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Abstract:

In the context of nocturnal life in urban space, lighting design is often considered as the main culprit, the first cause of hindrance to its quality of use, negatively affecting the image of the City at night.

The goal of this thesis is to define base parameters of urban lighting conceptualisation for a rationally adapted thinking for any night-time urban planning project. This theoretical study will focus on the determination of these parameters and the observation of their relevance in existing situations, for future lighting guidelines in relation to the urban nightscape.

The first part is dedicated to the study of works in urban planning and the experience of the city in its current setting, set in relation to the role of lighting and its application to the urban setting. This can be expressed in a research question,

“how can the integration of light as core of urban planning be used to extend the function, identity and well-being in the urban space, develop night life thought an improvement of the urban public space?”.

In a second part, we will review three public spaces where intelligent lighting design resulted in a positive impact on the development of the city at night. While these projects fitted different levels of activity, were different in size within the space and the local culture, the choices made in the design could be linked to these three parameters.

In conclusion we can see that designing light for the urban space cannot be defined through the application of standards, but that the needs of different users in different urban settings are based on a variation of common elements, which can be determined according to several parameters forming a core base of design, adapted to different situations.

Aalborg University Copenhagen
Faculty of Engineering and Science

Department of Architecture, Design, and Media Technology
Master of Science

Lighting Design
Master Thesis

Improving light for the night

Reflection on the determination of guideline for lighting in urban planning

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June 1, 2018

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Contents

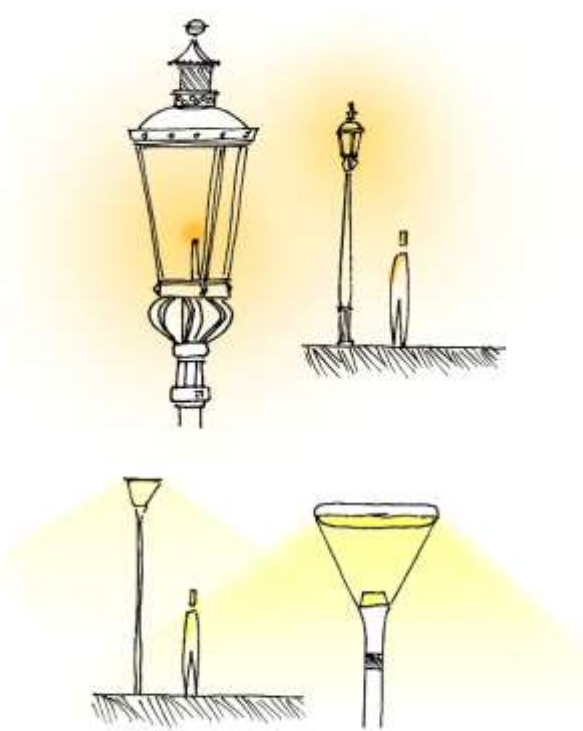
1. Introduction	6
1.1 Background	6
1.2 Vision	8
1.3 Initial research question	9
2 Literature	10
2.1 Introduction	10
2.2 Urban comfort	10
2.2.1 Health	11
2.2.2 Safety	12
2.2.3 Wellbeing	13
2.2.4 Natural disruption	14
2.3 Urban identity	15
2.3.1 Spatial structure	15
2.3.2 Night-time valorisation	16
2.3.3 Connecting places	17
2.4 Function	18
2.4.1 Wayfinding	18
2.4.2 Scale	18
2.4.3 Sustainability	19
2.4.4 Social development	24
2.4.5 People	25
2.5 Summary of literary review	25
3 Criteria	27
3.1 Function	28
3.2 Identity	28
3.3 Comfort	28
4 Final research question	28
5 Case study	29
5.1 Introduction	29
5.2 Nørreport Station: Defining a new narrative of use for an active central urban centre	29
5.2.1 About	29
5.2.2 Criteria fulfilment	31
5.3 Israels Plads: Reconnecting the city in the public space through comfort and sustainability	37
5.3.1 About	37
5.3.2 Criteria fulfilment	38
5.4 Letbane stations for Lyngby: Public transport a centre for public space development	42
5.4.1 About	42

5.4.2	Criteria fulfilment	45
5.5	Summary of the case studies	49
6	Urban lighting guidelines	50
6.1	Social functionality	50
6.1.1	City for the people	50
6.1.2	Connecting the users	50
6.2	Urban identity	50
6.2.1	Individuality	51
6.2.2	Presence	51
6.3	Comfort	51
6.3.1	Well-being	51
6.3.2	Sustainability	51
6.4	Conclusion	51
7	References	53
8	Notes	56

1. Introduction

1.1 Background

Town lighting is something that is rather new, with the first organisation of substantial lighting of the urban space with lanterns dated around the 15th century in Europe, and permanent street lighting, with the introduction of gas lighting, only developed in the 19th century. While this was the beginning of an organised illumination of the city at night, gas lighting remained a rather inefficient way of illuminating the streets. The development of electricity was the innovation that paved the way to a tangible night life in our cities, because it was a cheap and reliable way of illuminating the city. This extended the use of street lighting from a few key points of the city to the whole urban nightscape.



(illustration 1 – Old Copenhagen Gas Light lamppost and modern electric lamppost)

Two centuries of urban lighting have brought up multiple reflexions on the effects on how it could not only illuminate the night time but also shape the cities to our needs and create a special atmosphere.

Lighting in cities has brought up a noticeable night activity, that has evolved up to today into something essential in the life of the city. Night time activity exists because of lighting, because we need to see what we do, and electrical lighting is what made it possible to illuminate with ease our existences at night. Shops can function after dark only because of lighting that beckons the place to people and allows them to browse through the shops. Streets are

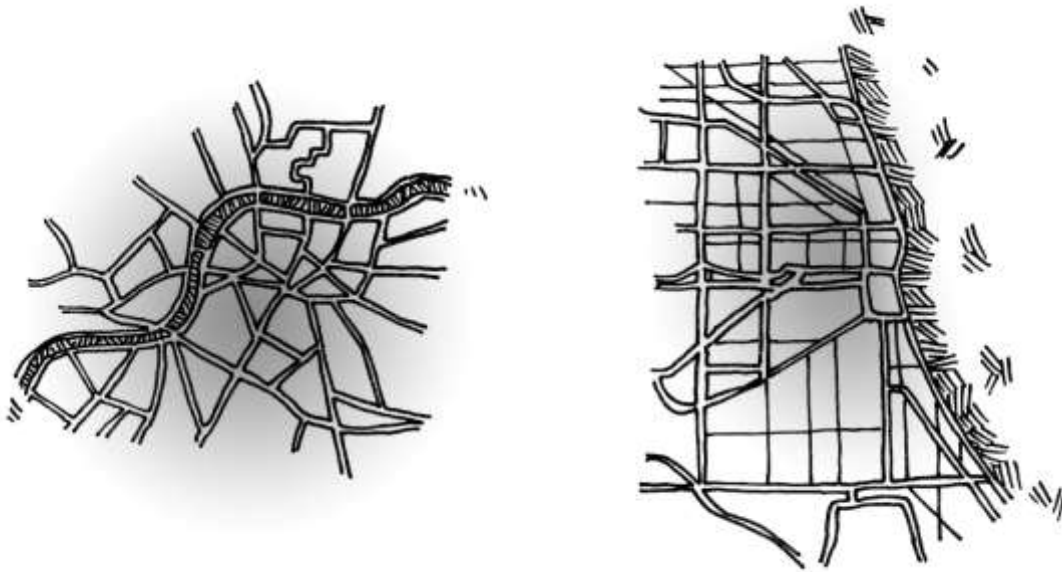
navigable at night because people can see their whereabouts and each other, making it practical and safe to move around. Additionally, people can watch the city, enjoy it as well as know their bearings, making light the shaper of the urban landscape at night.

All cultures and civilisations have had a core value about the development of their surroundings, a need for an organised structure. Cities are a prime example of this phenomena. Even in cities with an apparently anarchic organic growth such as Amsterdam or

Copenhagen, there has been a planning of paths, sectors and the determination of an urban identity, resulting in the aesthetics, practicality and narrative of these urban spaces.

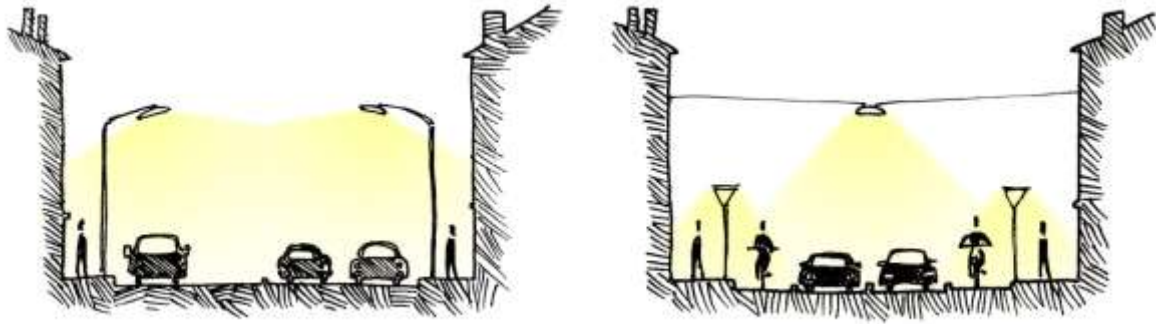
With the considerable growth, complication and interconnections of all populated areas, there has been a need for improving the way we create these spaces, summed up in the practice of urbanism. The old way of urban growth according to need was thought to be inadequate to how our cities should grow, since the management of a city of this scale would be inefficient, unable to follow the growth of activity and population housing.

The transition from the development of space from need to the manufacture of space for need has allowed our cities to grow bigger and buzz with activity. This has brought up a new problem. The urban planning brought up by the School of Chicago, Bauhaus, and the application of their principles after the war created cities where people felt overwhelmed by the scale of their environment and stressed by the constant activity within the urban landscape. Paradoxically, the faster and bigger city has been perceived as less human, a dead city.



(illustration 2 – Map of London and Chicago comparing the empirical sprawl to the grid)

The urban planning that was being referred to for building our cities was aimed only at practicality, and now the rejection we have of that practice and the renewed appeal for the old empirical way of designing cities have brought up a necessary reflection on the limitation of our modern urbanism. In addition, the excessive growth of our cities has reduced the benefits of current urban planning, making it more expensive in terms of economic and environmental values.



(illustration 3 – Car centred urban planning compared to multi user space urban planning)

The introduction of new initiatives in our cities such as the development of green spaces or the development of local activities, while still acknowledging the size of our cities by improving connectivity through transport and wayfinding, has shown that urban planning should not be used simply to make our cities more efficient. It should also make our cities healthier and more comfortable.

The introduction of lighting has made night time an integral part of city life, with nowadays activities occurring round the clock. But as night life depends on urban lighting, lighting should adapt to nightlife. Lighting does not exist in a vacuum, it projects on a physical space and makes it visible.

By shaping the appearance of the physical architecture, it gives an identity to the city and allows people to move around the space. It fits the needs of different activities, be it shops which require the presence of lighting to function, or parks which require the absence of lighting to thrive. Lighting also allows the existence of a comfortable metro system in the darkness underground.

In its current state, city lighting is meant to be functional, to make our street and interior spaces practical and safe, in order to recreate the visibility of sunlit time in the city, an artificial sun for our streets. However, with a better understanding of the importance of our natural behaviour, the effect of this pure artificial shaping of our lives has brought to light health and behaviour related issues. Furthermore, the cost of lighting on the environment and the economy has made it necessary to rethink the way we light up our cities.

1.2 Vision

Imagine if we could improve the usage of the urban space at night through a better applied lighting design?

How we design the urban space must shift because we understand today that the way we design our cities today does not suit the users' needs. This thesis will analyse what are the core elements that make up the building blocks of a good urban landscape. Through the study of the impact of lighting on the health, behaviour, and function of the city space and its users, we will investigate the role of lighting in shaping the city at night to conform to these core elements, helping make the urban space comfortable and practical to its users.

Through my experience as an inhabitant of Copenhagen, and my work as a lighting designer intern at companies working with lighting, YOKE Aps. and Gottlieb Paludan Architects, on street lighting and lighting for public transport spaces, this reflection will focus on what seems to me to be essential elements of the future of our cities, that is pedestrians and the public spaces they occupy in our cities.

The goal of this thesis will be to formulate a reflection on defining parameters allowing lighting design to help shape the urban space at night and create a better night life.

1.3 Initial research question

“How can the urban nightscape be improved through the application of the progressive values of urban design in lighting design in the shaping of our public spaces at night?”

The nightscape of our cities has become an important part of our cities, but it is also a cause of discordance in its current state. Therefore, there needs to be a better understanding of the people and the space they use to then be able to define how lighting can help fulfil their needs.

For this, this thesis will be separated into two parts.

It will delve first into a literary study and analysis of writing of the state of our cities, the shifting of requirements for a good urban space, and the parameters that can help meet these requirements. Shifting from an extreme utilitarian vision of urbanism, with a focus on car transit, the cities have moved to a slower and more social structure, defining the need for a strong identity of the urban space for our cities to thrive. This part will also observe the state of the current behaviour in lighting design, focused on functionality, and define new ways to light our cities, to enhance the new social growth of our urban structure, and minimise the effect of artificial illuminance on our natural cycle and our environment.

It will secondly analyse three different cases in Copenhagen of urban design of public spaces at night that are considered as good examples of urban lighting. These are the plaza above *Nørreport Station*, a meeting point in the nightlife, and a hub for public transport and general

traffic, *Israels Plads*, one of the city's most recent plazas, and the *Let Bane* stations within the centre of Lyngby, new additions to the public transport of the greater Copenhagen, and a means to develop activity surrounding the stations of the light railway. It will look at how the relation between lighting and the space fulfils these parameters, creating a functional and enjoyable space adapted to the modern and maybe future use of our cities.

2 Literature

In this chapter we will concentrate on a biographic study of urban planners and lighting designers to demonstrate the complementarity between lighting design and urban design. The material used for this study comes from several books and articles from prominent authors in both fields.

The goal of this study will be to determine parameters of design for a reliable illumination of the urban landscape at night.

2.1 Introduction

The mentality of how we create the urban space of our cities has changed. We value today more the well-being of the users than the efficiency of the functions they might use. We need to design a space that makes users feel more comfortable. As a basis for the manufactured space of the nightscape of our cities, lighting affects the health of its users, disrupting their natural biological cycle, affecting their feeling of safety, with darkness part of our natural fear of what could be lurking behind; their well-being, since it is the main player in the city visual, and finally the *environment* as a whole, affecting the poetry of the night and disrupting the fauna and flora of the cities.

2.2 Urban comfort

Our well-being depends partly on the balance of our biological clock, the so call "circadian rhythm"¹. Natural Homo sapiens behaviour is to lie down at night. The development of human activity at night or the impact of the early night in winter disrupts this cycle and can have strong effects on our health and behaviour. Circadian disruption due to nocturnal artificial illumination has been linked to stress, increased cardiovascular diseases, depression, insomnia or even obesity².

Lighting of the streets isn't meant to adapt to the natural structure, as it can be observed again in a study the National Institute of Environmental Health Sciences, "Missing the Dark: Health Effects of Light Pollution" (2009)³. It isn't even adapted to the activities of the nightscape.

"63% of the world population and 99% of the population of the European Union and the United States (excluding Alaska and Hawaii) live in areas where the night sky is brighter

than the threshold for light-polluted status set by the International Astronomical Union” (National Institute of Environmental Health Sciences, 2009, p.22)

2.2.1 Health

“Over-illumination refers to the use of artificial light well beyond what is required for a specific activity, such as keeping the lights on all night in an empty office building” (National Institute of Environmental Health Sciences, 2009, p.22)

With a study of 147 urban communities in Israel, comparing the light pollution satellite images illustrating outdoor lighting to maps of the same areas showing the distribution of breast cancer patients, the following was found:

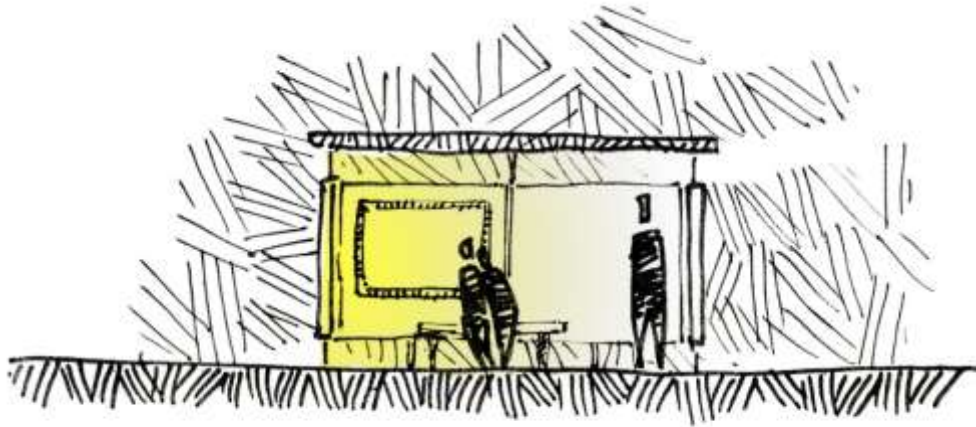
“Women living in neighbourhoods where it was bright enough to read a book outside at midnight had a 73% higher risk of developing breast cancer than those residing in areas with the least outdoor artificial lighting” (National Institute of Environmental Health Sciences, 2009, p.27).

City planners and activity centres in these urban areas rarely consider the health impact of lighting, focusing on visibility. Our cities’ nightlife is here to stay, so appropriate understanding and application of lighting in the urban space is necessary.

Light therapy has been used since its introduction in the medical field as a means to improve healing, for example treating the elderly, as described by Mariëlle Aarts, in 2016 article published in the “American Journal of Alzheimer disease & other dementias”⁴, stating the fact that:

“Light therapy is applied [...] as a treatment to reset the biological clock, to improve the cognitive functioning, and to reduce behavioural symptoms”. (Aarts, 2016, p.1)

While lighting is the cause of the issue of circadian disruption, it can also be the key to balancing it, through initiatives like light therapy. In the study of innovation in the field of urban lighting done by ARUP, the project by Umeå Energi “Reprogramming Bus Stops to Improve Mental Health”, the use of strong light panels placed at bus stops has improved the quality of life in the space, documented in the study of innovations in the field of lighting the urban night, “Cities Alive: Rethinking the Shades of Night”⁽²⁰¹⁵⁾⁵.



(illustration 4 – light boards integrated into bus stop booths in Malmö for light therapy)

With the implementation of these light panels at the bus stops, users could benefit from a session of phototherapy, helping to lessen the impact of long winter nights and night time activities on their health.

“The boards provide commuters with infrastructure-integrated light therapy specifically designed to combat seasonal affective disorder. The lights filter out harmful UV rays, preventing potential eye and skin damage. Winter bus use in the city doubled after the lights were installed. Since their installation, the bus stops have become more than just shelters; they contribute to residents’ health and wellbeing during the dark winter month”. (ARUP, 2015, p.42)

2.2.2 Safety

Lighting in our cities has been chosen so as to give a sense of safety to urban life, by shedding light on perceived dangers within the landscape and allowing people to see and appreciate their surroundings.

Peter R Boyce, English professor in architecture, studying the interactions between people and lighting, defines the following in his book “Human factors in lighting” (2014)⁶.

“People, particularly women, who saw the lighting as being unpleasant, unnatural and monotonous and of low brightness and who had a low level of environmental trust tended to consider the footpath more dangerous. These findings demonstrate that people’s assessments of any lighting installation depend not just on the lighting but also on their personality and attitudes.” (Boyce, 2014, p.442)

“At a basic level, what pedestrians want from such lighting is to be able to see where they are, to be able to move safely over the ground, to assess the risk to personal security and to avoid visual discomfort.”
(Boyce, 2014, p.456)

How lighting affects people and their apprehension of the space can be linked to standards of lighting. The quality of the space in relation to lighting depends also on our concepts of the environment that surrounds us. Because it is strongly related to our senses, it has a very personal and conceptual dimension. Lighting must be thought in context and not just on standard levels.



(illustration 5 – Perceived unsafety because of badly implemented street lighting)

2.2.3 Wellbeing

Jane Jacobs, an American journalist, activist and city philosopher, poses the inevitable problem of the development of urban spaces in her book, “The Death of the great American city” (1961) ⁷. Generally, a city will be occupied and grow even if it considered a “slum” like the streets of North End in Boston were before as she puts it. A city can survive on necessity, with people residing and working there because it is strategic, or it is cheap, but they will merely occupy the space and not live in it, creating a dead urban space.

Kevin Lynch is an American city planner, in his book, “the image of the city” (1960) ⁸. In his analysis of three American cities, Boston, Los Angeles and Jersey City, he determined that the capacity of a city to allow its users to naturally create mental images through a legible image of its urban landscape is the key to a successful and enjoyable use of the city.

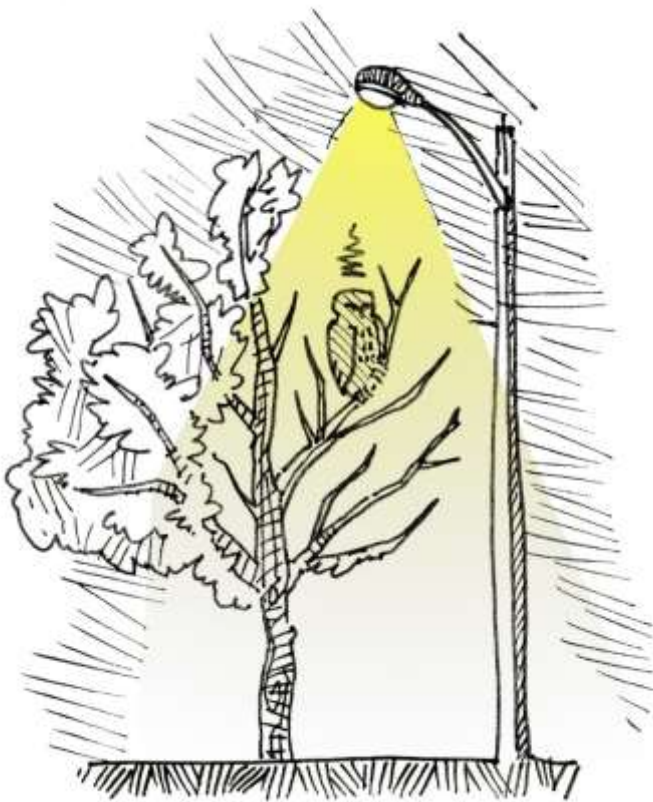
A legible map of the city has a strong effect on the users’ emotional security, countering the worry of getting lost. This security for users, a conceptual organisation of the space and the communication between users, heightens and complicates the human experience of the city.

“By appearing as a remarkable and well-knit place, the city could provide a ground for the clustering and organization of these meanings and associations. Such a sense of place enhances every human activity that occurs there and encourages the deposit of a memory trace.” (Lynch, 1960 – p.119)

“Heightening the observer’s attention, enriching his experience. is one of the values that the mere effort to give form can offer.” (Lynch, 1960, p.117)

2.2.4 Natural disruption

Unfortunately, the increased artificiality of our cities, especially the use of lighting on our street, is also a stress to the environment and other creatures living in the city. As much as the fact that artificial lighting and the development of nightlife has disrupted the human health, it has also had a dramatic effect on other living beings, putting our ecological balance at risk.



(illustration 6 – Artificial lighting has a negative impact on both fauna and flora)

Paul Bogard, an American Writer and professor, talks about the impact of artificial lighting at night on the environment and the narrative of the space in his book, “The End of Night: Searching for Natural Darkness in an Age of Artificial Light” (2013) ⁹, and in a TEDx talk in Bratislava “why we need darkness” (2016) ¹⁰.

“More than 60% of invertebrate species, mostly insects are purely nocturnal and 30% of vertebrate species are nocturnal and so many other species are what we call crepuscular. They're most active at dawn and dusk and all these creatures have evolved to depend on darkness to their time to move and mate and migrate and feed and be out in the world. Right when we flood

their habitat with our artificial light we essentially destroy that habitat.” (Bogard, 2016)

We need to understand the need to reduce light pollution in our cities, as described by Ulrike Brandi in her handbook “Light for Cities” (2007) ¹¹.

“Hence, it is Important to find the optimal balance between the desired light effect upon surfaces, elevations or objects on the one hand, and acceptable, albeit minimal glare from as few directions as possible on the other hand. This also applies to light emission. It occurs, for

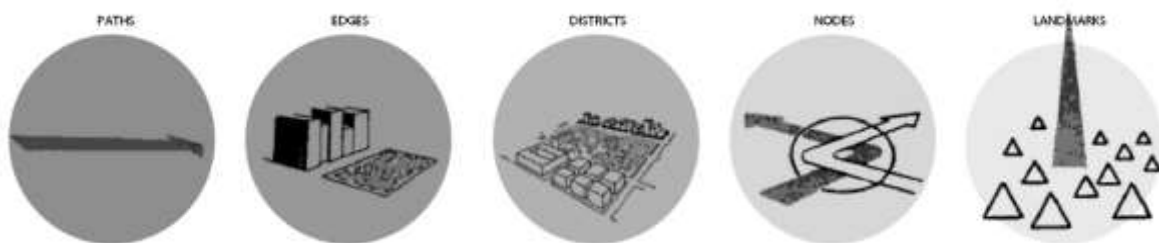
example, when private spaces such as front gardens or facades are lit too brightly from public light sources, causing more light to fall into home.” (Brandi, 2007, p.46)

2.3 Urban identity

Cities need dynamism in an age where the urban space feels monotonous. For this there needs to be an overhaul of contrast, ways to distinguish between different elements of the city, to remember them and structure the use of the city.

2.3.1 Spatial structure

Lynch determined a list of five categories through which the users create their image of the city: paths, along which the users move through the city, edges, which give boundaries to spaces and break the continuity of the city, districts, that break the city into areas sharing common traits, nodes, focus points in the city where things meet, and landmarks, which give a clear visual unique identity in the urban landscape (Lynch, 1960, p. 46).



(illustration 7 – The five categories in design of urban planning for a good mental image of the city according to Kevin Lynch)

To navigate through the city, one must differentiate between the parts of the city and the routes that allow the user to reach them. Therefore, the singularity provided by a clear identity is important. The difference in the physical structure is shaped by the natures of the 5 categories. These allow to visually set limits between the different parts of the city and create visual differences that result in a personal identity for each of these spaces in our mental map.

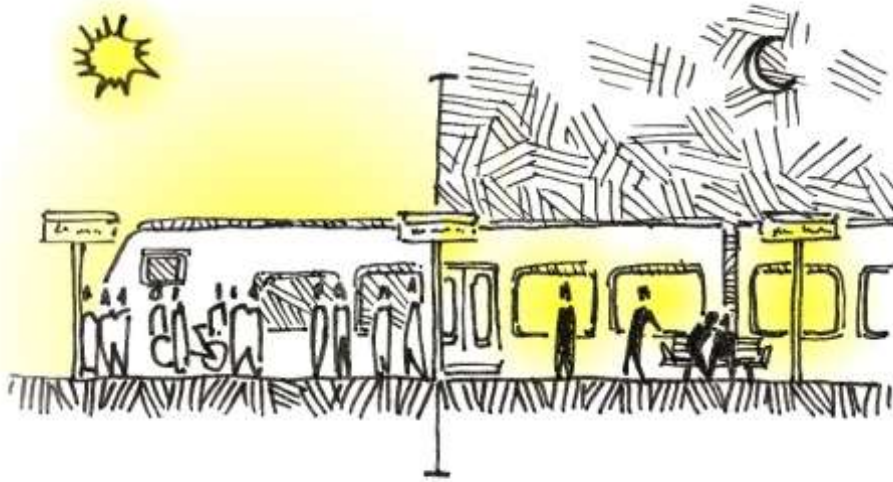
“Nothing is experienced by itself, but always in relation to its surroundings, the sequences of events leading up to it, and the memory of past experiences.” (Lynch, 1960, p.1)

“Where major paths lacked identity, or were easily confused one for the other, the entire city image was in difficulty.” (Lynch, 1960, p. 52)

Lighting for cities should follow a masterplan, so as to design the city in a homogeneous manner and align with the existing urban design. In a way, the different parts of the city can echo each other through the lighting plan, giving a sense of common urban identity (Brandi, 2007, p.35).

2.3.2 Night-time valorisation

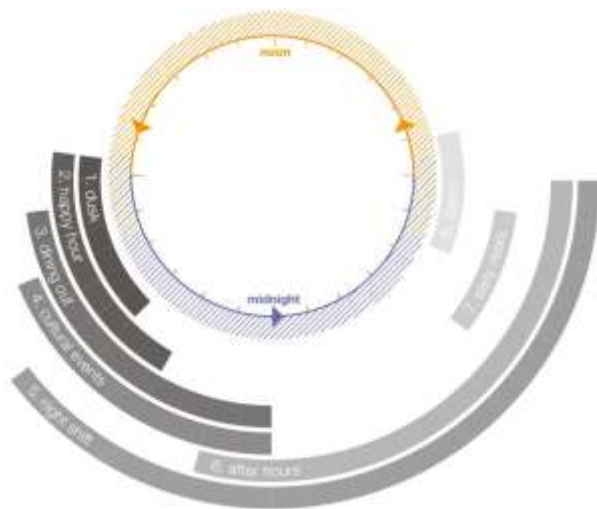
The activity at night is changing the way we perceive life in our cities. Before, lighting was designed to recreate the daytime experience, working with a constant natural light source, but development of night-time activities has forced an adaptation of design for the urban space in the dark, understanding that there is a similar complexity to the space at night as there was during the day.



(illustration 8 – Contrast of context for lighting between night and day at a train station platform)

“The 24h city is a phenomenon that increasingly shapes the way we experience urban life. A growing percentage of social and economic life now takes place in the hours after dark. Current developments towards 24h cities tend to blur our perception of day and night.” (ARUP, 2015, p.13)

The daytime dynamism must be brought into the night through a spatial transition brought upon by lighting, mimicking dusk, not so much as to end the cycle, but to morph the space to suit the new needs of the space.



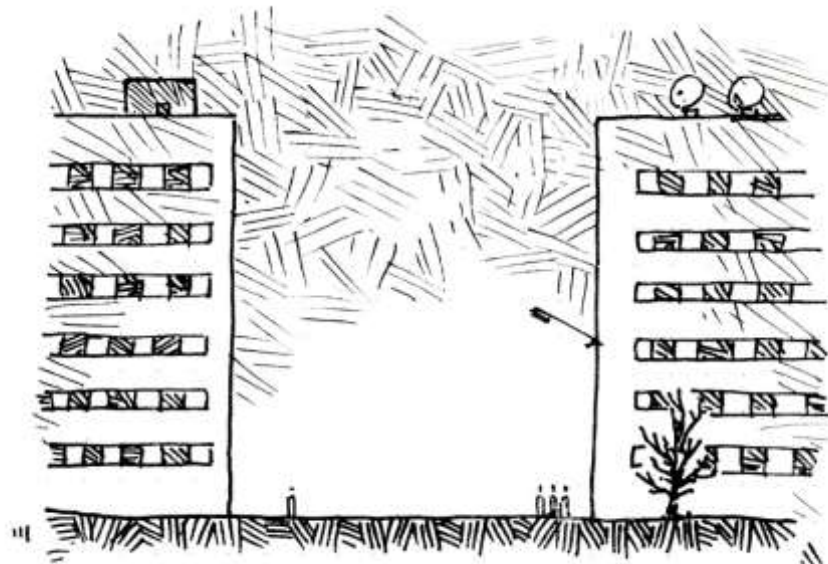
(illustration 9 – Night time activities placed on a time wheel as illustrated in ARUP's booklet, "Cities Alive: Rethinking the Shades of Night")

Though night-time is a continuation of the daytime dynamism of the city, it nevertheless morphs into different activities, implying that the environment changed according to the requirements of these different activities, with some general cultural occupations extending to the end of the evening, while night shifts and parties last longer into the night until morning.

2.3.3 Connecting places

For our cities, the public space must be designed to be more than just a space of transition between the buildings, otherwise it just feels like a dead space.

Mahyar Arefi, an American professor in urban planning, analysed how the aspects in the design of our spaces has contributed to a narrative of loss in our environment in his article “Non-place and Placelessness as Narratives of Loss: Rethinking the Notion of Place” (2007)¹². To him this can be defined partly through the sense of location (Arefi, 2007, p.3).



(illustration 10 – The urban space feels dull and empty when serving only as a space of transition such as in residential areas)

The culture of instruction over connection, brought upon by the current functional culture that defines our urban landscape, as well as the rise of technology and the complexification of our society, have resulted in the “loss of connectivity and changes in our social obligations” (Arefi, 2007, p.4).

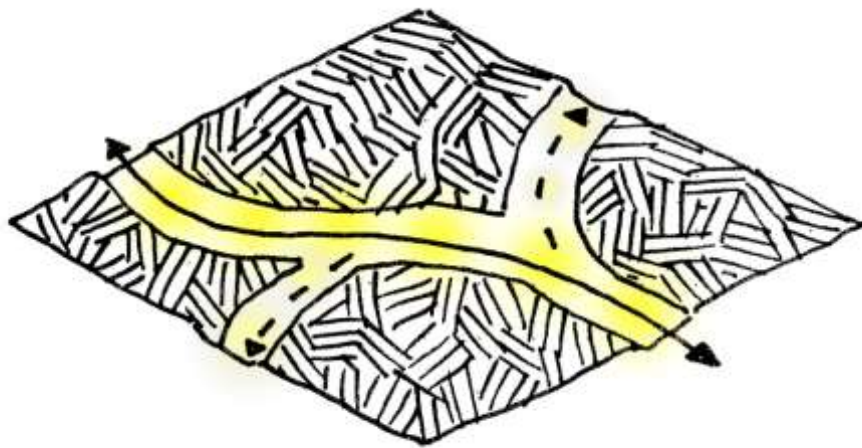
This has lessened the value of the public space in our cities, impacting in turn their aesthetical and functional qualities, because the needs of the users aren’t aligned with the way we designed the urban space.

2.4 Function

The city remains principally a structure of functions. We built cities for our civilisation to thrive. But the way we designed cities in the past can be seen as a simple network of connections between buildings, with no life in between. Better understanding the complex structure of today's city and its use and how we can better design for these can help integrate lighting functions.

2.4.1 Wayfinding

For the city to operate, people need to be able to circulate. This circulation is done along paths, which cut across the urban landscape. To be able to navigate these paths, continuity and directional quality are required.



(illustration 11 – Lighting serves a mean to shape the physical space to show paths)

“That paths, once identifiable, have continuity as well, is an obvious functional necessity. People regularly depended upon this quality. The fundamental requirement is that the actual track, or bed of the pavement, go through; the continuity if other characteristics is less important.” (Lynch, 1960, p. 52)

“[...] one direction along the line can easily be distinguished from the reverse. This can be done by a gradient, a regular change in some quality which is cumulative in one direction.” (Lynch, 1960, p. 54)

Shaping of the physical space with lighting can help direct users through the space by creating a visual hierarchy, creating paths or spatial groupings.

2.4.2 Scale

Jan Gehl, in his book “Cities for People” (2010)¹³, determines through thoughts and parameters how to create better cities, that suit the need for a safer, more sustainable and

stronger living environment. Redesigning the city for its users requires scaling down each part of the city to the human level.

Jan Gehl explains that:

“[...] working with the human scale means providing good city spaces for pedestrians that take into account the possibilities and limitations dictated by the human body.” (Gehl, 2010, p. 33)

An important point to consider in relation to the possibilities and limitations of the human body, is the 5 km/h speed at which pedestrians often travel. At that speed there is time to take in and experience a lot of details and features of the surroundings. Without any visual stimulation inputs, the walk quickly becomes boring. In the words of Jan Gehl:

“Five km/h architecture is based on a cornucopia of sensory impressions, spaces are small, buildings are close together and the combination of detail, faces and activities contributes to the rich and intense sensory experience. [...] The 60 km/h scale has large spaces and wide roads. Buildings are seen at a distance, and only generalities are perceived. Details and multifaceted sensory experiences disappear, and from the perspective of a pedestrian, all signs and other information are grotesquely magnified. [...] Taking a walk in 60 km/h architecture is an impoverished sensory experience: uninteresting and tiring.” (Gehl, 2010, p. 44)

According to Lynch, users need be able to sense their position within the space, that could be achieved through the scale of the path.

“Most often, perhaps, scaling was accomplished by a sequence of known landmarks or nodes along the path. The marking of identifiable regions as a path enters and leaves them also constituted a powerful means of giving direction and scaling to a path.” (Lynch, 1960, p.52)

The events and characteristics along the path - landmarks, space changes, dynamic sensations - might be organized as a melodic line, perceived and imaged as a form which is experienced over a substantial time interval. Since the image would be of a total melody rather than a series of separate points, that image could presumably be more inclusive, and yet less demanding. The form might be a classical introduction-development-climax-conclusion [...]” (Lynch, 1960, p. 99)

2.4.3 Sustainability

The city works if the space is designed to suit the context of the needs of its users. With lighting being the tool to shape the urban space at night, it is important to define the qualities of the

different parts of the urban space and the consequences of these when they conflict with the spatial needs.

In her handbook, Ulrike Brandi develops the typology of the urban nightscape, determining the role of lighting in time and space in the city (Brandi, 2006, p.54).

- Boulevard

Main paths of the cities, they are used by all users of the urban spaces, requiring a differentiation of the public light in three zones: pedestrians, street traffic and building lighting. Light on the street must be uniform and, as must be the light on the sidewalk. However, light for cars should be brighter and warmer, calling on drivers for a more relaxed attitude, while the sidewalks should be cooler to make users feel more comfortable. Since it provides a representation of the city to people moving in and out of it, great importance should attach to the design of the lighting displaying the space.



(illustration 12 – Boulevard illumination)

Carving the city skyline, the way these spaces are lit makes passers-by appreciate the effects of the rising or setting sun.

- Main roads & side streets

Secondary roads and passages, these paths are part of the identity of different districts of the urban space. While local activities such as bars and shops should be supported by a functional illumination, the comfort and security of the people living in the area should be prioritised.

The illumination of these paths should be limited to the travelled volume and reflect the identity of the area.



(illustration 13 – Urban area street illumination)

- Bridges & waterfronts

The lighting these artificial elements placed on exposed locations along and over the water should highlight the structure and encourage activity. On display, this lighting needs to clearly make out the edge of the water and alleviate risks for the users.



(illustration 14 – bridge illumination)

- Squares

Urban squares represent the source of inspiration for public lighting, being the places where it was first implemented. These are meeting points and hubs for city, so they need to be appropriately lit to allow people to walk in and out and linger in selected bright spots, without overdoing it. Landmarks of the urban landscape, the architectural elements surrounding the square should be lit, while not affecting the illumination of the public space itself.

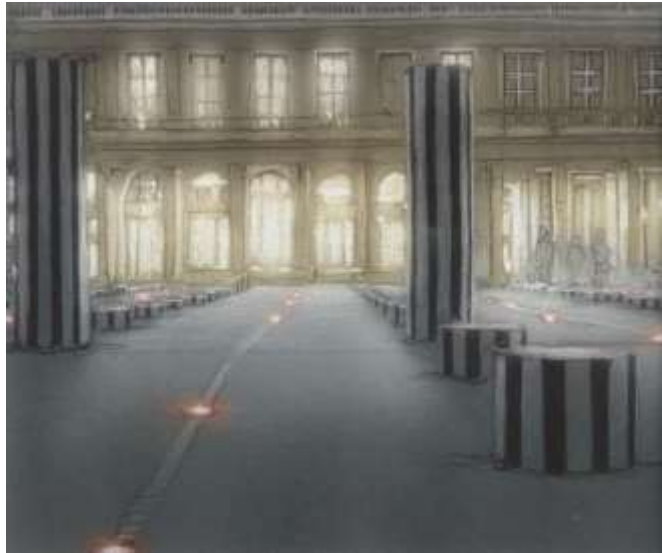


(illustration 15 – Public square illumination)

As urban nodes of the city, these spaces should reflect the activity of the city through their lighting, to support it and its users.

- Footpaths

Footpaths are calmer spaces in the city, differing from the roads by suiting a single type of users, pedestrians. Lighting these spaces is meant for the users to see and be seen, to give a sense of safety, and provide orientation. Light for these spaces should be discrete to suit the simplicity of the space and the comfort of the users.



(illustration 16 – Footpath illumination)

- Trees & vegetation

Light for parks has an artistic value to itself, serving more to sculpt the shape of the vegetation, mainly the trees and shrubs.



(illustration 17 – Green spaces illumination)

- Facades & illuminated advertising

Activity centres in the city have a need to visually advertise their presence, and in the nightscape, creating a contrast of light is seen usually as the most efficient way of doing it. However, there needs to be a reflexion on solution to limit this illumination, to not case harm to the surroundings and users.

“In spite of their triumphant advance in many European cities, illuminated ads are subject to planning approval, and rightly so. They are prohibited in some districts. No one wants to see ads reflected in Lake Zurich or in Hamburg's Alster. The use of light for advertising purposes should therefore be regularised with the specific ambience and location in mind.” (Brandi, 2006, p. 79)



(illustration 18 – Advertising and façade illumination)

- Underground

Underground spaces such as parking lots and metro station are disconnected from the sky and daylight, resulting in a constant illumination. The space needs lighting to help orientate and stimulate its population in a rather monotonous environment, and visually sculpt the space to extend the limits of the confined spaces.



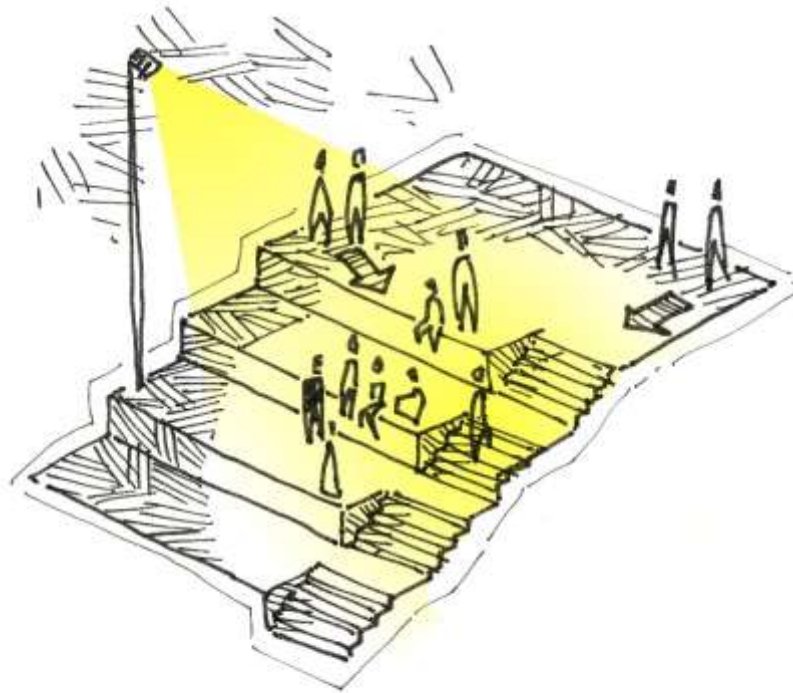
(illustration 19 – Underground illumination)

2.4.4 Social development

With the notion that cities should be more focused on the pedestrian users, urban design would shift to a more human centred notion, allowing the people to use the urban space. For people to use the space, there needs to be physical features to invite people to use it. The city should be designed to give use to space, avoiding a sense of emptiness.

“Make sure there’s never quite room enough.” (Gehl, 2010, p. 151)

Designing the space in this manner will make the city closer to the users, creating a more vivid and warmer experience of the city.



(illustration 20 – Lighting serves to draw people together in the urban setting)

“The connection between distance, intensity closeness and warmth in various contact settings has an interesting parallel in decoding and experiencing cities and city space. [...] In narrow streets and small spaces, we can see buildings, details and the people around us at close range. There is much to assimilate, buildings and activities around and we experience them with great intensity. We perceive the scene as warm, personal and welcoming. [...] This is in sharp contrast to the experience in cities and urban complexes where distances, urban space and buildings are huge, built-up areas are sprawled out, details are lacking and there are no or few people. This type of urban situation is often perceived as impersonal, formal and cold.” (Gehl, 2010, p. 53)

Moreover, the urban space should provide physical elements to improve the experience of the space, be it better urban furniture or additional elements that make the space special for the users and create a singular experience.

“At one end of the scale are the purposeful necessary activities, that is, activities that people generally must undertake: going to work or school, waiting for the bus, bringing goods to customers. These activities take place under all conditions. [...] At the other end of the scale are the largely recreational, optional activities that people might like: Walking down the promenade, standing up to get a good look at the city, sitting down to enjoy the view or the good weather.” (Gehl, 2010, p.20)

2.4.5 People

Seeing people, and seeing people using the space is an important aspect in the design of the public space, giving confidence to other in using the space and inviting them to interact. As Gehl puts it:

“Inviting cities must have carefully designed public spaces to support the processes that reinforce city life. One important prerequisite is that city life is a potentially self-reinforcing process. “People come where people are” is a common saying in Scandinavia.” (Gehl, 2010, p.5)

This can be seen in the natural need to experience others, with the need to have other humans to interact with, to give meaning to our senses.

“Experiencing life in the city is also diverting and stimulating entertainment. The scene changes by the minute. There is much to see: behaviour, faces, colours and feelings. And these experiences are related to one of the most important themes in human life: people. [...] The statement that “man is man’s greatest joy” comes from Hávamál, a more than 1000-year old Icelandic Eddaic poem, which succinctly describes human delight and interest in other people. Nothing is more important or more compelling.” (Gehl, 2010, p.23)

Lighting for the city should take in account the fact that the quality of the urban space goes through its people and how they interact with each other. Creating a functional space is good, but if people cannot acknowledge the existence of others around them, the urban space has no purpose.

2.5 Summary of literary review

From this literary review we can extract the following observations. With the improvement of urban planning cities have grown drastically, developing into complex structures of life, that are now constrained by the same means of concept that have brought them to life. The design

of the city has been for the past 50 years and more been looked at as a thing that needs to change, to grow into something more adapted to the current situation.

Focusing on the nightscape, the principal design tool that is illumination is vastly incompatible with the current use of the city at night. It is a health and environment issue because it is overused because of the need to compensate for the effect of darkness on the urban activities, being a strain on safety and economic development because of the lack of visibility. The need to recreate the situation of daylight or shield users from the night hinders the development of the nightlife and compromises the natural structure of the night, be it biologically or aesthetically.

The nightscape is a singular environment, but we consider it as an extension of the daytime structure of the city. In doing so, we prevent lighting from activities that exist because of the night, effectively considering them as oddities because they are structured by the rules of the day. The user needs of the nightscape put more emphasis on easy wayfinding and intimacy. Lighting the city at night should help create a space where users can feel comfortable and can identify in the night-life activities.

Considering the darkness as a problem and not a component of the nightscape creates a natural problem, that of the effect of artificially altering our own biological cycle, but also the whole ecosystem's cycle, putting them in a straining position, affecting their health and behaviour.

While lighting itself is a problem for those it affects, it is the overuse of lighting that is the most problematic, affecting even those that aren't actors of the nightscape, in natural areas such as parks and riverfronts, or trying to isolate themselves from the night-life, such as residential structures, having little to no role in the night-time activities. With the means today to light effectively the city and the understanding of how lighting can help support night-time activities, with light therapy, we can design the city in a more sustainable and healthy way.

Lighting the city with no consideration for the particularity of the nightscape creates another issue, that is of how it removes the appeal and the identity of the city. The city and its usage are defined by how it looks. The image of the city is shaped by how it looks during the day, and artificially illuminating the city from the street alters how the city looks at night.

This creates an alien space, where people can feel unsafe or disoriented, because of the change in visual references of the space. Traditional urban night-time lighting covers the city in a way to allow night-life activities to function, fulfilling a role of visibility. Without consideration for the different urban narrative, the illumination of our cities hinders its appeal.

This affect also the overhaul structure of the cities at night. Having grown and complexified, our comprehension of them seems harder to achieve, resulting in the alienation of certain less important part of the urban space through lack of visibility or being obscured by others, and in the alteration of the value of others in the process. Because of the property of lighting design to shape the aspect of the physical, we can shape a more comprehensive image of the city.

Urban planning at night should be more complex than creating a usable urban space after dark, for the reasons observed above, but also because the function of the city has changed, to include more users, different groups of users, and shaped out the necessity of connecting them together as a fundamental brick in the building of our cities.

Understanding the physical structure of the city and the use we make of it as users is necessary to have an adapted lighting masterplan for the city, to better suit wayfinding and activity development in the city.

The improvement of interactions between urban users (inhabitants) and the creation of usable urban spaces are what make the city alive. On one hand, the urban landscape is a space between places, a space of transition, from one building to another. We will have to make use of it, but if it is not enjoyable, our presence in the urban space will be as short as possible. Especially during the night with the negative connotation of the darkness, the urban space should be designed to compel people to make use of it, by covering more than its basic function, developing outdoor activities. The development of secondary functions of the cityscape extends the nature of its usage, for people to get the sense that the city can be used just for leisure rather than to fulfil a purpose.

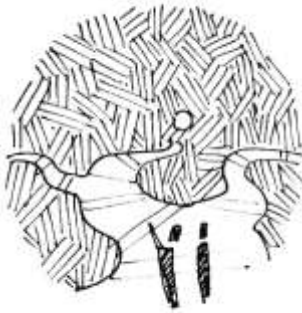
The improvement of the urban space for a non-essential purpose and pushing more people to make use of the urban landscape, there is a push for more interaction between users, to develop the social life of the city, especially at night. Lighting should serve to hierarchise the space further than for wayfinding for practicality, but also to help heard people in the space, and encourage the creation of an urban synergy.

3 Criteria

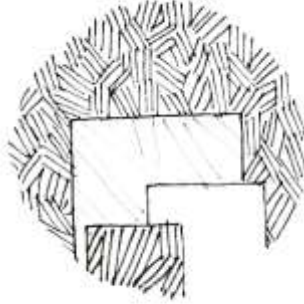
With an understanding of the elements of urban planning essential for the improvement of the night time urban structure of our cities, and the implication of lighting as the main factor of development of the nightscape in all domains through these different sources of literature and research projects, we can draw a list of criteria for urban illumination to improve the city night life. This can answer our initial research question:

“How can the urban nightscape be improved through the application of the progressive values of urban design in lighting design in the shaping of our public spaces at night?”

3.1 Function



Wayfinding



Structure



Socialisation

3.2 Identity



Spatial hierarchy



Narrative of use

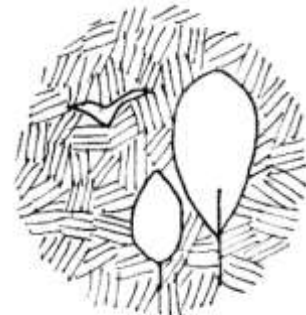
3.3 Comfort



Safety



Well-being



Sustainability

4 Final research question

“Can the integration of light as core of urban planning be used to extend the function, identity and well-being in the urban space, develop night life thought an improvement of the urban public space?”

5 Case study

5.1 Introduction

5.2 Nørreport Station: Defining a new narrative of use for an active central urban centre

The choice of Nørreport Station as an example of the use of lighting to create a good public space is to study the role of lighting in an active public space, a major actor of the city nightlife and urban life in general.

5.2.1 About



(illustration 21 – Old esplanade of Nørreport station 1918)

Nørreport station is the Denmark's oldest public transport station, opened in 1918 for train traffic going through Copenhagen, with extensions added in 1934 with the opening of the S-Tog service, a local train system for the metropolitan area of Copenhagen.

With the growing population¹⁴ and the creation of two metro lines, culminating with a traffic of about 165 000 users passing through the station every day, the project of renovation of the

station was given to Gottlieb Paludan Architects in collaboration with COBE Architects. This project required to refurbishment of the station to harmonise and improve access to the three underground platforms, train, S-Tog and metro, and structure the chaotic esplanade by integrating the importance of pedestrian and cycling traffic.



(illustration 22 – new esplanade of Nørreport station 2015)

The Project was designed by Gottlieb Paludan Architects in collaboration with COBE Architects, two Danish studios, to meet these objectives both at and below street level. The underground structure was renewed, together with passageways which are now equipped with satisfactory up-to-date ventilation, lighting and accessibility. On the surface, one of the two roads of Nørre Voldgade was suppressed to connect directly the area surrounding the station above to the commercial street of the medieval city centre.

“The new pedestrian carpet is paved with slabs of pale granite and sections of white concrete, these being resistant, low-maintenance materials which are easy to clean. The whole area is scattered with rounded areas placed in such a way as not to interrupt the flow of pedestrians. These are bicycle parking areas offering a total of 2,100 places. Five metres above the carpet and distributed along the avenue, there are six green roofs which are also rounded in shape. These are equipped with photovoltaic panels and planted with succulent sedums, which absorb carbon dioxide and help to slow the overflow in heavy rains.

Of these six shelters, the largest is that at the main entrance to the Nørreport Station. Clearly identifiable thanks to the large luminous letters of the station's name, it has a big overhanging porch and a completely glassed-in vestibule from which lifts and escalators go down to the platforms. The other five constructions, of differing shapes and sizes, are porches sheltering emergency exits, bus stops and a good part of the bicycle parking areas. Here and there, the esplanade is dotted with slender cylinders rising to about ten metres. These, the station's ventilation towers, also act as landmarks which are lit up at night like beacons symbolising the newly recovered metropolitan centrality of the place.”¹⁵

5.2.2 Criteria fulfilment

Function

Wayfinding

Nørreport at night remains a strongly active space within the urban life. Public transport runs all night long with buses replacing train at night during the week and the S-Train service running without interruption during the weekend¹⁶.

Being a central hub for the all transportation in the city, the night life in Copenhagen starts here and ends here. It needs to be a reliable space and infrastructure for all users.

The esplanade of Nørreport station integrates the existing lighting of the pedestrian streets leading into the city centre, with the standard street lighting fixtures following the three main paths of the space. First is the axis leading from the city centre on Frederiksborggade towards Dronning Louises Bro and Nørrebro, from a pedestrian active part of the city to a street space shared with bicycles, buses, and cars. Second is the Nørre



(illustration 23 – Bicycles and bus passage in periphery of the esplanade)

Voldgade, on one side a street for bicycles and cars still representing a strong driving artery of Copenhagen, and on the other the new pedestrian path connected to shops bordering the esplanade. The third is Gothersgade, bordering the botanical garden and Royal garden.

These paths through and around the space demand an efficient lighting structure, that doesn't interfere with the physical structure, making the standard street lighting fixture perfect for the task, blending into the environment, with a limited physical presence. It is a simple metal

casing fixture hanging from cables, attached to the surrounding buildings, and placed high enough so as not to be perceived directly and instead draw attention to the illuminated ground.

The suppression of one of the roads of Nørre Voldgade to attach the surface of Nørreport station to the city centre made the shops and other activity centre bordering the space visually closer to the elements of the station, with light from the shops illuminating directly the bicycles and the points providing access to public transport services. This visual link lures users of the esplanade to these activity centres.

Organisation

Nørreport station is a complex addition of transport services, with most of it being underground, so the additional lighting around the opening of the access points to the underground and the bus stops makes these clearly visible for users, directing them through the space with ease.

Additionally, underground activity has an impact on the surface activity, with unexpected changes in schedule affecting how users will travel through the city from this point, this being especially important early in the morning with people going to work, or late at night with those finishing their participation in the nightlife. Illuminated dynamic schedule boards give a quality to the functionality of the space.

Lighting at Nørreport station, above and below, suits the functional requirements of an active public space, through simple implementations of light, that affect the space in a passive way while clearly suiting needs in an efficient way.

Social development



(illustration 24 – Nørreport station esplanade lighting distribution plan)

The goal was to integrate Nørreport into the life of the central urban space. Urban planning for the city implies the need for the development of interaction between users, giving them the means to do so, but also creating a space that makes them willing, too.

The limitation of standard street lighting fixtures to these main axes creates a visual hierarchy, differentiating the elements of the station from the rest of the city, with specific lighting for the bicycle parking, for the gathering spots on the esplanade or for the service or access points of the public transport system.



(illustration 25 – Composite lighting of on the esplanade of Nørreport station)

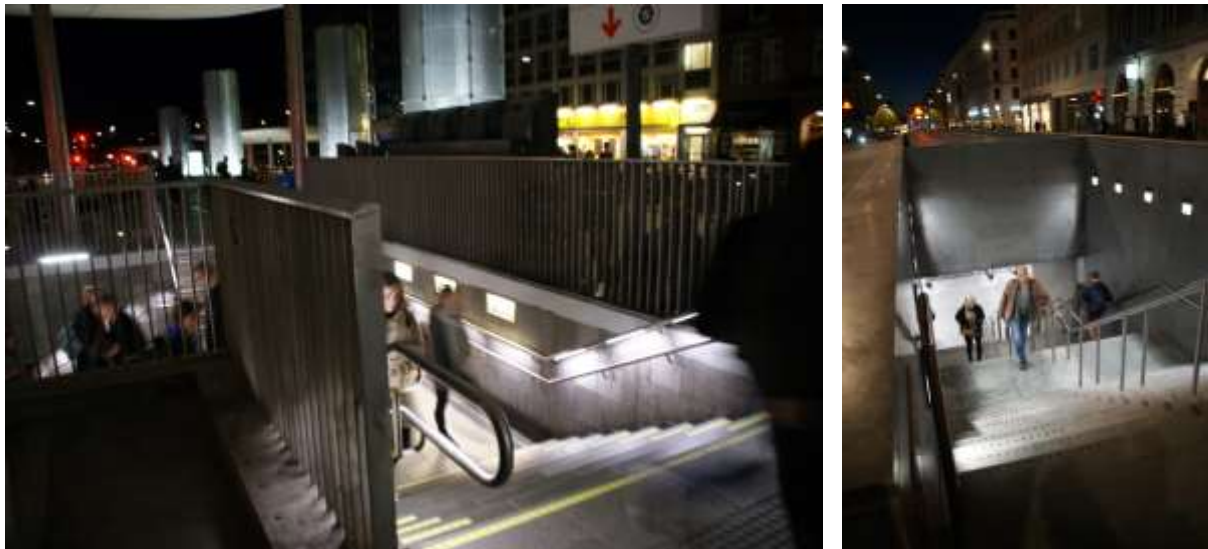
Direct overhead grid lighting for the main axis created paths for an efficient transition through the esplanade, as clear cuts in the myriad of elements of the plaza, while at eye level direct lighting shaped around the physical structures of the space created lighted zones to attract people to the activity centres and to the access points of the plaza and station.



(illustration 26 – Composite lighting of on the esplanade of Nørreport station – sketch detail)

Light emanating from the panels of the ventilation shafts creates radial light zones around them, which, by the location of the shafts, creates a path through the esplanade, with the light level adapted for a secondary semi-static use of the space by people.

The underground structure is enhanced by illumination along the stair railings, showing the way down, but also through the reflection of light on the floor surface, creating a visual thread of light guiding the user from underneath their tracks.



(illustration 27 – Lighting guiding users down to the underground platforms of Nørreport station)

Pillar lighting creates illumination strong enough to promote activity in this space making people visible to each other and allowing them to interact, but low enough to maintain an intimate enough environment for social development.

Identity

Nørreport has always had a strong identity because it is the main hub of the public transport. With the development of the city's night life its general identity needed to suit the use of night activities.

Spatial hierarchy

The concrete texture and the isolation from the city street lighting create clear edges defining the area of use of this public space, lacking the illumination and physical structure standards that are met for the surrounding roads.

The clear visual singularity of the architectural elements but also of the lighting fixtures define the space in the mental image of the city.

In the same sense the lighting helps define the physical features of the space accompanying the shape of the building at night. Each element of this space needs to have a purpose, it being

functional or aesthetic, to avoid contributing to the loss of identity of the space. The implementation of ventilation shafts could contribute to this problem but the addition of light panels around them change them into useful beacons.

Narrative of use

The light added to each bicycle rake creates a sense of order for cycle parks. It is split into different clusters which support a narrative for the space not only for the cyclists but also for all the station users.



(illustration 28 – Bicycle parking and its solar lighting lamps highlighting this function within the space)

Comfort

Nørreport is a busy station. Therefore, the designers have taken care to implement elements contributing to the user's well-being and comfort as well as a sustainable environment.

Safety

In this crowd people must understand their environment quickly and clearly. For example, the strong street lighting of the main axes makes the urban plan clear. These urban definitions through lighting help people to specialise and apprehend risk.

The fact that there is a minimum light through the whole space helps people visualise the use of the space and trust it. Moreover, lighting of faces in the areas of activity is obtained by a combination of the overhead street lightings, the low circular lightings of the space structures and ground up lights around the activity points of the esplanade. This makes it easy to recognise faces and intentions.

The warm illumination of functional spaces is adapted to their usage. This creates a sense of security. For example, the lighting of the island shops is strong and warm. In contrast the area surrounding the ventilation shafts and the benches are meant for social gathering for which a cool and more intimate lighting is desired and obtained. This also contributes to a feeling of safety.



(illustration 29 – Lighting of the ventilation shafts as a beacon point to gather users)

Order

The visual appealing of an organised space created by the rows of bike rack lights makes a beautiful picture. In addition, these thousand lights are creating a lovely atmosphere which helps forget the chaos of bicycle parking.

The constant lighting and functional aspect of the underground creates a monotonous and unfriendly environment for users. Something that seems to have been fought against in the renovation project of Nørreport station. For example, the stairs leading to the undergrounds are special, they are located above the stairs as well as along the railings. They contribute to a gradual transition between the outside and the underground.

5.3 Israels Plads: Reconnecting the city in the public space through comfort and sustainability

A second example with the case of Israels Plads offers the study of lighting to support a less active public space structure at night, focusing on ambiance and sustainability rather than function.

5.3.1 About

The space where Israels Plads stands today was once part of the fortifications of Copenhagen. The growth of Copenhagen pushed it out of its walls and they were demolished in the second half of the 19th century, resulting in a large gap in the urban space. The use of this more than 7,000 m² empty space by a grocery and flea market gave to the plaza its name “Grønttorvet”, which from 1889 to 1958 acted as a core commercial element of the city centre. The continuing growth of Copenhagen making the space a very desirable area for housing and parking, and the opening of a new market in Valby closed the market. This resulted in the use of Grønttorvet as a large car park in the middle of the city until its refurbishment in 2011 and 2012.

After being renamed Israel Plads in 1968 to celebrate the 25th anniversary of “The rescue of the Danish Jews”, the space saw first the creation in 2011 of two market halls with stalls selling food and groceries and named “Torvehallerne”, bringing a bit of life to the old car park, then

the plan for renovation of the remaining part of the plaza into a space dedicated to pedestrian use of sports and recreation.



(illustration 30 – New esplanade of Israels Plads)

“The cars are literally swept under the new urban carpet. The plaza also works as a transition between two worlds, the city, and the neighbouring park. The landscape character of the park continues into the plaza in the form of the organic pattern of trees. Towards east and west, the plaza is raised up and folded to provide niches. In addition, it has a sculptural expression that refers to its historical past as part of the fortifications. The surface functions as a large urban playground and a space for activity.

On the surface, unique facilities have been created to generate inspiration and space for many kinds of activity. For example, the cut-outs feature round bench formations under the tree crowns, where people can observe the life unfolding on the plaza. There is a green oasis next to the neighbouring school, and generous lowered areas for ball games and play are designed in rounded formations. The idea with the new Israels Plads is to celebrate the significance and the history of the site and revitalize it, turning it into a vibrant, diverse plaza for all kinds of people - for leisure, culture, activity and public events.”¹⁷

5.3.2 Criteria fulfilment

Function

The space of Israels Plads serves a double purpose. It serves as a new public space adding to the social and environment of Copenhagen, while fulfilling the still existing demand for car parking in the city. The design of the space follows the policy of Copenhagen to be a sustainable and user-friendly city by connecting to the neighbouring Ørsted Park and Torvehallerne food market, offering a recreational space with seating areas and sport facilities. It also includes the need for parking in the narrative by keeping the original function of the space but burying it underground so as not to hinder the other usages above.

At night we can find 4 different lightings illustrating the complexity of the space. First, to bring people together on the square, meeting zones are created through a combination of spot lights. This creates light zones separating spaces with stretches of darkness. These specific lit areas are scattered with benches on concrete slabs. This patchwork of lit and dark areas has been set to help people gather.



(illustration 31 – The combined illumination areas of the plaza creating a light path through the usage of light zones)

Second, the way to the car park is highlighted thanks to a strong and dense lighting issued from the ground and grazing the floor. This lighting does not impact the rest of the space and other usages.

Third, strong light spots illuminate the centre of the plaza to answer the need of visibility of sport users, basketball players and skate boarders. Finally, two different illuminations connect the plaza to Torvehallerne and the rest of the night light, and Ørsted's Park.



(illustration 32 – Strong illumination on the Sports court at the centre of Israels Plads)

On the one hand, to connect to the park, the light is subtle and faint, helping to adapt to the need of some element of darkness. On the other hand, the connection to the streets is implied by suitably strong lighting features.

Identity

This space has been created to gather people issued from the neighbourhood. It has been given a strong identity through recreational facilities and physical features. Lighting helps support these sportive activities using strong spot lights at 10 m high and a pleasant atmosphere is obtained. Some patches of darkness have been kept creating an identity of transition between the urban environment of the streets to the natural environment of the park.



(illustration 33 - Transitional lighting along the stairs that lead from Israels Plads to Ørsted's Park leading to the darker green space)

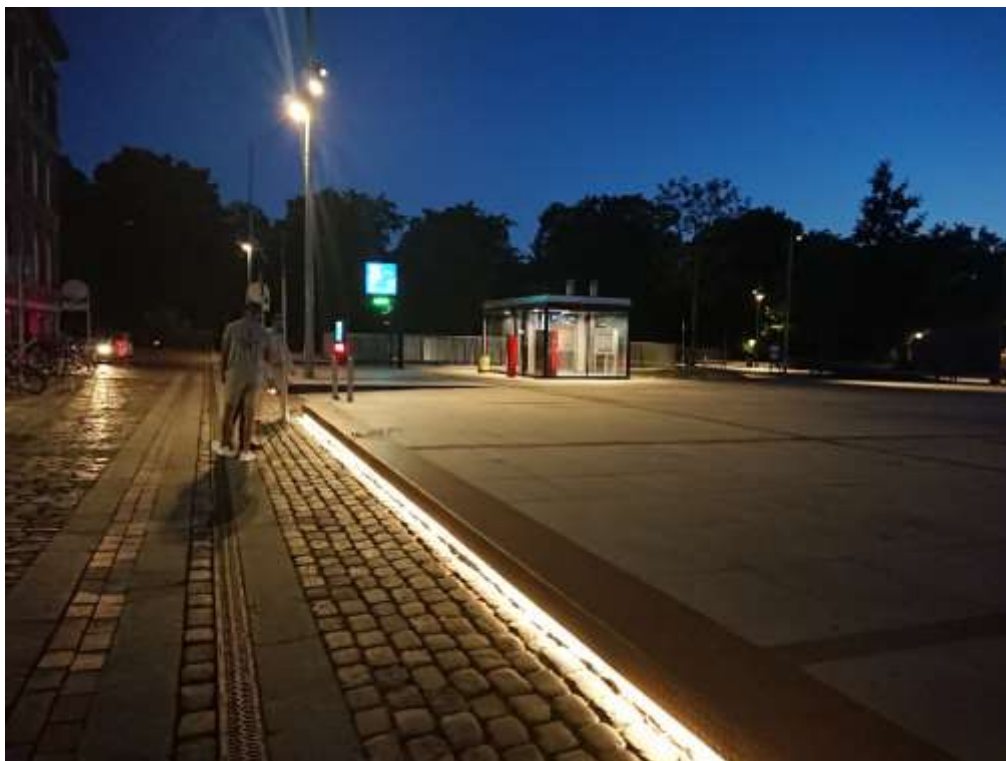
The car park is hidden underneath, so the lighting of its access points helps visually remember this function as part of the space identity. Efforts have been made to use an elegant lighting adapted to the curve of parking entrance.

The simple setup of illumination as a cluster of light zones created by stoplights from poles 5 m high corresponds to the rejection of a complicated space with a lot of traffic, lacking the commuter traffic and the bicycle parking of Nørreport station.

Israels Plads is a less active space than Nørreport station. Not supporting any public transport and more integrated in the residential structure of Copenhagen, its lighting serves to support an image of a calm and friendly space.

Comfort

The localise light zones of area sheltered by trees create an intimate setting for groups of people to gather and enjoy the night. The overheads and multiple sources of illuminations of this area allow visibility and facial recognition, crucial for users to trust their environment and the people using it. Preventing lighting of the plaza from spilling outside of the park, the building and the street in between reduces light pollution. This allows the protection of this urban night life such as the natural environment or people sleeping.



(illustration 34 – Directionality of lighting of the Plaza away from the residential building neighbouring Israels Plads)

5.4 Letbane stations for Lyngby: Public transport a centre for public space development

This project has got me interested since I heard about it when I was working for GPA in the fall of 2016. While the project is still in development and will not be built before 2030, it bears great implications in terms of future activities for the suburbs of Copenhagen it will cross.

5.4.1 About

“Gottlieb Paludan Architects (GPA) is the lead consultant on the project to design 28 stations and adjacent urban spaces and landscapes for the forthcoming Greater Copenhagen Light Rail System.

New transport needs have arisen since the so-called “Finger Plan” of 1947 presented an iconic plan for the urban development of Greater Copenhagen. Accordingly, eleven Greater Copenhagen Local Authorities, the Capital Region of Denmark and the Ministry of Transport and Building) joined forces to construct the Greater Copenhagen Light Rail System.

Glostrup, Lyngby, Buddinge, Herlev, Vallensbæk and Ishøj will become important new traffic junctions for the light rail system, buses together with regional and commuter trains. The light rail system is expected to carry 13–14 million passengers a year. However, this figure is expected to increase to 17–18 million as the areas along the light rail system become built-up.”¹⁸

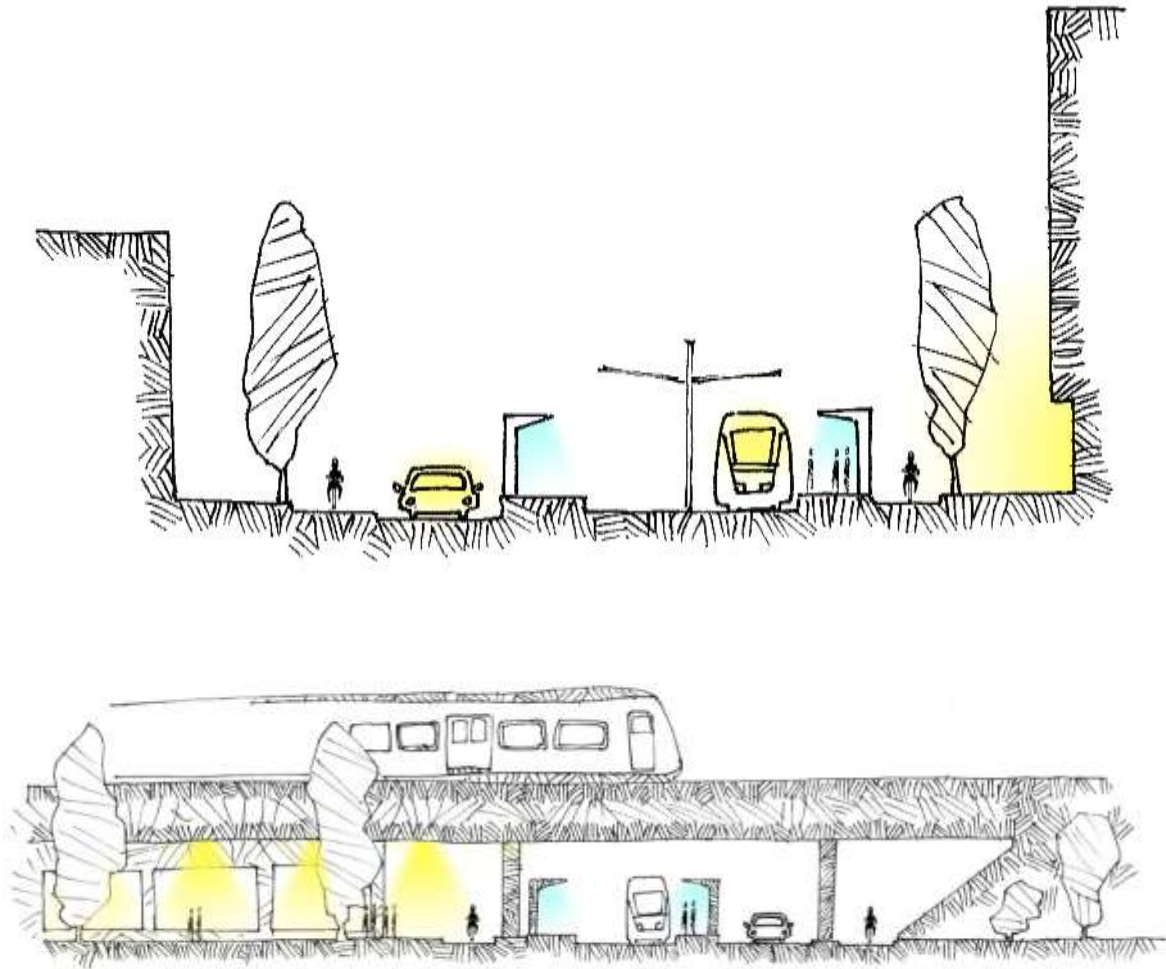
Lighting is an important element for infrastructure and architecture in the design by GPA, revealed through the example of Nørreport station and my personal experience of the people working there. Its implication in the project is greater than the simple function illustrated in the technical drawings that can be consulted today.

While the stations run from Lundtofte in the north to Ishøj in the south, this study will focus on one part of the network, the stations within the town of Lyngby, *Lyngby* and *Lyngby Centrum*. The first should be integrated to the train station and bus terminal, and the other should run through the town centre in the commercial district. This choice comes also out of a personal knowledge of the area, living in Lyngby, and the importance of activity in downtown Lyngby, the latter being the centre of a town with an important commercial area, historical background and connection to the University campus of Danmarks Tekniske Universitet.

Part of a large network meant to bring urban areas together through public transport, the stations of the Let Bane are built following variable standards, with one of them applying to the two light rail platforms of Lyngby Station and Lyngby Centrum.



(illustration 35 – Visual concept integration of the station into Lyngby centrum and Lyngby station)



(illustration 36 – Elevation sketches of the two light rail stations)

The version of these stations is two platforms serving two sets of rails in the centre of the street, reducing the existing highway from 4 to 2 lanes, with the addition of a cycle lane on one side of Lyngby station. The illumination of the platforms is done through 3 elements. The length of the platforms is illuminated by light fixtures integrated in the stair railings, lighting the ground, and by light panels integrated into the underside of the roof sheltering the information board and ticket booth. Light also emanates from the information stands, physical structures which indicate the station and support the check-in scanners for transport documentation.

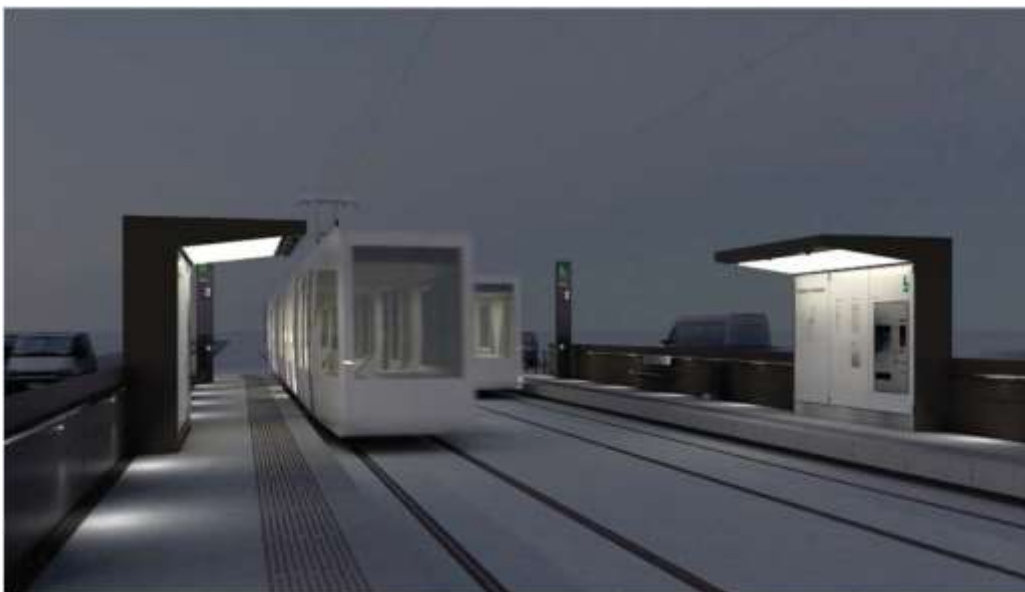
5.4.2 Criteria fulfilment

Function

The physical transformation of the area where the station will be implemented will require drastic changes, with illumination of the street having to match the reduced the number of lanes and the associated desired change in atmosphere brought upon by substituting public transport to motoring traffic. Thus, street lighting should reflect and entice an increase in local trading activity brought in by the implementation of public transport and the opening of spaces derived from it.

Wayfinding

Light from the railings serves as a means to guide users out and onto the trains, allowing for a clear visibility of the path thanks to the light washing the ground, but also because of the visual contrast between street lighting and platform lighting. The eye will be guided towards the platform. The rhythmic pattern of light along the way will give a sense of scale to the platform from afar and within the space.



(illustration 37 – Railing lighting washing on the platform in the context of Lyngby station)

Organisation

With clear and simple elements of lighting, the functions within the space are well defined. The area of mobility is defined by the path lighted by the railings, the lighting above the ticket booths gives visibility to this physical element, immediately catching the eye of the user searching for it, even amongst the crowd. Visually, the station is given a presence by the illumination of the information stand.

Guiding people with ease to and from the platforms will help integrate the station within the urban space, helping the public transport development of these spaces contribute to the development of activities around the stations.

Identity

The light railway project defines itself as a new means of transportation within the urban structure of Copenhagen, running along a main road and road public transport hub, Kampenborgvej and Lyngby Station's bus terminal, reducing the size of the road to set up the rails and stations, signalling a goal to reduce car traffic while improving the connection between the different areas.

The implementation of a new means of public transport on an axis designed originally for car traffic can be a difficult task, so the elements of the light railway need to be given a strong image to highlight their presence within the space and integrate them, in order to improve their usage.

Therefore, the use of lighting sculpts the space to shape its visibility.

Spatial hierarchy

The physical space of the station is well defined by the railing illumination, limited to illuminating the ground of the platforms and rails, except for the access points, where the light can bleed out onto the street, not shielded by the panels beneath the railing. By defining an outline for the light railway service structure, it is highlighting areas within the space, thus showing where to access it.

The illumination of the ticket booth and information stands gives users a visual understanding of the identity of a given station. They allow the user to see the name of the station but also from their experience of the visual identity of a bus stop or a train stop, understanding from afar the nature of a physical structure associated with bus or train traffic, like a bus stop shelter or an information stand for buses or trains.



(illustration 38 – Overhead lighting of the ticket booth)

Narrative of use

The visual shuffling of the space fits a narrative of use. The combination of the light path of the railings and the localised darker slabs of concrete at the crossing points shows the points connecting the platform to the surrounding space and ingrates it into a larger space, accessible to all.

The blue light of the check-in/out scanners, supported by the larger and more visible information stands, draws users to this necessary step before embarking upon the carriage.

The pattern of light along the length of the platform will also create a static resonance with the illumination emanating from the trains themselves, allowing commuters to have a visual scale to where they should stand to enter the carriages, and for spectators from outside the platform space to associate the platforms with the trains they witness.

Giving a memorable identity to a manufactured addition to the urban space allows it to better integrate within the space, providing people in general a new way of using the public space, instead of creating an alien structure that will antagonise them.

Comfort

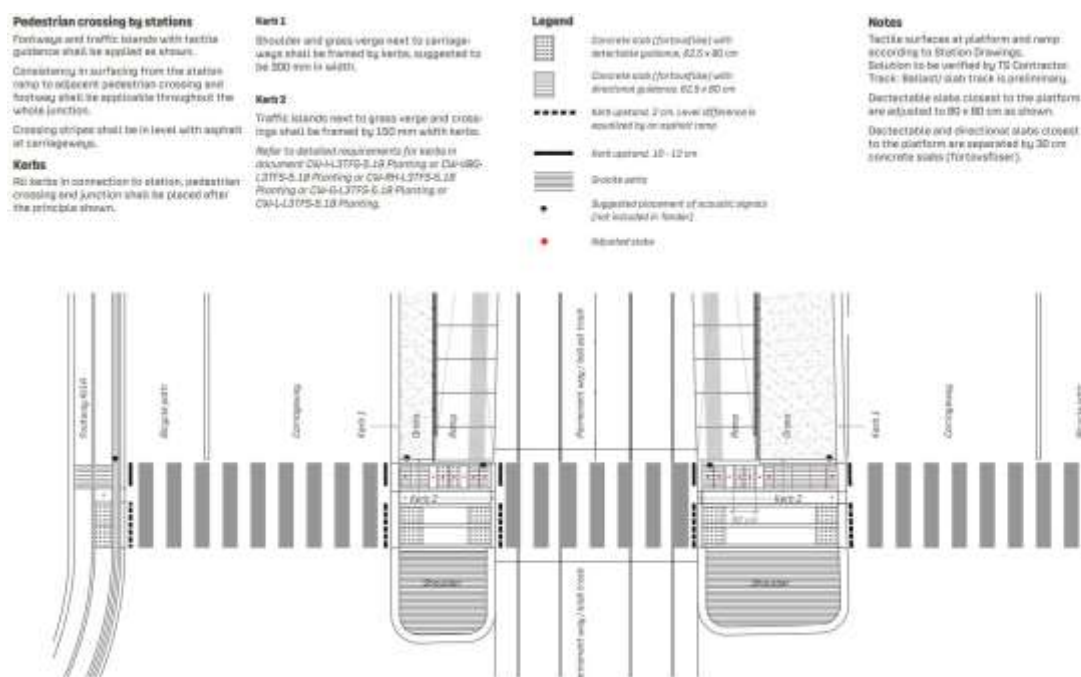
The development of public transport was to allow for an easy transportation for all and the implementation of public transport stations should bring an improvement to the use of the

urban space. Using light to improve the image of urban spaces related to public transport should give it a safer image, both in terms of practical security and the perception of safety, while moving away from the impact public transport can have regarding light pollution, affecting residents and the environment.

Safety

Users are kept safe through the clear definition of the functions of the space, allowing them to identify its different parts and physical elements, and making them see and be seen by other users. In order to keep them from being run over by a car, lighting shows their presence to the cars, and through the complementarity with the street lighting, make them aware of where the street starts, and make them able to see the cars coming.

The material of the platform, a light smooth concrete, with a high reflectivity, redirects the light from the railing to the faces of the platform's users, allowing facial recognition, which gives people a sense of security, as they can identify individuals and read their expressions.



(illustration 39 – technical drawing of the passageway from the platform to the street)

Illuminating the space with hardly visible light sources makes the space easier to experience, removing a strain on the user's perception, and creating a visually smooth image through this soft illumination.

This also limits the issues related to light pollution that would have been brought by a more direct illumination of the space, a matter that is also helped by the trees and vegetation that

will be planted around the railways, limiting the impact the lighting of the platform has on the illumination of the surrounding buildings.

Sustainability

Focusing the illumination on the platform limits the amount of power needed to illuminate the space, with little light wasted onto the surrounding space. This will limit the environmental impact of light on the surrounding natural life.

A clever combination of light and the surrounding physical elements and textures of the platforms makes the use of this public space at night more appealing, removing unsafe image of the public transport station at night and giving a visual comfort for users in an unnatural time for human activity.

However, while the lighting for the station has been properly thought of, the existing or adapted street lighting might not suit this situation, bringing issues of glare on the metal elements of the space and contributing to light pollution surrounding the platforms.

5.5 Summary of the case studies

The three case studies answer the criteria in different way on a common spectrum.

The notion of extended function resonates at different ranges. The illumination of these spaces serves as a means for wayfinding to direct people to and through them. This allows them to create paths for practical uses, connecting to transport and connecting the different geographical elements of the urban night-life together, but it also serves a means to connect users and give them a space for gathering.

Each space has its identity defined through lighting, though an illuminated narrative of use, but also through the shaping of the aspect of the physical space. giving an individuality defines the spaces in the image of the city and supports their function.

The notion of comfort is present through all, serving different purposes. For Nørreport, lighting serves as a mean to create a friendly space in contrast to usually dangerous urban central transit hubs, to attract people to the space and make the space more than just a necessary crossing point. Israel plads serves the needs of the needs to limit the impact of lighting over the urban area while still creating a usable and safe space in the residential neighbourhood.

6 Urban lighting guidelines

Through several case studies of urban planning projects concerning the integration of public spaces into the nightscape as direct actor or contributing to the development of the spaces they are part of, we can answer our final research question, as following,

“how can the integration of light as core of urban planning be used to extend the function, identity and well-being in the urban space, develop night life through an improvement of the urban public space?”

This question can be answered with the setup of guidelines that will define how to implement lighting in the design of the urban space. These guidelines can be broken down to three main parameters, based on a common structure for all urban spaces, applicable under different environmental conditions.

6.1 Social functionality

The use of lighting should be an extension from a functional aspect of visibility. The role of lighting in these projects helped structure the space for wayfinding and provide a specific organisation by creating a visual hierarchy. This resulted in a practical and comfortable space for all users, allowing for clear paths, and a visual understanding of the organisation of the urban space.

6.1.1 City for the people

Lighting the city should fulfil the functional needs on a more human level, adapted to the size, speed and behaviour of individuals, so that they can practically use the city, and they feel like they belong in the city.

6.1.2 Connecting the users

People in the city need light for visibility for needs of safety, to be able to assess the risks by discerning the surrounding and deterring no-good-doers through the protection of the light.

But light should also serve as a mean to create a space of exchange and mingling, through a visual understanding of the others, their expression and their individuality, but light should also allow intimacy.

6.2 Urban identity

The second parameter was the definition of an identity for the space. Giving an individuality to a specific space or structure within the urban landscape. The shaping of the urban landscape through light gave importance to these spaces and created a narrative of use within the public space. This created a strong image of the city in the mental map its users might create.

6.2.1 Individuality

The city has become fragmented and complexified. To understand the structure of the city at night we need lighting the shape the physical space and create a narrative to give personality and a place in the city to different areas.

6.2.2 Presence

The activity need of the city changes from one place to another, and the strength of the illumination should reflect that. Illumination should be relative to the level of activity and the relative presence of local users in the nightscape, following the nature of the districts, be it residential, park or the centre of the urban nightlife.

6.3 Comfort

Last, the third parameter considered the well-being of all actors of the urban landscape at night, be it the active users, playing a part in the night life of the city, but also passive users of the city that wish to be sheltered from its activity and the natural fauna and flora of our cities. Limiting the impact of light pollution to our night skies and understanding the uneasiness people have using the artificial dimension of the urban night, contribute to a more attractive and healthier city.

6.3.1 Well-being

Lighting the city is a purely artificial practice, disrupting strongly every natural behaviour. Illumination in the urban space should be thought to mimic natural structures and limit its influence on its surroundings. This would help limit the effect of light on the natural environment, fauna and flora, and support a healthy human usage of the night, possibly limiting the afflictions correlated to artificial lighting and night-time activities.

6.3.2 Sustainability

Making sure that the lighting will be able to sustain the test of time in terms of technology evolutions, cultural changes and physical afflictions

6.4 Conclusion

The implantation of these three parameters in the conceptualisation of our urban public spaces develops the structure of our nightscape to suit the needs of the more multi-dimensional night life of the modern city. The use and sustainability of the urban nightscape depends of its ability to support the composite array of users and functions of the urban space, creating a functional and comfortable city based on their senses and personal concepts of the urban space.

Through the analysis of works of literature about lighting and urban planning and several case studies of urban planning projects concerning the integration of public spaces into the nightscape as direct actor or contributing to the development of the public space they are part of, we can answer our final research question, as following,

“Can the integration of light as core of urban planning be used to extend the function, identity and well-being in the urban space, develop night life thought an improvement of the urban public space?”

Lighting can however not exist in a vacuum. While it is the key to making the city alive at night, it isn't the sole actor, and it must be considered as an important but not unique tool in the profession of urban planning. Light affects the urban planning as much as it is affected by it. Assimilating lighting design as part of a holistic structure to conceive a better urban landscape at night allows for a mutual help between the elements of urban planning.

The cooperating of lighting and urban design helps shape a more vivid and adapted concept in our projects of urban planning, being able to shape the aspect of the city in any manner wanted, and that following a set of objective rules that relate to the general basic structure of our city space.

The nature of these guidelines isn't perfect and truthful, but it is a malleable structure that can be applied to a wide range of urban environment. By breaking down the required structure of design we can create a more democratic apparatus of design for the nightscape.

While the application of these parameters in projects results in recognisably good results when taken alone or as part of the city as a whole, observing with a more selective view highlights the impact that existing bad lighting solutions have on them. Because lighting is a strong visual tool, it can as much have a good influence on the urban space than it can be ruined by other bad light sources.

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