Tjuvholmen waterfront, Oslo.Norway.

the neoliberal policies that ruled the American context since the 1980s.[20]

Since the economic crisis in 2008 in Europe, the construction of public spaces faced economic challenges which translated into public funding cuts. Compared to other cities, Copenhagen kept its interest in public space despite being seriously affected by the economic instability and even made its purpose of creating a more livable city part of the solution. Due to the limited resources, alternative measurements had to be implemented to pursue these goals and the participation of the private sector was of vital importance. But in this case, there was a subtle move away from the state as a direct provider of public space toward collaborative structures where public and private actors join forces to fund and facilitate.[21]

Initiatives like the Urban Nature Strategy for Copenhagen 2015-2025, state as part of its goals to ensure support to private initiatives and to engage in partnerships that will help create more urban nature.[22] Similarly, the

Architecture Policy 2017-2025 aims to impulse the creation of shared spaces and facilities where the design of buildings and urban spaces contributes to city life across the boundaries between public and private.[23]
Through these texts, it is clear that the political ambition of the city of Copenhagen is to develop attractive urban spaces and create more and better possibilities for leisure, working not only as solo but in collaboration with other actors as project organizers, funders, and owners.
To explore some examples of POPS in the city, three case studies will be analyzed and compared in the next chapter.

SECTION TAKE OUT

Nowadays, the production of public space is no longer exclusively a state affair. New formats such as P.O.P.S. are becoming increasingly common everywhere despite cultural, political, and social differences.

Compared to the US/UK model, P.O.P.S. in the Nordic context P.O.P.S. are characterized by:

- Close planning and development process
- Lack of use diversity
- Public initiatives to involve and incentive private actors in a more collaborative way.
- Less common features: strict control over the space, physical enclosure, inward orientation, and hostile architecture.

The inclusion of private interest in the production of public space does not have to necessarily mean poor-quality urban spaces. As active participants in the construction of the city, designers can collaborate on their improvement and integration of such spaces by:

- Giving space for social interaction and community activities and organization.
- Allowing users to take it or give it meaning and definition.
- Developing and testing devices to make these paces safe, accessible, and sociable.
- Collaborate with other actors such as the private sector and governmental authorities.
- Ensuring soft transitions between public and private.
- Designing flexible frameworks rather than a rigid masterplan to secure resilience

III.II URBAN LIGHTING: Public vs. Private

Nowadays, the experience of the city is no longer circumscribed to the sunlight hours. With the advent of electric lighting and its expansion to the streets, humans have colonized the night and a whole range of social and economic activities now take place in our cities after dark. This is especially significant in Danish society, where daylight hours are significantly reduced during the cold months.

Along with this nighttime colonization, the way we understand lighting has changed, and now its wider function in public spaces is recognized. Besides contributing with reassurance and wayfinding, urban lighting enhances the night-time experience, encourages public engagement, and increases the diversity of uses in the space. [5] Lighting can also contribute to the generation of identity and a sense of belonging to a community. In modern cities, the production of the night landscape is subject not only to the public sector. Public and private light interact, juxtapose, and sometimes even clash and as a result, influence this image and identity.[24]

And as lighting can be designed to encourage sociability or to foster a sense of community[25], it can as well be designed to repel and divide. According to G. Savicic and S. Savic [26], unpleasant or hostile (lighting) design are techniques and strategies in urban design where social control is an inherent property of objects or places. It recognizes a desire for a controlled environment and manifests as a "silent agent" to manage behavior based on the relationship between space, design, and social interaction. As the authors explain, hostile design "is characterized by a perverted user-centric approach (...) an anti-user perspective".

A classic example of hostile lighting design is the use of permanent and strong illumination of hallways and corridors in social housing blocks used to deter suspicious or unwanted behavior.[27] Or the use of pink light that enhances teenagers' blemishes to avoid them loitering around parks.[28]

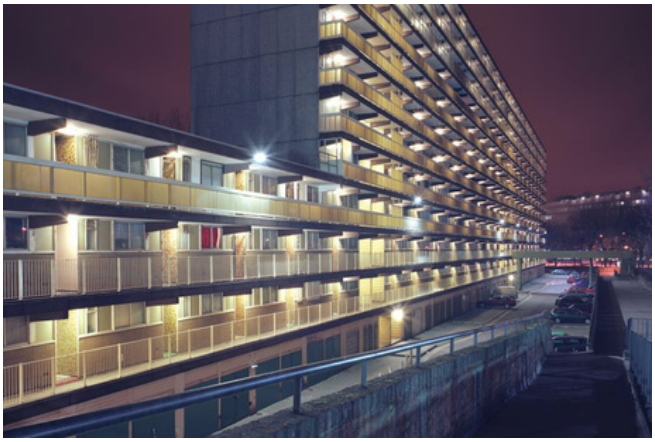


Figure 3.2.1 - State housing South London, UK.

"Public lighting is controlled by a political authority; private lighting is a result of the social and economic activity of the city." [24]

These kinds of measurements are being implemented by the local authorities or by

private actors and very often blurs the limits between public and private. As result, with the aforementioned changes in ownership and management of the public space, often the balance leans into more restrictive and discriminative policies.

As M. Rose describes, “we need to be mindful not just of erasure of space through building but of invisible barriers too”. This can be the absence of street furniture, the impression that you must look a certain way, or an unwelcoming atmosphere created through lighting.[29]

III.III URBAN ATMOSPHERES

As mentioned before, besides its reassuring and wayfinding roles, urban lighting can also contribute to generating atmospheres that attract (or repel) people to experience the city after dark.

According to K. Lynch said, humans built mental maps of the cities to navigate through them.[9] Lynch´s theory is centered around the human experience of the city and as part of this, atmospheres are essential to this. They are a vital part of how users perceive and understand the city. And while the solid world requires a good amount of effort (and money) to be altered, atmospheres are liable to be transformed.[30] Light is one of those elements, not the only one (others: weather, sounds, movement, architecture), in our urban environments that have enormous atmospheric potential, producing changes in the way we perceive and experience spaces.

“Lighting has long been recognized to how urban atmospheres are constituted and experienced. Light is integral to the perception and experience of our surroundings and our sense of ourselves as spatially and socially located.”[31]

Figure 3.3.1- Times Square, NYC.
Figure 3.3.2- Candles in Copenhagen´s windows.

According to G. Bohme, lighting is "perceived as atmosphere because all of what is seen takes on a tint that turns the diversity of what is seen into a unified whole."[32] According to him, atmospheres are perceived by all our senses, affect us emotionally, and have an influence when entering a space or transiting the city. There are many examples of how urban lighting is associated with a particular feeling in cities. For example, the first visual image of NYC that comes to mind is of Times Square with its bright billboards and vibrant spirit. Or in Denmark, the term "hygge", usually translated to English as cozy, is often associated with the soft light of a candle.[33]

Despite its attempts, lighting designers cannot perfectly design atmospheres as even though lighting is a key element in their formation, it is always accompanied by other environmental and socio-cultural elements. Atmospheres are inevitably attached to individual experiences and backgrounds that mold them. They are not universal and are inevitably informed by cultural values and understanding. This is because perception understood as the process of gaining awareness or understanding sensory information is the result of the interplay between past experiences, culture, and interpretation of what is being perceived.[34] All this baggage influences people's response to design, color, and light levels, affecting the production of atmospheres. [30]

Atmospheres are as well collectively produced, and this is especially relevant when we talk about public spaces. The presence of others, sounds, shadows, movement, and our ability or not to perceive their facial expressions can transform an ordinary park into a place of fear and danger or a space of wonder, relaxation, and social exchange.

> "Light is not only about visual perception but is deeply cultural in their indexation of activities or places, … in augmenting the constitution of spatially extended and shared atmospheres."[31]

The effects light has on atmosphere perception have been broadly studied from a variety of approaches and parameters. Conforming to H. Decottes, light can be quantified into six different parameters or principles [35]: (1) Illuminance, (2) Luminance, (3) Height, (4) Density, (5) Direction and Distribution, and (6) Color and Temperature. In relation to each of these parameters, there have been many studies centered on atmosphere perception some of which are listed below.

Illuminance

Illuminance refers to the quantity of light emitted by a light source hitting on a given

surface (lux).[35] Through its nuances from light to darkness, it plays a critical role in our emotional response to a space, reason why its relationship with the atmosphere has been extensively researched.

In the social field, an example of this by R. Baron et al. showed through a lab study that lower lighting levels and warm white light induce a calmer and more relaxed feel which also influences a positive social attitude. [36]

Luminance

As light is perceived through the human eyes when is reflected on surfaces, the concept of illuminance might fall short in explaining the perception process. Luminance intents to explain this phenomenon, quantifying the intensity of emitted light from a given surface (cd/m2).[35] Because of this, this concept is directly linked to the surroundings: materials, surfaces, and colors mold our response to lighting.

Brightness is sometimes confused for luminance, and even though they go together, this last one is related to the subjective sensation the viewer experience while observing. Against brightness comes darkness and their contrast is necessary to discriminate foreground from background, form, and space. They are crucial to establish hierarchy, and orientation and simultaneously, invoke different feelings in the beholder.

In relevance to this, D. Casciani and F. Musante investigating the social effects of lighting found that bright and uniform lighting is associated with safety perception and functionality. On the contrary, dim lighting was associated with a more evocative atmosphere for social inclusion, enhancing conversation and fostering social interaction.[37]

Similarly, M. Hvass et al., found through a lab test on light intensity and brightness ratios, that participants perceived the atmosphere as relaxed and private with low luminance intensities and that the lighting was considered harmonious and less glaring with low luminance ratios between focus area and surroundings. [38]

Height

The relationship between a light source, the ground and ceiling plane, and the human body shapes the perception of the space and its limits.[35] Despite its apparent simplicity, height can be used to control the luminance levels and provoke different senses over the space and atmosphere.

On a primitive level, light from above is associated with the sun while light from below is generally related to dawn and dusk. In terms of human scale, the proximity to light can also be associated with intimacy (a fireplace or a candle) while distance is often linked with publicness (sun).

This has as well expanded to a social construction, as M. Bille explains through ethnographic observations done in a visually impaired person's apartment who despite not being able to sensory experience it by herself, still associates ceiling lighting with more

productive tasks and lower table lamps with relaxation and sociability by a common learned language.[33]

Density

Density is defined by the number of fixtures in the space and how they are arranged. It can be used to create a hierarchy and give visual identity to the space.

In a pilot study on lighting quality to supplement existing illumination, U. Wänström Lindh found out that light patterns resulting from density can give the atmosphere experience of activity and movement. Under connected patterns, the room tends to be perceived as calmer, and coherent light patterns give the space a stronger identity. [39]

Direction and distribution

Distribution refers to the way light spreads over the space. It can be concentrated, where the light is focused on a narrow area, or diffuse where it is dispersed over a wide area. Together with directionality, it can expand or compress the space perception, and accentuate or negate object and form.

J. E. Flynn showed through a study how higher lighting levels and more uniform distribution from overhead lighting are associated with publicness while non-uniform wall lighting distribution with lower levels is associated with relaxation. [40]

Color and temperature

Color temperature defines the visual appearance of white light emitted by a given source (k), ranging from warm hues (red) to cool hues (blue).[35] Color can be used in lighting to intensify the experience of an environment or induce emotions through its psychological effects.

H. Wang et al studied the impact of dynamic color lighting on atmosphere perception through a studio lab. Their findings show that a more saturated light leads to a less tense, more cozy, safe, and lively atmosphere perception.[41] On the other hand, D. Casciani and F. Musante, found that warm lighting was usually linked to the perception of coziness and hospitality while cold white lighting was perceived as more technical.[37]

As seen in the examples listed before, light is usually studied through each of these parameters individually or in pairs due to scientific reasons but actually, they all interact together as one element in molding our perception of the space.

It is as well worth mentioning that no link to the social and cultural background of each study has been made, the reason why the presented findings might be contextual and change in other regions. As mentioned before, when working with atmosphere perception, factors such as cultural and social background have a strong impact on perception.

SECTION TAKE OUT

Atmospheres are a vital part of our experiences in the city after dark. Despite being influenced by many elements, light plays a key role in the generation of urban atmospheres. This influence has been extensively researched but primarily in controlled lab settings that fall short of portraying the complexity of this phenomenon.

III.IV CHAPTER CONCLUSION

Through this chapter, we investigated the characteristics of Privately Owned Public Spaces and the common issues they face such as lack of publicness and feeling exclusive or uninviting. We as well explored the current role of urban lighting and saw how it can model our perception of the spaces; we transit by influencing atmospheres. If the different parameters of lighting can be conjugated with the other factors that take part in this interplay, light could have the potential of transforming the social experience of Privately Owned Public spaces and help in their incorporation to the city.

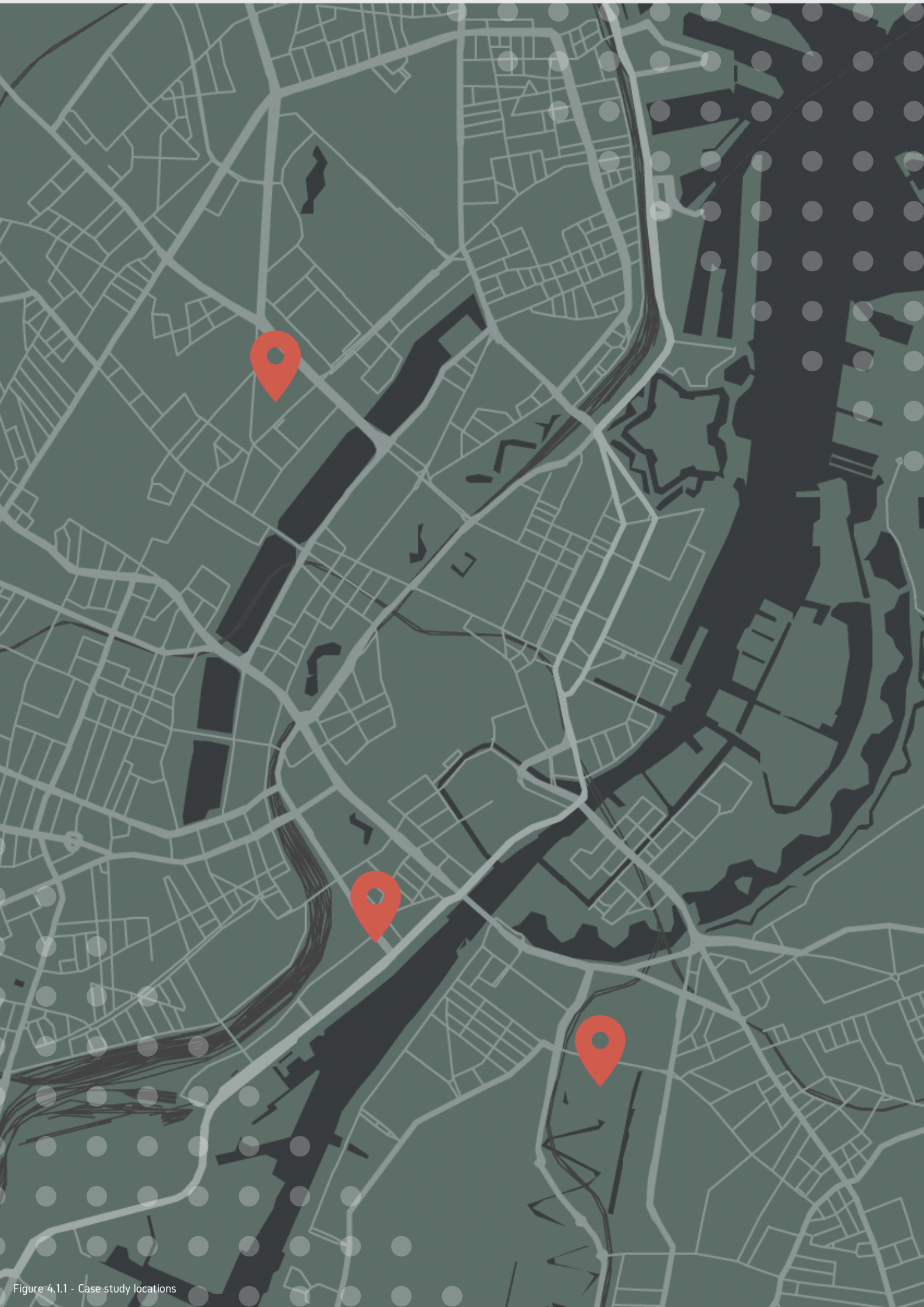


Figure 4.1.1 - Case study locations

IV. CASE STUDY

To learn about different Privately Owned Public Spaces in the city of Copenhagen, three case studies have been analyzed. The three spaces were observed during daytime and after dark searching to understand their use and significance throughout the day and the role lighting plays in each of them.

IV.I CASE STUDY METHODOLOGY

For this purpose, the cases of Karen Blixen Plads, The City Dune, and Sund Nature Park were selected based on location, use, and lighting solution. For the analysis, two methods were used: one founded on the relationship between the space and the surrounding city based on K. Lynch [9], and the second, on a smaller scale and based on the Project for Public Spaces framework.[10]

Kevin Lynch was one of the pioneers in introducing the concept of individual's perception into the field of urban planning. In his book, "The image of the city" [9] he explains how people orient themselves in the city through the construction of mental maps. These mental maps consist of five elements:

- Nodes: strategic focus points for orientation,
- Districts: areas characterized by common characteristics
- Landmarks: external points of orientation, usually an easily identifiable physical object in the urban landscape.
- Paths: routes along which people move throughout the city
- Edges: boundaries and breaks in continuity

The importance of having a clear mental map of the city is that it gives people a sense of emotional security, works as a framework for communication and conceptual organization, and elevates the everyday experience. As designers, understanding this mental map of the city will get us an insight into how people perceive, inhabit, and transit the urban landscape.

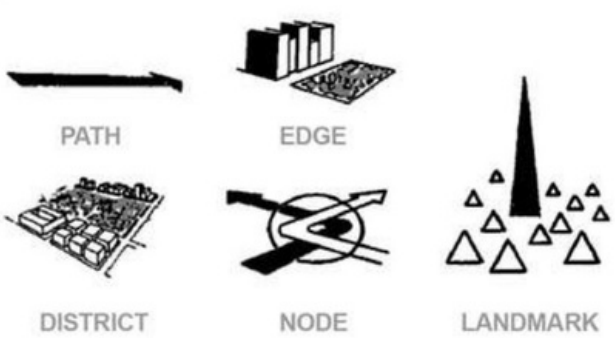


Figure 4.1.2- Kevin Lynch´s city elements

As already mentioned, the second part of the analysis is built upon the Project for Public Spaces framework, "What makes a successful place?"[10]. Developed as a result of the evaluation of thousands of projects, the Place diagram is a tool to judge the space based on four qualities:

- Access and linkages: linked to the visual and physical connections to the space.
- Comfort and Image: includes the perception of safety, cleanliness, and availability of seating areas.
- Uses and Activities: they are the reason why people attend to the space and what makes the place unique and special.
- Sociability: when the place fosters different types of social activities which creates a stronger sense of place and attachment to the community.

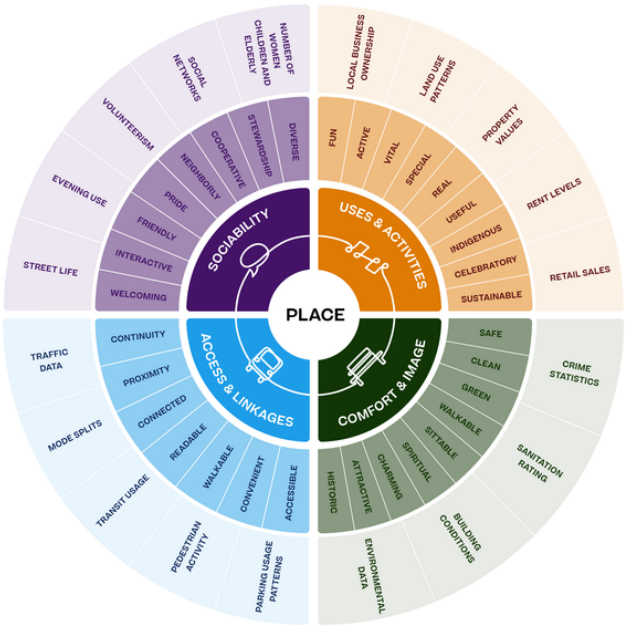


Figure 4.1.3- Project for Public Spaces framework

This toolkit was chosen because it takes a step further and involves studying more in detail the spatial characteristics of each case but still doing it from a perceptual point of view, understanding perception as a medium between physical features and behavior.

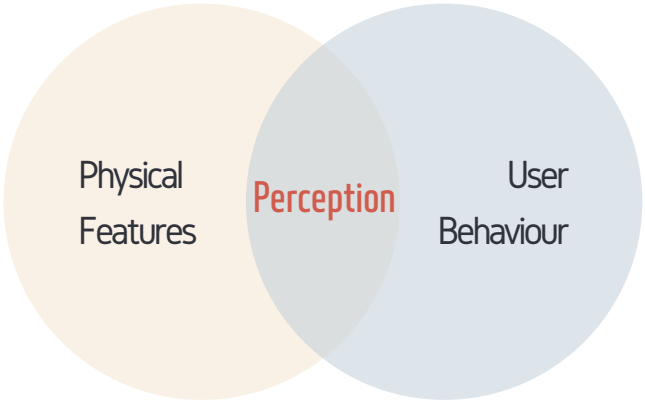


Figure 4.1.4

The evaluation of these four qualities was done for each space both during the day and nighttime to study how the proposed lighting affected the perception of the space. For this reason, the luminous environment was evaluated through a series of tools and techniques including observation, illuminance, and luminance mapping. Together with these, tracing maps were registered in each space for periods of 30 minutes on a weekday at 7 pm during springtime searching for links between user movement and lighting.

IV.II KAREN BLIXENS PLADS UNIVERSITY OF COPENHAGEN SOUTH CAMPUS

Karen Blixens Plads was finished in the year 2019 as part of the Copenhagen University South Campus. Designed by the Danish architectural firm COBE, it was proposed as the new heart of the campus, connecting the three main entrances to the university campus as well as providing a recreational space for the students, professors, and neighboring community.[42]

Its unique design proposes three hills that provide sitting areas and the much-needed space to park thousands of bikes. They break the flat landscape and give a very distinct and recognizable image that people instantly associate with the University of Copenhagen. Especially during the summertime, they serve as well as a scenario for multiple activities at all times of the day such as open concerts, demonstrations, and public talks. These hills also work as a shield to the sometimes quite strong winds that come from Amager Faelled Park and the organic green shapes that seamlessly penetrate the space create a transition between these two open spaces.[43]

The space limits are well defined, on three sides delimited by the university buildings and on the fourth by Amager Faelled. There is no direct connection between the square and the street, giving pedestrians and bicycles total priority. This is directly related to the human scale as well, all the elements in the space collaborate in this matter and are in balance with the human proportions

In terms of transparency, the surrounding building presents glass facades that allow passersby to perceive human activity behind the walls. Finally, the complexity of the space can be considered quite high as well, based on its architectural and landscaping design and the availability of street furniture like seating areas, tables, lighting fixtures, and greenery.

From K. Lynch´s perspective, the space works as a node, connecting the main entrances to the university campus and becoming a point from where users can easily orientate themselves in different directions. In a way, it works as a landmark as well due to its particular geography which can be recognized from the distance and constitutes a focal point from the surroundings.

This is particularly evident during nighttime when the bicycle hills are lit from within giving

Figure 4.2.1/2- Karen Blixen Plads by day and night

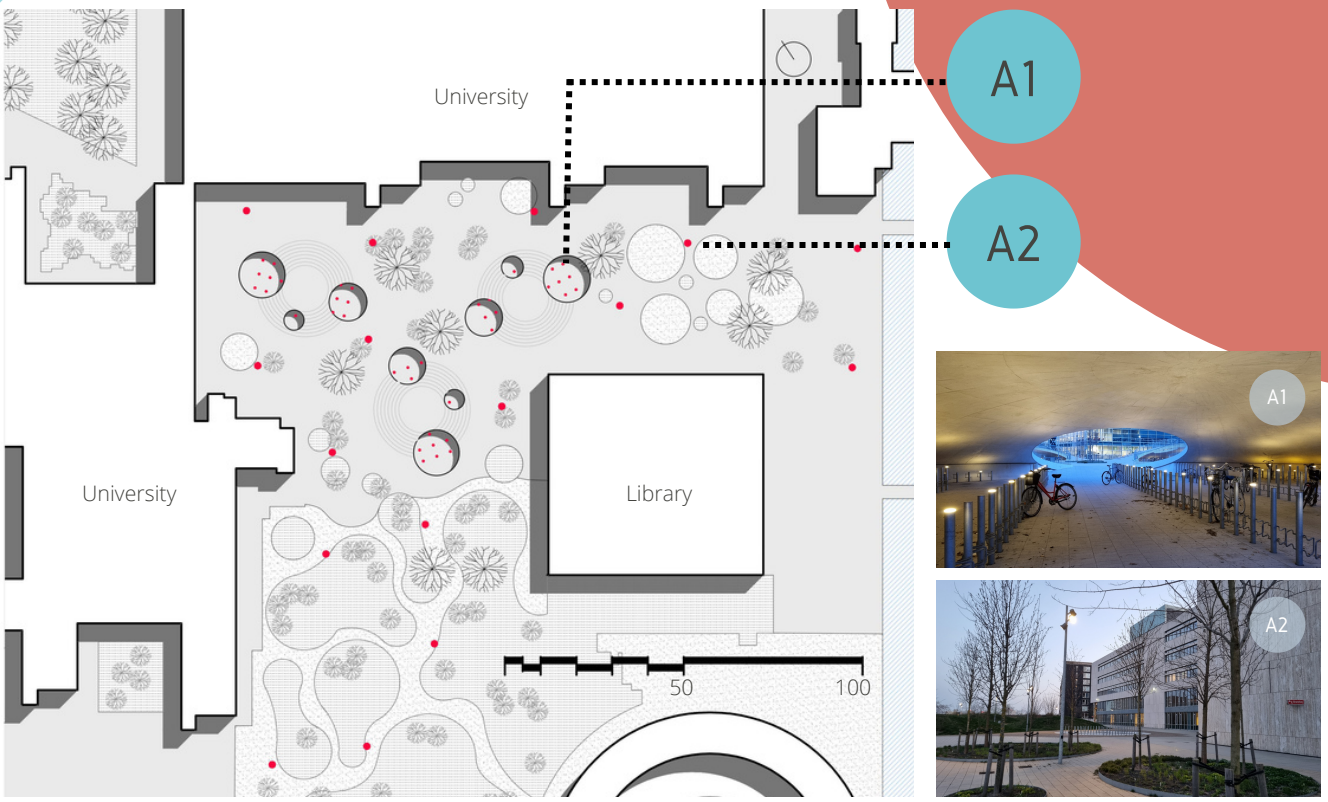


Figure 4.2.3- Karen Blixen Plads fixtures floorplan

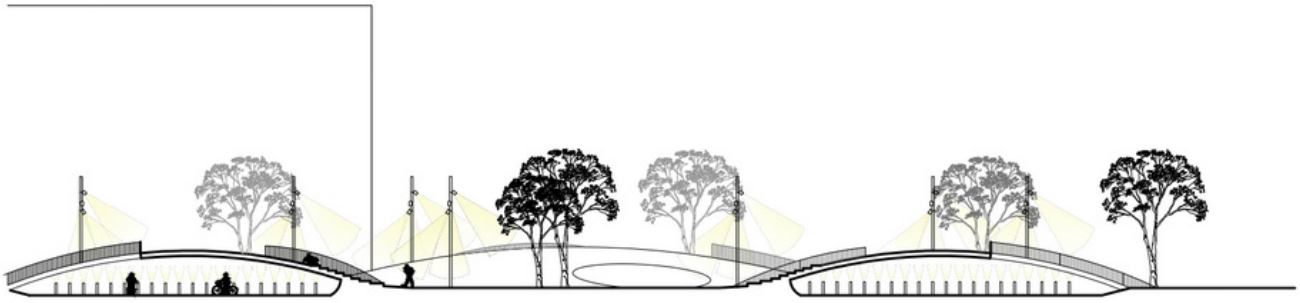


Figure 4.2.4- Karen Blixen Plads section

This is particularly evident during nighttime when the bicycle hills are lit from within giving Karen Blixens Plads a warm and safe atmosphere in the dark.[42] The domes are lightened from within with upward bollards that signalize the way and project over the ceiling, enhancing their shape and texture and giving the space a church-like spirit. These bollards, specifically designed for this project, work as well as bike racks maximizing their use.

The rest of the lighting in the space is supported by mast pole lighting. In terms of their density and distribution, it is interesting to note how the number of poles decreases towards Amager Faelled Park repeating the soft transition between the private and public while preserving the natural flora and fauna.

Despite being mostly used by the university's community, probably because of its location, the space has a continuous flow of people even during nighttime. Most of the activities observed after dark were dynamic, such as biking and walking but a good amount of people opted for static activities as well such

as groups of youngsters gathered playing music under the domes and others relaxing over the steps.

The apparent level of appropriation by its users is very limited. The space is extremely well kept, and nothing seems intervened or out of place. In spite of this, no signs of control were visible and students seemed to enjoy lots of liberty in the use of the space protected under the soft lighting.

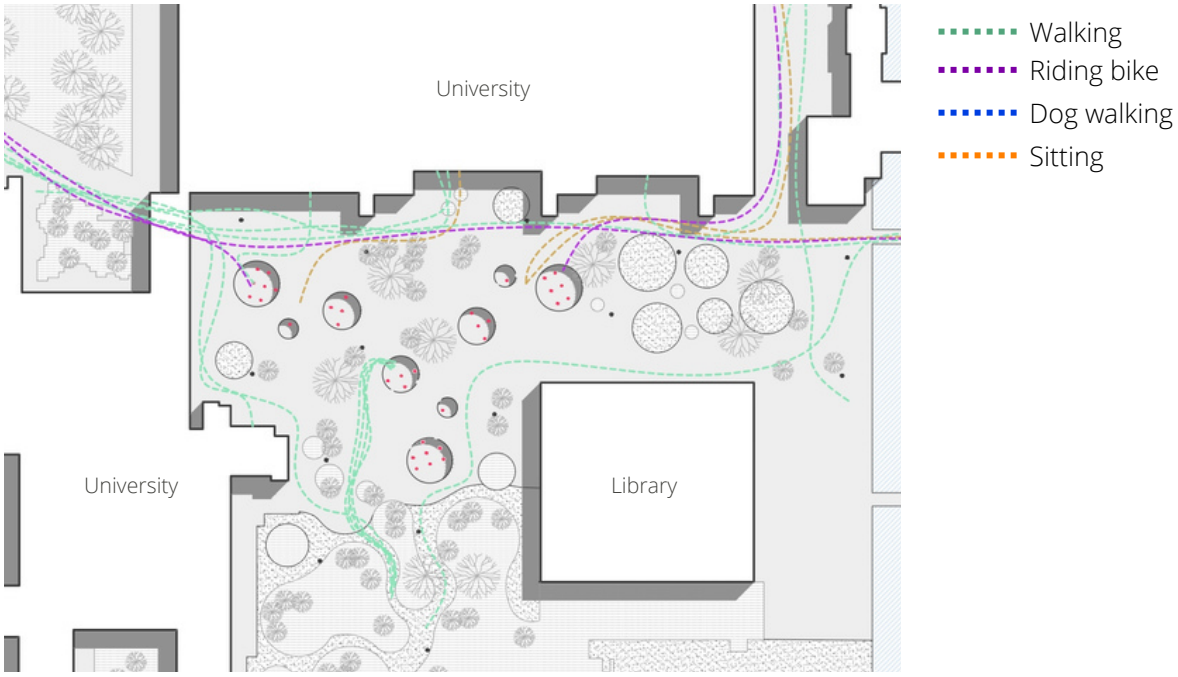


Figure 4.2.5- Karen Blixen Plads tracing floorplan

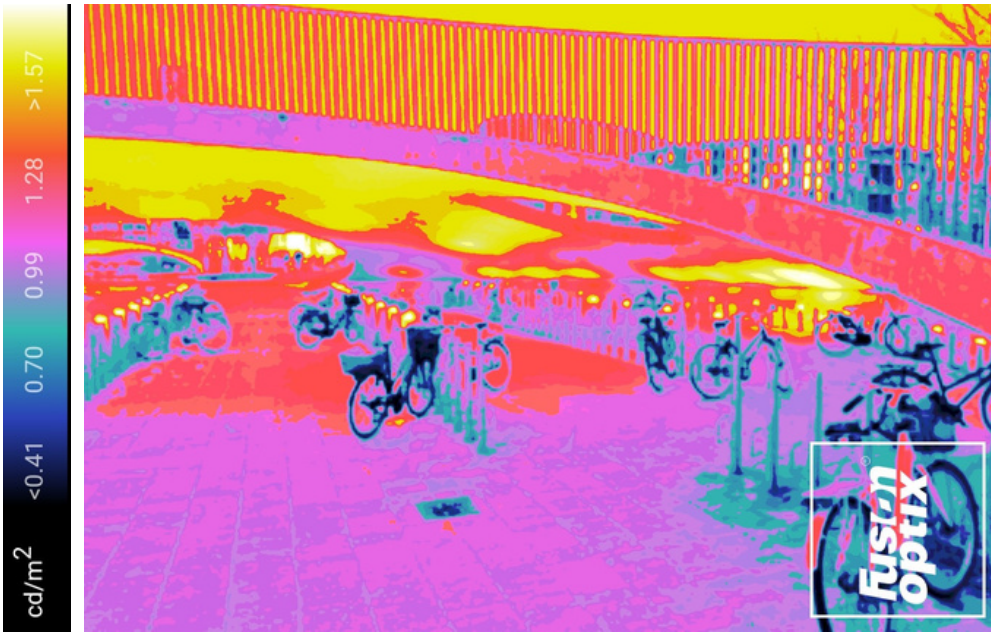


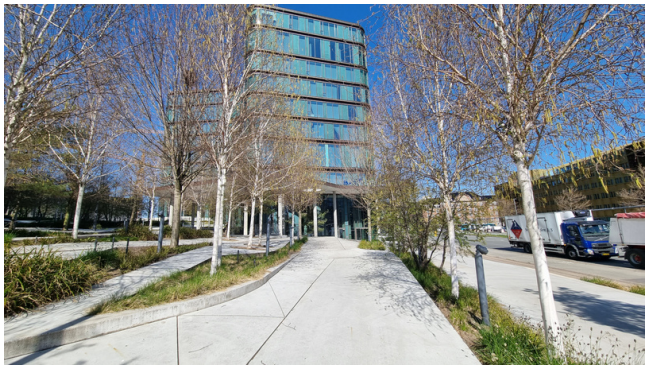
Figure 4.2.6- Luminance map - Taken April 2022 20:47hs

IV.III THE CITY DUNE / SBE BANK

The City Dune is a privately owned public space located close to the Kalvebod Brygge area, Copenhagen. When in 2005, the SEB bank decided to establish its Danish headquarters, the project envisioned two towers standing on the borders of a square parcel. This typology left free an important area of land which was resolved to be opened to the city creating a new urban space.

Kalvebod Brygge used to be part of the city port but the process of deindustrialization by the end of the 20th century left the area vacant and full of abandoned factory infrastructure. With the passing of the years, the character of the area was transformed, and new buildings took the vacant spaces leaving public space aside. The result was an area where cars were put in the center while pedestrians and cyclists faced difficulties transiting through. [44] The SEB building and City Dune as part of it, came then as a solution to improve the quality of the neighborhood and at the same time, enhance the corporate image of the company behind it. According to the project memory, “the City Dune is a welcoming space for employees and the local citizens to enjoy”. [45]

The new square consists of a series of concrete ramps at different levels which allows rain draining and collection, create an underground parking space for the facilities, and simultaneously, connect the project creating a green corridor through three neighboring building complexes. The limits of the space are clearly defined by the two L-shaped towers. Despite having a direct connection with the street, the possibility of crossing the space and continuing to the other buildings is not visible from the street and only people familiar with it, mostly bank employees, took the path in an upward direction.



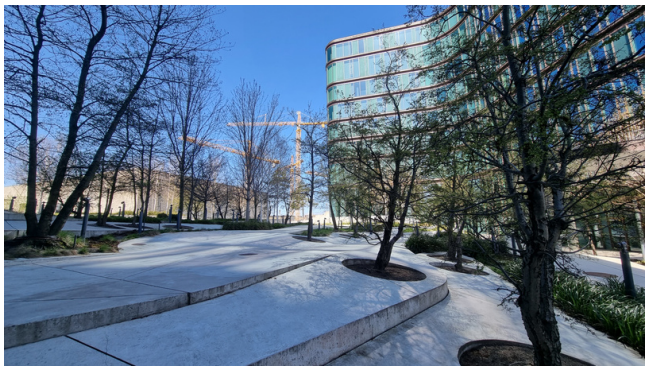
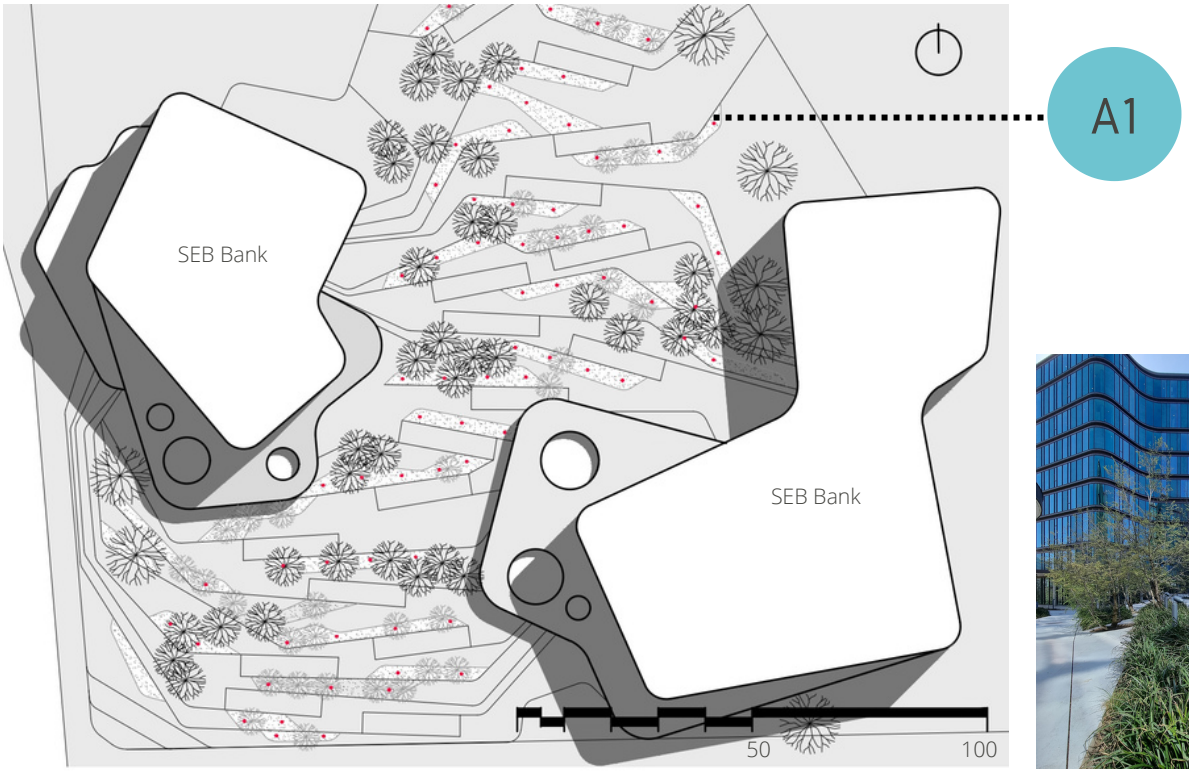


Figure 4.3.1- The City Dune by day

In this sense, from K. Lynch´s theory point of view, this space presents a challenge in its relation to the surrounding city. Looking at its floorplan it could be assumed at first look that it is a path but as stated before, from the pedestrian point of view from the street the wayfinding is not as clear, and unless familiar

with the area, most of the walkers just opt to continue their way through its borders. To a degree, it is possible to classify it as a node connecting the two SEB buildings and the surrounding complexes but again, this function is only identifiable mainly by those who work for the bank. The same logic could be applied to the other categories.

This lack of identification reflects the problems with this space. Despite its democratic and sustainable intentions, the result is inward-looking, and more than an urban space it functions as an accessible garden where bank workers can enjoy their break with no real connection to the city woven.



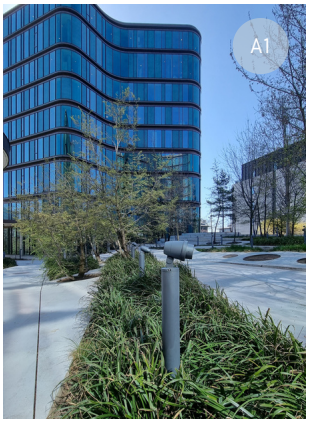


Figure 4.3.2- City Dune fixtures floorplan

Figure 4.3.3- The City Dune section

Figure 4.3.4- The City Dune by day

Observations supported this, showing a limited range of activities during daytime which declined even more after dark. Due to the lack of retail activities in the area, the circulation of people is low and aggravated by the availability of more attractive urban spaces for the public nearby. The nighttime users are mainly young couples looking to be out of the spotlight and cyclist enjoying their descent through the slope. The lighting hosts people looking for a more secluded space or that are simple passersby, influencing their perception and serving basic functions. The lights coming from more than 70 bollards help orientate through the space while creating a cozy and intimate atmosphere. The fixtures present a rather varied selection of angles, some of which are pointing directly to the face when one transits the space upwards causing an unpleasant glare effect. The illumination of the space is supported as well by masts lighting that cast shadows from the trees enhancing the sense of protection under a canopy.

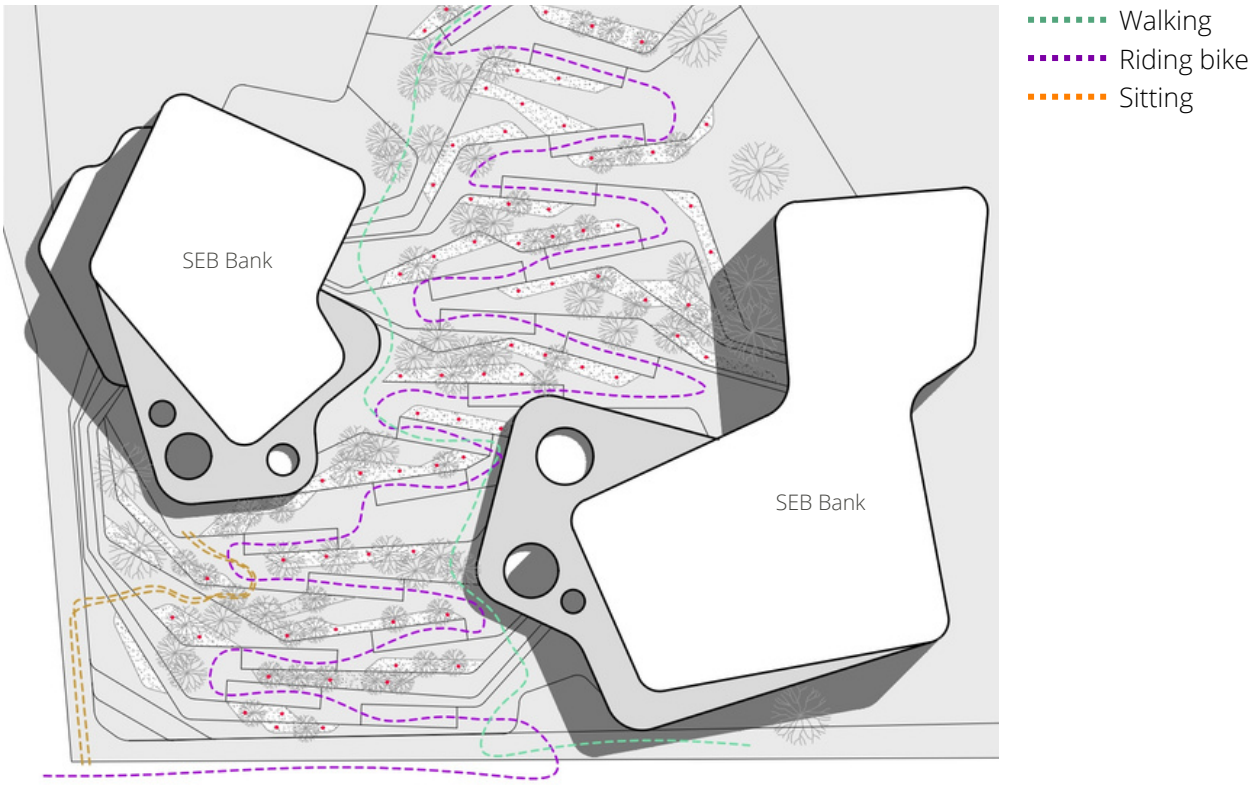


Figure 4.3.5- The City Dune tracing floorplan

Luminance maps were taken using the Fusion Optix app to translate light into a graphic form of spatial expression for analytical comparison. [5] Through this, it can be seen some of the problematic bollards that cause glare effect.

The City Dune is a good example of the complex relationship between atmospheres and attendance and use of the space. Despite some problems, during nighttime, the perception when transiting the square is relaxing and intimate. But because of other factors such as its location, urban typology, and connections, it ends up being underused.

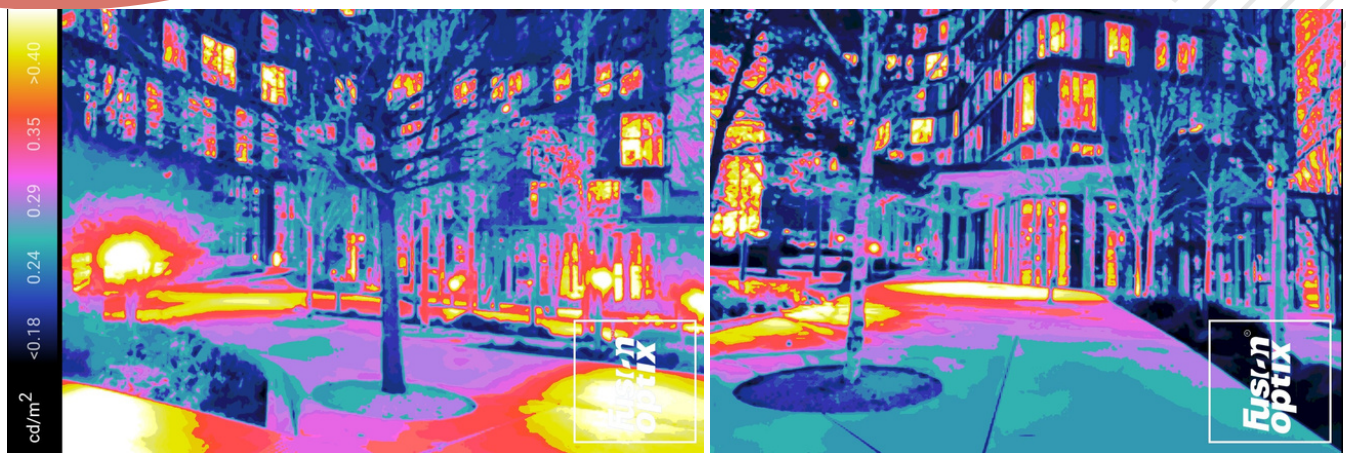


Figure 4.3.6- Luminance map - Taken April 2022 21:30hs

IV.IV SUND NATURE PARK / PANUM INSTITUTE

Nørrebro is one of the most densely populated neighborhoods in central Copenhagen. It is also known for its cultural mixture together with its lack of green areas. [46] In an attempt to reduce this gap, the project for an extension of Panum Institute decided to adopt a tower typology and dedicate its free surface to opening a new Privately Owned Public Space. Sund Nature Park, designed by SLA Architects, searched to provide not only a good setting for students and university researchers but become part of the everyday life of its neighboring community who seeks contact with nature.[47]

When approaching the space from the street, the element that instantly catches attention is The Good Detour, a 300m long bicycle and pedestrian bridge that connects both sides of the complex and offers a high view of the park and neighborhood. Back on the terrain, the park contains a variety of native and exotic trees and plants with an aim to amplify the sensorial experience and make it more resilient and adaptable to climate change. For this purpose, the whole complex is designed to collect rainwater to use for irrigation and in toilets.

Figure 4.4.1- Sund Nature Park by day

The lighting of the space is resolved using mast pole lighting along its main path, leaving the borders with only indirect lighting from the surroundings. The bridge is illuminated with a horizontal LED strip that accompanies its trajectory through and over the park, inviting users to its crossing. In terms of urban furniture, the space counts with two main seating areas, one in the middle of the park through a linear concrete bench and the other next to the university building with a set of wooden benches.

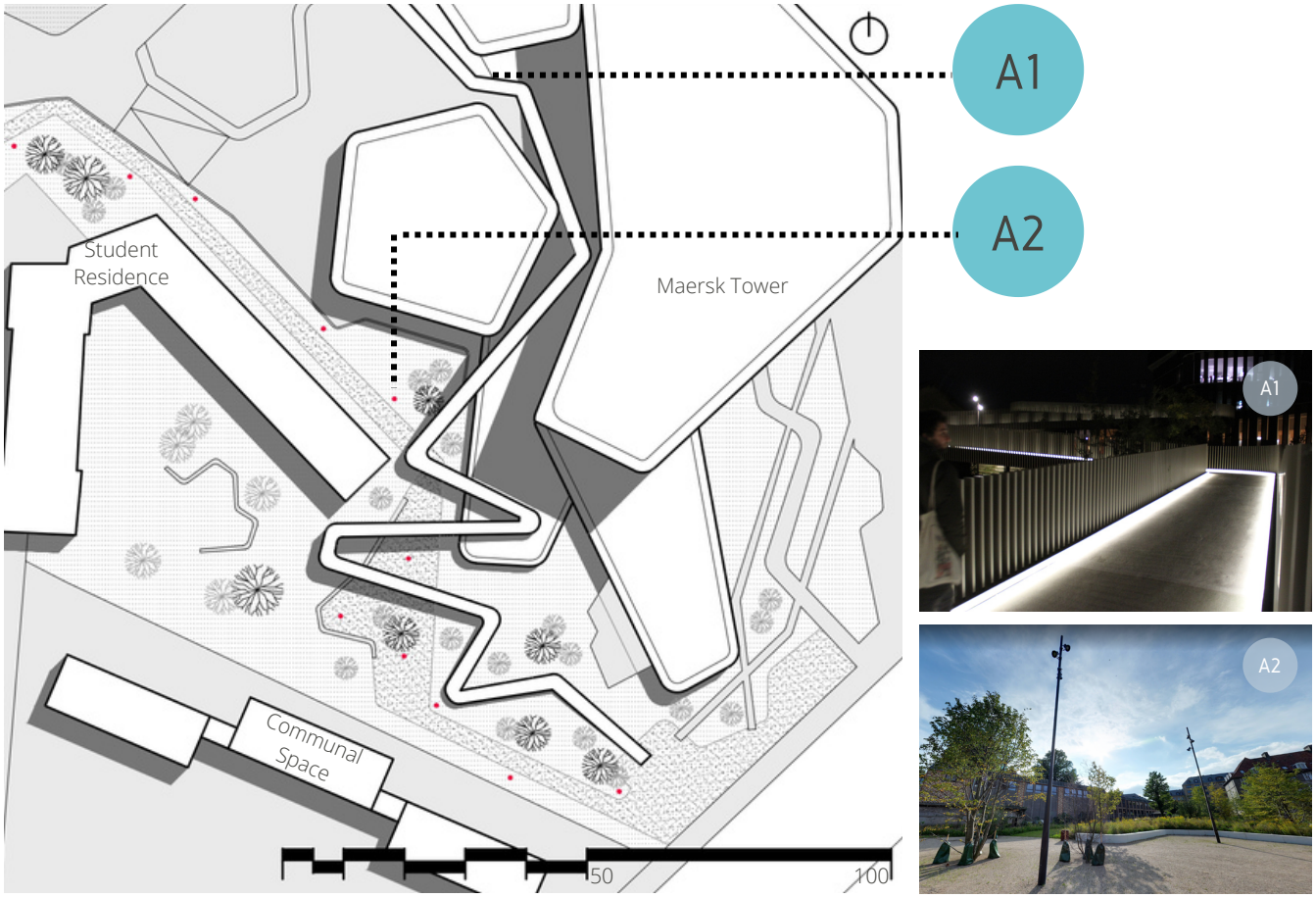


Figure 4.4.2- Sund Park fixtures floorplan

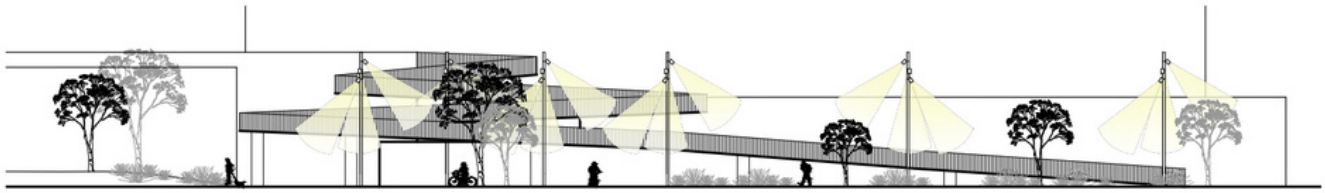


Figure 4.4.3- Sund Park section

During daytime, numerous groups of young people enjoy the sun and fresh air, especially in the last-mentioned area where the picnic tables are. Users engage in a variety of necessary and optional activities from morning to dusk. But this vibrant and young scene dramatically changes after dark as observations showed. Only necessary activities were observed during nighttime, such as dog walking, biking, or walking through on the way back home. An online survey done last year as part of the LiD9 Semester project reflected this behavior as well. It consisted of questions about visiting habits, safety, and atmosphere perception to get insight into how people use and sense the space and what situations they identify as problematic.

The answers showed that most of the people (36,8%) usually visit the space once per week while an important group (21,2%) did it every day. The most frequented times of the day were morning and afternoon (29,4% and 41,2% respectively) while only a small portion (11.8%) goes during nighttime. It is interesting to note as well that a significant majority only pass by (78,9%) and do not stay in the park. When asked about what activities usually bring users to the space, the most common answers were dog walking, cycling through the bridge, and running.

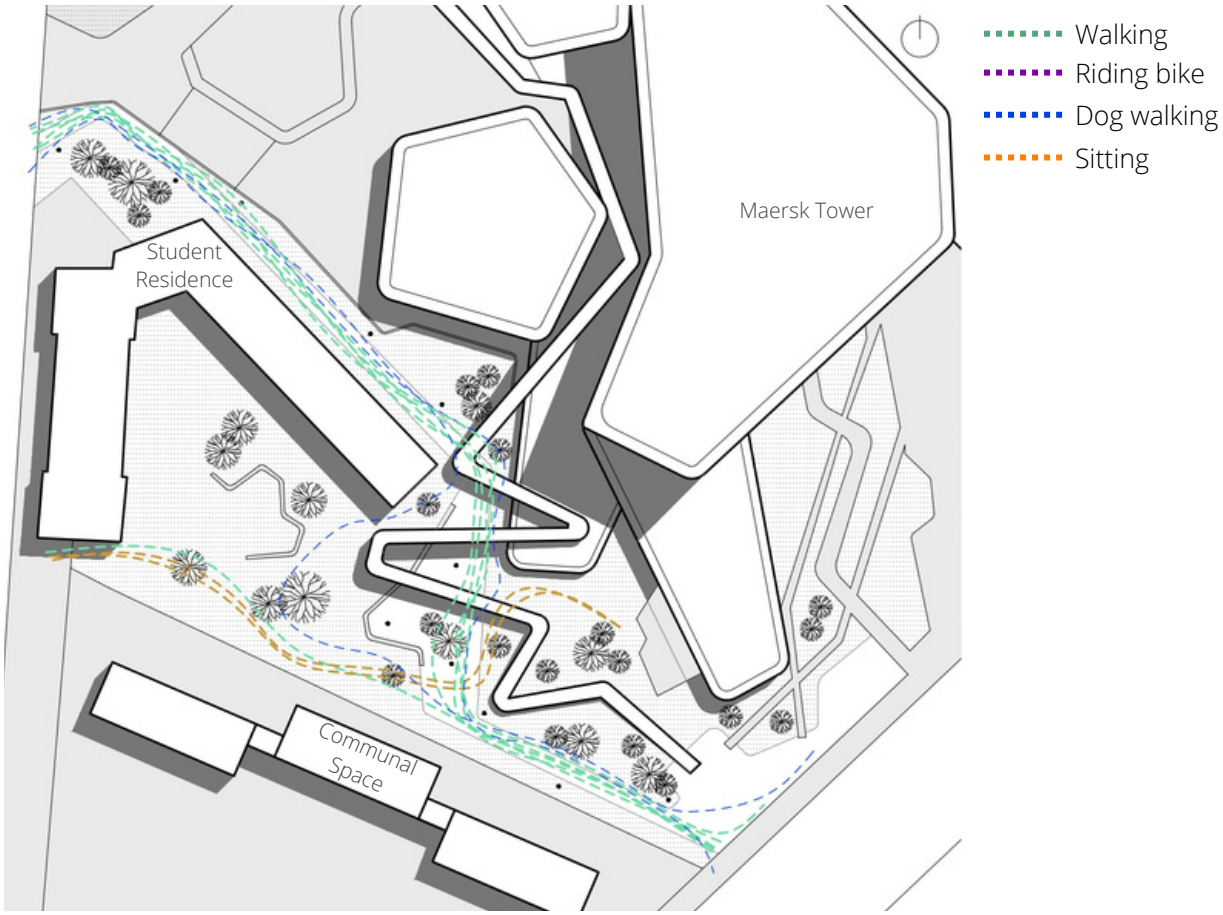


Figure 4.4.4- Sund Park tracing floorplan

Route patterns were analyzed through tracing and it could be observed that pedestrian behavior was directly related to the fixtures' disposition in the space. On only one occasion during the observations, it was observed people sitting in the picnic tables where there is no direct lighting. Most of the pedestrian transit through the park goes along the main path signalized by the overhead lighting. Bicycles and families with children usually opted for the bridge path probably attracted by its design. People, in general, did not linger in the park after dark. The lack of attractive seats with strong overhead lighting does not encourage relaxed sitting.

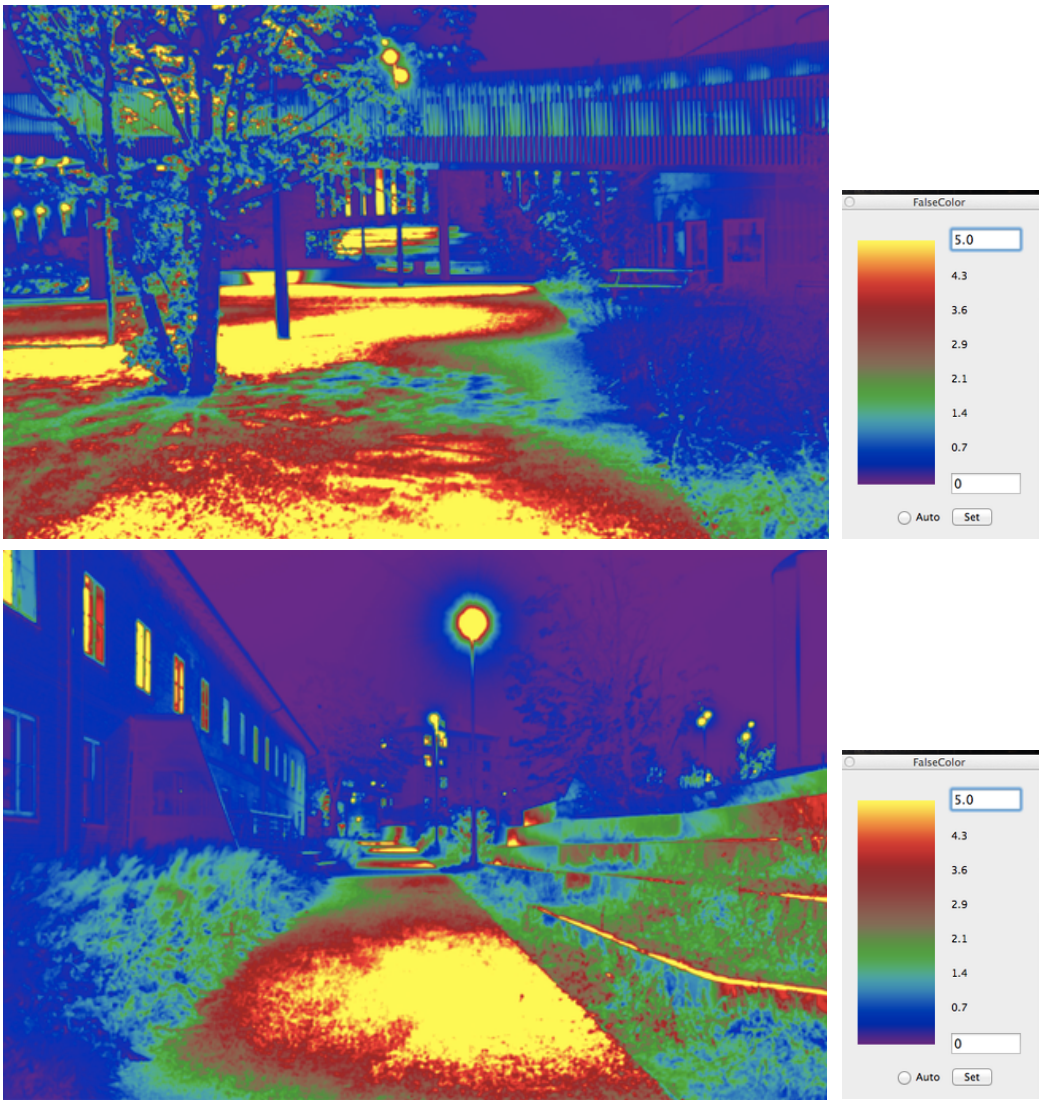


Figure 4.4.5 - Luminance maps

IV.V URBAN DESIGN QUALITIES

Based on the Project for Public Spaces [10], an evaluation of the attributes of the three case studies was made. This diagram developed to assess the quality of urban spaces evaluates four attributes that make a great place: sociability, use and activities, comfort and image, and access and linkages.[5]The table shows the information recorded about the three analyzed spaces and shows their attributes based on a series of yes and no questions based on observations aiming to understand how spatial attributes and lighting influence activities and behavior in each case.

	Statement	The City Dune	Karen Blixen Plads	Sund Park
Use and Activities	People are meeting each other in the space	YES	YES	NO
	People are interacting with one another	NO	YES	NO
	People bring their friends and relatives to see the place	NO	NO	NO
	People stay in the space for prolonged periods	NO	YES	NO
Sociability	There are choices of things to do	NO	NO	NO
	Many different activities are occurring	NO	YES	NO
	People of different ages use the space	NO	NO	YES
	People passing by are drawn into the space/stop at the space	NO	YES	NO
Comfort and Image	There is security presence/the area feels safe	YES	YES	YES
	There are enough places to sit and the seats are conveniently located	NO	YES	NO
	The space makes a good first impression	YES	YES	NO
Access and Linkages	People use a variety of transport options to reach the space	YES	YES	YES
	The space functions for people with special needs	YES	YES	YES
	The pavements lead to and from the adjacent areas and people can easily walk to the place	YES	YES	NO
	There is a good connection between the space and the adjacent buildings, and the occupants of the adjacent buildings use the space	YES	YES	YES
	The space can be seen from a distance, the interior is visible from the outside	YES	YES	NO
RESULTS		8/16	13/16	5/16

Figure 4.5.1- Urban design qualities comparison

For this purpose, the spaces were visited during weekdays when activity was at its peak and around the same time and similar weather conditions for comparability.

Karen Blixen Plads indicated a yes in 13 of the statements in the table, inferring that it rates high in use and activities, comfort and image and access and linkages, and moderate on sociability. The City Dune indicates a yes to 8 of the questions, with high rates in access and linkage, moderate on comfort and image, and low on sociability and uses and activities.

Finally, Sund Park got a yes in 5 of the 16 statements with moderate results in access and linkage and low in all the other categories.
These values match our movement and activity observations through mapping and tracing showing how these six factors are mutually reinforcing and contribute to the lighting design in creating an engaging urban nocturnal atmosphere in privately owned public spaces. Even though many factors like location and available activities, can affect the success of a space, these qualities without a good lighting design will prove insufficient.
If we linked these categories with the lighting solutions proposed for each space, it can be derived that spaces with lower levels and indirect lighting rates are higher in comfort and sociability in accordance with what was exposed previously in the literature review. This conclusion although, should not be generalized as results may differ in other privately owned public spaces not included in this work.

IV.VI ANALYSIS CONCLUSIONS

The analysis of these three cases on Privately Owned spaces in the city of Copenhagen, illustrates how lighting plays a major role in determining the use of these spaces. They show a wide diversity in form and function and a variety in lighting.
Lighting is not the only determinant factor in making a place inviting or not, but it can be a key complement to these environments.

"Nighttime design and lighting can make a public space more accessible, attractive and sociable by night while adding to the positive daytime reputation and image of that (public) space"(35)

CASE STUDY TAKE OUT:

- The urban quality and perception of Privately Owned Public Spaces in Copenhagen are very variable.
- The lack of human scale and imageability are the most frequent issues in this kind of space.
- There are no signs of user appropriation in any of the three cases analyzed.
- Lighting has a great influence on the space quality after dark although it is not the only determinant factor in the use of the space.
- Unique design elements work as important attractors to the space, by night particularly when light accompanies the design.
- Lighting changes the perception from daytime to nighttime, in some cases for better and in others for worse.

V. FIELD STUDY

Taking all the previously presented information from the analysis and literature research, a field test was performed on Sund Park to evaluate the change in atmosphere perception of the space under different lighting conditions and learn how designers can obtain and apply this knowledge to create more inviting and inclusive Privately Owned Public Spaces during nighttime.

V.I TEST INTRODUCTION

As shown in the literature review, one common problem with P.O.P.S is that they are often perceived as private or uninviting to stay and for this motive, they end up being underused. In times when cities are growing at a fast pace and the need for green areas is more urgent than ever, especially after the COVID19 pandemic, making the most of urban spaces should be on every city´s agenda.

Sund Nature Park as exposed before, located in one of the less green areas of the city is a perfect example of this. It is an urban space with enormous potential but for different reasons, it is not being used at its most, and as many users expressed, it is often seen as private or uninviting.

This study was done thanks to the collaboration of SLA Architects and in particular, Lisbeth Dam Kørner. Through their contact, the Panum Institute kindly agreed on lowering the light levels under our request in order to make this test possible. It was the studio´s desire to take this opportunity to revisit a past project, do a post-evaluation and learn through research how to improve it for future works.

V.II RESEARCH QUESTION

How do different illuminance levels affect the perception of the atmosphere in Sund Nature Park and how can these findings support a transformation of the place to become more inviting to people and an inclusive part of the urban surroundings?

If lighting has the potential to change the atmosphere of the space, it could be used as a tool to create a more inviting and inclusive atmosphere that encourages users to access and spend more time in the space.
According to the Collins dictionary, "inviting" can be defined as a place that has qualities that attract or make people want to experience it. [48] As for "Inclusive", it refers to the space that allows all kinds of people to feel a sense of belonging, rather than just for a few.[49]

UNINVITING > INVITING > COZY
PRIVATE > PUBLIC/INCLUSIVE > LIVELY

As seen in previous chapters, studies on public space show that a livelier atmosphere is usually linked to public space and works as an invitation to the space while a more relaxed and cozy feeling is usually associated with spaces for relaxation and socialization. Most of these studies were done under controlled laboratory conditions "where the complex, spatial, mobile, affective and sensorial context in which we usually experience light cannot be addressed".[50]

V.III TEST HYPOTHESIS

On Atmosphere Metrics [51], I. Vogels established through extensive research four categories to describe the atmosphere of a space: coziness, tenseness, detachment, and liveliness. From previous research presented before it can be deduced that:

- The atmosphere is perceived as livelier when the illuminance (or Luminance) levels are higher
- The atmosphere is perceived as more relaxed and cozier when the illuminance (or Luminance) levels are lower

In "Social life of small urban spaces"[52], W. Whyte shows how the connection with the street is the most important area in a public space. It is the one that attracts people into the space but "ideally, the transition should be such that it is hard to tell where one ends (Street) and the other begins (Urban space)". For this reason, it was decided to propose a higher luminous intensity at the entrance of the park to attract people by creating a livelier atmosphere and progressively dim it towards the center where the sitting area is located to create a cozy and relaxed atmosphere that encourages users to linger in the park.

V.IV METHOD

Ethnography has classically applied the act of walking while observing and asking questions as a research tool. But as Sarah Pink proposes in her book "Doing Sensory Ethnography" [53], this paradigm should be rethought. Researchers need to study behavior not only from a visual perspective which usually dominates the practice but by embodying the experience and using all senses as a route to knowledge as well.

"The idea of walking with others, sharing their step, style, and rhythm creates an affinity, empathy, or sense of belonging with them. Walking with others enables us to access elements of their sensory experiences of the world that might otherwise not be available to us."[53]

For this reason, for this test it was decided to use a combined methodology of commented walks and focus groups, creating a semi-structured discussion with test participants. In this scenario, participants were invited to walk together and experience the space with the researcher whose main function was to work as a moderator and activator of the discussion through a series of questions. This approach is very much in line with the work of L. Schwendinger and her light walks who uses it as a tool to engage with users and collectively create a new vision for lighting different areas. [54]

According to S. Sumartojo et al., this combination of "emplaced sensing, feeling and analytical knowing is a well-suited approach to investigating atmospheres due to their difficult to describe qualities". [31] As mentioned before, atmospheres are always subject to individual experiences and backgrounds, therefore the best way to investigate and understand them is to be immersed rather than regarding them from the distance.[31]

Despite the focus of the test being atmospheres, it can represent a challenge to talk about it specially for people outside the field. Apart from it, the sensory experience cannot be separated from the visual, so the questions were posed regarding more general aspects of the spaces instead of focusing specifically on the lighting and atmospheric aspects of the spaces. Activities, cultural struggles, and feelings are all linked together as part of the experience of the space.

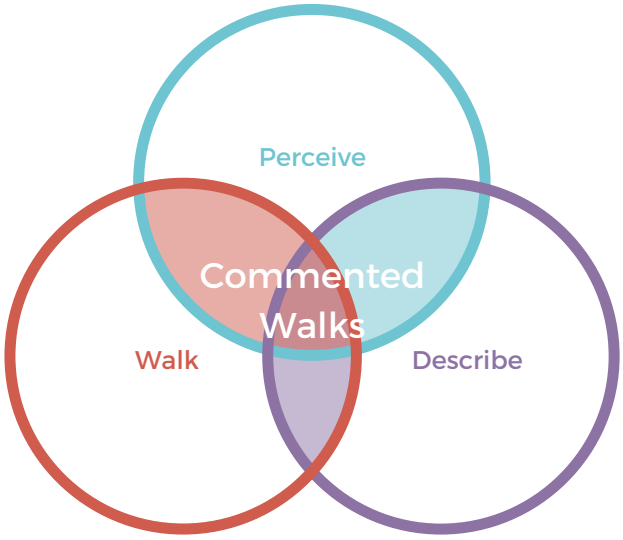


Figure 5.4..1

Traditionally, focus groups involve small groups of people summoned to discuss a particular topic where a moderator poses questions and records the conversation for later transcription and analysis.[55] As with any method that involves interaction, it has its benefits and potential concerns which are listed in table 5.4.2.

Focus Groups	
Benefits	Concerns
• Quick and efficient method to gather individual information in a group context.	• Problematic silence: participants dont share their opinions or information with the group
• Reduce the experimental demand as the research can fade into the background and let participants control the discussion	• Problematic speech: participants share opinions that do not represent their true belief or experiences. Bias or contamination.
• High external validity as they mirror the kind of conversations participants have in daily basis.	

Figure 5.4.2

Addressing these concerns, author J. Hollander [56] explains that the anonymity of a group can encourage people to give more candid answers. Participants may find a group context more comfortable than one on one interviews as they are not obliged to answer all the questions.

In terms of problematic speech or the fear that the answers may be biased by the presence of others, from the social constructionist perspective individual do not have stable attitudes or opinions. These ideas are constructed from the interaction. So, in other words, conformity, group thinking, and social desirability pressures do not bias the results instead, they are data as they reflect everyday interactions.[56]

Similarly, arguments about focus groups being artificially formed for the researcher´s purpose and that in consequence, produce contrived speech, while interviews or observation produce a more "natural" speech are common. However, all research situations are a way of social interaction and even observations are subject to dynamic contextual influences.[56]

To better understand the individuals'experiences, multiple data collection can be applied. Participants can for example complete a survey before or after the group discussion. Because they are confidential there is less chance, that they are linked to the group pressures.

In conclusion, all participants in the group were considered not as independent of each other and the collected data was analyzed from the social context from which it was collected. As a triangulation method, a final individual and written questionnaire were done to help untangle participants' responses and their relationship with the social context of the group.

V.V PARTICIPANTS

For the test, 12 people (8 men and 4 women) volunteered to participate. They were recruited from the university and through different groups on social media. Most of them were between 27 and 33 years old, students and workers from diverse nationalities. Before performing the test, all participants declared they did not suffer any condition that affect their eyesight.

V.VI EXPERIMENTAL DESIGN AND SET-UP

The study was carried out in Sund Nature Park, Copenhagen in spring (22nd and 23rd of March

2022, 4-7 degrees centigrade, clear sky) between 19.30 and 20.30hs (sunset at approximately 18.27hs). The study was set on the lower path of the park where most of the users walk every day based on previous observations of the space.

The installed fixtures included DALI system which allowed them to be easily tuned as desired. For this purpose, the central path´s mast poles were grouped into 4 light zones and each of these gradually dimmed from the Blegdamsvej into the interior of the park as shown on figure XX.

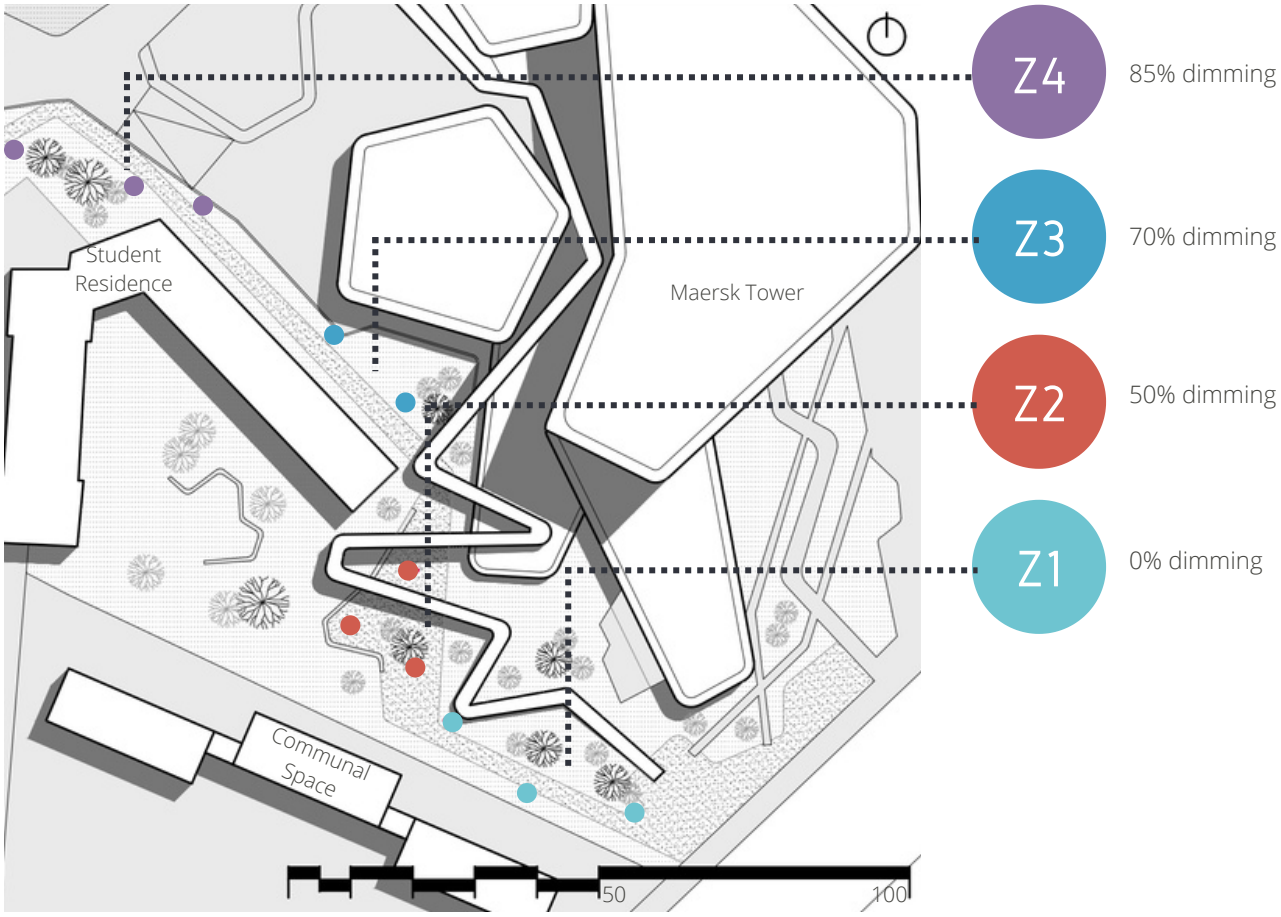


Figure 5.6.1- Sund Park test floorplan

To document and better understand the light distribution of the lighting proposal through the participant's eyes, HDR photos and Luminance maps created from them are presented in figure XX. HDR (high dynamic range) images allow capturing the horizontal illuminance and vertical luminance levels creating more comprehensive and informative pictures of how the space is perceived. [5]

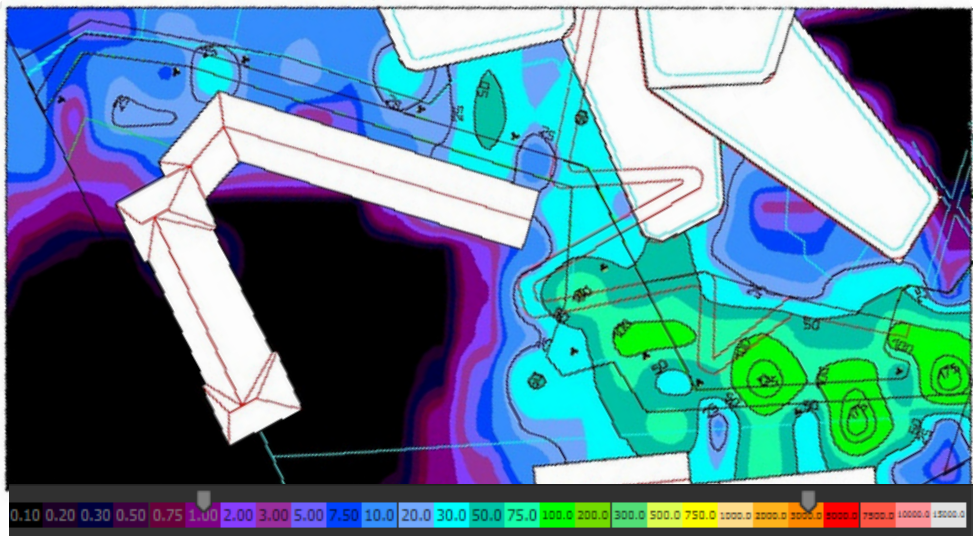
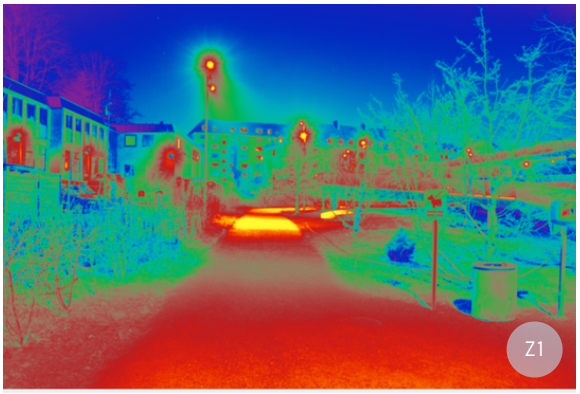
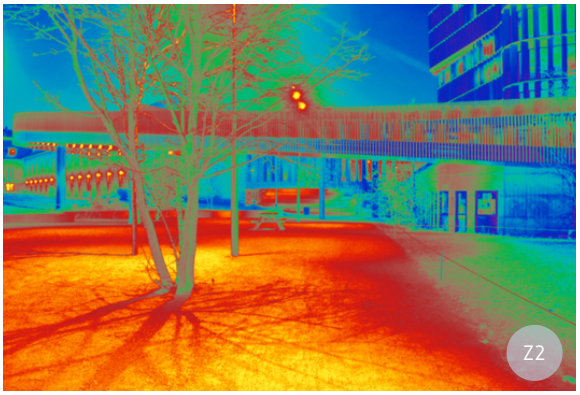
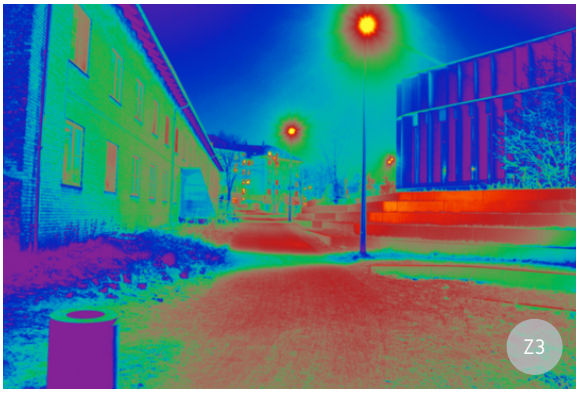


Figure 5.6.2- Sund Park test luminance map







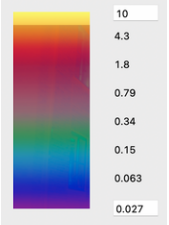


Figure 5.6.3- Sund Park test luminance maps

V.VII PROCEDURE

The participants were divided into two different groups, each of which gather at the designated meeting point at the entrance of the Panum Complex. In the companionship of the moderator/researcher, they were scored to the entrance of the park where a small introduction of the procedure was presented and permission to record the conversation was solicited. From this point, participants were invited to start transiting the space while asking the first question to encourage the discussion. The same procedure was repeated through the whole walk of the park and finally, returning through the bridge to get some final comments from an aerial perspective of the space.

Ultimately, an individual written questionnaire was completed by participants where they were asked to associate words from a list with the different areas of the park. The list consisted of 25 words based on I. Vogels' work [51] on Atmosphere metrics and the possibility that the participant added more.

Figure 5.7.1

V.VIII RESULTS

Group Discussion

The recorded answers were analyzed through a

The recorded answers were analyzed through a traditional coding method of four steps: organizing the collected data, recognizing, coding patterns, and interpreting.[57] In both groups, the discussion focused on the invitingness perception of the space together with recurrent comments on safety perception and orientation.

Due to the progressive change in lighting levels, most of the participants did not notice the lowering levels until the very end when asked. Most of the participants did not know the space and agreed that from the street they did not previously recognize it as a publicly accessible area. “I thought it was private, from the university. I mean, that you cannot walk through.” Another participant added, “It is very hidden, very inside. It feels like it is something only for the building, it doesn’t invite you to enter”.

In terms of sitting areas, two sectors were recognized by participants, zone 2 and 3. Referring to zone 2 (dimmed 50%), one participant referred “I would sit in the open space in the middle. Because of how it is illuminated and delimited.”. Zone 3 (dimmed 70%), on the other hand, was referred to as not inviting, “There are areas to sit here but they are not inviting”, “I feel it private so I don't realize I can sit there”.

This pattern was repeated when walking toward the interior of the park. On it, a user commented they felt as if walking into the heart of a city block. Because of the proximity of the windows from the surrounding buildings, they felt observed as intruders. The consensus about the lighting is on zone 3 and 4 was it was too dark and that the space limits were not well defined which made them feel unsure about where they could walk and not. “It's like a blind hallway, nothing calls my attention. Not even the lights invite me to enter”.

In general terms, participants said they usually do not transit or stay in spaces after dark or if they do, they prefer more open spaces or close to the water. There was a strong association between night and unsafety perception that affected people’s decision to go to open spaces at nighttime. This was particularly mentioned while transiting zone 3 and 4, “under the bridge, it seems like some is going to get killed or robbed.”

Even though the lighting in the bridge was not altered for the test, it is worth mentioning some of the comments received by participants. Most of them expressed they felt curious or attracted to the bridge and expressly referred to the way it was illuminated. “If I see something that makes me curious, I would like to come and see where it takes me, maybe if there was a light like the one on the railing of the bridge indicating direction it would be very different.”

Despite not being considered in the setting of the test either, some participants referred to the CCT of the lighting as well. “I felt that the light was also very cold, it doesn't invite you to stay. It makes me feel it's only to cut through.”

Individual evaluations of the atmosphere

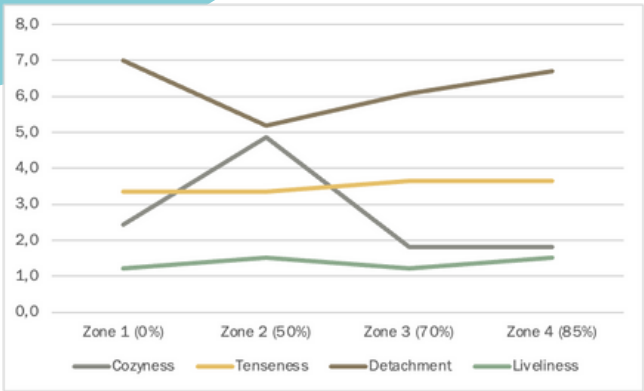


Figure 5.8.1- Atmosphere categories rated per zone

As part of the analysis, it could be seen the most frequent words found in the answers were depressive and relaxing, followed up by private. Based on I. Vogels´ Atmosphere metrics, each of the 25 listed words was classified under the four categories used to describe atmosphere: Coziness, Liveliness, Tenseness, and Detachment. The average overall ratings in each of the categories are shown in Figure 5.8.1. It was observed that Coziness peaked in Zone 2 where there was a 50% dimming from the original setup. After that point, the values decreased dramatically. Inversely, Detachment was rated the lowest for the same setting validating the previous results. As for the other two categories, Liveliness and Tenseness, the values were constant for all the proposed scenes.

V.IX DISCUSSION AND TEST CONCLUSION

This test centered on exploring the light and atmosphere perception at Sund Nature Park under different light intensities. Its purpose was to investigate how different levels of light and darkness impact the feeling of publicness and invitingness not in a controlled environment like in previous examples but in a real-life setting where many factors come into account.

From previous research, it was derived that atmospheres in urban spaces are perceived as livelier when the illuminance levels are higher and on the other hand, as more relaxed and cozier with lower illuminances. It was also the aim of this test, to link these concepts with the notions of publicness and private perception.

From the group discussion, it could be concluded that the sense of publicness vs private is directly linked with luminous intensity. Users express in general that the areas with lower light were perceived as more private and intrusive. The light position also influenced the answers on this aspect, participants expressed that they prefer low over overhead lighting as it gave them a sense of curiosity and attention that draw them to the space, but this aspect was not included in the experimental set up further studies should be done to obtain more conclusive data.

After reviewing the answers to the group discussion and written questionnaire, it can be inferred that the initial hypothesis linking high intensity with liveliness was proven and that this atmosphere category is directly linked with

the perception of “public/ness” while lower light intensities are perceived as “private”. As for the second hypothesis, lower light intensities were considered more relaxed and cozier until a certain point (50% dimmed) but at lower levels, the perception of tenseness increased.

Finally, despite not being formally included in the test set, during the group discussions participants mentioned other light parameters as influential on their experience of the space. High CCT was mentioned as less inviting than warm light and low light positioned was mentioned as well as more attractive and intriguing than overhead lighting. Although these aspects cannot be concluded from the present test, they match previous research on the topic as mentioned chapters before.

V.X LIMITATIONS

Despite the results being in line with the hypothesis, limitations in terms of nationalities and cultural background of the participants might have biased the results and for this reason, it is advised to explore further on this topic with a higher sample. As well due to the limited number of participants, conclusions based on age and sex could not be inducted and might be worth further exploration as part of future work.

Repeating the test at different times of the year will also be advisable as variations in weather conditions can influence the perception of the space.

VI. RECOMMENDATIONS

As a result of all the information presented through this body of work, a series of recommendations are proposed below. The purpose of these suggestions is to offer some scientifically and empirically proven guidance on the design of urban lighting for Privately Owned Public Spaces to make them perceived as more inclusive and inviting.

It is important to highlight that this framework is intended to be buildable and adaptable according to the space demands and characteristics. It is imperative as well to work in collaboration with all the involved parts and in a multidisciplinary approach to create successful urban spaces.

For clearer organization, these recommendations have been grouped under three different categories that accompany the three pillars of this thesis. These three pillars combined will offer a more holistic and resilient solution.

Light

- Adaptability: making use of the available technologies, a lighting design that is flexible and dynamic will be able to adapt to different circumstances and needs and be more resilient and sustainable to the past of time. It is good practice as well to revisit past projects and learn through research how to improve them.
- Human Scale: considering the human measurements and proportions when designing with light helps create a more welcoming perception and relaxing atmosphere that invites pedestrians to stay. Low lights can collaborate with this perception especially if combined with high luminance surfaces that avoid creating shadows on faces that might affect recognition.
- Soft borders and smooth transitions: generate soft borders and smooth transitions by avoiding high contrast that could cause glare and tunnel effect not allowing views of the surroundings, causing a tense atmosphere.
- Non-uniform: While respecting soft transitions, non-uniform lighting is recommended as combining different light intensities in the same space can help create different atmospheres. High illuminances are associated with publicness

Lower illuminances, on the contrary, are perceived as cozier and more relaxed and could help create areas for people to stay. The ideal levels should be studied in detail according to the space needs, user´s cultural and social background, and space´s activities.

- Orientation: Lighting on privately owned public spaces should provide orientation through the space, inviting to enter and guiding people through it to generate a sense of publicness and invitation.

Social

- Participation: Involve all potential users in the development of the project from the first stages of the design. Incorporating the potential users into the project can give an insight into the necessities, preferences, and other particularities. This will help achieve designs that better cater to their needs and generate a sense of community and inclusion despite the space ownership.
- Appropriation: Directly linked with the previous point, allowing a certain degree of appropriation as a distinct characteristic of public spaces can be a tool to generate a sense of collectiveness and belonging.
- Non-hostile design: as active participants in the construction of the city, lighting designers need to abandon intentional or not hostile practices and undertake an ethical and living approach to create healthy and inclusive urban spaces leaving aside their ownership.

Space

- Government collaboration: Make use of the tools governments offer to improve the design of privately owned public spaces and ensure their integration into the city. Simultaneously, designers can contribute to the development of new public tools to guide and adjust the lighting in such spaces as well.
- Designer commitment: revisit and analyze past projects to evaluate their effects on the space and possibilities to be improved for present and future works.
- Private compromise: All the previously stated recommendations should be accompanied by the collaboration of the private sector. As intermediaries, lighting designers can contribute to this by sharing their knowledge and generating awareness of the benefits this approach can bring to private companies and cities.

VII. CONCLUSION

This thesis was born intending to shed some light on the relation between urban atmospheres and lighting based on a relatively new urban typology, Privately Owned Public Spaces as a means of improving urban environments that are often perceived as exclusive or uninviting.

For this purpose, the initial research question that guided this search was:

How does lighting affect atmospheres in P.O.P.S. and how can lighting make these spaces inviting for pedestrians?

To answer this inquiry, a three-step approach was pursued consisting of:

1- An evaluation of relevant literature was reviewed to bring knowledge on what are the common characteristics and usual criticisms of Privately Owned Public Spaces. Together with this, the present-day role of lighting in the city and its links with the concepts of publicness vs private and atmospheres in the urban realm were explored.

2-An analysis of three case studies in Copenhagen was pursued to investigate more in detail the current state of P.O.P.S. in our context, their use, and lighting situation.

3-A field study based on Sund Nature Park was set up to explore the impact of light on the perception of the space atmosphere by combining group discussions and atmosphere metrics.

For the purpose of this last point, a second research question was proposed:

How do different light intensities affect the perception of the atmosphere in Sund Nature Park and how can these findings support a transformation of the place to become more inviting to people and an inclusive part of the urban surroundings?

The results on Sund Nature Park showed that higher light intensities are associated with publicness while lower ones are considered more private. Together with this, it was also concluded that lowering the light that can help create a cozy space atmosphere but to a certain point, after which it can turn negatively. Due to the limited number of participants and the lack of diversity in terms of age and cultural background, is difficult to get to absolute conclusions although the results are in line with the existing literature done on other fields and could be used as starting point for future investigations.

What can be derived from these results for sure is that lighting preferences and atmospheres are collective constructions subject to people's past experiences, upbringing, and social circumstances. For this reason, it is important to adopt a collaborative approach and include the user through the different stages of the project development. While lacking publicness, P.O.P.S. usually poses high urban design qualities as shown in the case study. As designers of the city, we can enhance their public nature by allowing greater flexibility and more opportunities for appropriation and inclusion.[18]

Exercises like the one done on Sund Park can be a great opportunity to engage with the public, share the atmosphere experience, embody it collectively and get an insight into different perspectives too. Lighting designers can as well learn from these experiences and gain knowledge from future endeavors. The collaboration and commitment of SLA Architects to this study is a great example of how practice can incorporate research to enrich our professional work.

In the end, light is not about levels or regulations, particularly in the city after dark. It is really about people and the possibilities it opens us to explore, sense, and discover. Many Privately Owned Public Spaces are still waiting to be discovered and enjoyed at their full potential. Lighting and urban atmospheres can contribute to that, I wish this work is a step further in that direction or at least to open the discussion and continue working in the making of a better city for everybody.

VII.I FUTURE PERSPECTIVE

As previously mentioned, there are many factors that intervene in the atmosphere sensing in urban spaces with lighting being only of these elements. Besides this, light can be analyzed under different parameters, of which the field test on Sund Park only evaluated one of them. For example, combining different color temperatures or even the use of color light in the space in combination with light intensity. Together with the obtained results in this work, it would be interesting to explore how these different parameters can be combined in privately owned public spaces to improve the public perception of them. likewise stated how the perception of the atmosphere is purely social and cultural phenomenon. As privately owned public spaces come in all shapes and sizes and cater to a wide variety of users, it would be necessary to explore more in-depth the differences in gender and social and cultural background in terms of lighting and atmosphere evaluation.

Atmospheres being dynamic and able to change, it would be interesting to explore as well different lighting technologies that could be applied to easily modify and adapt the light to activities, times of the day, and special events. Having an interactive system could help in terms of public engagement and work as an attraction for the public to the space.

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IMAGE CREDITS

All graphics and photos not listed below were produced by author María Florencia Sturla

Figure 3.1.2 Bloomberg https://www.occupy.com/article/fearing-protests-stock- exchange-london-rewrites-rules-paternoster-square#sthash.Gd2ddsH9.dpbs

Figure 3.1.3 https://www.bloomberg.com/news/articles/2011-10-12/protesters-to-occupy-london-stock-exchange

Figure 3.1.4 Schmidt Hammer Lassen Architects https://www.shl.dk/tjuvholmen-housing/

Figure 3.2.1 Getty https://www.planningresource.co.uk/article/1714361/council-develops-digital-tool-monitor-provision-promised-affordable-housing

Figure 3.2.2 Y. Gao https://www.pexels.com/photo/people-walking-near-concrete-buildings-1557547/

Figure 4.1.2 K. Lynch, The Image of the City. 1998.

Figure 4.1.3 Project for Public Spaces https://www.pps.org/

Figure 4.4.2 Self-produced/Google Maps

SOFTWARE & EQUIPMENT

Used Equipment:

- Luxmeter: Voltcarft MS-200LEDled
- Luminance Meter: Konica Minolta LS-150
- Spectrometer: GL Spectis 1.0 Touch
- Digital Camera: Canon EOS 500D

Software:

- Floor Plans and sections: Autocad
- 3d modeling: Sketchup
- Illuminance map: Dialux
- Luminance maps: FusionOptix
- HDRI and Luminance maps: Photosphere
- Interview analysis: Google PinPoint
- Layout: Canva
- References: Refworks

APENDIX

This appendix contains:

1. Summary of group discussion questions
2. Group Discussion Transcriptions
3. Model for test´s individual evaluation forms

Summary of group discussion questions:

- Were you familiar with Sund Nature Park?
- Do you come here often?
- What activities bring you to the space?
- Have you ever been to Sund Park during nighttime?
- What are the first things that call your attention about the space?
- Do you feel different when you walk through an urban space during the night compared to daytime?
- What area of the park would you choose to sit on?
- Do you find it easy to navigate through the space?
- Do you feel it is a space you would come and spend time in?
- Is there anything you would change to make it more attractive or appealing to spend more time in?
- What are your expectations of urban spaces during nighttime?
- Is there anything particularly good or bad?

Group Discussion Transcription

Group 1, March 2022 19:37

F: Did you know Sund park? Is it the first time you visit it?
I: First time
F: When approaching the park from the street, did you notice this was a public space
I: No
No, I have passed through this area for two years and never realized this was opened to the public I thought it was private, from the university. I mean, that you cannot walkthrough
F: What are the first things that catch your attention at first glance?
I1: The bridge
I2: The bridge and the building on the side where there are people dancing
I3: The things painted on the walls
I4: The space where we are, feels like the heart of a city block. With the buildings around it, with the windows looking directly, you realized you are inside the block. It doesn't feel like a common park or square.
I5: I feel it's too simple like something is lacking.
F: And what do you think about the lighting of the space?
I1: I like how it's lit
I2: I think it's correct. The bridge is highlighted with that light line and I like how the light escapes between the bars.
I3: But I think that area it's a bit dark
I4: I feel the same about that area, I do not know if it belongs to the park. (back of zone 2, towards collegium). You cannot see anything there; it seems you will be walking almost blind. Is there a way to the street there?
F: Yes, you can connect with the street through that path.
I1: You don't realize that
I2: I will walk through here (central path), I would go over there.
I3: Yes, the path is limited by the light, that seems something that people did as a shortcut.
It is illuminated in a certain way that marks you the way.
I4: Also, those threads do not allow you to walk there, I don't know if that's to avoid people walking on the grass or if it's something temporary. That's something I don't usually see in other parks.
F: Do you think you feel different walking through a park at night compared to when you do it during the daytime?
I1: Maybe it is because of the weather, but I don't think I would feel like staying here for very long.
I2: when the weather is nice, I prefer spaces that are close to the water.
I3: Or that has something different, here I feel there is nothing interesting
I4: I think I´ve never been to a park at night except to walk my dog. In my country, it is not very

common, maybe because it isn't very safe. You usually don't go to a park at night.
I1: And I feel that this park it's very hidden, very inside. It feels like it is something only for the building, it doesn't invite you to enter.
I4: Yes, I didn't see any place to sit
I1: But there are, you have those benches, and the steps. There are, but it is not inviting.
I5: But on the other part, that is more open, next to the street, there is nowhere to sit. So it seems more like a pass-by place.
F: If you have to sit somewhere, where would you prefer to do so
I1: The open space in the middle. Because of how it is illuminated and delimited
I2: Me too, but only because it is more open. Because if Im going to sit somewhere I am going to search for an open space but not because I feel it is more inviting. I think the area with the steps (zone 3) is more inviting, but you end up looking up to a wall
I3: But don't you think you kind of lose them when you pass by? Maybe because it seems like a private space so I don't realize I can sit there. Maybe I would sit there, but from the street, I don't realize I can come and sit here so I would probably never come here.
I4: Also, the entrances are like two hallways
I3: It´s true.
I4: The entrances are a bit weird.
I5: It doesn't seem like a big entrance, like in a square where you look at it and you get a whole view of the space.
I4: We enter on a side of the bridge, here. It's like a blind hallway and nothing calls my attention. Not even the lights invite me to enter.
I3: It could be could if I enter and something then surprises me but that doesn't happen.
I2: Maybe during the day It's more inviting, but like this not.
I4: Something that calls my attention is that there is nothing for children, usually in a park you find something
I5: But here you have a university, this seems more like a place for students to relax. I think it is more focused on the people from the university.
I3: Maybe it's a park only to walk and not to stay. There are some parks that maybe are not to stay. I don't know a lot about the city but maybe close there is a nicer space to maybe stay or not. And this is just a space to walk through.
I5: I liked what you said about the entrances, that´s true, if you are here, you don't see anything, I don't know what there is inside and the buildings don´t allow you to see to the other side.
I3: But as I say, maybe if it's a park to enter the university only, I come to the university from here with my bike, I go through the bridge and I enter, that's it, maybe it's not meant to be for me to stay
I4: I think it only invites you to walk the dog, there are signs and poop bags

I5: Maybe I am looking at it from my social background, maybe this idea that at night it is not safe, not here because Copenhagen is safe but maybe the people from here feel different, maybe they would sit here and drink a beer

I3: It reminds me of another square in Amager, that has an entrance from the back that you can't see.

F: Do you think it was easy to navigate through the space

I1: No, nothing gave me a clue

I2: I think there is a clear line created with the lights until here it´s the park, that is not. What we said before about that path. It's from here to there, it's that line. The light somehow marks a direction.

F: Do you think it's a place you would come?

I1: No

I2: Maybe during the day but not like this

I3: I wouldn't tell my friends to come here even if I lived close

F: Is there anything you think could be improved to make it more inviting to come

I1: For me, it's very important that it's an open space. As we said before, if it's a place where I don't see an exit or how big it is, it doesn't attract me except if it is on my way, if Google tells me to go through here.

I2: If you look from here, it seems you hit a wall.

I3: From here it's not very nice, there's nothing to see. From the other side, it's nicer, it feels more like the main entrance.

I4: Here it seems like a parking lot

I5: To come here, I would need more space to sit, more green, more plants

I3: I would like to have a map saying you are here and where you can see how the space is.

To see where the path leads.

I2: How it is lightened it doesn't make me feel like staying, for example, to come at night and drink something with my friends.

I3: Maybe if there was something like that LED line over there on the railing indicating a direction it would be very different. Because if I am walking through this and I see something like the light on the bridge, all along the floor, I see a line that it´s entering the space and I would think, what is that? Where does it take me?

If I see something like that it would make me curious, and I would like to come and see where it takes me. But not like this.

I2: Maybe it could have something more creative like other places that have something interesting or different to see. Like that rooftop in Nordhavn, it is a place you go only because that's there. Maybe here they could add something that attracts people

I3: I think that here the different levels, the plants, and everything is made on purpose and there is an idea behind it, but it doesn't invite me to walk here. I think it's a good idea, that it's a bit hidden but it's

not successful for me.

I1: I walk in front a million times and I never saw this space. Until I saw the map with the directions at where we were meeting, I didn't realize where it was.

F: Let's go back from the beginning through the bridge

I1: When I was coming, I took a photo of this, the parking entrance, see that it has that yellow light like a line that attracts your attention.

I2: The access to the bridge is also hidden, that line of light should be visible from the street at least

I3: In the central area, I feel also that the light was very cold, it doesn't invite you to stay, I feel it's only to cut through. There is something in the lighting

I4: I wasn't expecting this space after the entrance with all the plants and trees. But here some of the lights are not working.

I3: The bridge is really cool.

I4: It's great that it crossed through the building, I love that. The green roofs are really cool too, but they look as if they can't be used.

I2: Under it looks like someone is going to be killed or robbed.

Model for test´s individual evaluation forms

Sund Nature Park Study

Welcome to our study. We inform you that all the compiled information will be anonymously recorded and used only for statistical purposes.
Thank you for your collaboration with this project.

Age	
Nationality	
Occupation	

☐ I declare I do not suffer any kind of visual impediment that affects my normal sight.

1- ¿Did you know Sund Park?
☐ YES
¿Did you notice any recent changes? .....
.....
☐ NO
From the street, ¿did you realize it was a public space?.....
.....

2- ¿Do you feel it is a space you would like to come or spend time in?.....
.....

3- ¿Is there any area you like the most? ¿Why? ¿Do you feel light had an influence on it?
.....
.....
.....

4- ¿Is there any area you dislike the most? ¿Why? ¿Do you feel light had an influence on it?
.....
.....
.....

5- ¿Did you perceive the space as "*tense*" in any area/s in particular? If so, in which one/s?
.....
.....
.....

6- ¿Did you perceive the space as "*relaxed*" in any area/s in particular? If so, in which one/s?
.....
.....
.....

7- ¿Did you perceive the space as "*cozy*" in any area/s in particular? If so, in which one/s?
.....
.....
.....

8- ¿Did you perceive the space as "*vibrant*" in any area/s in particular? If so, in which one/s?
.....
.....
.....

9- ¿Which words would you use to describe Sund Nature Park?

	Scary		Depressing		Inspiring		Uncomfortable		Stimulating
	Relaxed		Exciting		Intimate		Unpersonal		Accessible
	Threatening		Warm		Vibrant		Romantic		Private
	Cozy		Safe		Luxurious		Peaceful		Hostile
	Oppressive		Pleasant		Mysterious		Boring		Cheerful

Other:.....