LIGHT AS A TOOL TO STRUCTURE URBAN PLANNING

A Socially-Oriented Approach

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ABSTRACT

How can light positively influence and encourage pedestrians' engagement and interaction with the urban environments at night? In this Master Thesis, I questioned how to develop nighttime urban planning from a socially-oriented approach. In order to answer this question, I studied different evidence such as two publications, three lighting designers' and a lighting studio' approach; three case studies analyses, two of them located in Colombia (Cartagena and Medellín) and one in Sweden (Stockholm); and my own qualitative observation and quantitative measurements studied between April and May at Norrmalmstorg and Biblioteksgatan in Stockholm, Sweden. From that review, I propose a Guideline consisted of three sections: (1) **Main dimensions,** (2) **lighting attributes**, and (3) **lighting systems** in urban planning. In general, this guideline is a framework to develop the analytical tools for various design stages in nighttime urban planning.

Keywords: Human perception, citizens engagement, nighttime lighting, nighttime urban life, social interaction, nighttime urban planning, 24/7 cities.

ACKNOWLEDGEMENTS

To Florence, because every student is looking for a mentor and I had the fortune to have a great one. Thanks to her tutoring that help me to explore new ways to approach lighting and to find so much inspiration through the way.

To both lighting designers and lighting design studios generosity, by making available all their know-how to young designers through reports, publications, books and conferences that allow us to find guidance. I have found in lighting designers, a group of professionals open to sharing their knowledge and experience.

To the lighting laboratory at KTH, professors, classmates and lecturers, this learning journey has been exciting. One year is too short for such intriguing topic, light.

LIGHT AS A TOOL TO STRUCTURE URBAN PLANNING

1. INTRODUCTION

“For most people, the night is all about sleep. But what happens when we make do without sleep and stay awake through the night? What do we see when we gaze into the darkness? What feelings do we have when we listen to the stillness of the night? And how do our lives change when we bring light into the darkness and turn the night to day?”

The Night: Everything but Sleep. Museum für Kommunikation Frankfurt. Luminale March 2018

Nowadays most of the world population lives in urban areas, demanding an urban infrastructure that works 24/7. In contrast, urban planning mainly considers the daytime situation without taking into account the changes between people's activities from day to night. As a result, there are currently high demands for the functioning of cities, linked to the daily activities that people develop during the daytime, without considering the characteristics of the nighttime; either the reality of cities' infrastructure. From this situation, researching lighting in urban environments is a great opportunity to propose a method to approach to **urban planning** at **nighttime**, from a socially-oriented approach.

So far, research has been done, proving the positive influence in the sustainability of cities in social terms, of developing lighting design projects in urban environments. These research had been studied from two main scales: (1) city scale, by analysing the benefits of lighting design proposals in squares, parks or streets brings to cities' functioning; and (2) pedestrian scale, specifically pedestrians' wayfinding throughout the city, related to the perception of safety. From that, how to articulate these two scales, considering the changes between the activities that people's develop in diverse slots of time during nighttime; and how lighting typologies influence the way in which pedestrians choose paths to follow or decide to stay in

Introduction | Methodology | Guideline | Discussion | Conclusions

specific areas at the urban spaces has not been developed in depth. That is a gap, that this research looks to explore.

Additionally, from all the possible approaches to urban planning, the **socially-oriented approach** is the most challenging, due to two factors: (1) it is the qualitative element that promotes people's engagement and interaction with the urban environments and the sustainability of the city in social terms; and (2) it is the most difficult element to address and communicate to government (professionals who make decisions related to future of the cities) and technicians (who execute the urban projects). This due to cities' benefits because of the social sustainability aspect is difficult to quantify; since this aspect mainly consists of soft facts related to qualitative aspects.

Finally, as the multinational firm of planners and designers, ARUP mentions: "*No matter what the purpose of use, nighttime active public spaces should be designed and used to maximize the efficiency and effectiveness of the user*" (ARUP, 2015). In those terms, the socially-oriented approach should be a transversal element throughout the design process, link to users' requirements and motivations, by having people at the core of the design proposal. From that, all the elements studied should be focus on how citizens make use of the public spaces, the activities that they carry on

and the changes of this activities during the nighttime period. In order to achieve that, this thesis presents an answer to the following question: **How can light positively influence and encourage pedestrians' engagement and interaction with the urban environments at night?**

2. METHODOLOGY

This research was built from a socially-oriented approach to urban planning, based on **pedestrians' perspective**. As result, the research was developed considering the pedestrians' scale related to how they interact with the urban infrastructure (figure 1.1), and the activities that they develop in diverse slots of time during the nighttime period in cities. Additionally, the urban scale selected is characterized by having pedestrian and vehicular areas, with mix use between commerce and housing or working areas; and an intermediate density in terms of influx of pedestrians (figure 1.2). Finally, during this research, to study pedestrians' perspective, the context had a relevant role. For this reason, to establish a comparison between different contexts was relevant. For this research, the comparison was made between **Sweden** and **Colombia**, and how these contexts influence the way in which citizens *dwell** in the public space and how are they engage with urban environments.

*In this research, the word *dwell* is used as a concept taken from the urban design field, that comes from a movement called "*Placemaking*". This concept inquires about "*how does the city shape its citizens?* ...and... *how does public space affect mood, emotion, interaction, bodily health, sociability, habit?*" (Bitar, 2015).

LIGHT AS A TOOL TO STRUCTURE URBAN PLANNING

SOCIALLY-ORIENTED APPROACH
PEDESTRIANS' PERSPECTIVE

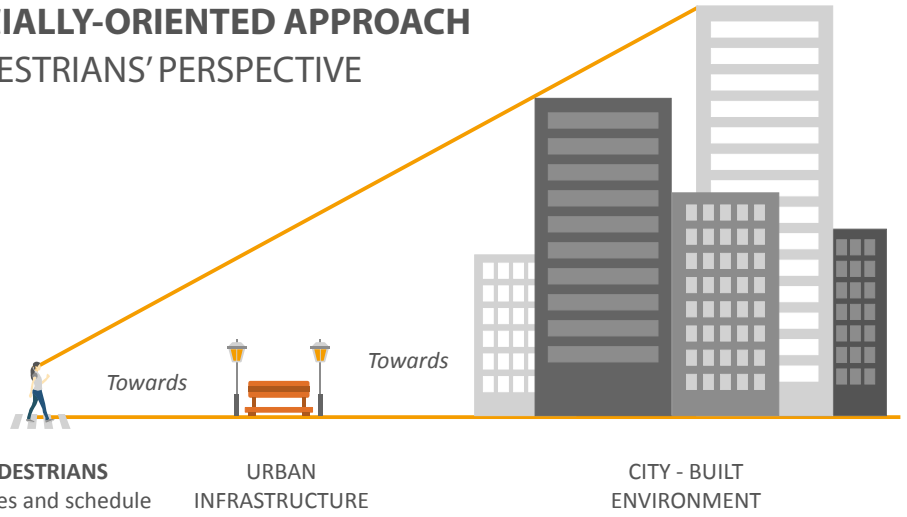

Figure 1.1 Socially-oriented approach to urban planning based on pedestrians' perspective - For this research, the urban infrastructure is studied from pedestrians' perception and scale, towards the city | Scheme: Author

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URBAN SCALE
SELECTED FOR THIS RESEARCH

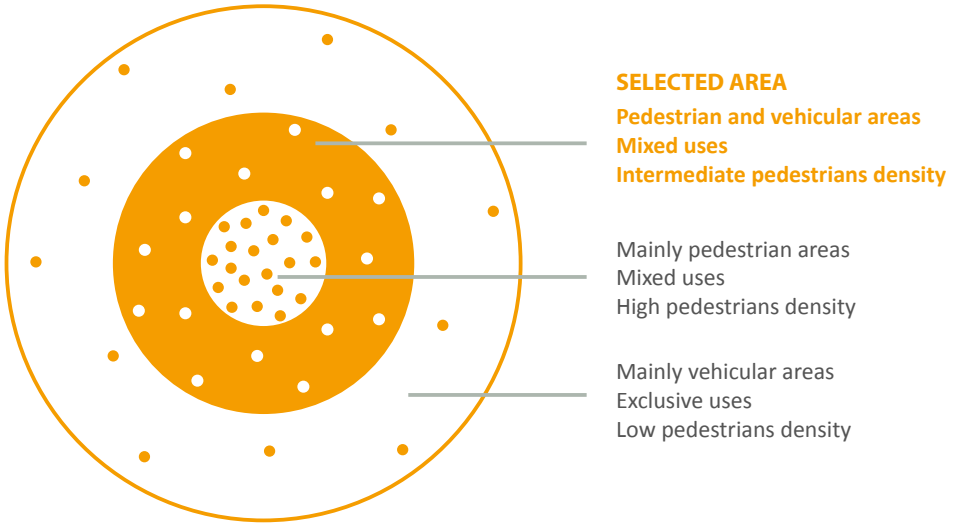

Figure 1.2 Urban scale selected for this research - The graphic shows a physical scheme of a city scale, where generally city centres have a high density of pedestrians due to its urban configuration; in contrast, areas in the periphery are characterized by having less density of pedestrians. From that, the area selected for this research is an intermediate area between these two scales| Scheme: Author

This study was done based on the analysis of different evidence to establish the framework to approach the nighttime urban planning. In the figure 1.3 can be seen an overview of how does this evidence contributed to structure the outcome.

2.1 Structure

To establish the *framework* of the guideline, the RIBA Plan of Work 2013 was studied. This "*is the definitive UK model for the building design and construction process*" (RIBA, 2013). This guideline was analysed with the aim to determine which of the stages during the design process are the essential ones to address a project with a socially-oriented approach.

2.2 Content

To determine the *information* and *processes* needed in each stage, diverse evidence was studied such as two publications; three lighting designers' experience and a lighting studio' approach; and three case studies analyses. From this, the urban planning strategies that had a socially-oriented approach were extracted. That, with the intention to define the analytical tools to consider to structure an urban project.

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Even though each item of evidence was analysed independently, the findings are collected and connected to structure the content of the guideline. This evidence was divided into two approaches. The first one was *literature review* related to nighttime urban planning. The second one was the *case studies analyses*. Next, each item of evidence will be presented.

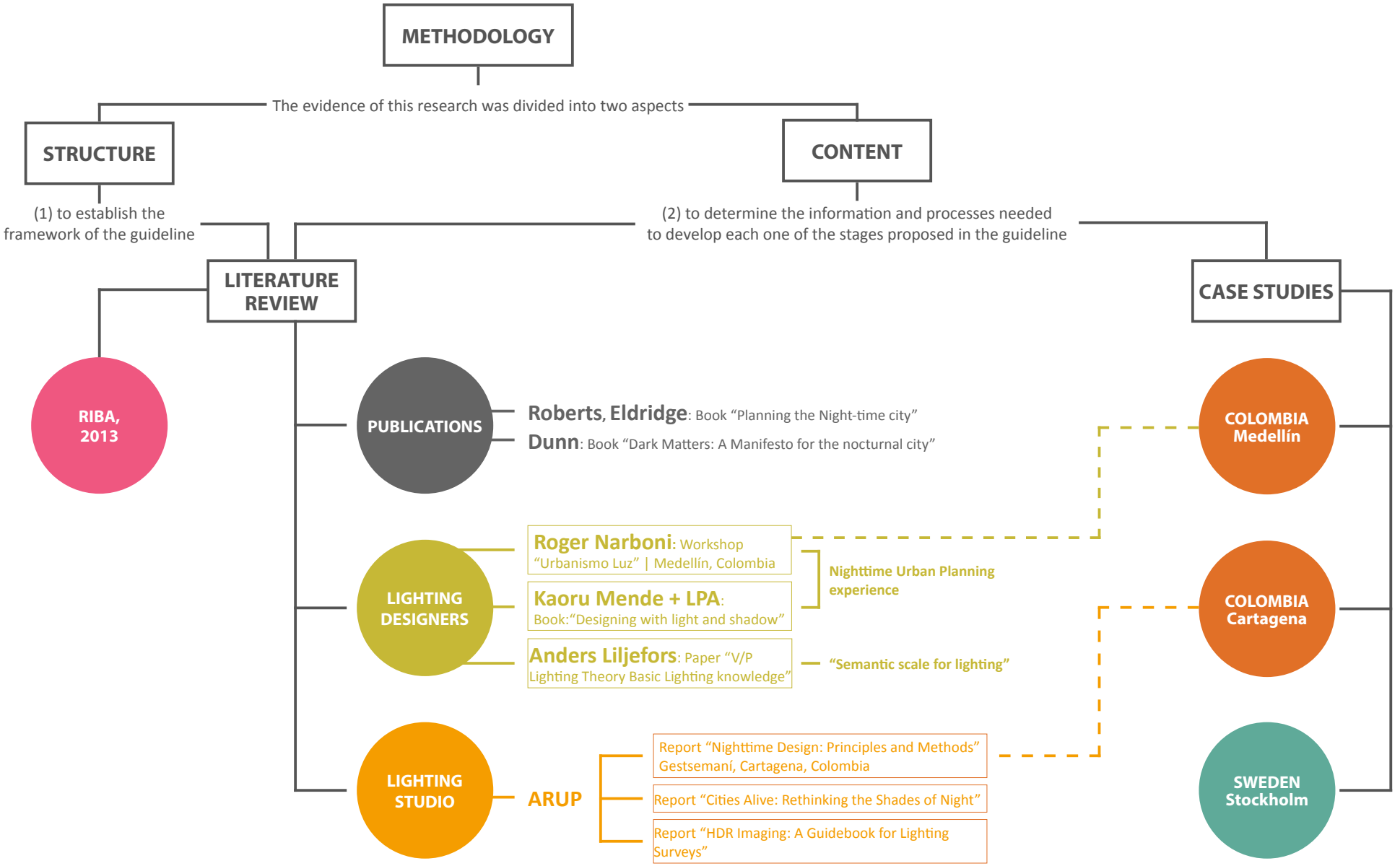

Figure 1.3 Overview of the methodology used in the research | Scheme: Author

3. LITERATURE REVIEW

In general, the findings from the literature review contributed to determining the main dimensions and lighting concepts to consider in nighttime urban planning.

3.1 Publications' review

-The selection of the two publications presented in figure 1.3 was based on the link of its content to diverse approaches to the nighttime period -such as social, economic and urban configuration-; and the current tendencies in urban planning that have been proposed from the analysis of pedestrians' requirements. From this, the urban planning strategies that have a socially-oriented approach were extracted.

3.2 Lighting designers' experience

The selection of the three professionals presented in figure 1.3 was based on two aspects. Firstly, lighting designers that have been developing

lighting urban projects having the pedestrians in the core of the structure of their design process, in diverse geographic locations. Secondly, the methodological approach to qualitative aspects in lighting design projects. This analysis was done by reviewing publications and a workshop where the author was a participant. From that, three aspects were studied: (1) The main considerations to develop a lighting urban project from a socially-oriented approach; (2) how these promoted pedestrians' engagement with public spaces; and (3) the tools that they have been using or developing to go through each one of the stages during the design process in urban planning.

3.3 Lighting studio approach

The selection of the multinational firm of planners and designers, ARUP, was based on their wide experience developing urban planning all over the world; and their commitment to propose projects with a socially-oriented approach. This studio was analysed through a case study developed in Cartagena, Colombia, and reports that the studio has done related to nighttime urban planning.

4. CASE STUDIES ANALYSES

In order to compare pedestrians' interaction with the urban infrastructure in different contexts, three projects were selected in two locations: Colombia and Sweden (Figure 1.4). In these projects, three main aspects were examined: (1) the differences between how pedestrian dwell the urban environments; (2) the existing urban policies related to lighting in each context; and (3) the levels of awareness related to the lighting design field.

Additionally, even though the weather influences the way how people make use of the public spaces, the period of time studied at Stockholm was during the months of April and May of 2018 having an average temperature of 14°C in May of 2018* (Time and date, 2018). A warm temperature that can be comparable to Medellín -average temperature of 16°C in November of 2014* (Time and date, 2018)-, and Cartagena- an average temperature of 14°C in February of 2015* (Time and date, 2018)-. From this situation, there were studied the contrasting characteristics found in each context.

*The average temperature presented corresponds to the dates when the pedestrians' studies took place: Stockholm at the end of April and during May, 2018; Medellín during November, 2014; and Cartagena during February, 2015.

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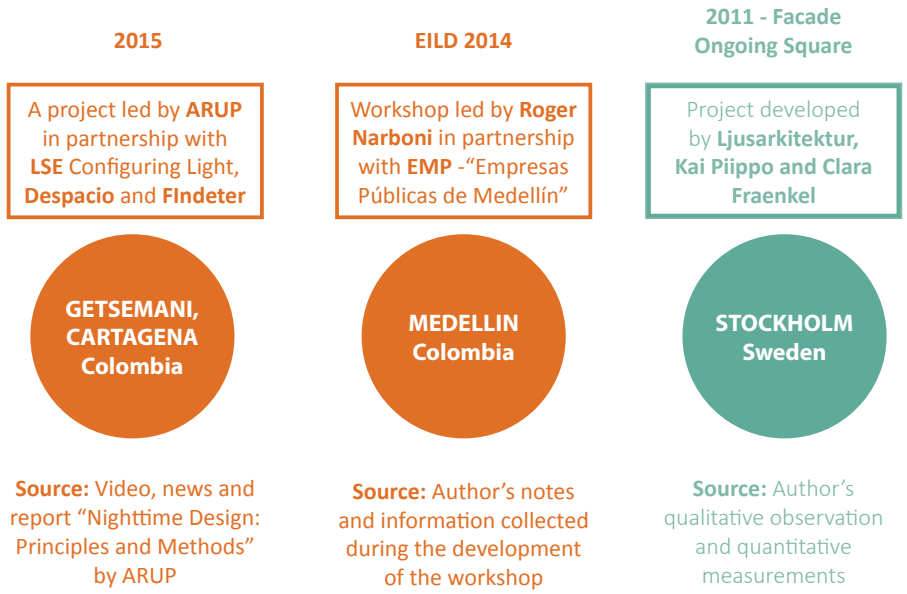

Figure 1.4 Projects analysed | Scheme: Author

4.1 Colombia

In this case, two projects were selected: Pilot installation in Getsemaní Cartagena, Colombia, developed by ARUP; and the Workshop developed in Medellín, Colombia, "Urbanismo luz" in the framework of the EILD -"Encuentro Iberoamericano de Lighting Design"- 2014, led by Roger Narboni in partnership with EMP -"Empresas Públicas de Medellín"-; in this last one, the author was a participant. The pedestrian engagement with urban environments, in these projects was studied according to the elements presented in figure 1.5

4.2 Sweden

For this location, a square and a street were selected as primary urban elements -**Norrmalmstorg** and **Biblioteksgatan**- in Stockholm, Sweden. These projects were selected due to three aspects: (1) the proposals were developed by lighting designers; (2) are located in an area with mix uses between commerce and working areas; and (3) the pedestrians belong to a varied group. Additionally, the data were collected during the spring season between the months of April and May of 2018. The main aim of the study was to establish the relationship between people's urban engagement and the lighting typologies proposed.

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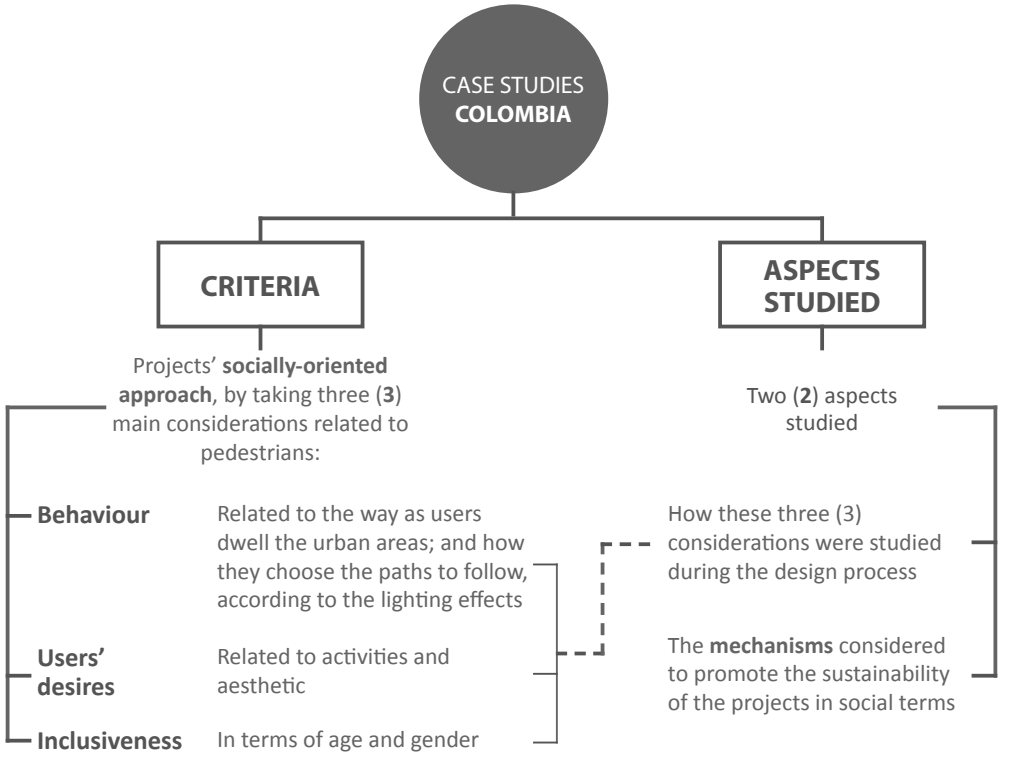

Figure 1.5 Case studies: Colombia - Selection criteria and aspects studied | Scheme: Author

4.2.1 Author's qualitative observation

The aim of this step was to determine the changes in pedestrians' behaviour in relation to light conditions. For that, the observation method was the result of the study of three approaches done by different professionals presented in figure 1.6. From these approaches were extracted the relevant aspects to study pedestrians' behaviour. As result, the observation was structured into two steps presented in figure 1.7. Firstly, six time-lapses were taken in typical days (Monday to Wednesday) in different time slots, by using an iPhone SE, to analyse people's behaviour, in relation to the paths that they followed in the public areas, and how these changed between daytime and nighttime period (figure 1.8, 1.9). Secondly, a comparison between daytime and nighttime was done by considering four aspects: paths, pedestrians' group, permanence and velocity (Addendum 2.1). Additionally, during the nighttime period, there were studied three aspects: nighttime activities, atmospheres and scenes.

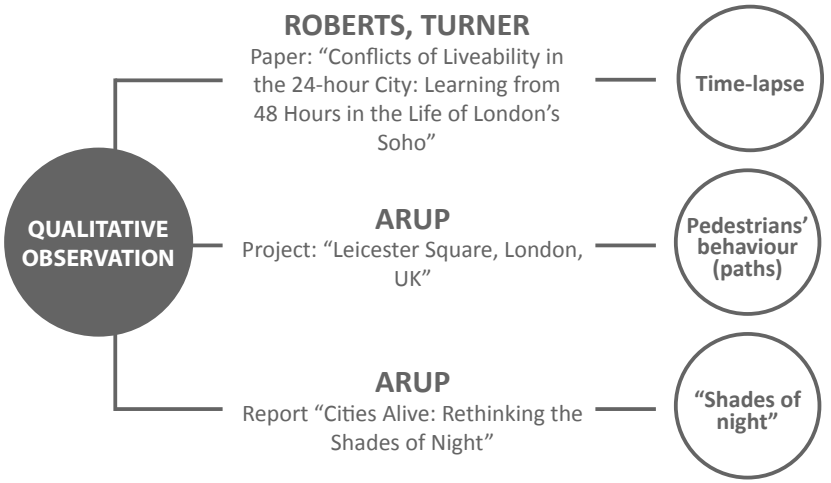

Figure 1.6 Evidence studied to structure the author's qualitative observation | Scheme: Author

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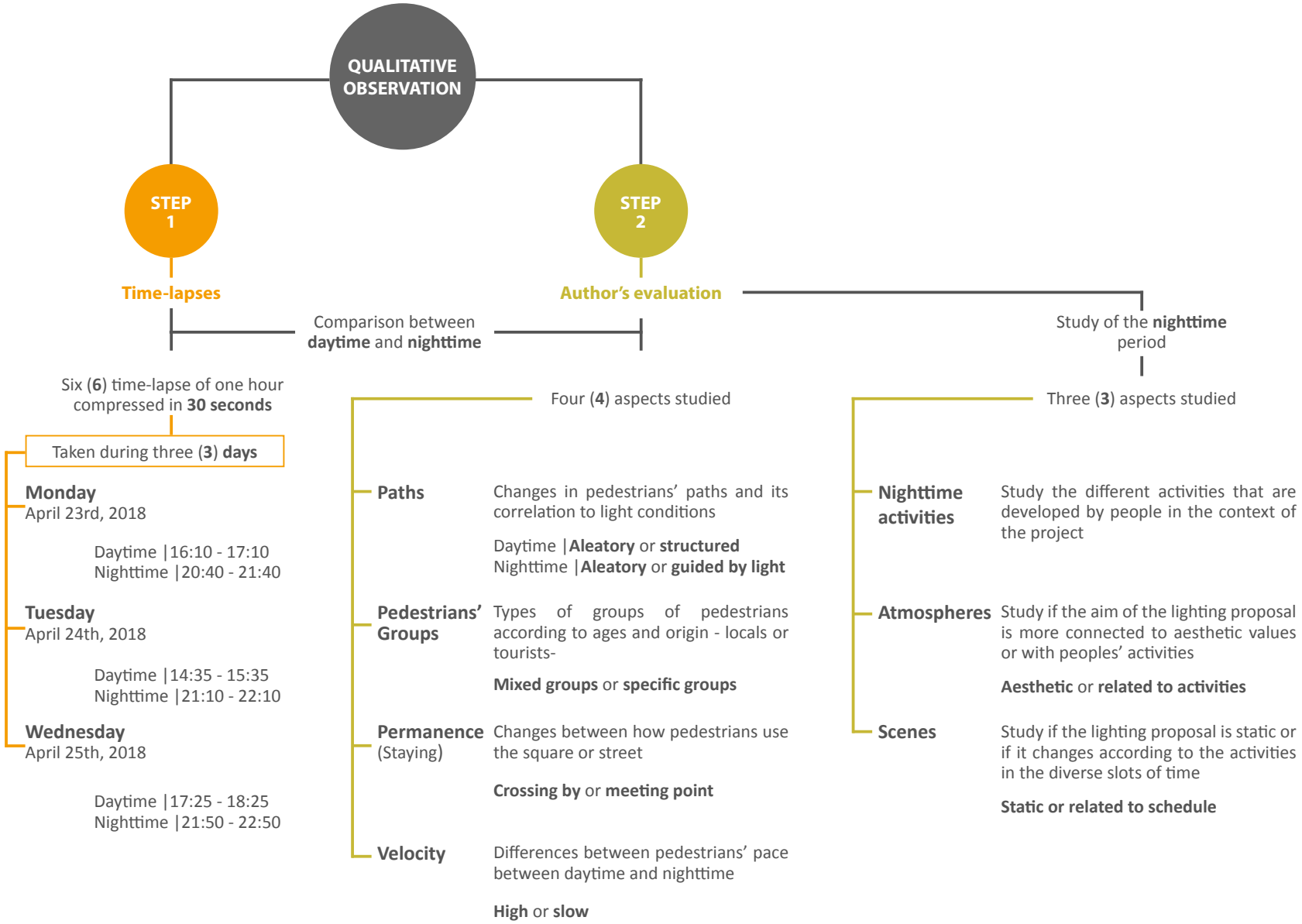

Figure 1.7 Methodology of the author's qualitative observation - The first four (4) aspects of the "Author's evaluation" were studied during the three days in which the time-lapses were taken, during the daytime and nighttime period. Additionally, for the each of the four (4) aspects studied two variables were considered. For the case of the first aspect "Path", the term of the variable was changed between daytime and nighttime to make more evident its relation to light | Scheme: Author

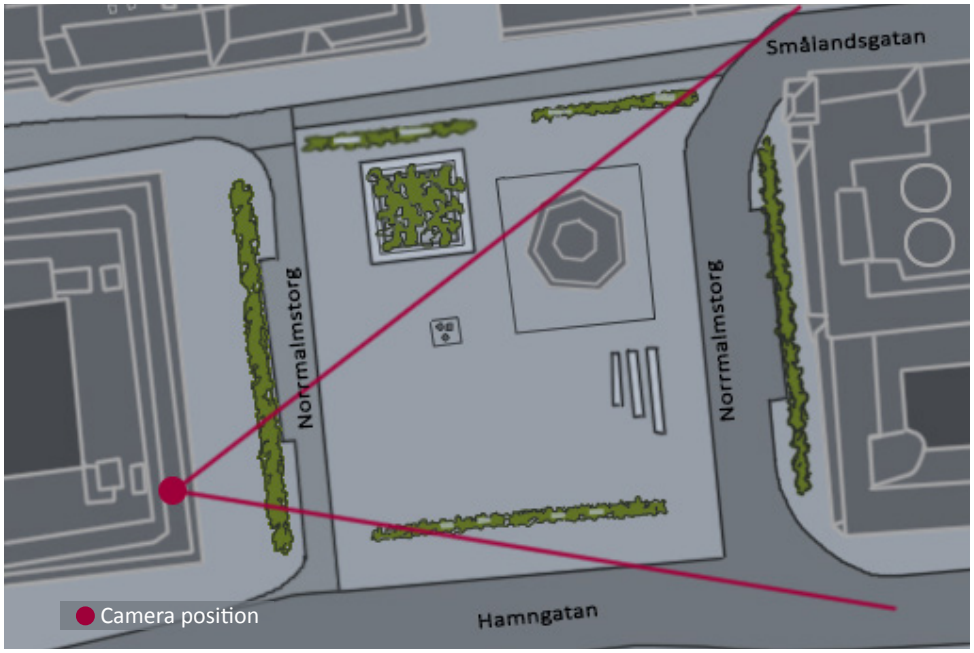

Figure 1.8 Camera position and view angles of the time-lapses | Scheme: Author

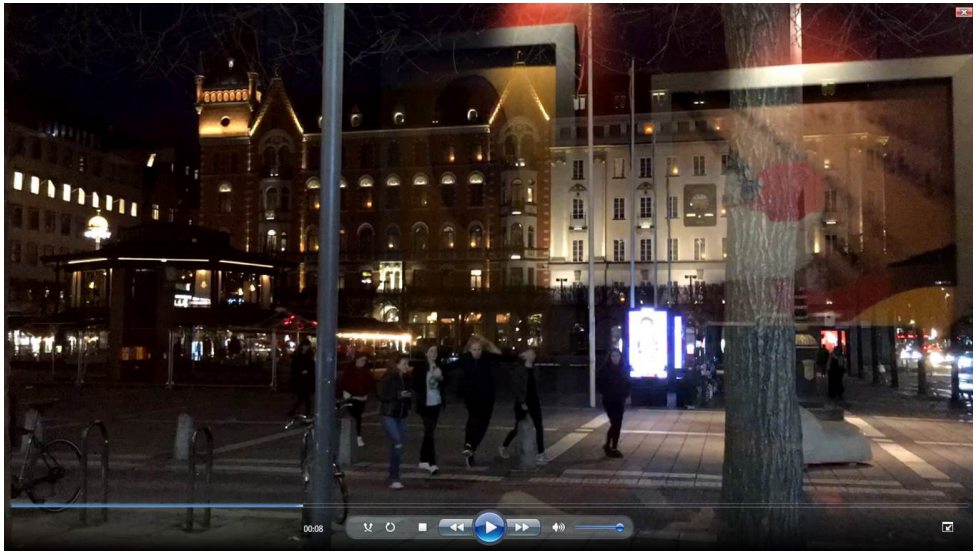

Figure 1.9 Time-lapse still - Tuesday, April 24th, 2018 - Nighttime period 21:10-22:10 | Photo: Author

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4.2.2 Author's quantitative measurements

The aim of this step was to study how the lighting technical specifications can be addressed to encourage pedestrians engagement and interaction in the public spaces. For that, the observation method was the result of the study of two approaches done by different professionals presented in figure 1.10. From these approaches were extracted the relevant aspects to study pedestrians' behaviour. As result, diverse measurements in the **horizontal** and **vertical plane** were taken on site during the nighttime period (figure 1.11, figure 1.12). Those measurements were divided into two steps presented in figure 1.13. Firstly lighting attributes such as light' position, color temperature, color rendering and lighting levels were assessed. This data was collected with a CL-500A illuminance spectrophotometer. Secondly, HDR images were taken in diverse points of the project by using the app Aftab Luminance, to evaluate lighting distribution and shadow.

As result, qualitative and quantitative information was gathered that allowed the author to study how lighting conditions influence pedestrians' behaviour in urban areas. Those findings contributed to determining the lighting attributes that lighting designers should bear in mind to develop the concept design stage.

Figure 1.10 Evidence studied to structure the author's quantitative measurements | Scheme: Author

Figure 1.11 **Biblioteksgatan**: Evidence studied to structure the author's quantitative measurements - The measurements of the lighting levels were taken in three (3) different points by using a CL-500A illuminance spectrophotometer Konica Minolta - The HDR images to study the perception of a person's face were taken in the same three (3) points by using the app Aftab Luminance - The HDR images to study the lighting distribution were taken from two (2) different points | Scheme: Author

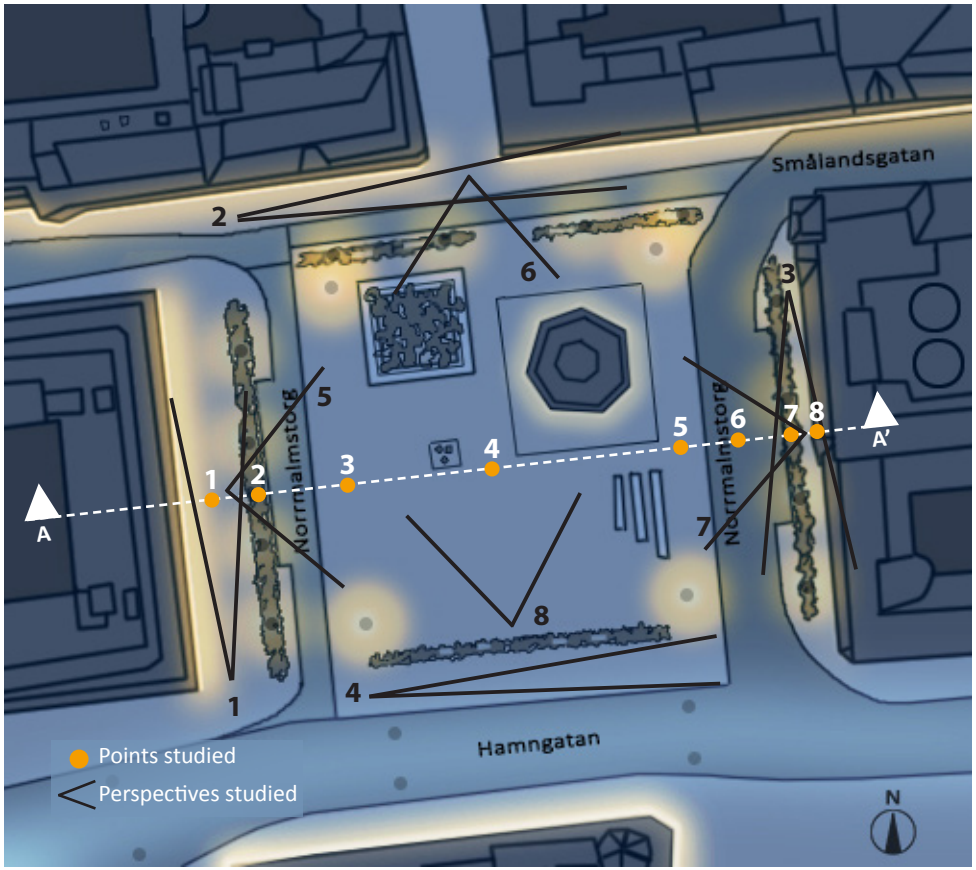

Figure 1.12 **Norrmalmstorg**: Evidence studied to structure the author's quantitative measurements - The measurements of the lighting levels were taken in eight (8) different points by using a CL-500A illuminance spectrophotometer Konica Minolta - The HDR images to study the perception of a person's face were taken in the same eight (8) points by using the app Aftab Luminance - The HDR images to study the lighting distribution were taken from eight (8) different points | Scheme: Author

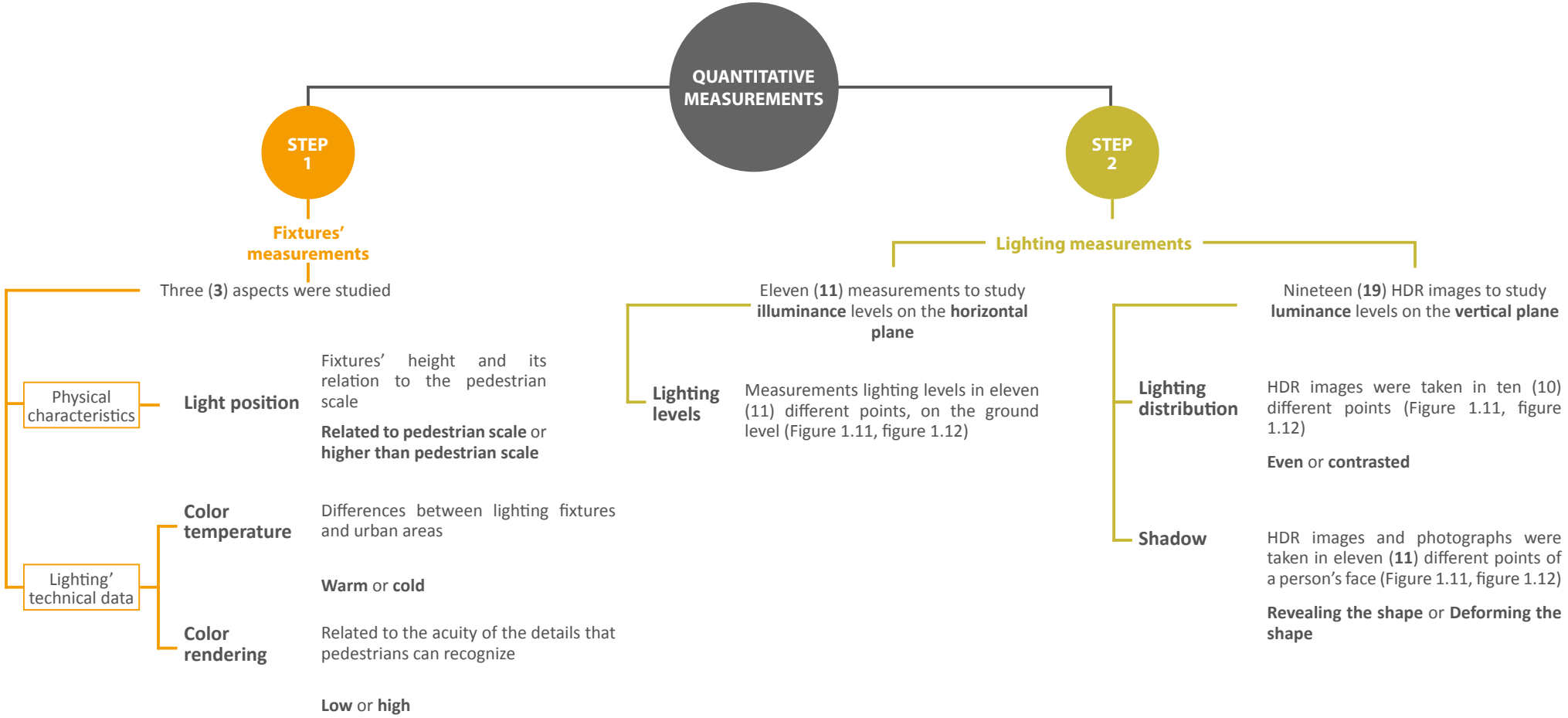

Figure 1.13 Methodology of the author's quantitative measurements - The measurements related to color temperature, color rendering and lighting levels were taken with a CL-500A illuminance spectrophotometer Konica Minolta - The HDR images were generated through the app Aftab Luminance | Scheme: Author

5. GUIDELINE | Results

The main outcome of the research is the relevance of the users' role -*pedestrians*- during the site research and concept design in urban planning. This due to, pedestrians' study allows to determine the aims of the urban project; gives designers hints for the design concept according to their needs and context; and contributes to the sustainability of the urban projects, in social terms. This relevance is highlighted in the comparison between the case studies of **Cartagena**, **Medellín** and **Stockholm.**

From that review and having the pedestrian as the core of the urban planning at the nighttime period, a **Guideline for the nighttime urban planning** is proposed with the intention to make available to upcoming lighting designers the knowledge, evidence and tools that professionals have been developing in this field.

Guideline for the nighttime urban planning

The aim of the guideline is to establish the **framework** to structure urban lighting proposals, by identifying the **attributes in the light** that **encourage people** to **dwell and explore the city**.

As result, after the different design stages outlined in the "*RIBA Plan of Work 2013*" were studied, the three first design stages were selected. That because, through the first stage can be aligned the design intentions with the multidisciplinary teams involved in the design of urban projects, and in the second and third stages is possible to address those intentions in the lighting proposals. The three stages proposed are presented in the Figure 1.14 and how each item of evidence contributed to the content of each stage is summarized in the addendum 3.1

From that review, each stage will aim to help lighting designers to structure their proposals, to plan the outcomes of each step, and it will present a list of tools to go through each one of the tasks.

THREE STAGES
PROPOSED IN URBAN PLANNING

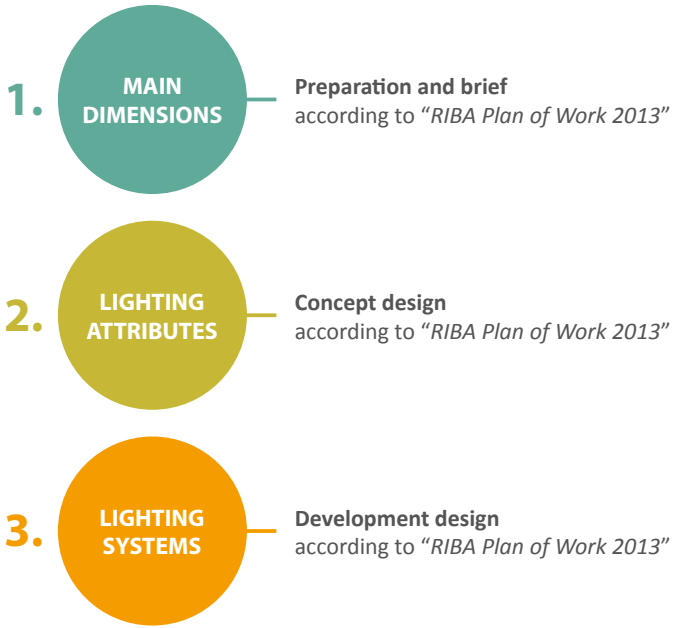

Figure 1.14 Three stages proposed for the Guideline for the Nighttime Urban Planning | Scheme: Author

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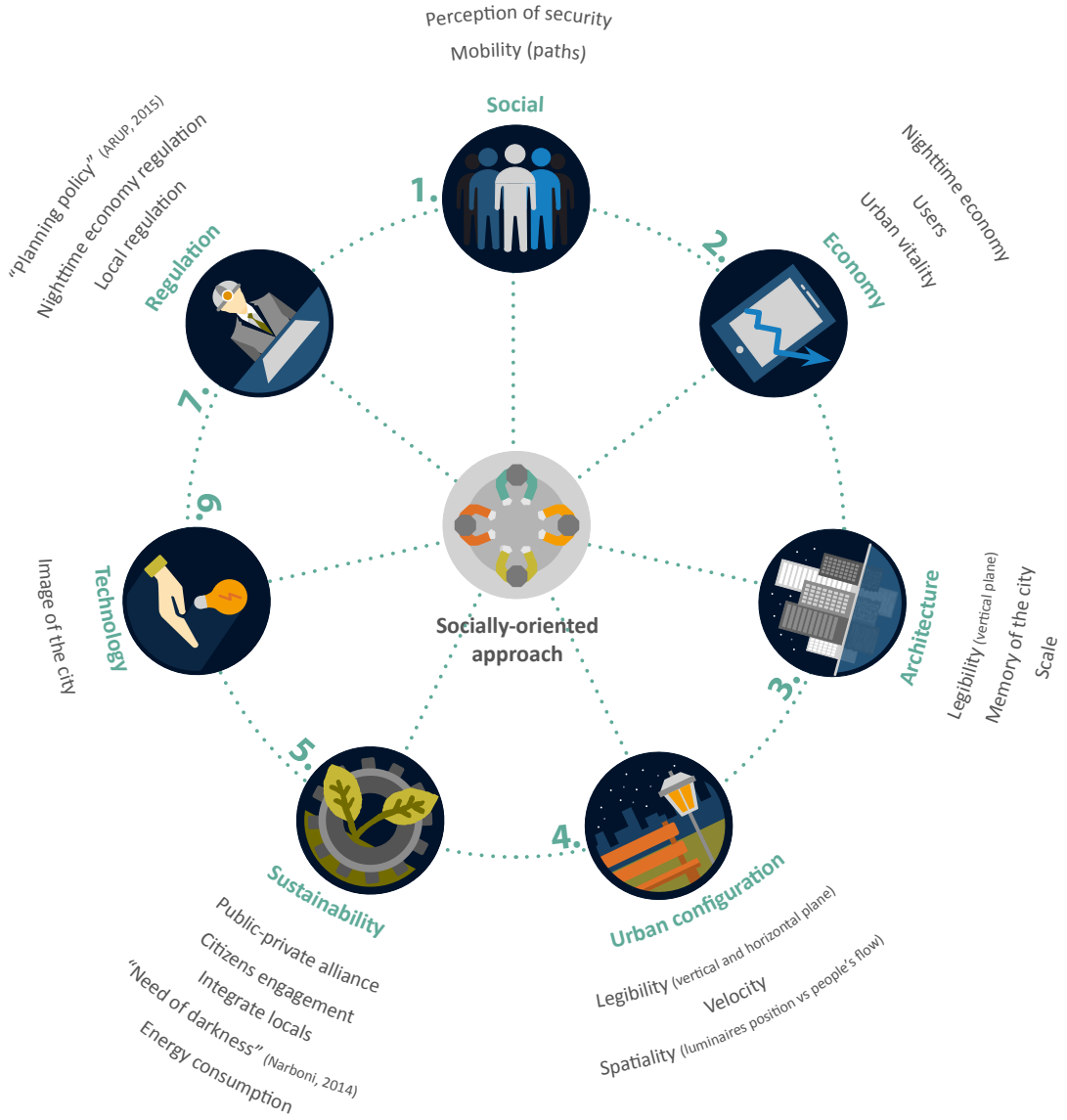
6. MAIN DIMENSIONS IN URBAN PLANNING

This section presents the result of the information extracted from the literature review and the analyses of the case studies (Addendum 3.2). Taking as a starting point that all the evidence have the social dimension in common, this stage gathers all the dimensions that contributed to guarantee the development of projects from a socially-oriented approach. From that, the **main dimensions** in **urban planning** are seven: social, economy, architecture, urban configuration, sustainability, technology and regulation.

In addition, each dimension has sub-elements to study during the site research stage related to **pedestrians' profile** and the **activities** that they develop (Figure 1.15). Some of the dimensions and sub-elements are common between different items of evidence studied, and others are proposed due to specific considerations of the projects developed as can be seen in Figure 1.16. For this reason, the sub-elements should be defined together with the interdisciplinary team involved in the project. That with the intention to coordinate common design intentions between the different disciplines.



MAIN DIMENSIONS
PROPOSED IN URBAN PLANNING

LEGEND

- Main dimensions
- Sub-elements to consider to define the main dimensions

Figure 1.15 Proposal of the Main Dimensions in Urban Planning and the sub-elements to define together with the interdisciplinary team - The Main Dimensions are the results of the findings of the evidence studied | Scheme: Author

CONTRIBUTION OF EACH ITEM OF EVIDENCE TO THE MAIN DIMENSIONS PROPOSAL

LEGEND

- Main dimensions

Evidence

- Publications
- Lighting designers | lighting design studio
- Case studies

Conection between concepts

—— Clear proposal of all the dimensions
– – Partial proposal of the dimensions

Figure 1.16 Main Dimensions in Urban Planning - Summary of the evidence studied for the proposal of the Main Dimensions - Each dot represents the dimensions that are proposed by each item of evidence - Even though all the evidence had the social dimension in common, not all of them consider all the dimensions proposed | Scheme: Author

Additionally, to approach to each dimension different professionals have developed diverse analytic tools, that can be applied in other projects (Figure 1.17). An example of these tools is the "**Shades of night**" developed by multinational firm of planners and designers, ARUP. This tool was used by the author to study the activities that pedestrians develop in the surrounding areas of Norrmalmstorg and Bibliteksgatan in Stockholm, Sweden. Through the use of this tool, the author was able to identify the diverse activities that people develop in the context, in different slots of time (Figure 1.18).

In general, in this stage lighting designers have to be aware that each one of the main dimensions should be aligned with the **"social purpose"** of the urban area. From that the "social purpose" is the result of the **pedestrians' profile** and the **activities** that they develop, and should consider all the elements that allow a city to work. Furthermore, taking into account, that these dimensions also could be applied to the daytime scenario, designers should bear in mind the transition between daytime and nighttime; dawn and dusk.

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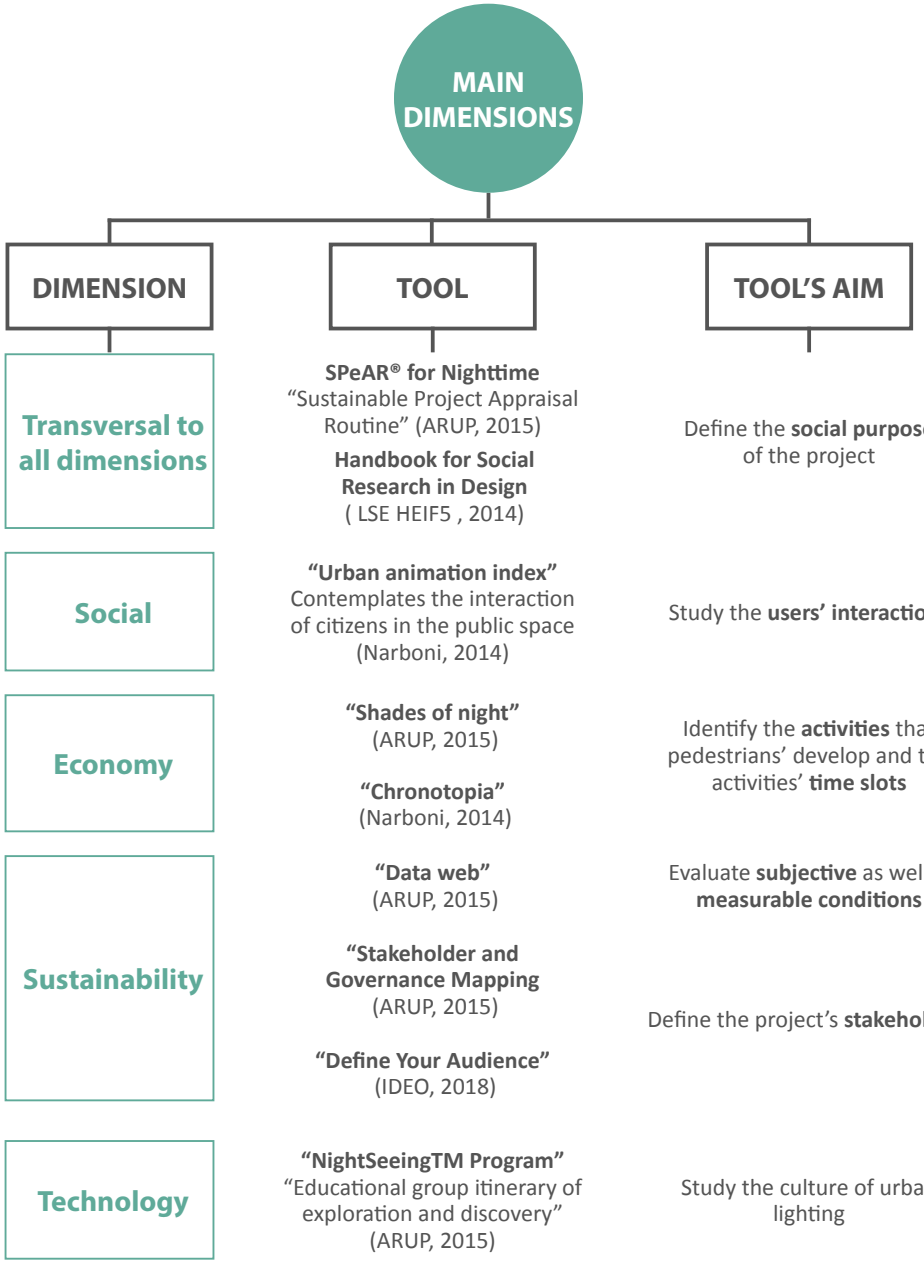

Figure 1.17 Tools developed by professionals that can help designers to go through each Main Dimension of the Urban Planning and to co-work with the interdisciplinary team of the urban projects | Scheme: Author

SCHEDULE OF THE ACTIVITIES DEVELOPED
TOOL: 'SHADES OF NIGHT' BY ARUP

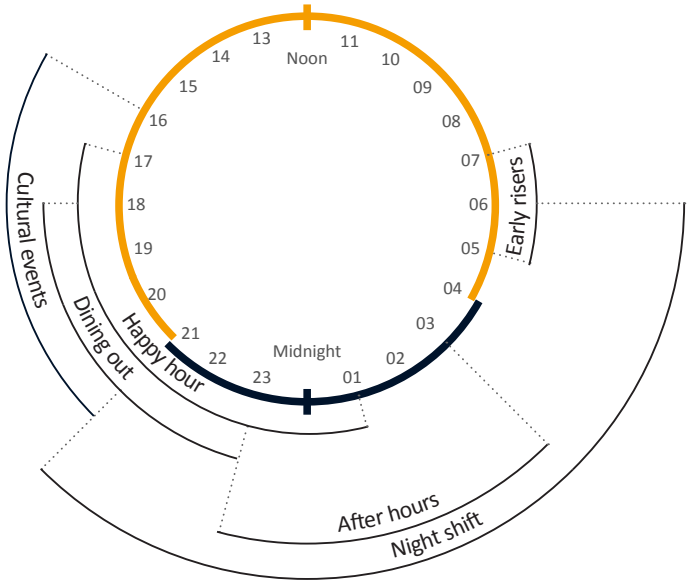

Figure 1.18 Norrmalmstorg and Biblioteksgatan - Study of the activities that people develp during the spring season between the months of April and May - The study was done by using the tool "Shades of Night" developed by ARUP. All the names and definitions of the "Shades of Night" are according to ARUP classification - During the study was found that the shop windows of the stores remain lit all night | Scheme: Author following the methodology of ARUP "Shades of Night"

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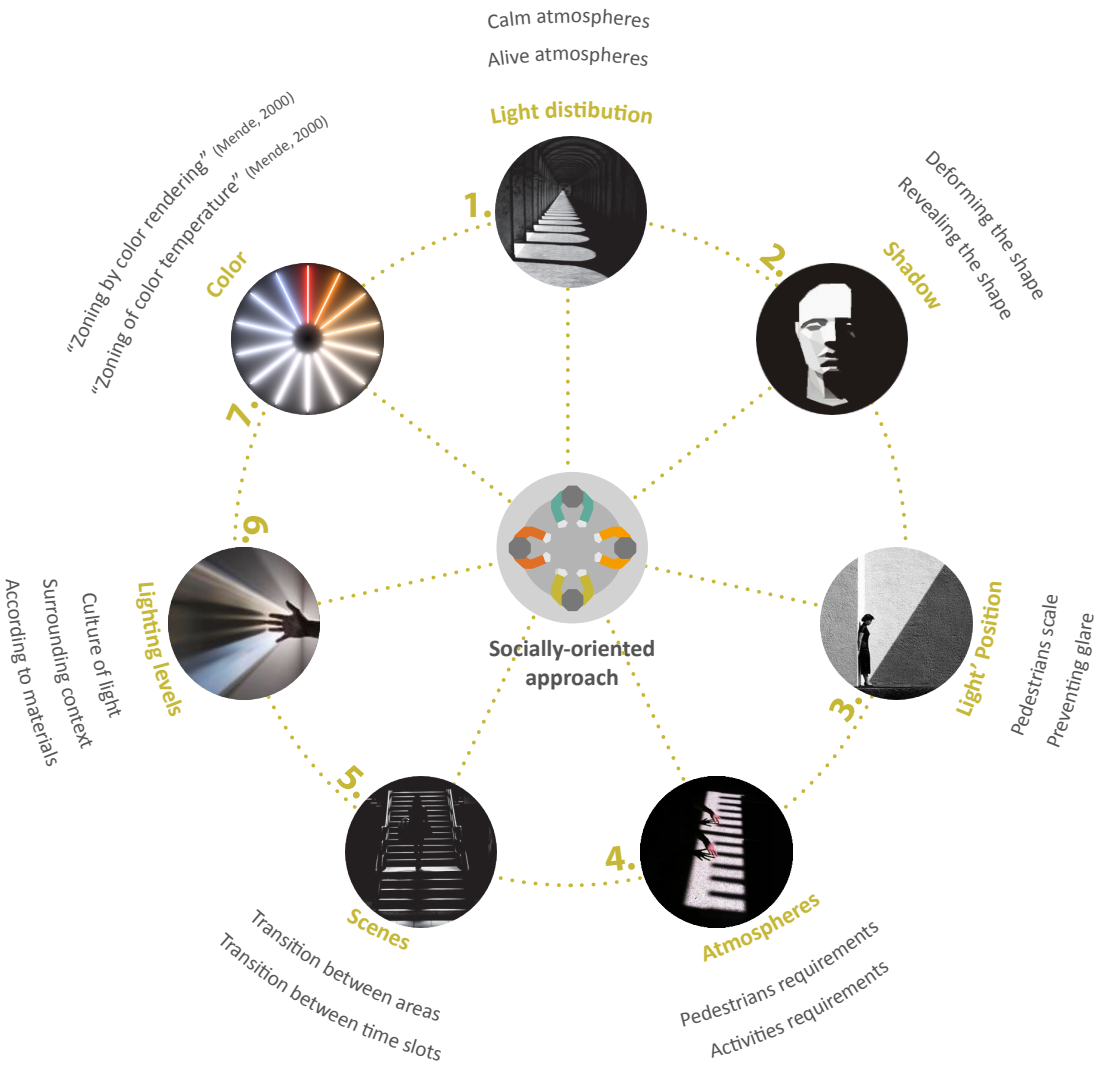
7. LIGHTING ATTRIBUTES IN URBAN PLANNING

This section presents the result of the information extracted from the literature review and the analyses of the case studies (Addendum 3.3). These attributes are related to lighting concepts which lighting designers should be familiar with. From that, after having defined the first stage, the second stage should help designers **to translate the main dimensions into lighting attributes**. In other words, to translate the social purpose(s) into lighting concepts. The lighting attributes in urban planning are seven: light distribution, shadow, light' position, atmospheres, scenes, lighting levels and color.

In general, during this stage, lighting designers should think about what information of the urban environment needs to be communicated to pedestrians. For that, designers should answer the question: Which visual cues are required by pedestrians, to locate and to orientate in the space? (Liljefors, 1999).

In addition, each light attribute has sub-elements to consider and be defined during the concept design (Figure 1.19).



LIGHTING ATTRIBUTES
PROPOSED IN URBAN PLANNING

LEGEND

- Lighting attributes
- Sub-elements to consider to define the lighting attributes

Figure 1.19 Lighting Attributes in Urban Planning and the sub-elements to consider by lighting designers during the lighting concept design - The Lighting Attributes are the results of the findings of the evidence studied | Scheme: Author - Icons' source: https://www.pinterest.es/

CONTRIBUTION OF EACH ITEM OF EVIDENCE TO THE LIGHTING ATTRIBUTES PROPOSAL

LEGEND

- Lighting attributes

Evidence

- Lighting designers | lighting design studios
- Case studies

Conection between concepts

- —— Clear proposal of the lighting attributes
- – – Partial proposal of the lighting attributes

Figure 1.20 Lighting Attributes in Urban Planning - Summary of the evidence studied for the proposal of the lighting attributes - Each dot represents the lighting attributes that are proposed by each item of evidence - From these insights, the author was able to determine that these seven attributes should be considered during the concept design process of urban projects, due to the relevance of each attribute in the pedestrians' perception of urban environments | Scheme: Author

- Light distribution | As Liljefors mentions "*Even very small differences related to spatial distribution of brightness will be perceived, making this entity one of the richest tools for the architectural design of the space.*" (Liljefors, 1999). In this way, the light distribution should be thought-out according to the time slots' and activities' requirements that pedestrians develop in the urban areas. As result, designers should propose high contrasted environments -alive areas- in areas or time slots when the purpose is to encourage interaction; or low contrasted environments -calm areas- in spaces or time slots when the purpose is to allow fluent paths.

- Shadow | This is an attribute that can be used to reveal the three-dimensionality of the space and to give information to pedestrians about depth. Additionally, this attribute is related to how pedestrians perceived other people, and how this perception encourages citizens to dwell the city. In this way, the shadow should be thought to promote the pedestrians' perception of safety.

- Light' position | This attribute has two main goals. Firstly, to be related to pedestrians' scale -between 2.5 and 3.0 meters height-. As Kaoru Mende recommends: designers should not to "...*draw a sketch of light without scale and people shape. Include people to remind yourself that light is*

indeed installed for people. Always have an accurate scale to be able to make a sketch that can be developed into a detailed design." (Mende, 2000). Secondly, to prevent the glare. For this, it is necessary to think about the luminaires' position according to pedestrians scale and how do they move around the space.

- Atmospheres | This attribute is related to the space' vocation. This vocation is defined by the different activities that each group of pedestrians develop. For example, some pedestrians can use a square as a connection point between their working areas and their way home; meanwhile, for other pedestrians, as the case of tourists, the same square can be a point to locate themselves in the city or to take a rest. In this way, the diverse atmospheres should allow, to all groups of pedestrians to develop their activities in a harmonic way.

- Scenes | The lighting scenes should be related to the flow of time, and the change of the activities that pedestrians develop according to the hour of the night, and the day of the week. In this way, the urban areas should be dynamic places, where the diverse layers of light could be combined in each time slot, to promote the sustainability of urban areas both, in social and in energy consumption terms.

- Lighting levels | The first approach to this attribute should be to inquire about the pedestrians culture of light according to their geographic location; it is not the same perception of brightness for citizens from Scandinavian countries than for citizens in countries close to the Equator line. From that, even though an area can be perceived by pedestrians as a dark environment, this area still could fulfil the levels required by regulation (Liljefors, 1999). Additionally, the immediate context of the urban element also influences the perception of the levels of light. In this way, as Liljefors mentioned: "*...the same room can be experienced dark entering from a considerably brighter space, and bright when entering from a darker room*" (Liljefors, 1999).

On the other hand, the materials of the environment also influence the way as pedestrians perceive the space; the same space with the same light output can be perceived darker or brighter just by changing the materials. In this way, by understanding the reflection properties of materials, designers can use the accurate amount of light to allow pedestrians to develop activities and increase their perception of security, without over lit the spaces. A clear example of this can be found in the approach of the lighting designer Linnaea Tillet (Casciani, 2011).

- Color | This last attribute is related to how pedestrians perceive the urban environment. For that, it can be studied two aspects proposed by Kaoru Mende. Firstly, "*zoning of color temperature*" (Mende, 2000); this selection should be aligned with the emotions that designers want to arouse in pedestrians -from warm and cosy environments to transitions areas that encourage a quicker pace-. Secondly, the "*zoning by color rendering*" (Mende, 2000) can be related to the perception of details in the space, by answering the question: how much visual information pedestrians need to dwell and to move around the space?

For this research these attributes were studied in Norrmalmstorg (figure 1.21, 1.22, 1.23, 1.24, 1.25, 1.26), and Biblioteksgatan (figure 1.27, 1.28, 1.29, 1.30), in Stockholm, Sweden. Next the results are presented.

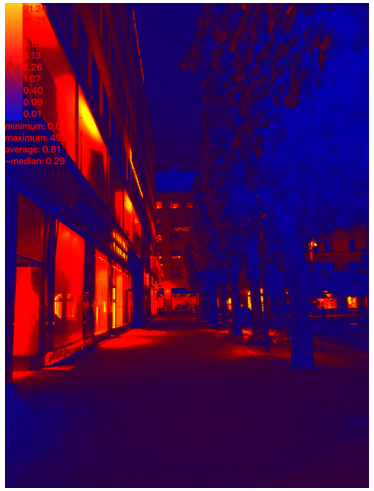
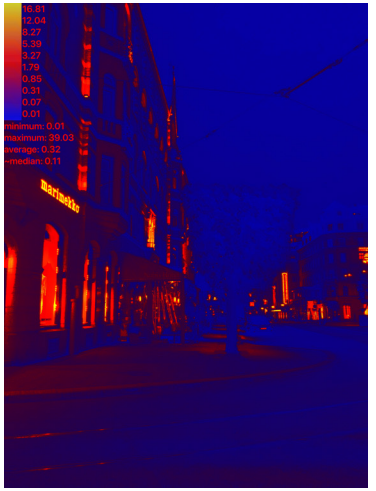
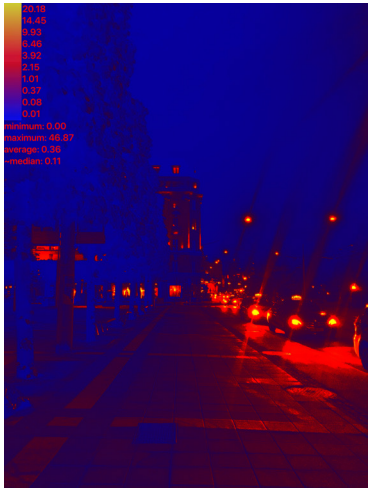
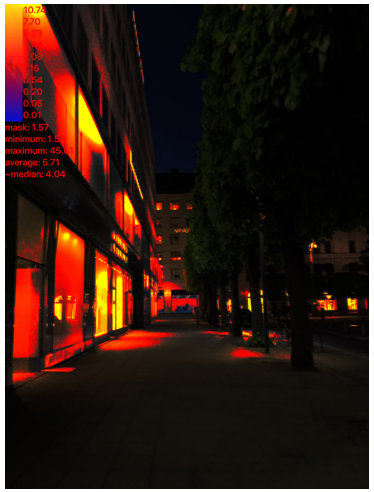
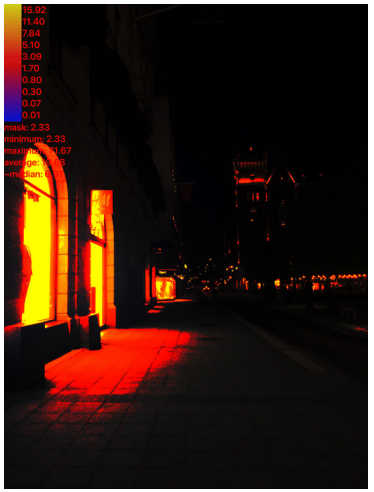
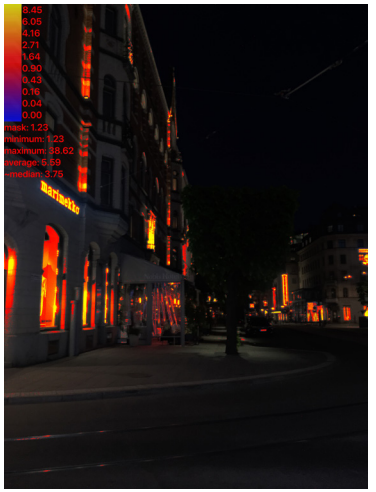
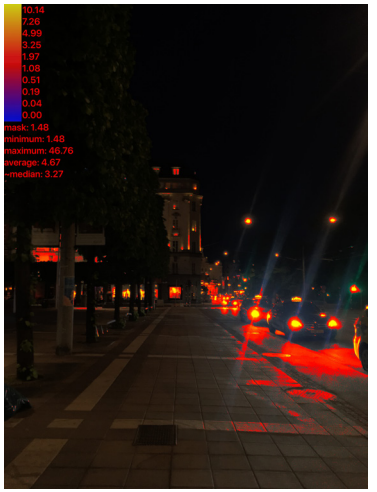
7.1 Norrmalmstorg

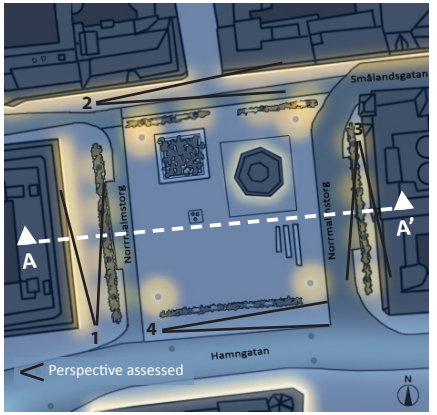
In this section, the results of the lighting attributes assessed through the author's qualitative observation and quantitative measurements studied between April and May in Norrmalmstorg are presented.

In the next graphics, the seven **lighting attributes** *proposed in the guideline for urban planning are assessed and commented: light distribution, shadow, light' position, atmospheres, scenes, lighting levels and color.*

Norrmalmstorg, Stockholm
Photograph by author

LIGHT DISTRIBUTION | STREETS

	1. Norrmalmstorg - West	2. Smålandsgatan	3. Norrmalmstorg - East	4. Hamngatan
HDR Image				
Photo				

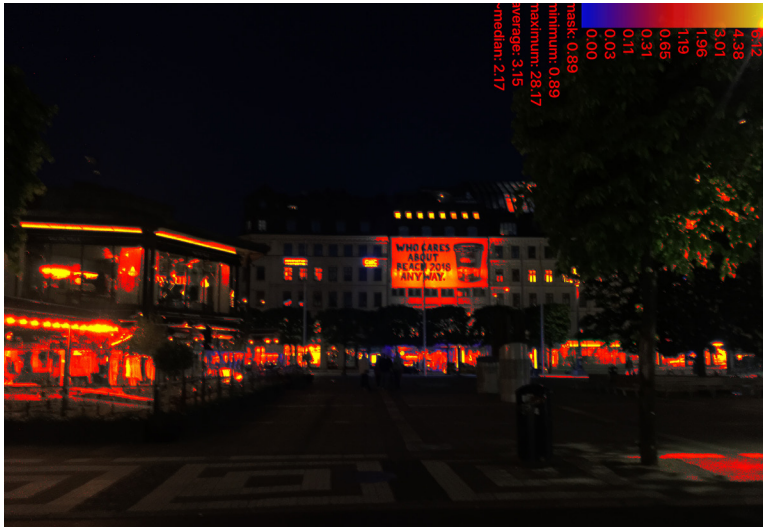


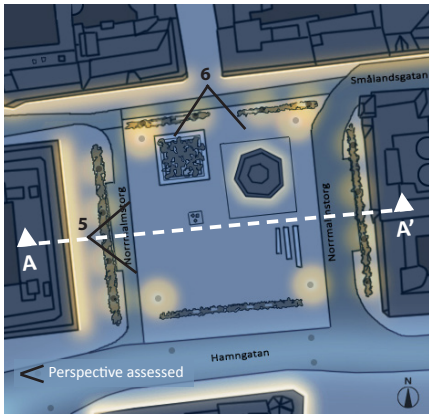
COMMENTS

The brighter points perceived in the streets around the square are from the shopping windows (vertical plane), in the first floors. The rest of the street is perceived with a uniform level of light.

Figure 1.21 Norrmalmstorg: Light distribution - Perception of the streets around the square - The HDR images to study the lighting distribution were taken in four (4) different points by using the app Aftab Luminance | Source: Author

LIGHT DISTRIBUTION | SQUARE

	5. Square from **Norrmalmstorg - East**	6. Square from **Smålandsgatan**
HDR Image		
Photo		

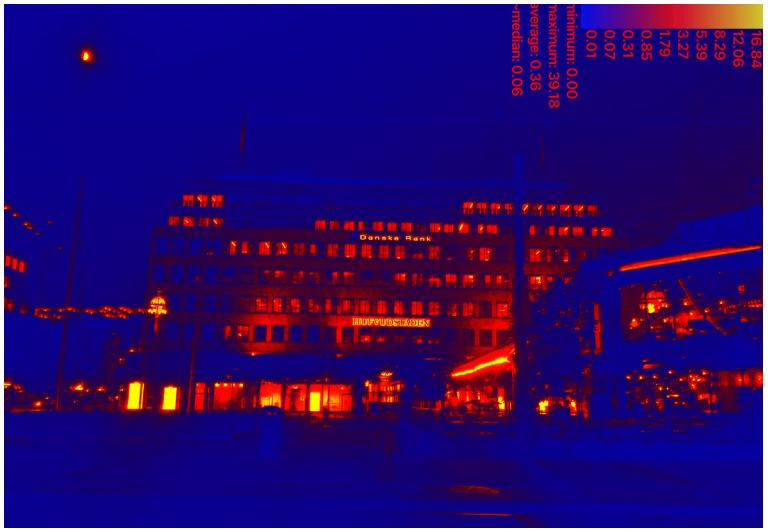
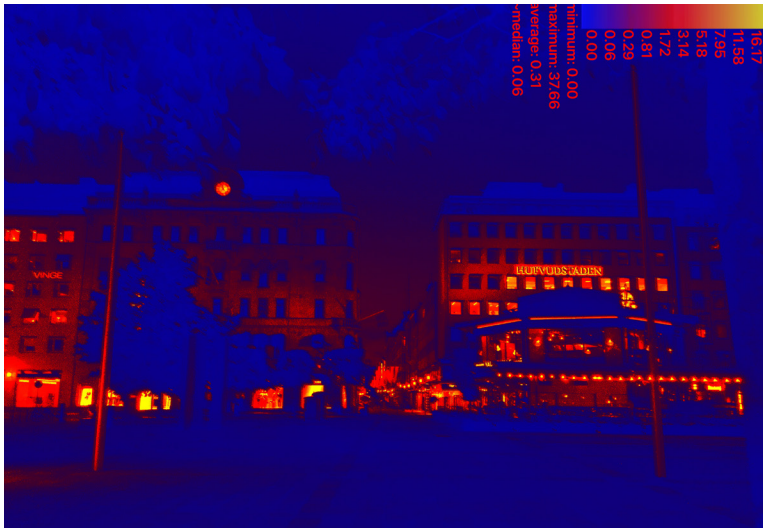


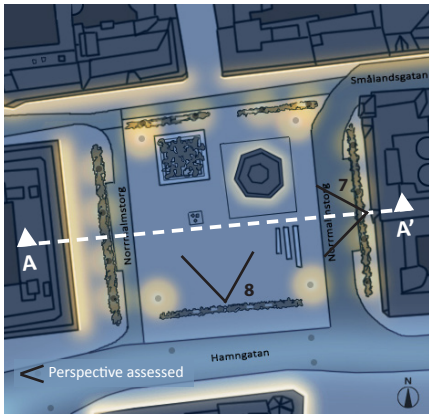
COMMENTS

The brighter points perceived in the square are from the buildings around in the distance (vertical plane). In general, the interior of the square is perceived with a uniform level of light.

Figure 1.22 Norrmalmstorg: Light distribution - Perception of the square - The HDR images to study the lighting distribution were taken in two (2) different points by using the app Aftab Luminance | Source: Author

LIGHT DISTRIBUTION | SQUARE

	7. Square from **Norrmalmstorg - West**	8. Square from **Hamngatan**
HDR Image		
Photo		

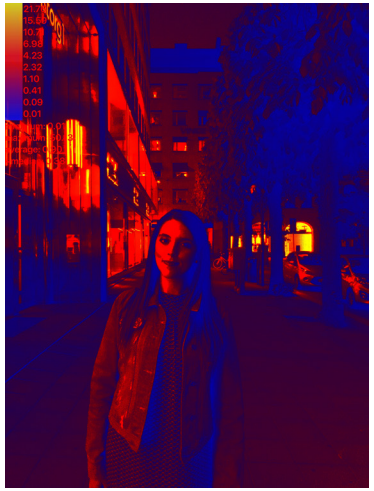
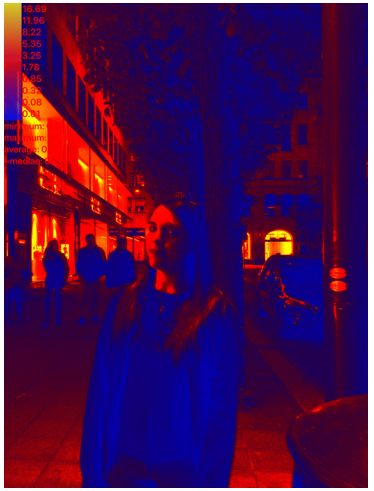
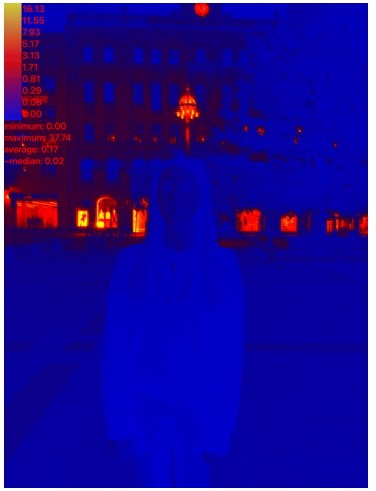
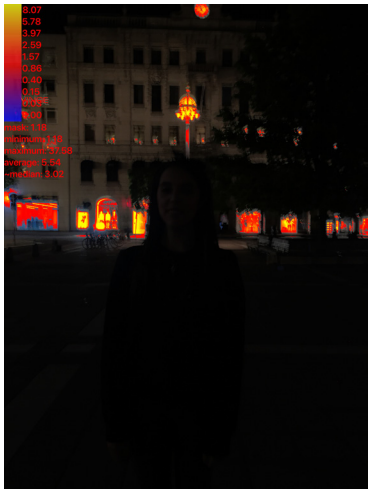
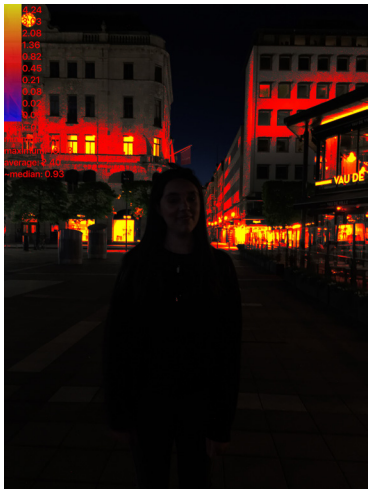


COMMENTS

In these two perspectives the luminance from the shopping windows (vertical plane), in the first floors, takes centre stage. Meanwhile, the interior of the square is perceived with a uniform level of light.

Figure 1.22 Norrmalmstorg: Light distribution - Perception of the square - The HDR images to study the lighting distribution were taken in two (2) different points by using the app Aftab Luminance | Source: Author

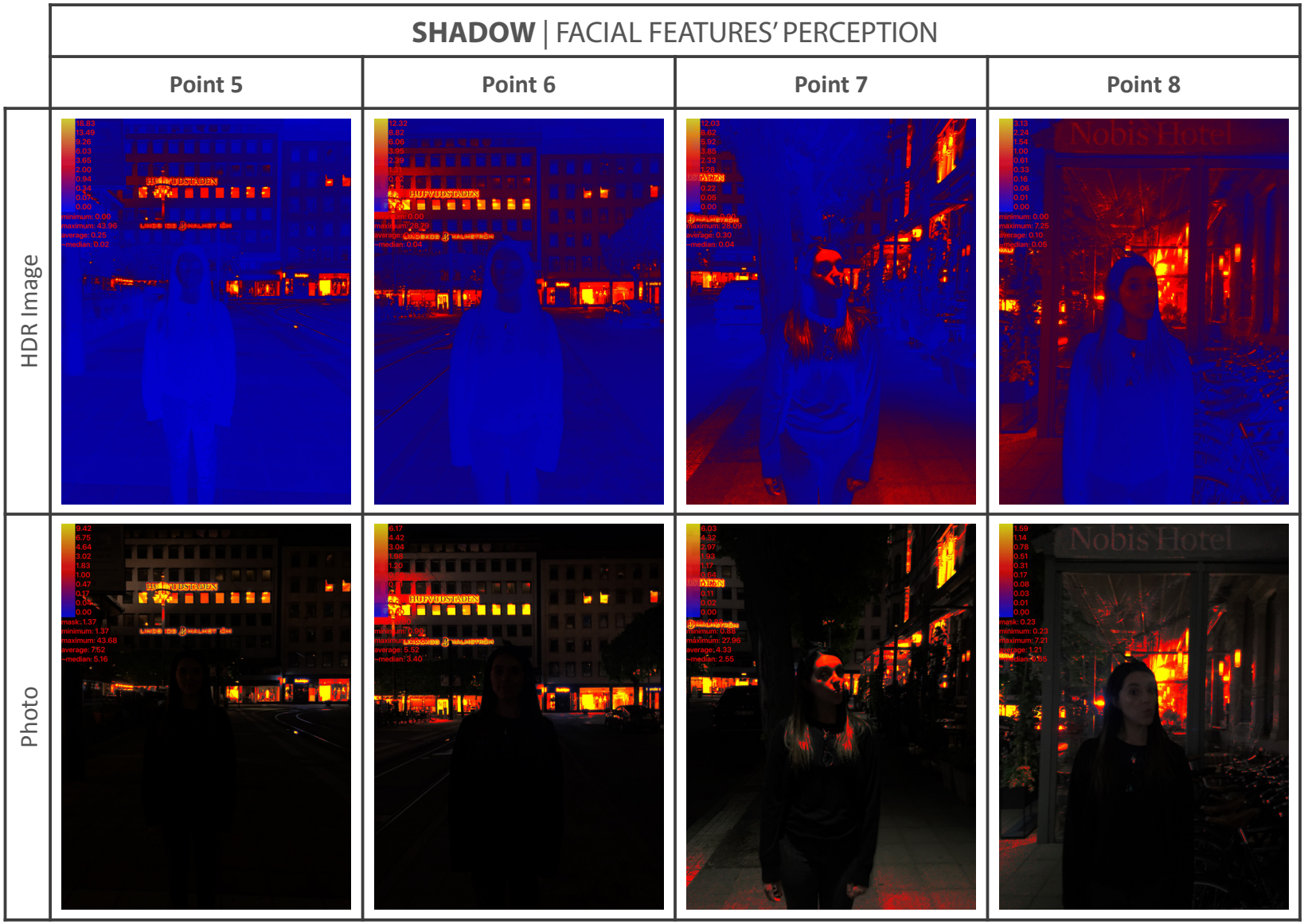
SHADOW | FACIAL FEATURES' PERCEPTION

	Point 1	Point 2	Point 3	Point 4
HDR Image				
Photo				

COMMENTS

Although in none of the points the facial features are deformed; at points 3, 4, 5 and 6 the facial features are difficult to recognize, due to the facial illumination is too low.

Figure 1.23 Norrmalmstorg: Shadow - The HDR images to study the facial features were taken in eight (8) different points by using the app Aftab Luminance | Source: Author



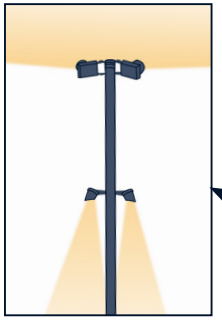
COMMENTS

At the point 7, the facial features are deformed due to the light' direction. On the other hand, at point 8 to perceive clearly the facial features from a short distance is possible, because of the light coming from the horizontal and vertical plane. In contrast, from a far distance pedestrians cannot recognize the people's face due to the facial illumination is too low.

Figure 1.23 Norrmalmstorg: Shadow - The HDR images to study the facial features were taken in eight (8) different points by using the app Aftab Luminance | Source: Author

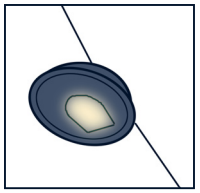
LIGHT' POSITION, LIGHTING LEVELS AND COLOR

PLAN OF NORRMALMSTORG

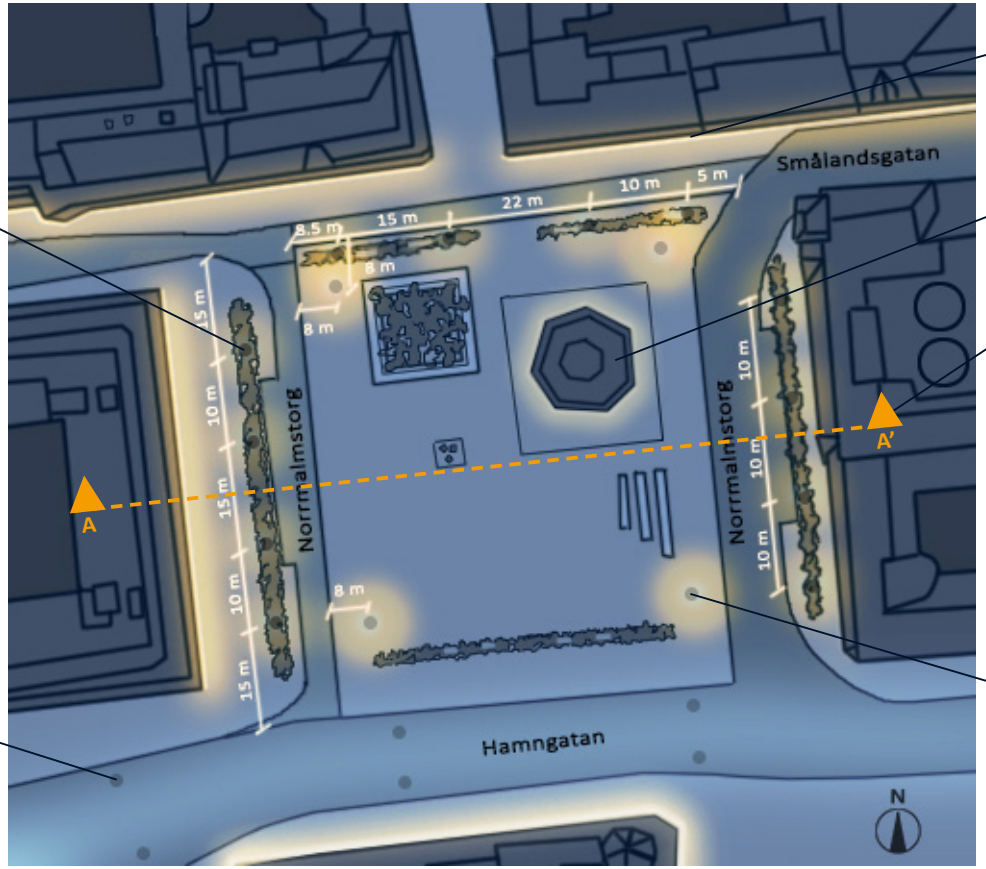


12 *Light poles: Projector + Spot light*

- LED
- 3637 K
- 102.3 lx
- Ra = 78
- H = 6 meters



6 *Catenaries*
H = 10 meters



Light from stores

Light from a restaurant

Section A-A' presented in figure 1.22

4 *Light poles: Square*

- LED
- 2935 K
- 82.6 lx
- Ra = 90
- H = 9 meters

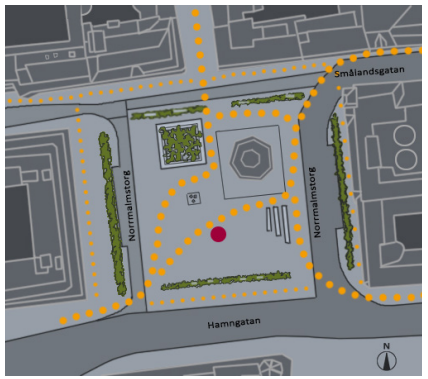
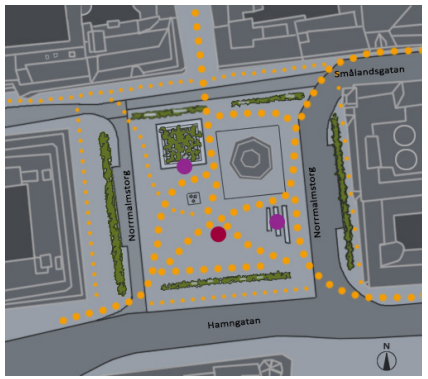
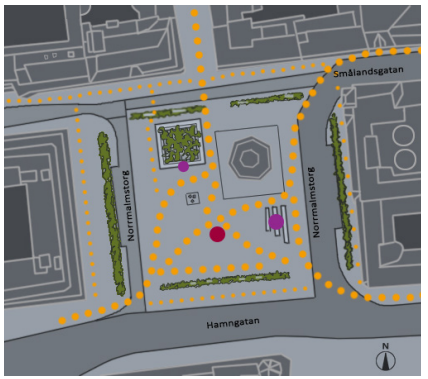
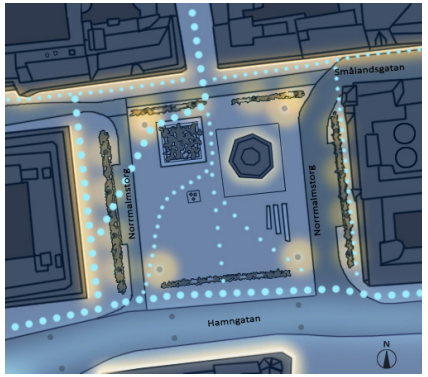
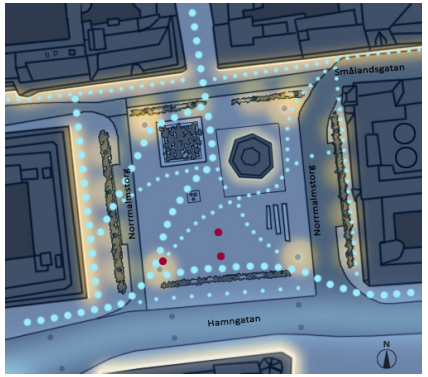
Figure 1.24 Norrmalmstorg: Light' position, lighting levels and color - Plan of the current lighting layout - The measurements of lighting levels, color temperature and color rendering index were taken on the floor level below the urban fixtures with a CL-500A illuminance spectrophotometer | Scheme: Done by the author following the methodology of "Lighting Detectives: Newsletter vol.86"

LIGHT' POSITION, LIGHTING LEVELS AND COLOR | SECTION OF NORRMALMSTORG

COMMENTS

- In the surrounding areas of the square the *light' position* is related to the pedestrian level; a situation that is reinforced by the light coming from the commerce in the first floor of the surrounding buildings, that remains lit during the night.
- Even though the *lumen output* of the luminaires located in the facade West (Point 2) and East (Point 7) of Norrmalmstorg is almost the same -between 103.7lx and 102.3lx-; the lighting level of the adjacent pedestrian ways (Point 1 and 8) varies in a wide way -33.1lx and 2lx-, due the influence of the light coming from the commerce and the hotel.
- The *color temperature* of the luminaires is warm white -between 2935 K and 3637 K-. The light coming from the restaurant is perceived warmer that the context.
- The *color rendering* of the luminaires is between 78 and 90.

Figure 1.25 Norrmalmstorg: Light position, lighting levels and color - Section of the current lighting layout showing the light distribution in the vertical plane and measurements taken on the horizontal plane - The measurements of lighting levels, color temperature and color rendering index were taken on the ground level in the different points indicated in the section, with a CL-500A illuminance spectrophotometer Konica Minolta| Scheme: Done by the author following the methodology of "Lighting Detectives: Newsletter vol.86"

	2018 04 23 | **Monday**	2018 04 24 | **Tuesday**	2018 04 25 | **Wednesday**
Daytime			
Nighttime			

ATMOSPHERES AND SCENES
NORRMALMSTORG' OBSERVATION

LEGEND

Paths

- Paths chosen by pedestrians during daytime
- Paths chosen by pedestrians during nighttime

*The bigger the dots, the more pedestrians following the path

Permanence (Staying)

- Meeting points
- Areas of permanency

Figure 1.26 Norrmalmstorg: Atmospheres and Scenes - Results of the qualitative observation - Comparison between daytime and nighttime of the paths chosen by pedestrians (For more details refer to addendum 2.1) | Schemes: Author

COMMENTS

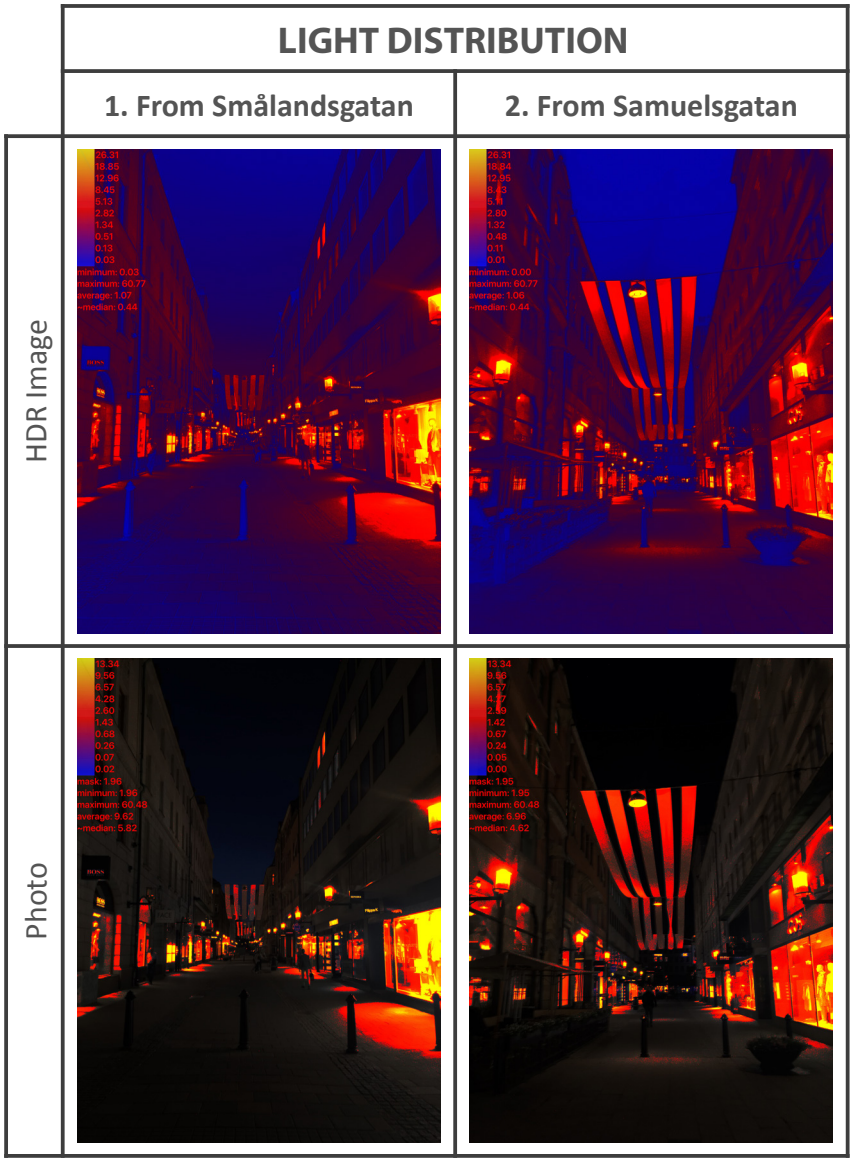
- Even though during the nighttime the pedestrians' pace is slower compared to daytime, the pedestrians do not stay in the square.
- In general, the layout proposed, encourage people to cross by but not to stay, due to there are not perceived diverse atmospheres in the square. Additionally, during the nighttime the paths that pedestrians follow come closer to the areas with higher levels of light.
- The lighting layout remains the same during the all the nighttime, and the days of the week.
- The facade lighting is soft and even in all the buildings, except for the hotel located in the east facade where the architectural elements are highlighted.
- The luminaires are concealed between the shrubbery taking care of the aesthetic of the square both during daytime and nighttime.

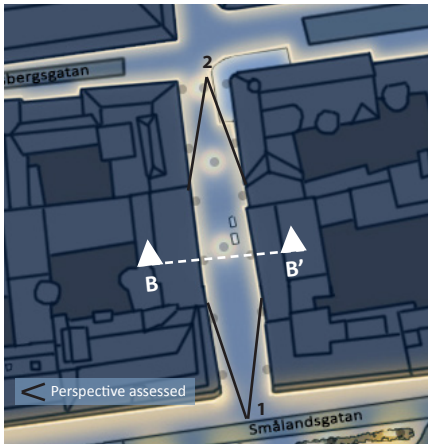
7.2 Biblioteksgatan

In this section, the results of the lighting attributes assessed through the author's qualitative observation and quantitative measurements studied between April and May in Biblioteksgatan are presented.

In the next graphics, the seven **lighting attributes** *proposed in the guideline for urban planning are assessed and commented: light distribution, shadow, light' position, atmospheres, scenes, lighting levels and color.*

Biblioteksgatan, Stockholm
Photograph by author

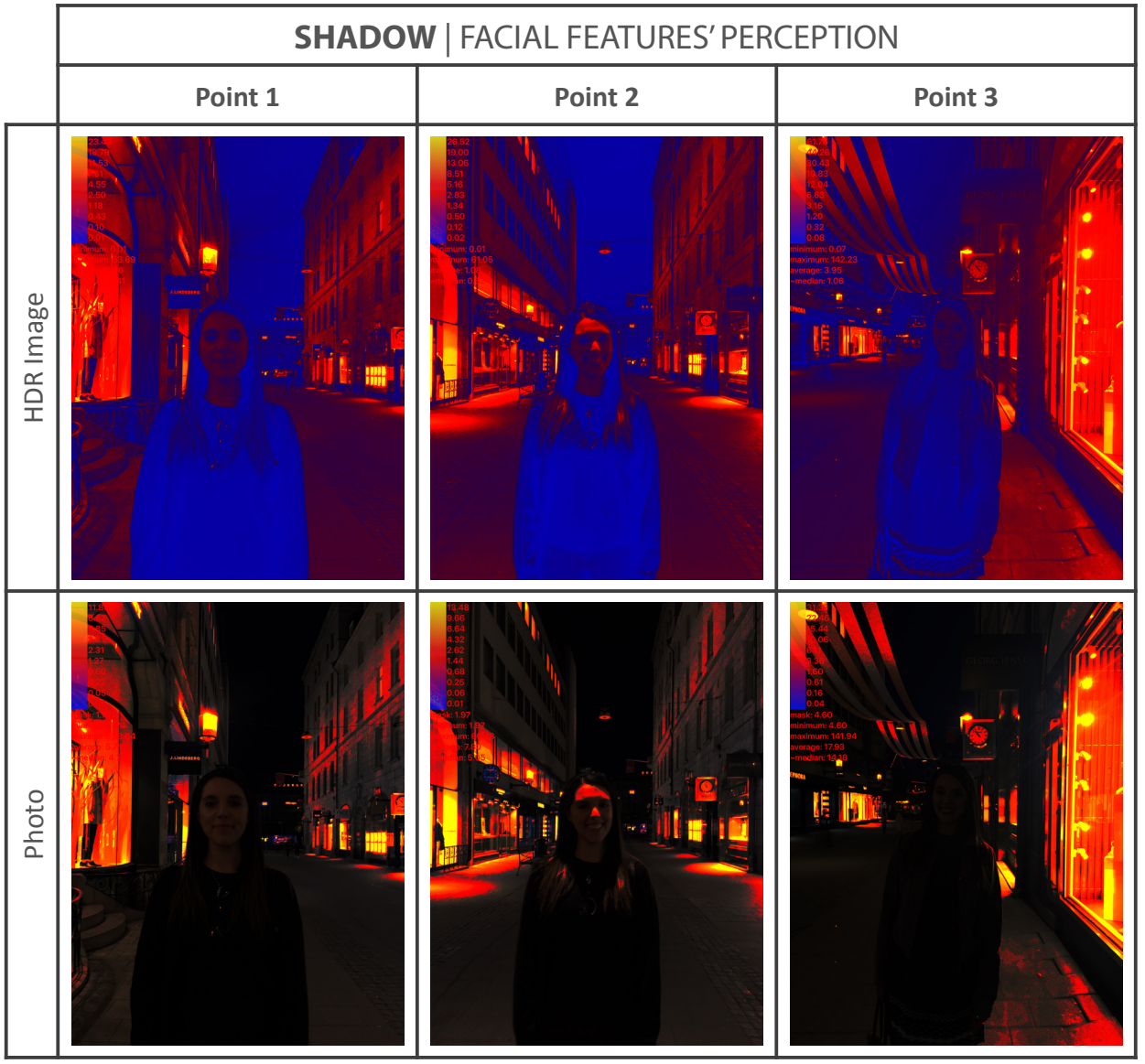




COMMENTS

The brighter points perceived in the street are from the shopping windows (vertical plane), in the first floors. The rest of the street is perceived with a uniform level of light.

Figure 1.27 Biblioteksgatan: Light distribution - The HDR images to study the lighting distribution were taken in two (2) different points by using the app Aftab Luminance - In the moment when the HDR images were taken some of the luminaires were turned off. A situation that influence the results | Source: Author



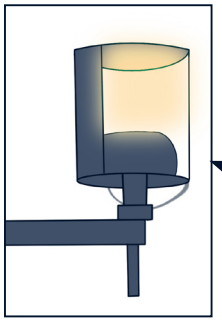
COMMENTS

At the point 2, the facial features are deformed due to the light' direction. At point 1 and 2 the facial features are perceived in a clearer way due to the light direction is both coming from the horizontal (wall-mounted luminaire) and vertical plane (shopping window).

Figure 1.28 Biblioteksgatan: Shadow - The HDR images to study the facial features were taken in three (3) different points by using the app Aftab Luminance - In the moment when the HDR images were taken some of the luminaires were turned off. A situation that influence the results | Source: Author

LIGHT' POSITION, LIGHTING LEVELS AND COLOR

PLAN OF BIBLIOTEKSGATAN



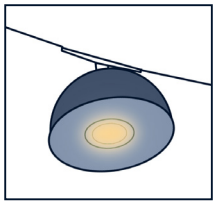
12 *Wall-mounted luminaires*

- LED
- 3934 K
- 331.3 lx
- Ra = 82
- H = 4 meters

Light from a restaurant

Light from stores

Section B-B' presented in figure 1.28

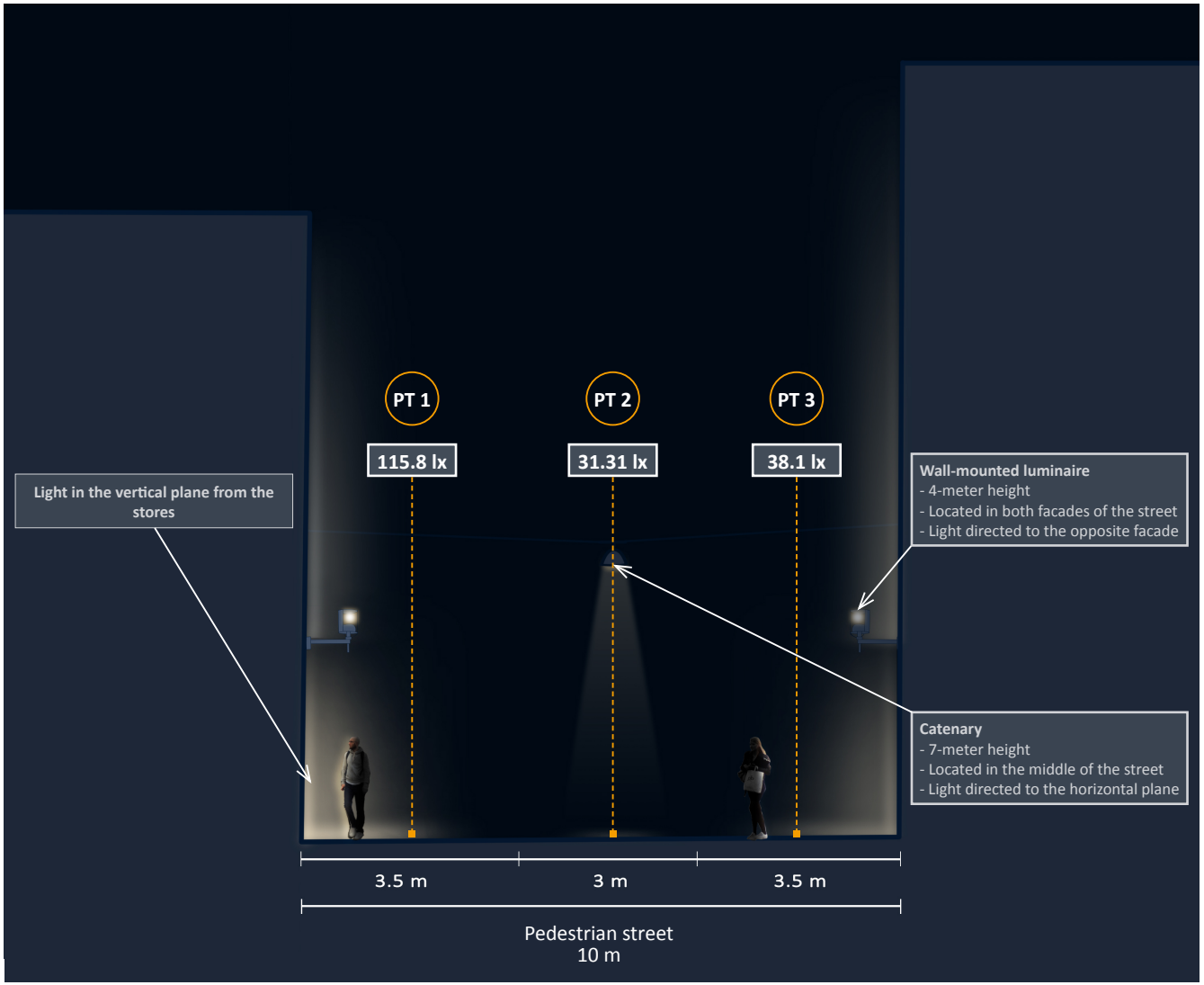


5 *Catenaries*

- LED
- 2931 K
- 143.5 lx
- Ra = 87
- H = 7 meters

Figure 1.29 Biblioteksgatan: Light' position, lighting levels and color - Plan of the current lighting layout - The measurements of lighting levels, color temperature and color rendering index were taken on the floor level below the urban fixtures with a CL-500A illuminance spectrophotometer | Scheme: Done by the author following the methodology of "Lighting Detectives: Newsletter vol.86"

LIGHT' POSITION, LIGHTING LEVELS AND COLOR | SECTION OF BIBLIOTEKSGATAN



COMMENTS

- In the street the *light' position* is related to the pedestrian level; a situation that is reinforced by the light coming from the commerce in the first floor of the surrounding buildings, that remains lit during the night.
- The *lighting levels* of the areas closer to the facades (Point 1 and 3) varies in a wide way -115.8lx and 28.1lx-, due the influence of the light coming from the stores.
- The *color temperature* of the luminaires is warm white -between 2875 K and 3307 K-.
- The *color rendering* of the luminaires is between 85 and 87.

Figure 1.30 Biblioteksgatan: Light position, lighting levels and color - Section of the current lighting layout showing the light distribution in the vertical plane and measurements taken on the horizontal plane - The measurements of lighting levels, color temperature and color rendering index were taken on the ground level in the different points indicated in the section, with a CL-500A illuminance spectrophotometer Konica Minolta| Scheme: Done by the author following the methodology of "Lighting Detectives: Newsletter vol.86"

8. LIGHTING SYSTEMS
IN URBAN PLANNING

This section presents the result of the information extracted from the analyses of the case studies. This third stage should allow designers to propose a set of **lighting effects** according to the **social purpose(s) of the space**. From that, five considerations are proposed: light on the vertical plane, light on the horizontal plane, stages of the project, scales of the approach, and scalability of the proposal (Fraenkel, 2018) (Figure 1.32).

Lighting systems should support the urban tendency to plan districts where citizens are "...able «to work, rest and play» within the same physical neighborhood" (Roberts, Eldridge 2009). Taking into account that currently, the urban districts' aim is to facilitate multiple activities, such as working areas, commerce and housing, **lighting proposals** in these urban areas should **trigger pedestrians to develop diverse activities**, according to the needs of each area and the schedule of those activities (Figure 1.31). For this reason, a lighting proposal should not be composed of one specific effect, but a set of lighting effects.

Introduction | Methodology | Guideline | Discussion | Conclusions

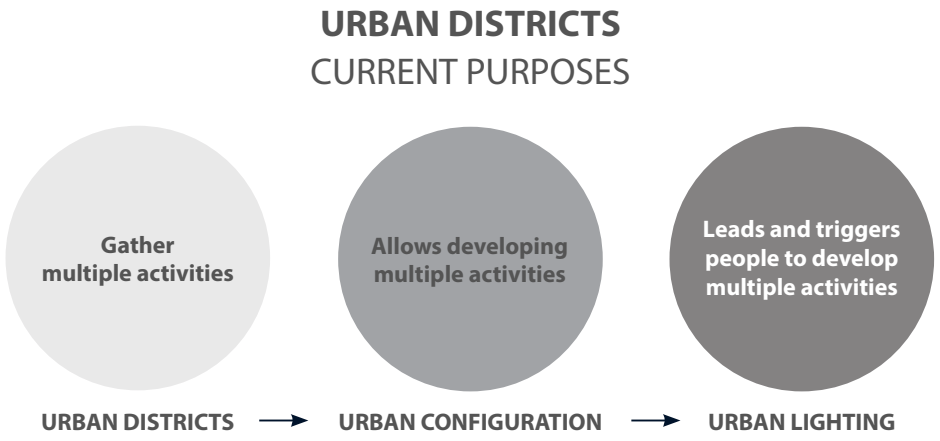
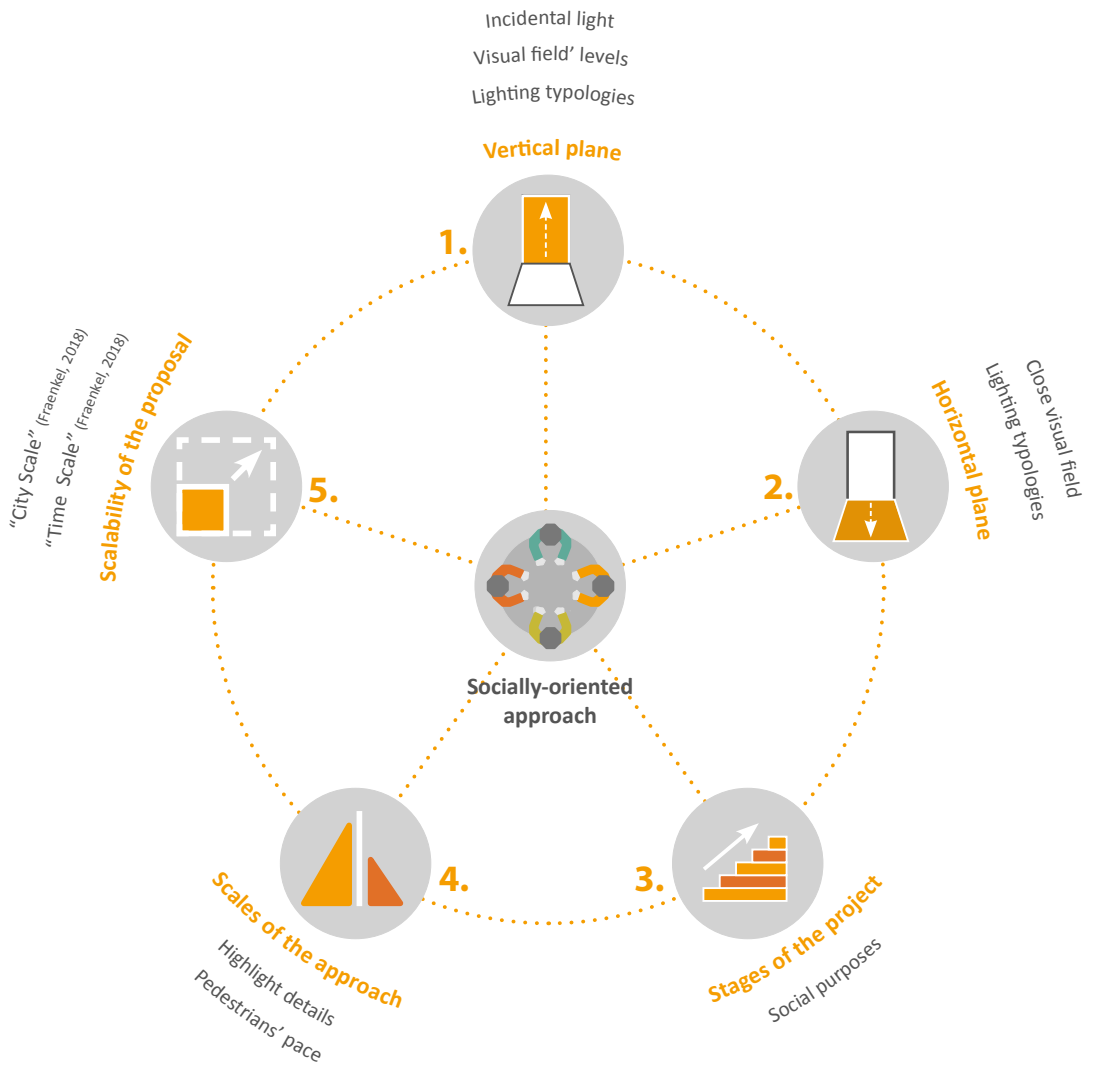


Figure 1.31 Current purposes of the urban districtics and the urban elements that compose them | Scheme: Author



LIGHTING SYSTEMS
PROPOSED IN URBAN PLANNING

LEGEND

- Lighting systems
- Sub-elements to consider to define the lighting systems

Figure 1.32 Lighting Systems in Urban Planning and the sub-elements to consider by lighting designers during the lighting concept design - The Lighting Systems are the results of the findings of the case studies analyses | Scheme: Author

CONTRIBUTION OF EACH ITEM OF EVIDENCE TO THE LIGHTING SYSTEMS PROPOSAL

LEGEND

- Lighting systems

Evidence

- Author's study and conversation with Clara Fraenkel
- Case studies

Conection between concepts

—— Clear proposal of all the Lighting systems
- - - Partial proposal of the Lighting systems

Figure 1.33 Lighting Systems in Urban Planning - Summary of the evidence studied for the proposal of the Lighting Systems - Each dot represents the lighting systems that are proposed by each item of evidence | Scheme: Author

As Kaoru Mende mentions "*just as some human beings are lifeless by day but come to life at night, some parts of the city become active only at night*" (Mende, 2000); in that way, lighting designers should think which lighting typologies can be used to highlight the different urban elements, according to the information needed to communicate to pedestrians, in each time slot of the nighttime.

- Vertical plane | In general, this plane allows pedestrians to locate in the space and to identify other pedestrians' facial features. From that, the vertical plane has four characteristics: (1) gives pedestrians information related to depth; (2) provides a reference of the scale of the space; (3) contributes by establishing hierarchies in the space; and (4) gives pedestrians visual references to locate themselves in the space. Even though currently a clear regulation related to the vertical plane has not been implemented, designers should bear in mind that the luminance values -related to the vertical plane-, are what pedestrians perceive in the space, as was previously noticed in the study of Norrmalmstorg and Biblioteksgatan (Section 7.1 and 7.2).

- Horizontal plane | This plane is related to the paths that pedestrians follow. The horizontal plane should provide safety to pedestrians in the

close visual field, by allowing them to identify the change of levels on the floor and any element that could limit pedestrians' mobility. In other words, this plane should allow pedestrians to move around the space in a safe way. Furthermore, currently, most of the regulation related to outdoor lighting has been done in this plane by establishing different lighting levels according to roadways categories.

From the description of these two planes, it can be concluded that light on vertical and horizontal planes should work together. This is because each one of the planes provides diverse information to pedestrians that allow them to locate themselves and move around the space. As result, if the lighting proposal focuses on just one of the planes, the proposal will fail to fulfil pedestrians' visual requirements. Finally, some examples of how diverse lighting typologies encourage pedestrians to dwell the city are presented in figure 1.34.

EXAMPLES OF LIGHTING TYPOLOGIES | VERTICAL AND HORIZONTAL PLANE

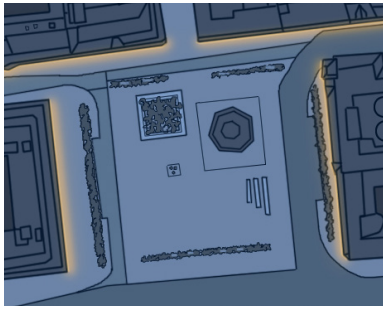
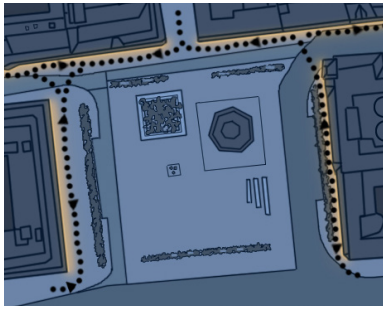
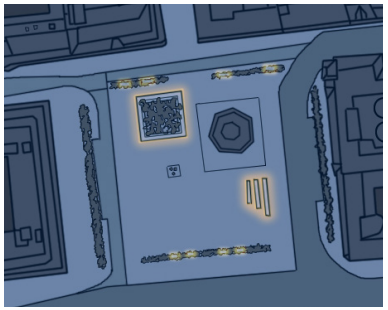
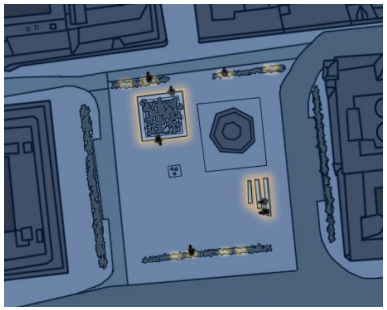
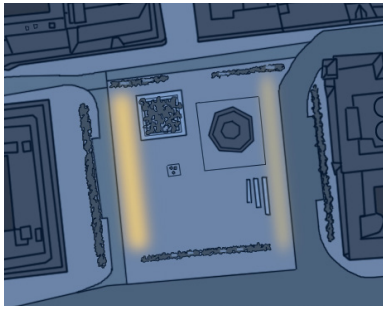
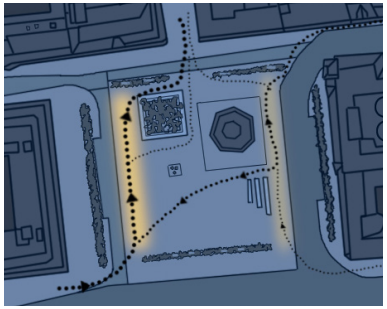
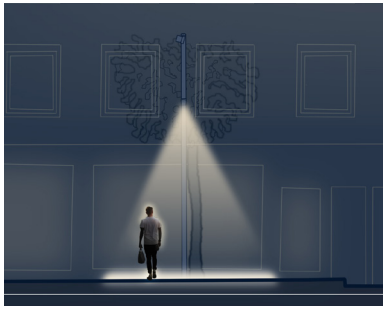
	Lighting effect	Pedestrians' reponse		
1. Facade lighting				**- Encourage pedestrians to move around the square at a fluent pace** **- Give visual references to pedestrians**
2. Integrated in furninture				**- Encourage pedestrians to stay** **- Increase perception of security among passers-by**
3. Paths lighting				**- Influence the paths that pedestrians follow to cross the square**

Figure 1.34 Comparison between lighting effects and pedestrians response | Scheme: Author

- Stages of the project | In urban planning, it is common that projects are developed in different stages, which is a situation that designers should bear in mind in order to make sure that their proposals can be sustainable in time. For this, designers should answer the question: Which are the essential areas of the project that should be implemented first?

As Fraenkel suggests, the first step should be to answer what contribution light can make, to encourage pedestrians to cross the square or street. For example, a combination between path lighting -in the perimeter of a square- and facade lighting can encourage people to go around the square, and still gives them an option to cross inside the darker areas if they prefer to do that (Fraenkel, 2018). In the same way, the next questions should be related to the priorities of the "social purposes" proposed for the urban area and then to translate them into project stages.

- Scales of the approach | Lighting systems should also consider the diverse pedestrians' approach scales; and in that way, to define which details are going to be revealed in each moment. This has the intention to arouse pedestrians' curiosity and promote vibrant spaces.

By developing a storyboard of the diverse approach levels of pedestrians, designers should be able to consider the elements that need to be highlighted in each scale. Urban spaces are dwelt in a dynamic way, from

Introduction | Methodology **Guideline** Discussion | Conclusions

this, by considering the diverse urban landscapes pedestrians observe when they move around the space, could help designers to propose visual hierarchies to perceive during pedestrians' urban journey.

- Scalability of the proposal | Even though in many cases, lighting designers develop specific urban projects -a street or a square-, these individual projects make part of a bigger system, a district and a city. From that, designers should be able to visualize their projects in the bigger picture. Inquiring about what would happen if the guidelines proposed for their projects were replicated in all the district or the city, can give designers perspective, to define which are the essential elements that would allow pedestrians both to read the city and to develop different activities in the diverse slots of time.

Fraenkel mentions, for example, the possibility of how the city would be perceived if all buildings were allowed to have facade lighting to highlight them. In that case, those buildings that can be distinguished due to their contrast with an even and soft-lit surrounding in the context would probably be completely blurred if all the surrounding facades had the same proposal (Fraenkel, 2018). As result, instead to give a reference to pedestrians, urban areas would be perceived as excessively lit spaces, without hierarchy, a situation that would result in an excess of information to pedestrians and mislead them.

9. DISCUSSION

From all the results studied, different elements made evident the relevance of the pedestrian study in urban planning at nighttime. Next, these elements will be presented.

- Guideline for the nighttime urban planning

Although pedestrians responded in diverse ways to lighting conditions and have different requirements according to their context; a method can be proposed both to inquire about general parameters to study pedestrians in diverse contexts and also to assess urban lighting projects from a socially-oriented approach.

- Main dimensions

As Fraenkel mentions, a key point for urban project development is the **cooperation between public-private alliances** (Fraenkel, 2018). A situation that was found in the three case studies analyses. In all of these is, the stakeholders were involved in an active way during the site study and concept design stages. This is a key factor to guarantee the projects' sustainability.

On the other hand, even in just one street, many types of pedestrians can be found. Because of this, the **users study** together with the activities that they develop, and the in time which they develop them is a relevant element that gives essential insights for the lighting proposal and the projects' sustainability. Additionally, the study of the users has even more relevance when the projects are designed by foreign studios or professionals.

- Lighting attributes

The **culture of light of the context** must be a factor that designers should be aware of. This perception is related to how citizens perceive the lighting levels of the environment according to their culture; for example, Japanese people are more used to darker environments compared to other cultures (Tanizaki, 1977).

Also, the **perception of lighting levels'** is influenced in a range of ways according to the planes that are lit -vertical or horizontal-. For example, in the Biblioteksgatan' project, even though the lighting level of the horizontal

through facade lighting, after the implementation of the project the whole place was perceived brighter (Fraenkel, 2018).

Another significant finding was that in order to **perceive facial features** clearly is required to have light in both horizontal and vertical planes as was assessed in figures 1.23 and 1.28 in this research. Light just coming from above casts shadows that deform facial features. Nevertheless, further research is needed to establish how this influences pedestrians' behaviour in the public spaces.

- Lighting systems

Finally, during the design development the **incidental lighting** coming from the surrounding context -stores or restaurants- should be assessed. This due to incidental light, influences the perception of the space, in terms of hierarchies, as could be noticed at figure 1.21, where the higher luminance values are from the stores. As result, the stores become the main visual references when pedestrians are walking at the surrounding streets of Norrmalmstorg.

10. CONCLUSIONS

Even though this thesis does not present a definitive framework to develop urban lighting proposals, the outcome offers a guideline with elements and concepts that designers should bear in mind for the development of urban projects. In that way, the guideline should be adjusted according to each project's requirements and context.

- Further research

In order to establish a better framework and to build solid comparisons between diverse contexts, it is necessary to include other lighting designers' approaches and to review additional case studies. Also, other seasons should be studied, to assess the transition between activities and schedules during the whole year.

Additionally, the study of daylight in urban planning should be taken into consideration in the proposals. This with the intention to promote sustainable projects both during daytime and nighttime.

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LIGHT AS A TOOL TO STRUCTURE URBAN PLANNING

LIST OF FIGURES

LIGHT AS A TOOL TO STRUCTURE URBAN PLANNING

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ADDENDUM

This section presents the additional formats developed during the research process and supplementary information collected during the development of the thesis.

1. CONVERSATION

With the aim to know by first hand the design intentions and the way in which lighting designers addressed the urban projects at Norrmalmstorg and Biblioteksgatan a conversation with Clara Fraenkel, one of the lighting designers involved in the projects, was arranged by the author.

ADDENDUM 1.1 | A conversation with Clara Fraenkel | May 18th, 2018

Clara Fraenkel holds an MSc in Architecture; and an MSc Human Aspects on Interior and Exterior Lighting. She currently, works at White arkitekter AB. During the conversation held at White arkitekter officess, she mentioned many relevant topics that contributed to the content of the results and discussion part of this thesis. Those insights were divided by the author into two aspects, that are going to be presented next.

Projects' insights: Biblioteksgatan and Norrmalmstorg

Firstly, the **relevance of the alliances between public and private sectors**; a scenario that was seen in Biblioteksgatan (3 owners) and Norrmamlstorg (8 owners) where from owners' initiative and the cooperation of different representatives of the municipality, a cohesive project was possible to develop. Additionally, this project represents the first collaboration between the city public sector and privates. In these alliances, Fraenkel sees the future of nighttime urban planning.

Secondly, related to the **study of the users**, in this case, **pedestrians**, during this conversation Fraenkel commented how the pedestrians were studied in Bibilioteksgatan. From that study, there were found three types of users: (1) pedestrians that cross by the street in a quick pace; (2) pedestrians that walk in a slower pace observing the shopping windows; and (3) pedestrians that walk really close to the facade. This was an intriguing finding that made evident the diversity of pedestrians' behaviour that can be found even in

LIGHT AS A TOOL TO STRUCTURE URBAN PLANNING

just one street.

Thirdly, in order to **avoid glare perception** from users, the wall-mounted luminaires' design was carefully adjusted with shades, considering the users' visual field. Additionally, these luminaires were selected to lit the facades and highlight the **vertical plane** of the street. From that, even though the light level of the street was decreased, by having lit the vertical plane made that the perception of the whole space was brighter.

Finally, related to the design intentions at Norrmalmstorg, Fraenkel highlight that **light can enhance** the **activities** that happen in the urban environments, but it can not promote these activities by itself. Even though all the proposals discussed during the design process has not been implemented, the activities that users develop in the square and how to accompany these activities through the light were elements discussed during the proposal development.

Considerations in Nighttime Urban Planning

Besides the information related to the design process of Norrmalmstorg and Biblioteksgatan, during this conversation, Fraenkel mentioned four relevant aspects to take into account during the design development.

Firstly, related to the project execution, by knowing that projects' implementation could be divided into **stages** or not completely implemented, Fraenkel suggests, that designers could inquire about what contribution light can make, to encourage pedestrians to cross the square or street. For example, a combination between paths lighting (in the perimeter of the square) and facade lighting, can encourage people to go around the square, and still gives them an option to cross inside the darker areas is they prefer to do that.

Secondly, taking into account that squares and streets make part of the

Secondly, taking into account that squares and streets make part of the
whole urban system of cities, Fraenkel commented on the relevance to consider the **city scale**. In that way, designers should think about how their proposals are going to influence the surrounding context, how pedestrians move around, and how could be perceived the whole city, if the design intention for the project proposed would be replicated in the whole city.

To give an example, Fraenkel inquired about how the city will be perceived if all the building were allowed to have facade lighting to highlight the buildings. In that case, those details that can be distinguished due to their contrast with an even and softly lit context could be completely blurred if all the surrounding facades would have the same proposal. In that case, instead, to give a reference to pedestrians, the urban environment could be perceived as excessively lit spaces, without hierarchy.

Thirdly, Fraenkel mentioned the relevance in the design process to study the **history of the place**. As Fraenkel mentioned, to know the history of the place is relevant to learn about the mistakes and good practices that have been done during the time. Insights that can contribute to developing the lighting proposal

Finally, related to human scale, in order to design the lighting proposal at meeting points and places to stay, the diverse **pedestrians' approach scales** should be studied. In that way, which details are going to be revealed in each moment should be defined, by proposing the hierarchy of the elements that pedestrians are going to look at.

As result of this conversation, many relevant elements to consider during the design process were aroused. These two projects are intriguing examples of the development of lighting design projects are urban areas, and make it clear the relevance to study the users' perspective, conform a multidisciplinary team and to involve all the stakeholders during the design process.

2. QUALITATIVE OBSERVATION

The observation process was done during the spring season between the months of April and May of 2018. The urban areas selected are Norrmalmstorg square, and Biblioteksgatan in Stockholm, Sweden. These projects were developed by the lighting designer Kai Piippo.

ADDENDUM 2.1 | Format for the comparison between daytime and nighttime

Path

Daytime	Aleatory	Structured
Nighttime	Aleatory	Guided by light

Pedestrians

Daytime	Mixed group	Specific group
Nighttime	Mixed group	Specific group

*In this case a mixed group is considered by integrating pedestrians of all ages. Also including locals and tourists.

Permanence (Staying)

Daytime	Crossing by	Meeting
Nighttime	Crossing by	Meeting

Velocity

Daytime	High	Slow
Nighttime	High	Slow

	2018 04 23 | **Monday**	2018 04 24 | **Tuesday**	2018 04 25 | **Wednesday**	**Outcome**
Daytime and Nighttime	***Path*** *D.* Aleatory — Structured *N.* Aleatory — Guided by light **Pedestrians** *D.* Mixed — Specific *N.* Mixed — Specific **Permanence** (Staying) *D.* Crossing by — Meeting *N.* Crossing by — Meeting **Velocity** *D.* High — Slow *N.* High — Slow	***Path*** *D.* Aleatory — Structured *N.* Aleatory — Guided by light **Pedestrians** *D.* Mixed — Specific *N.* Mixed — Specific **Permanence** (Staying) *D.* Crossing by — Meeting *N.* Crossing by — Meeting **Velocity** *D.* High — Slow *N.* High — Slow	***Path*** *D.* Aleatory — Structured *N.* Aleatory — Guided by light **Pedestrians** *D.* Mixed — Specific *N.* Mixed — Specific **Permanence** (Staying) *D.* Crossing by — Meeting *N.* Crossing by — Meeting **Velocity** *D.* High — Slow *N.* High — Slow	***Paths*** It was aleatory during the daytime and during the nighttime increased the preference for the paths with a higher level of light, but all paths were maintained. Also, at nighttime, the paths came closer to the areas with higher levels of light. **Users** There was a presence of mixed groups in both scenarios, but during the daytime, the rate between groups was almost the same (all ages + locals and tourists), but at nighttime, there was more presence of people between 20 and 50 years old. Additionally, there were fewer users during the nighttime. **Permanence** (Staying) An area to cross by, to stay (benches), a meeting point and to make decisions during the daytime. At nighttime, the activities were reduced just to a place to cross by. **Velocity** At nighttime, the users' pace was slower, compared to daytime. The later (time), the slower was the people's pace.

Addendum 2.1 Norrmalmstorg - Results of the qualitative observation - Comparison between daytime and nighttime | Scheme: Author

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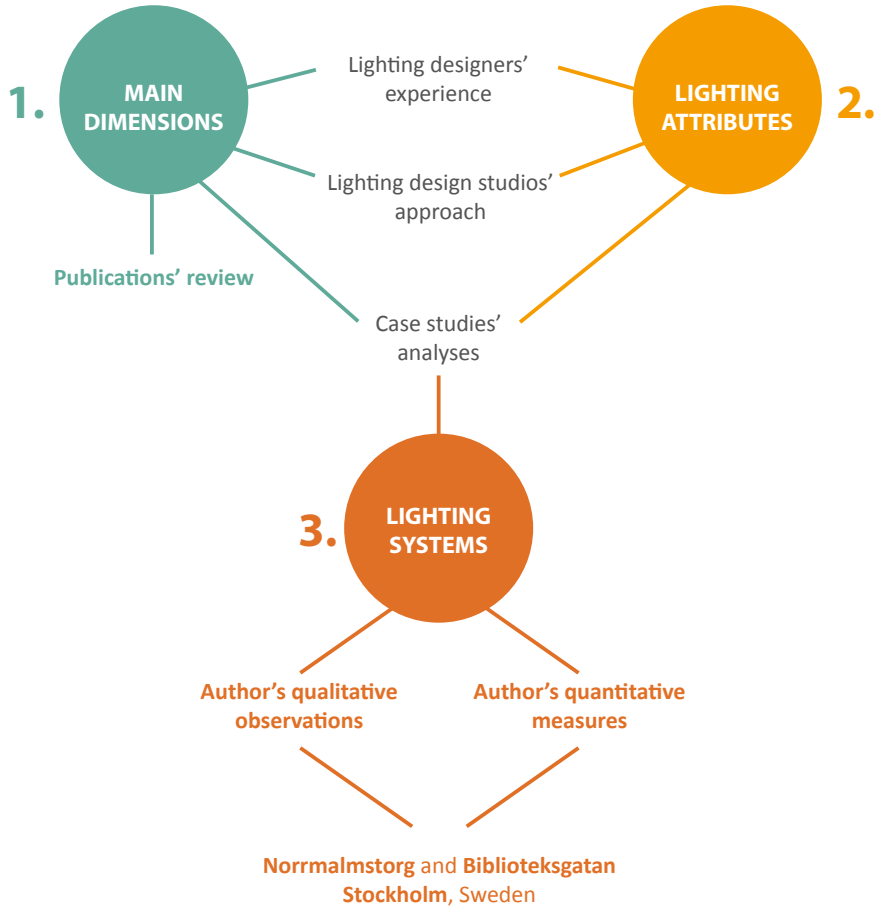
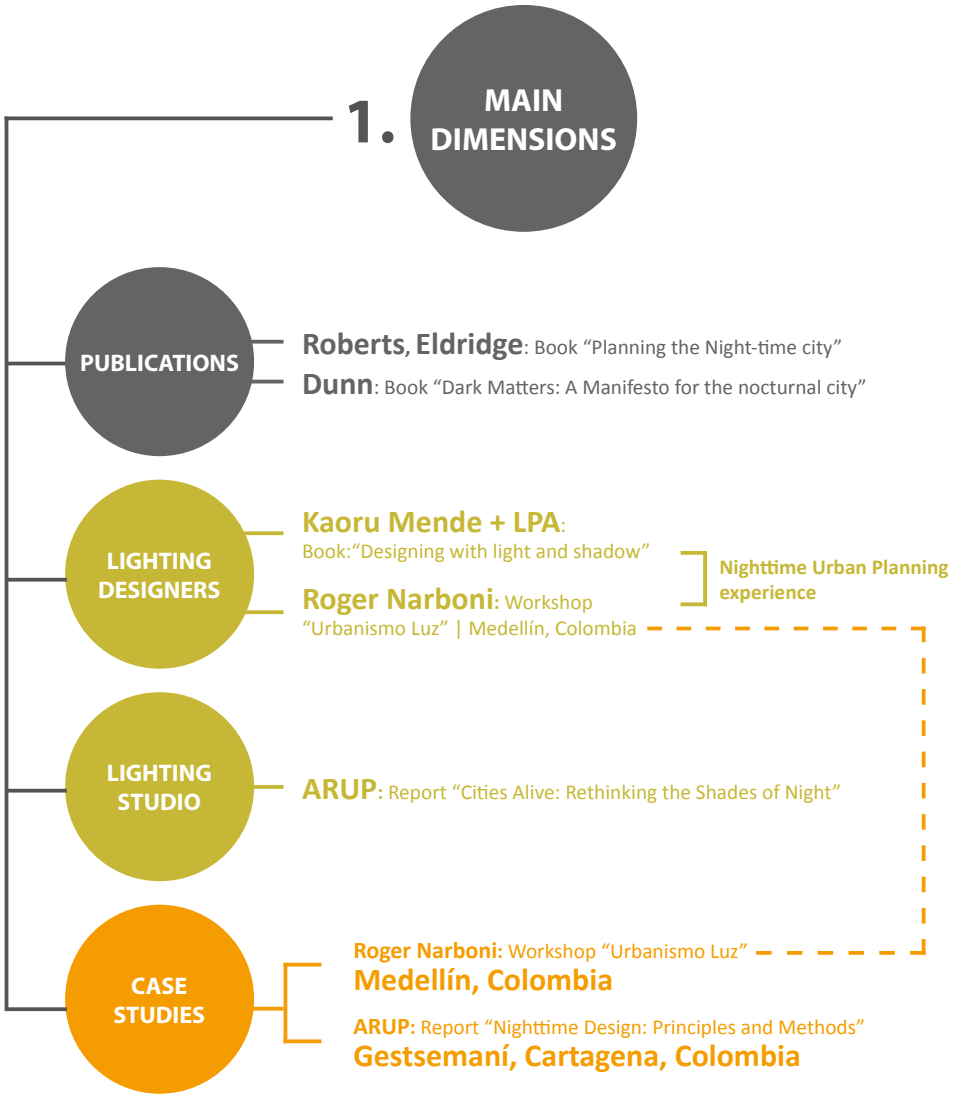
3. ANALYSIS OF EVIDENCE

All the evidence studied contributed in diverse ways to the content of the outcome. Next it is detailed how each item of evidence contributed in each stage.

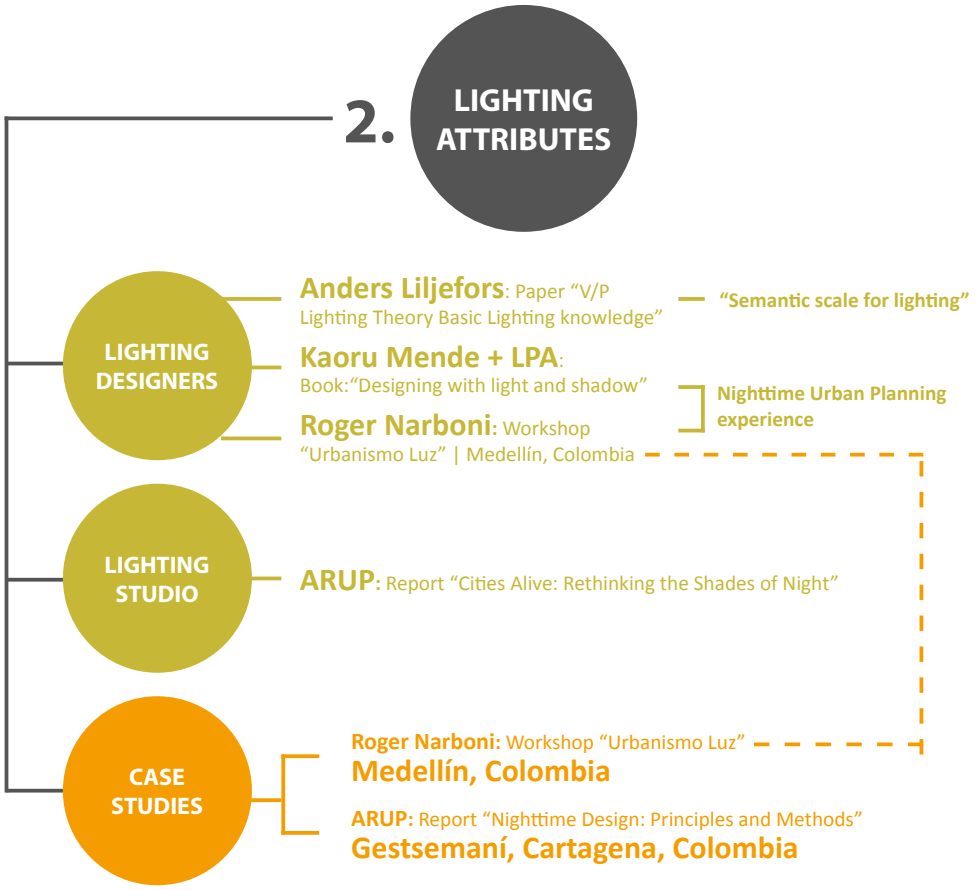


Addendum 3.1 Guideline methodology scheme | Scheme: Author

LIGHT AS A TOOL TO STRUCTURE URBAN PLANNING



Addendum 3.2 Evidence studied to propose the Main Dimensions in Urban Planning | Scheme: Author



Addendum 3.3 Evidence studied to propose the Lighting Attributes in Urban Planning | Scheme: Author

LIGHT AS A TOOL TO STRUCTURE URBAN PLANNING

“To go out into the night is a conclusive act. It heralds the end of the day and the beginning of a new time and place to explore. Not simply the urban landscape but also one’s self: a chance to encounter and attend to our deepest sense of being”

Dunn, Nick, 2016. *Dark Matters: A Manifesto for the Nocturnal City*. Zero Books. Winchester, UK.

Tutor | **Florence Lam**
Author | **Cristina Gil Venegas**
2018, Stockholm, Sweden

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