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Multiple Functions of Light: A Dialogue Among People, Light, and Space

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Abstract/ Eng

This study explores a new perspective on urban lighting design, redefining it as a multifaceted tool for regulation and communication within diverse urban contexts and physical environments. By investigating people's perceptual and emotional experiences in nocturnal spaces, this work begins on a mission to uncover fresh insights while critically evaluating established techniques and methodologies in urban lighting design. Building on normative research that identifies various non-verbal regulatory tools such as graphics, sounds, gestures, and lighting, the secondary objective of this work is to construct a comprehensive taxonomy of lighting functions. Subsequently, it analyses pivotal elements, including the interplay between these functions and the spatial characteristics of the environments, while exploring the profound impact of lighting on emotions and emphasizing the capacity of lighting to serve as a powerful artifact for emphasis, attracting, guiding, safetying, and alarming human behaviour in diverse spatial settings. Finally, this report highlights the theoretical and practical approaches to utilizing lighting as an artefact to regulate people without imposing any formal regulations in different spaces.

Keywords: urban lighting; artificial lighting; regulation; communication; human behaviours; human-environment interaction; psychological responses; smart city.

Abstract/ Ita

Questo studio esplora una nuova prospettiva sulla progettazione dell'illuminazione urbana, ridefinendola come uno strumento poliedrico di regolazione e comunicazione all'interno di diversi contesti urbani e ambienti fisici. Indagando le esperienze percettive ed emotive delle persone negli spazi notturni, questo lavoro inizia con la missione di scoprire nuove intuizioni valutando criticamente tecniche e metodologie consolidate nella progettazione dell'illuminazione urbana. Basandosi sulla ricerca normativa che identifica vari strumenti regolatori non verbali come grafica, suoni, gesti e illuminazione, l'obiettivo secondario di questo lavoro è costruire una tassonomia completa delle funzioni di illuminazione. Successivamente, analizza gli elementi cruciali, inclusa l'interazione tra queste funzioni e le caratteristiche spaziali degli ambienti, esplorando al contempo il profondo impatto dell'illuminazione sulle emozioni e sottolineando la capacità dell'illuminazione di fungere da potente artefatto per enfatizzare, attrarre, guidare, proteggere e allarmante comportamento umano in diversi contesti spaziali. Infine, questo rapporto evidenzia gli approcci teorici e pratici all'utilizzo dell'illuminazione come artefatto per regolare le persone senza imporre alcuna regolamentazione formale nei diversi spazi.

Parole chiave: illuminazione urbana; illuminazione artificiale; regolamento; comunicazione; comportamenti umani; interazione uomo-ambiente; risposte psicologiche; città intelligente.

1. **Introduction**

1.1. Introduction

In this work, I aim to explore new perspectives in urban lighting design by discovering people's experiences in urban lighting through exploratory research. This thesis defines urban lighting design as a discipline that aims at improving the quality of urban space and can be one of the regulative tools in urban space. In this sense, this thesis aims to focus on the influence of lighting on people to make a critique of the existing urban lighting design discourse.

Lighting can stimulate our brain and define our relationship to the world around us, Lighting professionals work hard to keep the stimulus narrow to get the intended reaction. Although there is a direct correlation between this stimulus and human visual performance, what about those lighting reactions that go beyond task performance? In a themed atmosphere, lighting may serve to build anticipation. lighting can help in navigating a new environment. In a peaceful and scary situation, lighting may serve to create a sense of tranquillity and harmony. In a theatrical play, lighting may serve to add mystery. Furthermore, illumination might make us despise a space that we would otherwise find pleasant. How does our brain interpret visual information to create these kinds of reactions? Also, in terms of language lighting can be considered as a language and a communication tool between spaces and people. What do we mean when we say "language"? Any systematic or non-systematic mode of communication is referred to as language. A sender, a receiver, and a message are always present. Language can be verbal, or non-verbal, such as drawing and graphics language and body language (policeman gesture), even tactile, such as braille. When discussing non-systematic communication, we are referring to a language lacking defined norms and processes. Light might be considered a non-systematic language from one perspective, as it is frequently understood differently throughout the world based on cultures, contexts, and traditions. However, there are certain occasions when light may be viewed as a systematic

language, such as traffic lights, where the colours red, green, and yellow all transmit the same message. We will take an abstract approach to light as a non-verbal language and an expressive medium that communicates messages and affects moods and emotions in this study.

Communication is the process of understanding, receiving, and exchanging meaning. The technology of communication, the characters of the information senders and receivers, their cultural standards of reference and procedure for communication, and the range of the communication process all determine the process of communication. "Communication networks are the patterns of contact that are created by the flow of messages among communicators through time and space" (Monge, Contractor & Contractor, 2003). Recently the focus of attention by philosophers, psychologists, and anthropologists concentrated mainly on descriptive and representative (communication) centrism. Drawing, for example, could have many typologies variables between "epistemic function" and "ruling function" (Moroni & Lorini, 2020)

1.2. Inspiration

Throughout history, the moon has held a captivating place in our collective consciousness. It has not only been regarded as an entity but also as a source of wonder, inspiration and speculation regarding its potential influence on human actions. This fascination with effects sets the stage for a research study aiming to explore the relationship between lunar cycles and human behaviours. Salvatore J. Graziano (Garzino, 1982) effectively argues that the standing belief in the impact of the moon on behaviour is more than just superstition. Human behaviour shedding light not only on historical perspectives but also, on how lunar rhythms can potentially be integrated into our comprehension and management of daily life. Lunar can affect human reproduction and intricate harmony between natural and human physiology and aspects such as fertility, menstruation and birth rate (Zimecki, 2006; Chakraborty, 2014), Nearly 6 million births in

France between 1968 and 1974 found that more babies born between the last quarter and the new moon than during the first quarter of the lunar cycle (Stringer et al. 2017).

Also, there is an affiliation between moon cycles and accidents like homicides, suicides, and even particular patterns of behaviours (researchers evaluated daily accident statistics as well as data on barometric pressure and the synodic lunar cycle: Lieber, 1978; Zimecki, 2006). Also, "human tidal waves" attributed to the moon's gravitational pull may be to blame for the higher crime rate on full moon days (Thakur & Sharma, 1984). On another side, the biological clock in the human body controls several physiological activities, including sleep and wakefulness affected by the lunar phase (Röösli & Jüni, 2006), the body inhibits the generation of melatonin, a hormone that promotes sleep and controls the sleep-wake cycle, when exposed to intense light, especially in the morning.

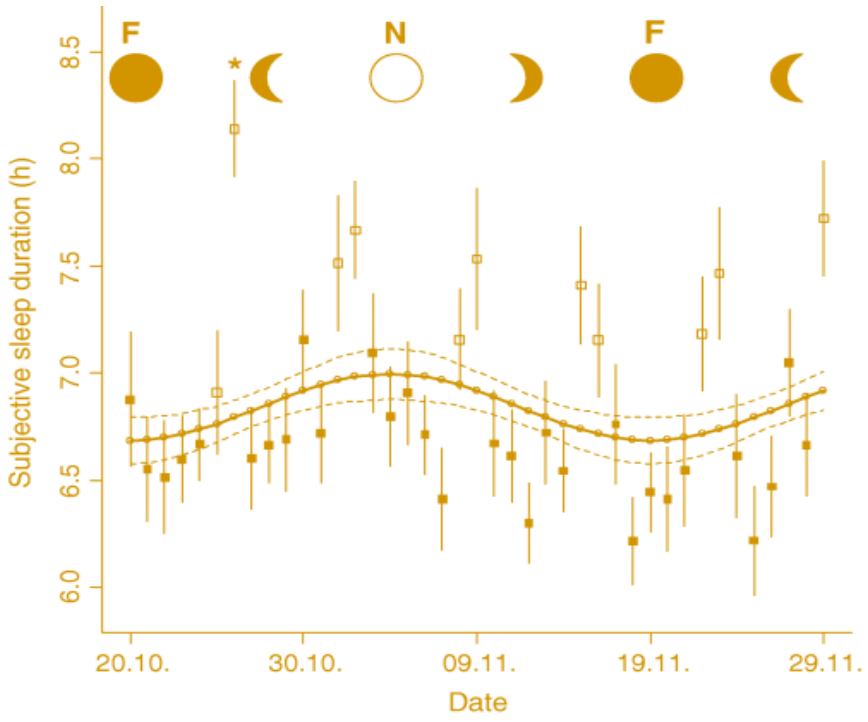


Figure 1 Sleep Duration According to Moon Phase (Röösli & Jüni, 2006).

In Islamic culture, moon observation remains increasingly important, particularly in defining important dates such as the start and end of Ramadan and other Islamic holidays that follow the lunar calendar. The sighting of the new crescent moon,

indicating a new lunar month, marks the traditional commencement of Ramadan. This practice, wherein moon-sighting committees and religious leaders diligently seek the moon's appearance on the 29th day of the preceding month, triggers the onset of Muslims' month-long fasting and spiritual observances. Similarly, Eid al-Fitr's celebration, denoting the end of Ramadan, and the conclusion of Ramadan itself are contingent on lunar cycles. The following Islamic month, Shawwal, and Eid celebrations are authenticated by the new moon's sighting on Ramadan's 29th day. Within Ramadan, moon sighting assumes profound cultural and religious importance, fostering unity as the Muslim community collectively marks the month's beginning and end while gazing at the moon. This shared experience fosters unity, excitement, and a heightened cultural and spiritual significance of moon observation in Islamic tradition. Ultimately, the moon emerges as a pivotal guide, shaping the start and end of Ramadan and the joyous observance of Eid, underlining its indispensable role in framing Islamic cultural practices.

Figure 2 A Diagram for the Moon Phase (edited by author)

To conclude, the moon's influences and effects convey a great incentive to initiate new research projects investigating the unseen and indirect effects

of artificial sources of light on human psychology and behaviour. The moon's natural brightness, which has visible effects on many aspects of human existence, has sparked interest in how artificial lighting in our modern world might similarly shape our lives. While previous research concentrated on moon effects, a relatively unexplored area is understanding how artificial lighting, extensively unseen, interacts with ordinary routines and emotional reactions. This investigation is especially important in our daily advanced technology when artificial illumination goes through our surroundings. Essentially, the moon regulates as a driving force, encouraging us to broaden our scientific research into fresh aspects of human interaction, and contributing to a deeper appreciation of how external stimuli, including lighting, intricately mould human reactions.

1.3. Objectives

The main objective of this research thesis is to discuss lighting in the urban context as a communication tool between people and space, how lighting can affect emotion and tackle social, environmental, and health problems, and analyse the nature and power of lighting to be able to regulate them without rules or norms in different spaces. Through choosing many case studies of different urban lighting contexts, the study aims to identify and classify a detailed description of multiple functions of lighting and explore the typology of lighting as a communication medium in urban and architectural spaces. Finally, to reflect those results by theoretical and practical approaches to possible reality.

To reach original research toward a possible typology of a regulative function of lighting, by defining the urban lighting design as a discipline that has a psychological and physical effect on human beings and can increase the amount of information received by people in space. All these effects of light on human beings make light a significant element of urban life. For this reason, this thesis defines light as a significant parameter in the built environment.

An evaluation of the existing know-how of urban lighting design in terms of its accordance with people's needs and expectations is the main emphasis of this study. In this respect, I aim to provide new perspectives on urban lighting design via typologizing lighting function and role in urban contexts through exploratory research on people's perceptive experience of nocturnal urban space.

1.4. Research questions

The key question is the following: How do people interpret and understand urban lighting, and what specific characteristics do they correlate with obtaining different emotional reactions - specifically, preferences, influences, motives, and safety perceptions? Additional levels develop within the scope of this question: How are these perceived illumination characteristics related to emotional assessments and subsequent human behaviours? Furthermore, in the absence of clear instructions or laws, what is the relationship between lighting attributes, emotions, behaviour, and the variables salient for regulating and orienting without direct governance? Furthermore, what is the realm of self-regulation within urban spaces? This entails understanding which specific aspects of lighting emerge as significant to individuals as they navigate their surroundings. This aspect assumes heightened importance in light of the absence of explicit governance or rules, emphasizing the intrinsic role that lighting plays in shaping the experiences and behaviours of urban denizens.

To put it simply this research question aims to investigate the relationship, between lighting, how humans perceive it the emotions stimulated and how it influences our behaviour in city environments. By examining the characteristics people associate with lighting and how it affects their emotions and actions this study seeks to shed light on the connection between light and the human experience, in areas.

1.5. Methodology

The selected methodology is a combination of background research in different fields, psychological, physical and architectural. a first-level analysis of more than 28 existing examples and studies, and a deeper analysis of 11 selected case studies. The use of the qualitative method more than the quantitative method is relevant since the research examines lighting as a medium to communicate and regulate. Under specific time limitations in the research, the theoretical background investigation, and the qualitative method were the most suitable to gain important insights into the topic. The strength of the qualitative methodology is that the data are based on human experience.

The procedure of thesis research starts with an analysis of multidisciplinary literature reviews related to the basics of communication theory, the human-environment interaction theory, and behaviour theory, to understand how light can stimulate the human brain. Then collecting different types of examples and case studies, Analysing and dividing them into six typologies after a sufficient understanding of lighting role. I set some parameters in order to select which projects could be the most beneficial for my research question. The parameters were set regarding the scale, the location, the technology used, as well as the regulatory function of light.

Important limitations of the extent of analysis in the six categories that are presented in the fourth chapter, because of the time frame. The research is limited by concentrating on existing examples and projects that use the architecture of the city and places as a canvas for communicating a non-direct message.

2. Theoretical framework

2.1. Behaviour theory and the human-environment interaction theory

As a way to explore the link between how people think and interact with their world and environment, I will present a review of the literature and previous studies on behaviourism and human environment-interaction theories. Behaviourism theory broadly defines and postulates that an individual develops all aspects of behaviour through experiences related to the connection between environmental stimuli and responses to those stimuli (Tomporowski, 2003), and those responses may include cognitive elements, unobservable mental processes and choice in mediating the behaviour of the individual. Many researchers pursue the lawful relationships between behaviours and observable social and physical environment (Jensen, 2006), and extended areas of study to focus on the effects upon the environment.

There are branches of behaviourism that operate on the assumption that not all behaviours are visible, including internal mental processes affecting the stimulus-response relationship such as purpose, expectation and cognition (Hineline, 1992). Cognitive behaviourism studies how the mind processes information leading to behaviours and looks at how memory leads to motor responses that are based on environmental inputs, in other words, many behaviours can be performed without thought because those behaviours are learned within specific, relatively stable environments.

There are different models of behaviour change. Several of them have been developed to guide practitioners and academics (Heimlich & Ardoin, 2008). The communication and persuasion model posits that communication can change attitudes and behaviours that are linked in the same causal chain, in this model, inputs include the source, the message itself, the channel, the recommended behaviour change and influence. Outputs of the model are changes in specific cognition and observed behaviours This model is widely used in communications and media studies (Graeff et al. 1993).

On the other hand, the human-environment interaction model, adapted from the work of Swedish environmental psychologist Töres Theorell and lighting researcher Kjell Küller, proposes that human behaviour is influenced by the interaction between the individual, the environment, and the task at hand. This model emphasizes the importance of considering the dynamic relationships between these factors when designing lighting environments. Personal characteristics including age, gender, culture, and status of health are included in the individual components as they might affect how a person reacts to illumination. Physical aspects like light intensity and quality, as well as spatial organization, colour, and texture, are all environmental influences. The term "task factors" refers to the particular tasks that are performed in the environment and how the lighting affects them, such as reading, working, or interacting with others.

According to this concept, the interaction between different factors, which might result in a complex and dynamic system, affects human behaviour. In addition, the lighting requirements for a place of socialization might turn out to be different from those for a workplace, and the lighting needs of an elderly person with visual disabilities may differ from those of a young adult. By understanding the complex interactions between the individual, environment, and task, designers can create lighting environments that meet the needs and preferences of users, while also promoting health, well-being, and productivity. The human-environment interaction model provides a useful framework for understanding these interactions and developing lighting design strategies that optimize human performance and experience in a variety of settings. The effects of light on people and the urban environment are reviewed under two categories: the psychological effects of light and colour on human beings, and the environmental effects of light on air pollution.

2.2. *Light and colour psychological effects on human beings*

In this section, I present the literature and previous studies on human response to and preference of light and colour, in order to present the relationship between perceived attributes and emotional appraisals within surrounding and spatial context. This effect contains two main sections: the effect of light intensity and distribution in interior space and exterior space, and the effect of colours on human being's behaviours.

According to studies, the effects of light and colour on people in urban exterior environments have received limited attention from scientists, most research that attempted to define the relationship between perceived lighting characteristics and emotional responses was conducted for interior spaces. Although current studies on how colour and light affect humans aren't focused on urban exteriors, the field of environmental psychology presents considerable knowledge about this topic.

2.2.1. The effect of light intensity and distribution

The major studies have reviewed the effect of light intensity and distribution on human beings, We will categorise the literature reviews under two subtopics interior spaces and exterior, concerning the spatial context of the research and literature findings.

Study reveals that people use the brightness and distribution of lighting as a basis for their assessments of an interior space. The classical study of Flynn concludes that lighting condition affects the mood: non-uniform lighting cues relaxation, perceptual clarity is reinforced by higher central and horizontal lighting and the feeling of spaciousness is boosted by bright and uniformly lit interiors (Flynn et al., 1979). Other studies conclude that people report more positive feelings under low brightness and warm light (Baron & Rea, 1991; Loe, 1993). Nevertheless, Gifford reveals that low brightness creates more intimate environments. On the other hand, studies of other groups concluded that individuals prefer brilliantly lit areas and that the distribution of light has significant

effects on how people experience the space, also concluded that as the illumination level on a surface increases the space looks more spacious (Yücetaş, 1997). group at the Bartlett School of Architecture at University College London explained that two independent dimensions - brightness and interest - (derived from non-uniformity) - could be used to explain responses to 18 different lighting designs for a windowless two-person office, the experiments showed that people prefer higher illumination levels in interiors and the light pattern has a significant effect on how people feel about the interior space (Veitch & Newsham, 1998).

In another study on the effects of light on the interpersonal communication and mood of the users in interior spaces, Gifford (1988) concluded that light level (brightness) affects communication levels. According to his research findings, general communication occurred in brighter settings,

On the other side, there are limited research and scientific knowledge about the effect of lighting on human beings in exterior spaces and urban context. According to landscape architect Moyer, there is a relationship between lighting and emotional reactions (Moyer, 1992), and perceived attributes of lighting - based on the direction and brightness of light - and emotional reactions of people. At night, the combination of the eye admitting light in and the brain interpreting this visual information gives humans clues and direction and stimulates feelings of comfort, interest, pleasantness, etc. Also, it may direct how people see and feel about space by controlling the brightness introduced into the space, the brightness control can direct people's attention and movement through an exterior (Moyer, 1992). Moyer also stressed that the level of light from one area to another too high contrasts introduces confusion in space, people feel comfortable when they can see the boundaries of space, seeing the boundaries of an area of an object is important for perception since the outlines are seen first then the eye scans the surfaces within outer contours (Michel, 1996).

2.2.2. The effect of colour

This section includes a study of how colour affects people and raises questions about how the effect of different colours (and light in various colours) affects people and the need for balance between unity and complexity in the built environment. Many psychologists have proposed that cultural learning is the cause of the relationship between certain colours and emotional responses. However, cross-cultural studies and studies on humans at different age groups conclude that the emotional reaction of people to the colours is more innate than learned.

These studies additionally demonstrated that people respond to particular colours in ways that are identical to one another. Human beings are immediately, instinctively and emotionally moved when they are exposed to colour. Every human being gives psychological reactions such as sympathy, antipathy, pleasure or disapproval as soon as he/she perceives a colour or colour combinations (Mahnke, 1996). Mahnke stresses that colour which is created by light, is a form of energy, and this energy affects body function, mind and emotion. Colour affects cortical activation (brain waves); functions of the autonomic nervous system - which regulates the body's internal environment - and hormonal activity; and that colour arouses definite emotional and aesthetic associations.

The study discovered that exposure to *Red Light* led to increased arousal, characterized by fluctuations in blood pressure, a faster pulse rate, and an uncomfortable sensation of constriction in the throat. The glaring brightness of the light was perceived negatively, causing headaches; in fact, one participant requested the experiment to end after only two minutes due to this discomfort. The study did not identify any components associated with pleasure in this scenario. Participants described *Yellow Light* as "powerful" and reminiscent of the sun in terms of its impact on tension. They reported a sensation of vibration at their core. However, the light did not evoke feelings of calmness or pleasantness. *Violet-Blue* Light elicited a sense of pleasure among participants. They noted its strong calming influence, describing it as remarkably restful. The blue hue was regarded as conducive to concentration. Notably, no negative or stimulating elements

were detected in this context. *Green Light* was perceived as pleasant and agreeable by participants. In terms of its calming effect, it was rated as more soothing than red light. Subjects also noted a certain compelling quality about it (Mahnke, 1996). Here are the findings of these two studies that correspond with the general selections made in the colour-psychology test on associative-symbolic content from different counties worldwide.

Table 1 An Interdisciplinary Understanding of Colour in Different Cultures (De Bortoli & Maroto, 2001)

	Africa	**Asia Pacific**	**Western Europe**	**North America**	**Latin America**
White	Victory, Purity	Death, Neutral	Surrender, Purity	Purity, Elegant	Purity
Black	Maturity, Masculinity	Life, Stability	Death, Evil	Death, Evil	Death, Religion
Red	Death, Bloodshed	Joy, Fire, Fertility	Love	Warning, Passion	Death
Green	Fertility	Youth, Birth	Fertility	Healthy	Vegetation
Yellow	High Rank	Power, Royalty, Masculinity	Hazard	Happiness	Sun
Blue	Harmony And Love	Sadness	Truth, Fidelity	Trust, Official	Trust, Tranquillity
Purple	Femininity	Royalty	Luxury	Nobility	Sadness

To conclude and emphasize human psychological responses to colours are a blend of innate and learned factors, with innate tendencies perhaps holding the most significant influence. Meanwhile, emotional reactions to colours are often seen as personal, there exists a possibility of discovering universal attraction in the use of colours (Küller, 1981). Furthermore, Küller points out the substantial number of cross-cultural studies encompassing participants from diverse nationalities spanning Africa, Asia, North and Latin America and Western Europe. These studies encompassed various participant groups, including men and women, children and adults, as well as professionals and laypeople. Ultimately, he concludes that the capacity for accurate responses to colours is

either acquired through learning or stems from an inherent emotional reaction to distinct colours.

2.2.3. Activities under the influence of the lighting

Lighting plays a significant role in influencing various activities across different contexts. It can impact our mood, perception, productivity, safety, and more. Here are some examples of activities influenced by lighting.

Reading and Studying: Reading and studying require optimal lighting conditions to ensure comfort and efficiency. Proper lighting prevents eye strain, allowing readers to engage with text for extended periods. Task lighting, such as desk lamps with adjustable brightness, is commonly used to provide focused illumination. The right lighting level ensures that text is visible and easy to read, enhancing comprehension and information retention. In educational settings, well-lit classrooms and libraries contribute to effective learning environments.

Cooking and Food Preparation: A well-lit kitchen is essential for safe and effective food preparation. Adequate lighting over countertops, stovetops, and cutting areas ensures that cooks can work with precision and accuracy. Proper visibility reduces the risk of accidents and cross-contamination during food handling. Bright task lighting is particularly important in areas where detailed tasks such as chopping, measuring, and seasoning take place. Additionally, the right colour rendering in lighting helps chefs assess the freshness and quality of ingredients.

Ambience and Relaxation: Lighting has a profound impact on creating different moods and atmospheres. In spaces meant for relaxation and unwinding, such as bedrooms and lounges, soft and warm lighting is often used. This type of lighting creates a cosy and inviting ambience, encouraging relaxation and comfort. Dimmable lighting systems provide flexibility to adjust the light intensity according to individual preferences and activities, allowing occupants to create their desired atmosphere.

Art and Display: Lighting plays a critical role in showcasing artworks, museum exhibits, and retail displays. Well-designed lighting enhances the visual impact of objects, drawing attention to details, textures, and colours. Different lighting angles and colour temperatures can create various effects, from dramatic spotlighting to uniform illumination. In galleries and museums, adjustable lighting tracks or fixtures are used to customize lighting for different exhibits, ensuring that the artworks are presented in the best possible way.

Theatre and Entertainment: Lighting is an integral part of theatrical productions, concerts, and entertainment events. Stage lighting enhances performers' visibility, creates mood changes, and accentuates storytelling elements. Dynamic lighting effects, such as colour changes and spotlighting, contribute to the emotional resonance of performances. Lighting designers meticulously plan and execute lighting setups to support the narrative, evoke emotions, and engage the audience visually.

Outdoor and Landscape Lighting: Outdoor lighting serves multiple purposes, including safety, security, and aesthetics. Streetlights illuminate roadways and pedestrian paths, ensuring safe navigation at night. Landscape lighting highlights architectural features, trees, and pathways in outdoor areas, enhancing the visual appeal of buildings and gardens. Well-planned outdoor lighting contributes to a welcoming environment and prevents accidents by ensuring visibility in dark or poorly lit areas.

Exercise and Fitness: Lighting in fitness environments influences motivation and performance. Well-lit gyms and exercise studios create an energetic atmosphere that encourages physical activity. Bright, evenly distributed lighting ensures that participants can see their surroundings, exercise equipment, and their form while working out. Proper lighting also enhances safety by reducing the risk of accidents during exercises that involve movement and equipment use.

Retail and Visual Merchandising: In retail spaces, lighting significantly impacts the shopping experience. Well-designed lighting draws attention to products, highlights specific displays, and guides customers through the store's layout. Effective lighting can influence

customers' perceptions of product quality and even influence their purchasing decisions. Accent lighting, track lighting, and spotlighting are commonly used to create visual interest and emphasize featured items.

Medical and Healthcare Settings: Lighting plays a crucial role in healthcare environments, ranging from examination rooms to patient recovery areas. Proper lighting conditions aid medical professionals in performing accurate assessments, diagnoses, and treatments. In patient rooms, lighting can affect mood and comfort, contributing to a sense of well-being. Surgical lighting must provide precise illumination to ensure optimal visibility during procedures. Additionally, lighting controls that mimic natural daylight can support patients' circadian rhythms, promoting healing and improving sleep quality.

These examples illustrate how lighting has a profound impact on various activities across different settings, influencing everything from safety and functionality to mood and visual aesthetics. The type of lighting used, and its strategic design are essential factors in creating environments that cater to specific activities and enhance overall experiences.

3. Exemplary cases

3.1. Meshiereb lighting plan concept

The *Msheireb* is a 35-hectare mixed-use complex that is being built to revitalize Doha's downtown. The lighting masterplan development standards offered guidelines for the type of development that occurs after dark and contains a variety of layers or aspects, such as street lighting, orientation, guiding, and signs, as well as general remarks and particular compliance requirements (Zielinska-Dabkowska, 2019; Cengiz, 2022). The location is in the heart of Doha, therefore the concept concentrated on blending the proposed construction into the existing environment. With relation to lighting, several significant themes were created and implemented at every level of the planning to emphasize road, street, and urban open space hierarchy.

Figure 3 Msheireb properties project

The design intends to provide Doha with a modern solution rather than a generic approach to a modern city. Maintaining linkages to the past, present, and future was crucial given the area's history as a dynamic fishing port, the importance of the Corniche, and the unique architectural language and cultural context of the region. In terms of lighting, this translates into contemporary technology, but in understated ways

that emphasize texture and pattern, draw attention to the development's various roofscapes, and minimize unnecessary light and light pollution.

Figure 4 Urban lighting plan strategy sketches

For the building facade illumination, the 'Light-Dark-Light' idea was created in collaboration with other disciplines, this implies that the majority of the buildings in the development should all have decorative lighting that emphasizes the distinctive and varied roofscape as well as the building entrances or ground level. The façade should be generally left in the dark, and when illuminated, it should be done discreetly to highlight special textures or patterns. Landmark structures, like mosques, were classified as the exception to the criteria because they also serve as a major site entry or have a unique civic purpose.

The hierarchy map provides a visual representation of the streets and their subordinate relationships among each other, portraying the overall breakdown of the *Msheireb* Urban grid. The physical characteristics such as the section of the streets will

determine the lighting specification, representing the complex technical requirements for every specific area according to its function and characteristics. Paths are specifically provided to allow pedestrian access from parking lots to shopping and recreation areas, paths that link residential complexes to areas of communal gatherings, and paths through parks (Zielinska-Dabkowska, 2019). The principal aspect to achieve in pedestrian lighting is security feeling and comfort, that's uniformity is not a must in lighting design for walkways, to reach this pleasant pedestrian lighting we must avoid dark spots and any unnecessary glare (Cengiz, 2022). Also, A cyclist must negotiate his way in all types of weather without protection against the elements; therefore, viewing conditions at night must be extremely good. The positions of cycle paths will vary considerably within the site. They can be located alongside the road or completely separated from any other transport route such as through parks and open or wooded fields. Each situation must be considered individually, and consideration be given to the suitability of using the lighting of an adjacent route for the cycle path. As the main requirement of visibility will be the determination of changes to or the presence of objects on the pathway the concept of path surface horizontal illuminance is recommended as standard.

3.2. London lighting master plan

The London Lighting Master Plan is designed to significantly enhance safety and boost tourism and culture exchange in the city by implementing a range of measures that improve visibility and mitigate risks within the city and interpretation of city landmark visualization. The plan focuses on enhancing lighting in areas where they frequently commute, such as sidewalks, crosswalks, and bike lanes. By improving visibility in these areas, it becomes easier for pedestrians and cyclists to navigate, while also increasing their visibility to motorists, thus reducing the likelihood of accidents. One crucial aspect of the plan is the positive highlighting of conflict areas, where different road users interact by strategically illuminating these areas, the plan raises awareness among

individuals, promoting caution and safer behaviour (Bosetti & Wills, 2021). Brighter lighting in conflict zones helps individuals recognize potential risks and encourages them to take appropriate precautions, effectively mitigating potential dangers. The plan creates a well-lit environment that prioritizes visibility, reduces risks, and ensures the safety of well-being. Also, integrated lighting is utilized in areas with changes in levels, such as staircases or ramps, to improve visibility and reduce the risk of falls or accidents (Bosetti & Wills, 2021). Adequate illumination in these areas allows individuals to perceive elevation changes, ensuring their safety as they navigate through such spaces.

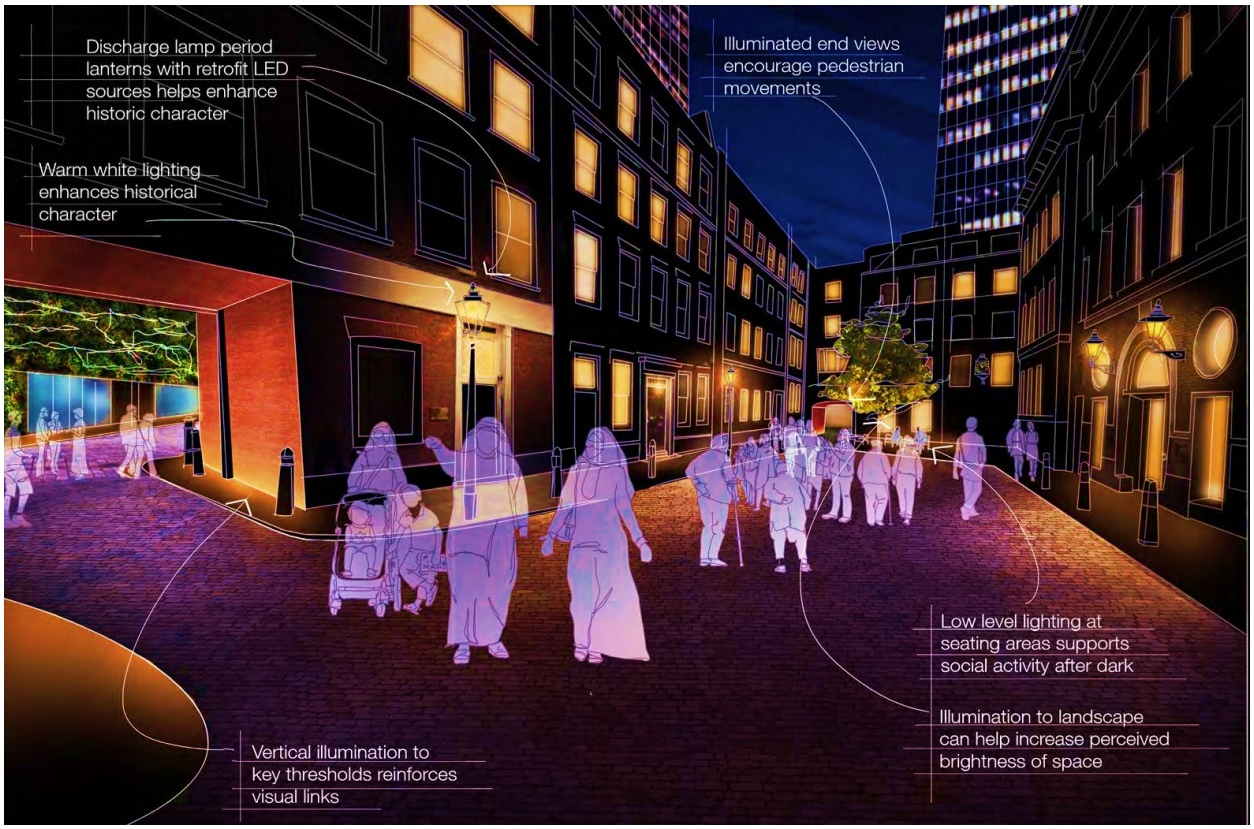


Figure 5 Sketch for Fleet Street (edited by Author)

On the other hand, lighting plays a crucial role in the cultural development, interpretation, education, and tourism of the City of London. To maximize its impact, several recommendations are proposed. Firstly, the development of a simple policy for highlighting key buildings, bridges, and landmarks is suggested, starting with a pilot project in the Culture Mile area. This would enhance their visual significance and cultural value. Secondly, it is important to avoid over-lighting, floodlighting, and inappropriate

use of colour to preserve the authenticity and aesthetic integrity of cultural assets. By maintaining a balanced approach, the natural beauty of these structures can be accentuated without causing visual pollution. Implementing a City-wide smart lighting control system is also recommended to efficiently manage lighting schemes throughout the city. This would enable precise timing and coordination while reducing energy consumption and light pollution. Lastly, coordinating feature lighting with local, national, and international events would enhance cultural experiences. The flexibility to customize lighting effects during specific occasions creates a cohesive and immersive atmosphere, capturing the spirit of the event and engaging both residents and tourists.

By embracing these recommendations, the City of London can harness the transformative power of lighting to enrich cultural encounters, foster community engagement, and attract visitors. The thoughtful and strategic use of lighting showcases the city's rich heritage, creates a dynamic cultural environment, and contributes to its overall appeal as a global cultural destination (Speirs & Major LLP, 2018).

Figure 6 Sketch for Culture Mile (Edited by Author)

3.3. The National Museum of Art in Japan

In an art museum, lighting is crucial to how much the visitors understand and experience the exhibits. To identify the ideal lighting environment, and how the influence of correlated colour temperature (CCT) and lighting mode on the visual perception of observers in art museums. The results of the experiments reveal that CCT plays a significant role in shaping observers' visual perceptions, particularly in terms of relaxation/tension, fun/boredom, and warmth/coldness. Furthermore, the lighting modes of accent lighting and mixed lighting significantly influence observers' perception of beauty/ugliness. However, the study indicates that general lighting has minimal impact on observers' perception, regardless of CCT changes. Interestingly, under accent lighting and mixed lighting conditions, CCT demonstrates a substantial influence. Specifically, when the CCT is 4000 K, there is no significant difference between accent lighting and mixed lighting. But, at 270 K, there are notable distinctions between the two lighting methods (Gao et al., 2020). Regardless of the CCT value, general lighting stands apart from the other two lighting approaches. Moreover, the experimental results also deviate from Kruithof's rule (which suggests that as colour temperature decreases, less light is needed for visual comfort. It proposed cool white light for bright environments and warm white light for dimly lit spaces.), which adds an interesting observation to the study.

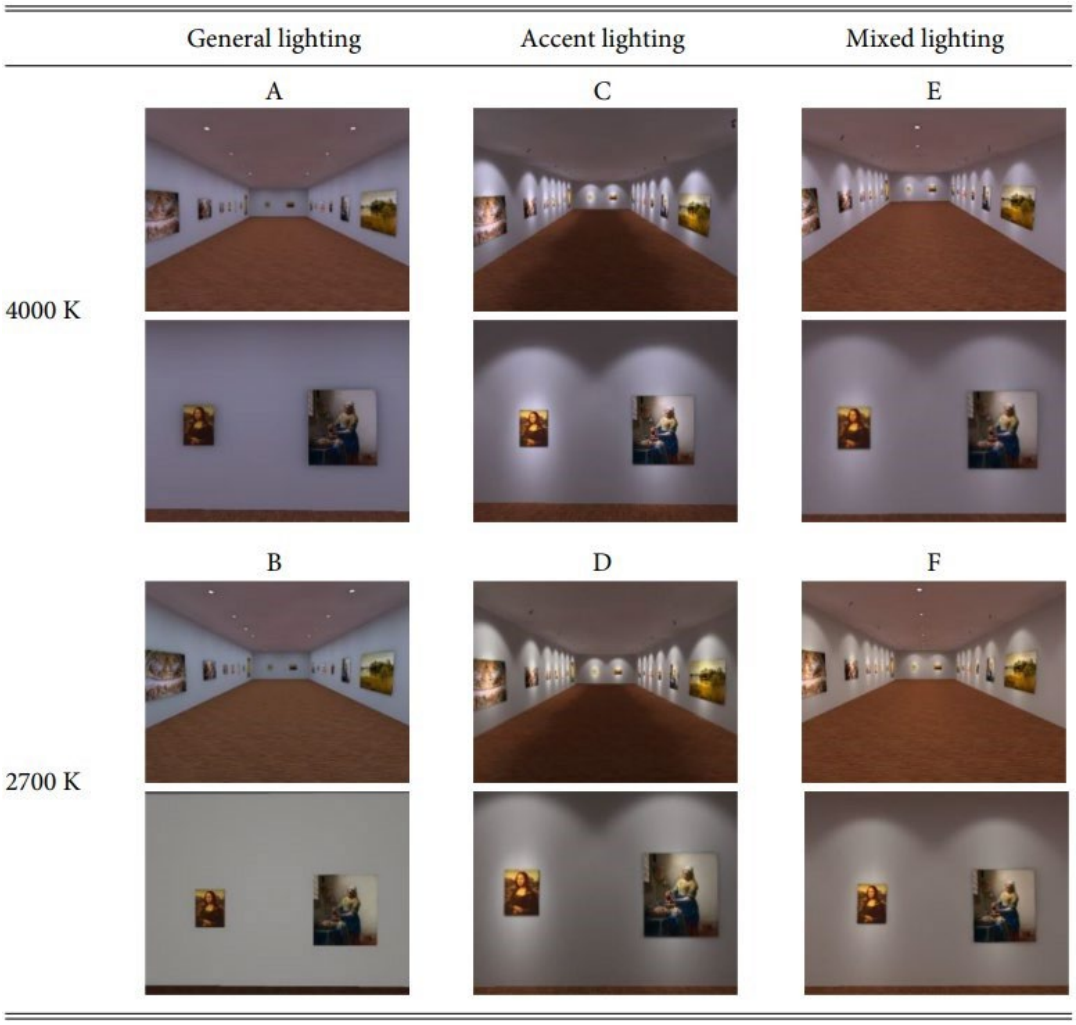


Figure 7 Different Lighting Design Schemes in The Hall (Gao et al., 2020)

Based on these findings, the researchers provide valuable recommendations for the lighting design of art museums. They emphasize that relying solely on general lighting yields inferior results compared to the other two lighting methods. Thus, it is not advisable to use general lighting alone in art museums, and a preferable approach is to adopt mixed lighting. When the CCT is 4000 K, the distinction between accent lighting and mixed lighting is minimal. Therefore, designers can opt for accent lighting alone if desired. To achieve even better outcomes, a small amount of general lighting can be added. However, at a CCT of 2700 K, mixed lighting surpasses accent lighting in terms of visual perception. To conserve energy while maintaining satisfactory results, it is recommended to reduce general lighting while incorporating mixed lighting. It is important to note that this study's narrow CCT range limited the ability to determine the optimal CCT condition.

Future research should aim to address this limitation by exploring a wider range of CCT values (Gao et al., 2020).

This research acknowledges that the visual perception of individuals from different age groups may be affected differently by the same lighting environment. However, the participants in this study primarily consisted of students of similar ages. Therefore, future research should consider expanding the age range of subjects to analyse and discuss the emotional responses of different age groups in art museum lighting environments.

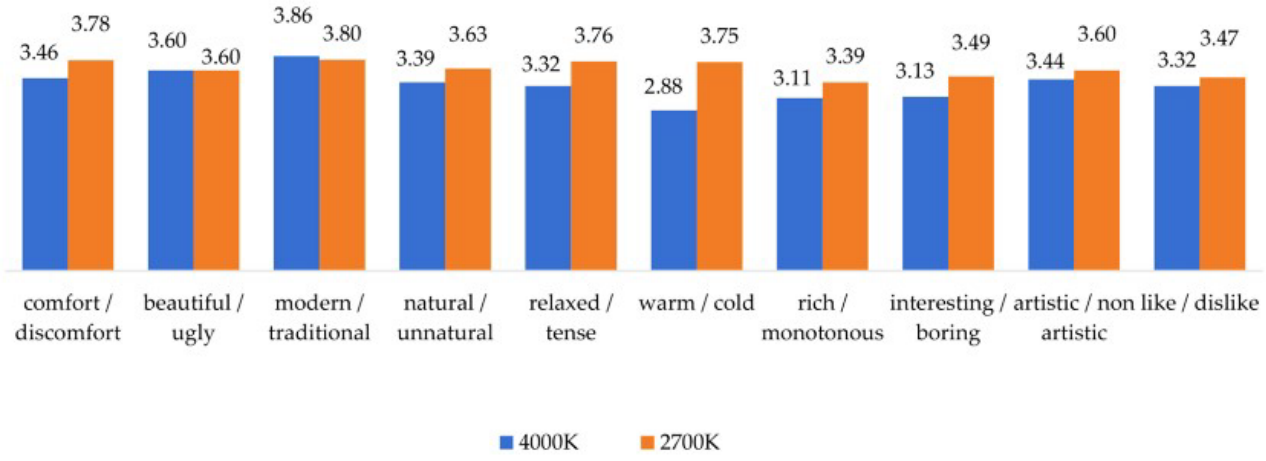


Figure 8 Average Value of Word Pairs Under Different CCTs (Gao et al., 2020)

3.4. Traffic street lighting

Traffic lights are essential for regulating traffic flow, service levels, and road user safety. According to pedestrian research, traffic light spacing, and signal congruency might also influence a driver's decision-making process and govern people and driving behaviours through its systemic lighting colours, which are well-known to most people as a cultured basis.

Figure 9 Traffic Signs and Signals (A. Rose & Hach, 2023)

There are many kinds of research conducted on driver behaviours at different traffic light signals were observed and analysed, along with the impact of warning schemes. At red lights, the majority of drivers adhere to the norm of stopping, regardless of the warning scheme employed. This behaviour remains consistent and unaffected by the type of warning scheme. However, it is worth noting that crossing red lights is more common than expected, indicating potential safety concerns (Yang et al., 2016). Yellow lights witness a variety of interpretations by drivers. Contrary to their claims of slowing down, the most common behaviours observed are speeding up and maintaining speed. Notably, warning schemes do influence yellow light behaviour. Countdown timers increase the proportion of cars that accelerate at yellow lights while decreasing the number of drivers who maintain their speed. Insights from the sampled drivers revealed that the main considerations for crossing a yellow light are the driver's speed and distance from the intersection (Felicio et al., 2015). The prevailing norm of not slowing down at yellow lights highlights the need for improved safety measures. When it comes to green lights, the typical driver behaviour is to maintain their speed. This behaviour remains consistent across different warning schemes. However, the second most common behaviour is speeding up, which is not statistically affected by the warning scheme (Felicio et al., 2015). Nevertheless, the warning schemes still impact driver

behaviour, particularly during the last 5 seconds of the countdown timer or the blinking phase of the blinking light warning scheme, where there is a significant increase in drivers who accelerate to cross the intersection.

In conclusion, Traffic lights also influence speed control, and pedestrian behaviour, and contribute to managing traffic flow and reducing congestion, ultimately shaping how drivers interact with the road environment and other road users.

3.5. Little dancer sculpture

Lighting has a complex and multidimensional effect on sculptures, directly impacting how they are seen and understood. Several aspects are considered, including the sculpture's size, physical characteristics, and distinguishing traits. Lighting is a potent tool for emphasizing these qualities and conveying critical information to spectators. The lines of the sculpture are important because they may portray emotion or movement. Lighting may draw attention to these lines, whether they are gentle curves or sharp angles, increasing the intended visual impression. Furthermore, positive and negative spaces are important in sculpting the sculpture's form and detail. Positive and negative areas may be improved with skilled lighting methods, providing depth and complexity to the artwork.

The texture is another important aspect that lighting may enhance (Sumartojo, 2022). The texture of the sculpture's surface becomes more prominent when it is carefully illuminated, allowing spectators to enjoy its tactile properties. Additionally, lighting can successfully communicate facial expressions in sculptures. The artist's intended emotions and tales may be brought to life by suitably lighting the facial features, strengthening the viewer's relationship with the artwork.

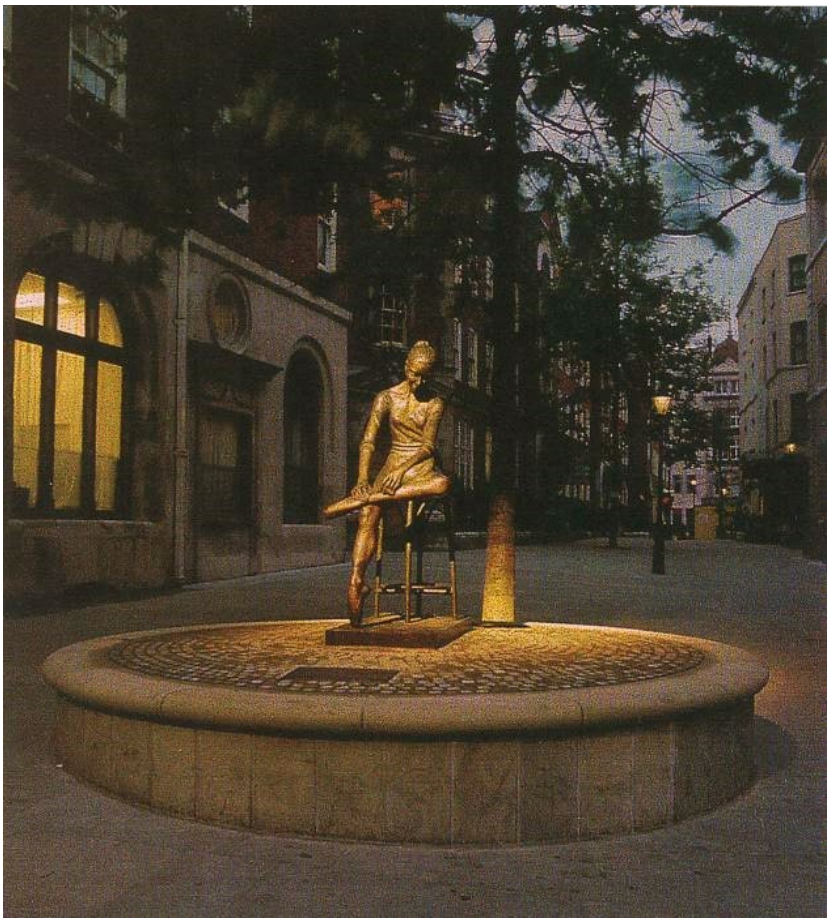


Figure 10 Little Dancer, Covent Garden, England (Philips, 2001)

Downlighting is a popular lighting technique for sculptures since it keeps the sculpture's natural look. Downlighting cast shadows on the bottom of textural features, simulating the impression of sunshine and giving depth and character to the sculpture. However, it is critical to consider the projected illumination direction. Shadows projected from above can have a considerable influence on the visual presentation of the sculpture, perhaps changing pleasant elements into uncomfortable or unappealing ones and modifying the overall impression of the artwork. The artwork "The Little Dancer" at Covent Garden, reported by Phillips in 2001, is an exemplary example of the efficient use of downlighting. A single metal halide lamp suspended seven meters above the sculpture eliminates glare while throwing an adequate pool of light on the monument's face (Philips, 2001). This ingenious downlighting approach both protects and improves the sculpture's natural look, allowing visitors to fully appreciate its aesthetic significance.

Moreover, lighting is critical in the perception and interpretation of sculptures. Lighting may direct the viewer's comprehension and create a more fascinating and immersive experience with the artwork by considering the sculpture's size, physical characteristics, distinguishing features, and desired emotional expression.

3.6. Tokyo, Roppongi - Lighting and city's dynamic

Roppongi Hills, situated in Minato Ward in Tokyo is surrounded by the iconic 54th skyscraper and substantial architectural elements that together make up the area's mix of commercial, residential, and museum facilities. A series of levels that crossed the whole land connected the gardens and outdoor areas. The lighting masterplan was intended to reflect the use of high-quality luminaires and the newest technologies as part of a cutting-edge lighting design approach. Since the Roppongi Hill Lighting Masterplan should be targeted for a futuristic city, technology was excessively used in this project and was analysed in detail, and an appropriate lighting strategy was conceptualized. The lighting design for Roppongi Hills on several aspects based on viewpoints, changing scenarios with time, adhering to the architectural character of the space, and employing the most appropriate lighting design and technology, these design criteria, and viewpoint relates to the manner people perceive and navigate through space.

Roppongi Hills lighting master plan objective is zonal division, which separates the site into two main portions, where the commercial spaces are distinctively separated from residential. Moreover, within each parcel, the landscaping in the outdoor spaces was lit differently from each other, dependent on their adjacent surroundings (Cybriwsky, 2011). For example, low Colour Temperature and low-level lighting were utilized for landscape lighting in the Japanese Garden that is next to the residential area, but Fiber optics wrapped trees are the highlight of the surreal garden of Roku Roku Plaza. Hence, the lighting had to respond to the different functions each area embodied, like the use of low-level lighting for the vegetation and parks, outdoor plaza, and high technology utilized for façade illumination. Together, the Colour Temperature of the chosen lamps is

different to highlight the character of the lit space, low Colour Temperature lamps for intimate spaces, and cooler Colour Temperature for areas of higher pedestrian traffic flow. The difference in lighting strategy allowed non-uniformity for visual interest and clarity in navigation (Cybriwsky, 2011).

3.7. Lighting for tourists in Valladolid

Urban nightlife is becoming increasingly important in the tourist and hospitality industries, while many capital cities and cultural capitals have successfully built thriving nightlife scenes, smaller communities frequently lack the cultural assets to attract travellers interested in nightlife or party-focused tourism. To address this, several medium and small-sized cities have developed stunning types of illumination as a tactic for attracting tourists and extending their stays.

Figure 11 The Millennium Dome – Valladolid (Imtech, 2016)

The use of illumination in cultural-led regeneration schemes is viewed as a means of promoting the city and providing an alternative to typical leisure places. However, there is

a growing emphasis on creating sustainable lighting solutions and unique designs. As an example, Valladolid and its project 'Ruta de los Rios de Luz' are used. The initiative not only sought to conserve power and minimize light pollution, but it also acted as a catalyst for rewriting Valladolid's lighting plan in the direction of sustainability. Many researchers raise certain concerns, notwithstanding the effectiveness of similar initiatives in terms of drawing visitors and encouraging sustainability (Giordano, 2018). It implies that the initiatives frequently focus primarily on the growth of midnight tourism and fail to address wider concerns such as lighting pollution and urban energy consumption. The importance of a complete Lighting Master Plan for the entire city is stressed. Furthermore, the influence of lighting on the visual change of urban environments on the overall urban experience implies that seeing light as a scenic material and orchestrating lighting effects may shape and affect how people perceive and experience the city at night (Giordano, 2018). The approach is not neutral but rather highly political, as it aims to exercise ambient power and create a seductive spatial arrangement.

In conclusion, while the development of vibrant nightlife and the use of spectacular illumination can be beneficial to tourism and sustainability, there is a need for a more comprehensive approach that addresses issues at the urban level, considers the social and experiential aspects of lighting, and integrates innovative design and technologies with a critical perspective.

3.8. Lighting and branding in retail shops.

The influence of lighting schemes on brand image and customer perception in shop design. The studies attempt to bridge the gap between the domains of lighting and marketing by providing a deeper understanding of the link between architectural lighting and brand communication. by underlining the need for design teams to balance the various effects of lighting on brand marketing tactics. The questions centred on studying subjective lighting response and its relationship to brand indexes as well as

evaluating the impact of lighting patterns on how consumers view a brand. Many data suggest that in some interior kinds, brightness alone may be considered a predictor of brand characteristics, but not for different shop types (Schielke & Leudesdorff, 2015).

There are significant correlations between lighting and brand perception shown by lighting patterns, changes in lighting patterns may have an impact on both good and negative brand indices, illustrating the significance of balancing various brand aspects to fit with the aimed brand image. According to some findings, spatial patterns formed by lighting show a greater impact on brand appearance than changes in light patterns alone (Schielke & Leudesdorff, 2015). There is a study that also includes an economic perspective, suggesting that a store's perceived price perception is independent of real investment and operational costs. The finding is significant for real-world illumination. It implies that, in order to make a better brand statement, it may not always be required to remodel a store's lighting scheme (Quartier et al., 2009), but rather simply alter certain light settings.

Figure 12 Accent Light Application (Erco, 2023)

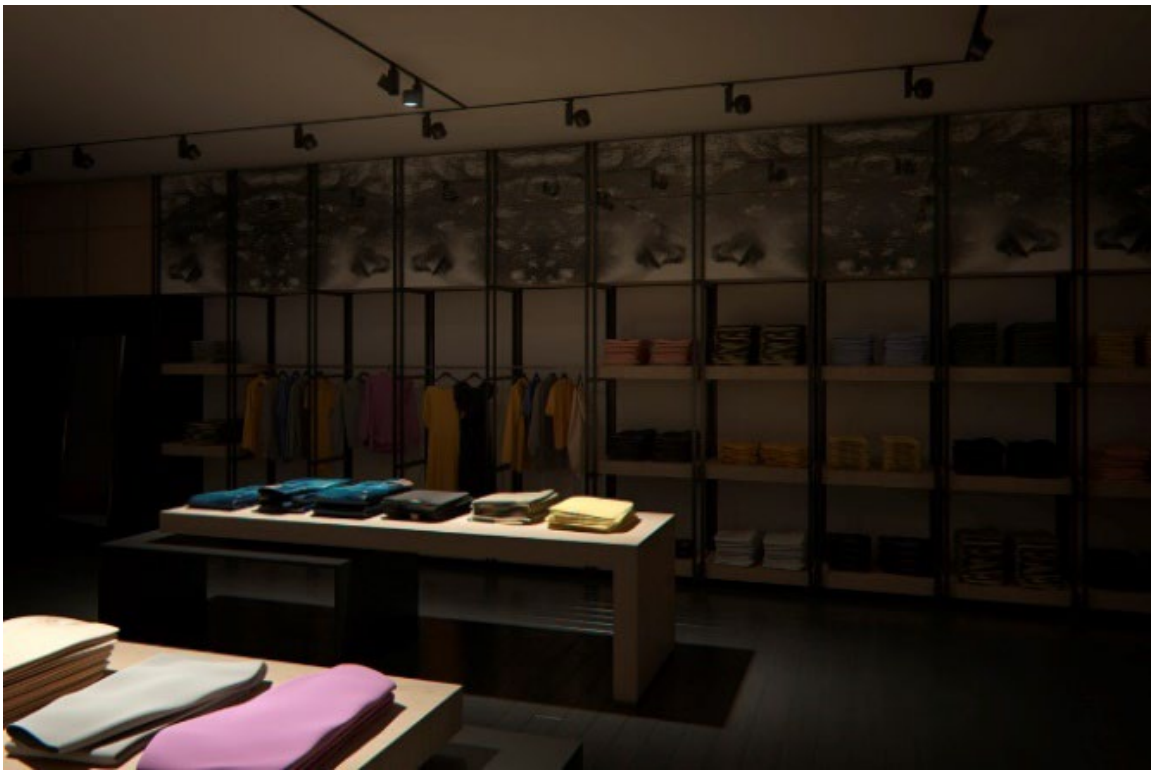


Figure 13 Focal Lighting Application (Erco, 2023)

Also, researchers found that the colour temperature of the lighting may be utilized to guide clients to certain areas of the shop or even specific goods, by tracking consumer's eye movement in several store's lighting setups observed that people's eyes automatically tend toward places with contrasting light rather than highly lighted areas, and that blue light attracts the most attention of any colour (Schielke, 2015).

3.9. Airport lighting

Airports are complicated there are countless moving parts in and around them, from passengers to baggage, ground transportation to cargo, and from airport staff to the planes themselves. And airports serve multiple uses. They are industrial buildings with a hospitality component and a civic duty. according to anthropologist Marc Auge, are a "non-place" since we travel through them to go from one location to another. They are a part of the trip rather than the goal.

Figure 14 Schiphol Airport Amsterdam, (Signify, 2023)

Architects and designers are continually discovering new ways to influence passengers' movement through a terminal, getting through a terminal can be one of the more anxiety-inducing parts of their journey, so airport designers do their best to create a calm environment. When it comes to the most stressful part in order to create a calming atmosphere for passengers, designers rely on some more obvious techniques. Simply adding natural light and adjusting it to somewhat match the light levels outside is another way to create a more soothing environment. At most airports, when the sun goes down, they crank up the lights to try to create the same amount of life in the terminal at night as they do in the day. When natural light is unavailable, the airport should have enough modulated lighting. Using UV and infrared waves as a solution in lounge halls which can enhance the overall passenger experience in airport lounge halls (Waldek, 2019). Cleaner and more sanitized environments can provide peace of mind to travellers, while comfortable thermal conditions contribute to a positive atmosphere during their waiting

time. Also, by using UV-C light for disinfection, the risk of contagion in high-touch areas like seating, tables, and restrooms can be minimized (Waldek, 2019). This can be especially valuable during flu seasons or when dealing with outbreaks of contagious diseases.

In conclusion, using UV and infrared waves in airport lounge halls can offer various benefits, including enhanced sanitation, improved indoor air quality, energy efficiency, and overall passenger comfort. However, proper planning, safety considerations, and effective implementation are essential for reaping the full advantages of these technologies while providing a safer and more pleasant experience for travellers.

3.10. Restaurant lighting

As examples above, environmental lighting design can be a powerful tool to be leveraged in the curation of marketing collateral for hospitality businesses to attract customers (Kim and Moon, 2009; Ryu and Han, 2011).

A well-designed service scape encompasses the evoking power to create positive meaning associations (Lunardo et al., 2016). In the restaurant context, one such positive meaning that the service scape portrays is ambient intimacy. Prior research on atmospherics shows that ambient intimacy is a powerful psychological mechanism that explains the impact of environmental design on customers' approach intentions. For example, restaurants' lighting affects customers' moods and dining choices, according to Cornell University research, consumers are 16 to 24 percent more likely to order healthful cuisine in well-lit restaurants (Lin and Mattila, 2010). This is due to the fact that bright light stimulates the senses and heightens emotions. The same bright light that helps diners adopt healthier choices also enables them to perceive stronger tastes.

Figure 15 Restaurant Dining Corner (To, 2021)

In conclusion, insights into how lighting design can target a group of customers and speak to a current practical need in restaurants' marketing and business management by influencing visitor behaviours in order to select their meals or the amount of this selection. This can help the business developers in the feasibility study to settle menu selection or even kitchens' supply management.

3.11. Lighting and spiritual value

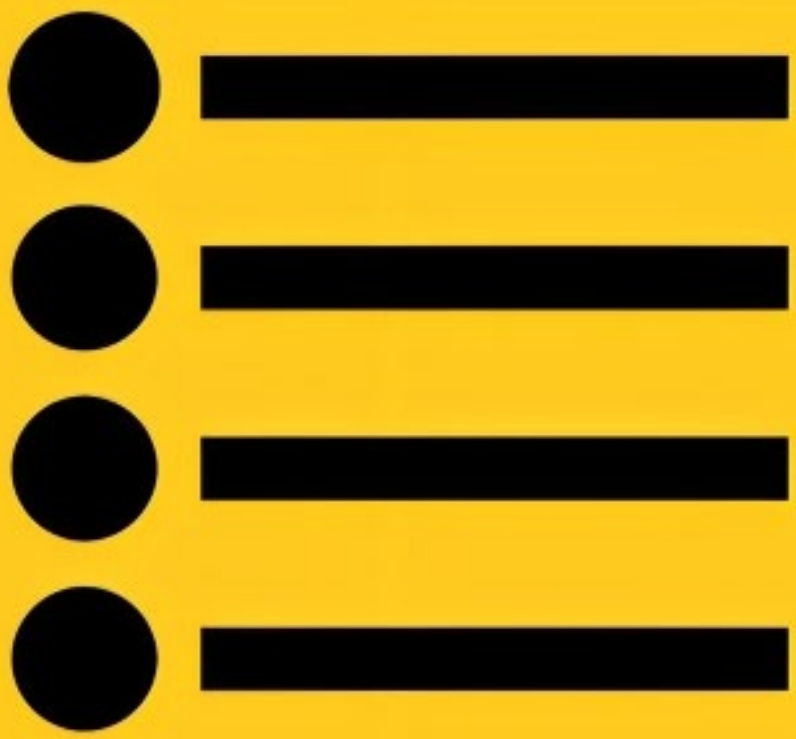
As previously mentioned, people have different states of mind in different places, and "light" is one of the most essential aspects influencing people's emotions in an interior environment. The study, which was conducted with 50 participants utilizing a church design in a virtual reality environment, intends to examine individuals' mood changes in the constructed church based on artificial light circumstances. There was a significant connection between architectural aesthetic scores and the difference in average positive mood scores in places with natural and artificial illumination. It was also

discovered that female participants in the study reported a greater percentage of pleasant moods than male ones (Kayhan et al., 2021).

Figure 16 Example of a digital model of a Church (Mansour, 2022)

Therefore, one of the main questions of the study, "How does the lighting of churches with a correct artificial lighting system change people's psychology", is believed to be an important criterion in the design of such structures. The study of happiness and anxiety has mostly focused on human psychology. Furthermore, it has been said that religion provides individuals with an essential spiritual value, which can have therapeutic effects in some circumstances (Saroglou et al., Citation 2008; Wills, Citation 2009). However, the influence of light in religious architecture is undeniable and has great importance and semantic broadness, and it has a very wide emphasis on the principle of manifestation. The role of light is to clarify the matter and reduce the solidity and coldness of the building. Light is diffused as a manifestation of existence in the mosque or church space to be one of the constituent elements of the perceptual space and give its space a spiritual sense and atmosphere. Indeed, light has given dynamicity and active life to Islamic decorations for example. The light and decorations of the mosque, instead of attracting the mind, lead the human to an imaginary world and draw him/her to the true light in which the manifestation of truth is (Arjmandi, et al., 2011)

In conclusion, thoughtful lighting design in religious buildings influences people by treating them to respect the saintliness of the place and around it and can profoundly impact the spiritual and emotional experiences of worshipers, fostering a sense of connection with the divine and creating a sacred and memorable environment. It is essential to work with experienced lighting designers who understand the unique needs and symbolism associated with each religious tradition to ensure the best possible outcome.



4. Typology of lighting functions

An analysis was conducted in previous examples with a focus on activities and projects that utilize lighting as a medium to communicate a message to people around and generate social interaction. There is a wide range of projects and cases across the entire world. In this section, a classification table has been created in which some basic information about the projects is shown. project, Location, technology, information and message, and the regulative function are all provided.

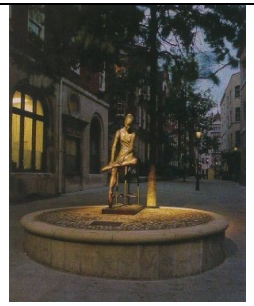
It appears that light is undoubtedly a way to communicate transmit and receive messages quickly and efficiently, without requiring verbal translation. It has been used in many interventions to create a visual effect and, more significantly, to dynamically influence the passage of messages and information. That may be interpreted as an informative message, aesthetic message, regulative, emphasizing, or therapy tool. There are several categories of existing forms of communication. Face-to-face communication, Social Media Communication, Written Communication, visual and drawing communication, we try to explain how lighting as a tool of communication a regulative medium without any systemic regulation "except for traffic streetlights" influence people's behaviours and emotions.

People have been exposed to light since birth. Daylight and artificial light are seen on a regular and unintentional basis, and humans have become habituated to both. That is, children, teenagers, adults, and the elderly will all be affected by light differently based on their educational level, lifestyle, their cultural background, and on various levels depending on their age, etc. The light should have rules, grammar, and codes like any other language. Although it might not have grammar, a displayed lighting installation that will convey structured messages should have a systematic arrangement of lighting features and important constructions (systems of logical linkage). also as mentioned in exploratory examples; colour, brightness, intensity, darkness, direction, rhythm, contrast, and dynamics all play a significant part in the effect that is produced. "The power of language is that there is a difference between the signifier and the signified; the power of

light is that there is not. But light is like a language. How, then, does it do what it does?". Language is any other systematic or non-systematic means of communication, such as gestures or animal sounds: the language of love, body language, etc. By using the metaphor of language to describe the capacity of light. Light can create shared behavioural reactions to people who have comparable cultural backgrounds, light could be considered as a language in an abstract way. The table was prepared after extensive investigation for each project, and the information sources are published in the bibliography chapter. We can classify the functions of lighting into main seven functions as follows:

Table 2 Project category and typology

NO.	Picture	Project	Location	Technology	Language/ Message	Regulative Function
1.		Lunar illuminate	**Moon in the sky**	Natural light	▪ Informative message for months ▪ Influence reproduction/ sleeping pattern/ Prevent accidents and crimes	▪ Guiding/ orienting ▪ Safetying ▪ Alarming
5.		Meshiereb lighting plan	**Doha, Qatar** mixed-use complex project to regenerate the heart of **Doha**	Light up building rooftops, illuminate prominent landmarks, and provide lighting for public hallways and open areas.	▪ Aesthetic to emphasise architectural elements. ▪ Regulative to develop the master plan and control people's Movement.	▪ Attracting ▪ Guiding/ orienting
6.		London Lighting Master Plan	**London, United Kingdom** Lighting Plans of New Development Area in London**.**	Different colour temperatures to highlight the landmarks and lighting of the conflict zones.	▪ Regulative to guide people's movement. ▪ Informative to boost tourism and culture	▪ Safetying ▪ Attracting
7.		The National Museum of Art	**Japan, Tokyo** Lighting project to enhance visual perception and experience.	General lighting and accent light emphasis focus on the Artwork painting.	▪ Informative to attract and focus to enhance expression and interpretation. ▪ Aesthetic	▪ Emphasizing ▪ Attracting

8.		Traffic Street Light	General study	Systemic colour (Red, green, and Yellow)	▪ Regulative message in a systemic way to arrange people/car	▪ Alarming/ alerting ▪ Guiding/ orienting ▪ Prescribing ▪ Safetying
9.		Little dancer sculpture	**Covent Garden, England** Lighting to enhance and bring attention.	Use projected up-lights and down-lights to the sculpture.	▪ Informative to bring interest to the scene, dramatic tool. ▪ Aesthetic around the place.	▪ Emphasizing ▪ Attracting
10.		Roppongi Hills lighting master plan	**Japan, Tokyo** zonal division project to separate commercial spaces from the residential area.	a cutting-edge lighting design approach and landscaping lighting.	▪ Regulative to divide zones. ▪ Aesthetic for urban and architectural features.	▪ Guiding/ orienting ▪ Attracting
11.		The Millennium Dome in Valladolid	**Valladolid, Spain** A project to boost nightlife and increase tourism.	Unique design with sustainable lighting by tactical urban development.	▪ Informative message to perceive and experience the city at night.	▪ Attracting

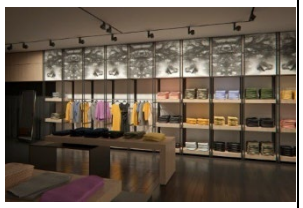
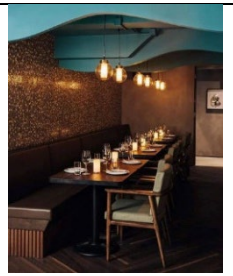
12.		Lighting and branding in retail shop	General study	utilize up-lighting and accent lighting fixtures for enhanced product promotion and branding.	▪ Informative language to attract people to some products.	▪ Attracting ▪ Guiding/ orienting
13.		Lighting therapy in airports	Schiphol Airport **Amsterdam**	UV light and infrared waves in the waiting lounge. Signs lighting.	▪ Therapeutic way to minimize stress and biophilic travelling.	▪ Ta'-healing ▪ Prescribing ▪ safetying
14.		Restaurant lighting	General study	Project amber or blue light to the food or Candles.	▪ Therapeutic message to affect the taste of food or to feel to eat less in blue light.	▪ Ta'-healing ▪ Prescribing ▪ Guiding/ orienting
15.		Lighting and spiritual in church	General study	Lighting atmosphere, decoration lamp feature, and candles.	▪ Therapeutic to treat people respecting the holy place and reduce stress and anxiety. ▪ Aesthetic	▪ Ta'-healing ▪ Emphasizing

Table 3 Functions and Examples number

Regulatory function of light	Description	Examples
Emphasizing	To catch the attention of people	4,6,12
Attracting	To assemble people	2,3,4,6,7,8,9
Alarming/alerting	To keep away people	1,5
Guiding/orienting	To influence the movements of people	1,2,5,7,9,11
Prescribing	To impose/oblige or forbid behaviours	5,10,11
Ta'-healing[1]	To relax/heal people	10,11,12
Safetying	To protect people	1,3,5,10

4.1.Emphasizing

Emphasizing is a use of language to imply more than is said, it is a use of language to mark importance or significance, through either the intensity of expressions or linguistic features such as *stress* and *intonation*. The artful use of interior lighting in public areas goes beyond mere functionality; it elevates the ambience and emphasizes landmarks, breathing life into the architectural marvels that define our urban spaces. Thoughtfully designed lighting arrangements play a pivotal role in guiding and captivating the public while creating a lasting impression on those who traverse these hallowed grounds.

[1] "Ta'-heal" "تأهيل "is an Arabic word that has the same meaning as healing or therapying, which means treatment intended to relieve or heal a disorder

Figure 17 Exploring Architectural Elements with Lighting Emphasis

Lighting plays a crucial role in emphasizing and drawing attention to unique architectural features of buildings or hidden orders of behaviours to be stressed in urban environments, such as intricate facades and ornate details. Additionally, creative lighting design can add visual interest, excitement, and engagement to an urban space, using techniques such as coloured lights, dynamic lighting effects, and lighting that changes over time. Properly designed lighting can also provide wayfinding and enhance safety and security in urban spaces by illuminating pathways, signs, and landmarks, deterring crime, and reducing accidents and injuries. Overall, lighting is essential in creating engaging, attractive, and safe urban environments.

4.2. Attracting

To draw by a physical force causing or tending to cause to approach, adhere, or unite. Or draw by appealing to the emotions or senses, by stimulating interest, or by exciting admiration; allure; invite, and also to make people want to visit a place or find out more about something or to buy or invest in something.

Lighting serves as a powerful tool to capture attention within urban spaces. Its strategic application can transform mundane urban settings into captivating and inviting environments. By accentuating architectural nuances through well-placed lights, guiding pathways with illumination, and highlighting landmarks and sculptures, lighting draws the gaze of passersby. Interactive installations with different intensities and colours that respond to human presence add an element of intrigue, while dynamic light displays projected onto buildings, open areas or reflections in water features provide a mesmerizing spectacle. With smart technology, and creative contrasts, lighting in urban spaces becomes a dynamic force that fosters engagement, sparks curiosity, and enhances the overall urban experience. Strategically harnessing lighting to attract and entice people in city centres and retail stores is a dynamic approach to creating inviting and bustling spaces. Enhance the ambience of public plazas and squares with well-designed lighting. Use a combination of overhead lighting, perimeter lighting, and feature lighting to create a welcoming and vibrant atmosphere for gatherings and events, host dynamic light shows or projections on the facades of buildings or open spaces. These shows can feature changing colours, patterns, and animations synchronized with music or themes, captivating the attention of both locals and visitors.

Figure 18 Lighting Specific Area to Attract People

Creating an environment that assembles people into landmarks or special events through lighting involves a careful interplay of imagination, technology, and human connection. By strategically capturing the impact of light, you can attract individuals towards significant spaces or occasions, fostering a sense of anticipation and engagement. One way to achieve this is by illuminating pathways with precision, using lighting to modestly call and guide attendees towards the focal point. Employing techniques like uplighting, downlighting, and floodlight to underline architectural details or event features creates a captivating visual journey that draws people closer. Moreover, colour psychology plays a pivotal role in this endeavour. The choice of colours can evoke specific emotions and align with the event's essence. Utilizing warm and vibrant hues can ignite excitement and energy, while cooler tones can evoke tranquillity.

Figure 19 Illuminating Bazar Square to Foster Community Gathering

Crafting lighting designs that assemble people into landmarks or events requires a holistic approach. From casting expressive shadows to integrating event-specific imagery, each element works in harmony to tell a visual story that draws people into the heart of the experience. This narrative can be further enriched by adapting lighting sequences as the day progresses, building up excitement as the sun sets and night falls. Ultimately, by infusing creativity, inclusivity, and innovative technologies, you can create an environment that not only captures people's attention but also immerses them in an unforgettable journey of light and emotion.

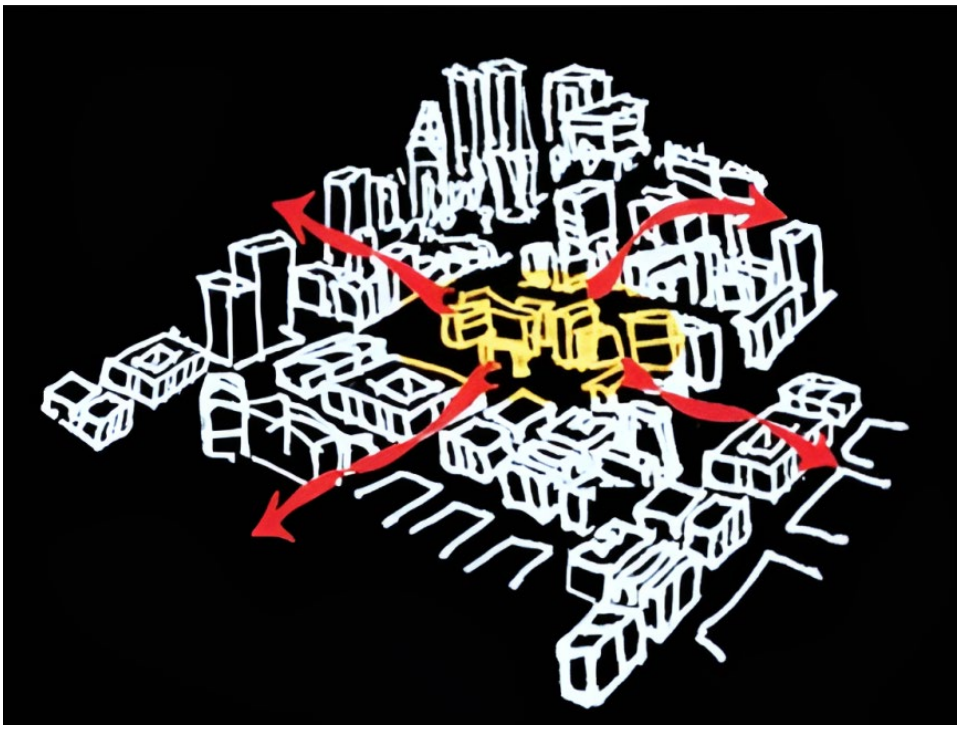


Figure 20 Lighting as an Instrument for People's Assembly

4.3. Alarming/alerting

Lighting can be a crucial instrument for alarming and alerting people in emergencies to keep them away from potential danger. In urban spaces and interior locations, lighting can be combined with audible alarms or sirens to create a multi-modal alert system. For example, bright lights or flashing lights can be used in conjunction with loud sirens or alarms to grab people's attention and alert them to an emergency situation, such as a fire or evacuation order. The combination of lights and audible alarms can provide a more comprehensive and effective means of alerting people, especially in noisy or crowded environments where audible alarms alone may not be sufficient. Flashing or strobe lights are highly visible and attention-grabbing lights that can be used as visual alarms such as lighting houses on the water surface which serve to warn mariners of dangerous shallows and perilous rocky coasts, and they help guide vessels safely into and out of harbours.

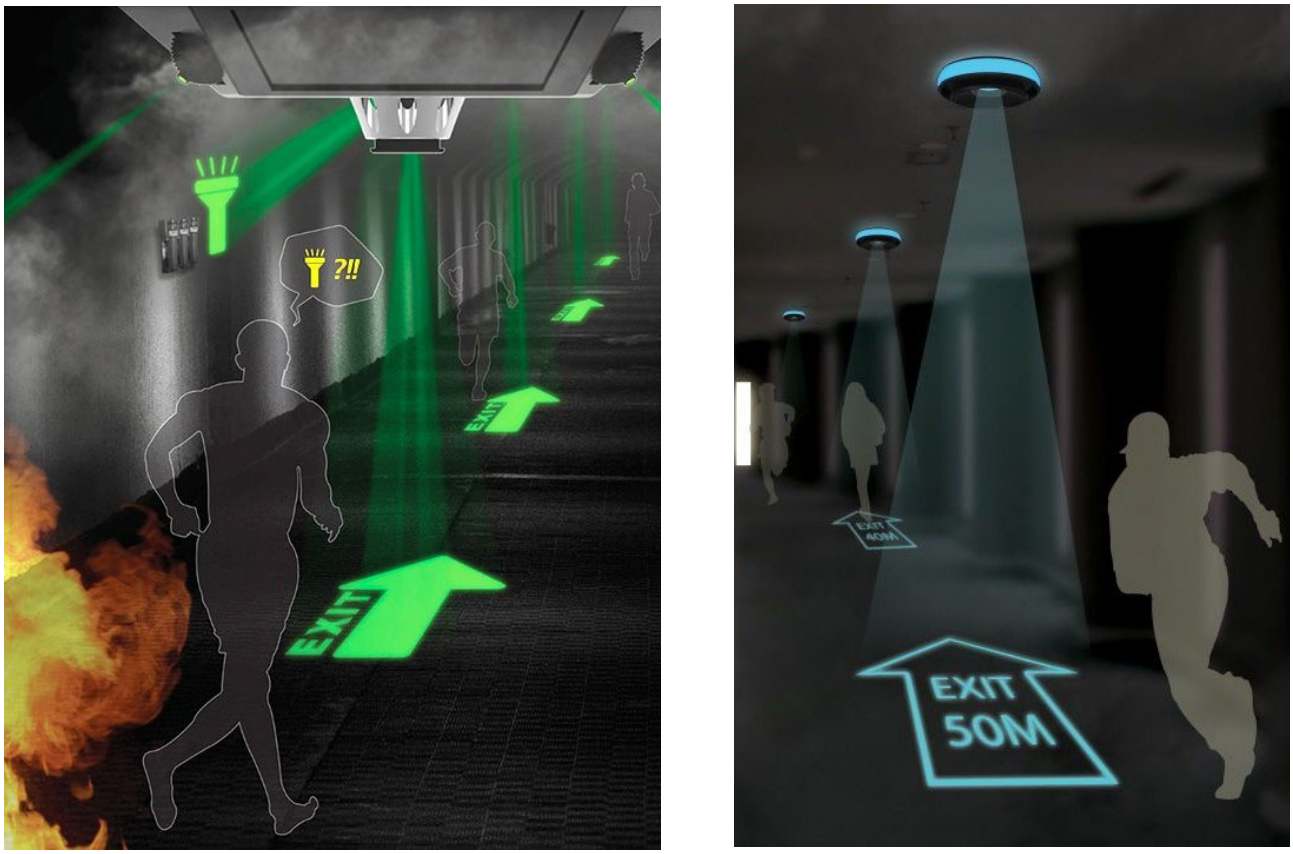


Figure 21 Emergency Evacuation Route Illuminated for Safety

Digital displays or signs with lighting can be used to convey emergency messages or alerts in urban spaces and interior locations. These displays can show text, graphics, or symbols that provide information about the nature of the emergency and the actions that need to be taken, such as "Emergency Exit," "Evacuate," or "Danger." By incorporating lighting into digital displays or signs, the messages can be made more visually prominent and attention-grabbing, ensuring that people are alerted to the emergency situation. Dynamic lighting effects, such as changing colours, flashing patterns, or pulsating lights, can be used to create visual alerts in urban spaces and interior locations. For example, in case of an emergency, lights that change to a bright red colour or flash rapidly can draw people's attention and signal the need to take immediate action. Dynamic lighting effects can be programmed to respond automatically to emergency triggers, such as smoke detectors or motion sensors, providing a visually compelling alert that can quickly grab people's attention and prompt them to respond. Wayfinding lighting can also be used to alert people in emergency situations by guiding them towards safe

exits or evacuation routes. Well-lit pathways, exit signs, and directional lighting can help people navigate through unfamiliar spaces during emergencies, providing a clear visual indication of the escape routes. In case of an emergency, the wayfinding lighting can be intensified or changed to a distinct colour, such as red or green, to clearly indicate the safe paths and alert people to the emergency situation. In case of a fire or other emergency, smart lighting systems can be programmed to turn on all lights to maximum brightness, flashlights, or change to specific colours to quickly alert people and guide them towards safety. Smart lighting systems can also be integrated with other emergency measures, such as fire alarms or security systems, to provide a coordinated response and ensure that people are alerted to the emergency situation.

In conclusion, in a world where urban spaces continue to evolve, the integration of lighting as a tool for alarming and alerting demonstrates the forward-thinking approach necessary for building safer, more responsive environments. By capitalizing on lighting's potential, urban spaces can become not only visually captivating but also robustly equipped to handle emergencies, maintain public security, and effectively communicate critical information. The strategic use of lighting as an alerting tool represents an investment in the safety and well-being of urban communities, ushering in a new era of dynamic, illuminated urban landscapes.

4.4. Guiding/orienting

The concept of using lighting to guide and orient people in urban spaces encompasses a multidimensional approach that combines design principles, psychological cues, and human behaviour considerations. The theoretical framework for lighting's guiding and orienting role revolves around the idea of creating an intuitive and seamless experience for individuals as they navigate through complex urban environments.

Figure 22 Enhance Walking and Leisure Experience

This concept involves the strategic placement of lighting elements to establish visual pathways to guide pedestrians on safe routes. By integrating lighting into the physical layout of the space, designers establish a visual hierarchy that naturally leads people from one point to another. Furthermore, it employs lighting as a form of communication, offering visual cues that facilitate orientation. Illuminated signage, directional markers, and symbols provide clear information that aids in decision-making and wayfinding. The use of colour, intensity, and shape in these elements enhances their visibility and comprehension, ensuring that individuals can navigate without confusion.

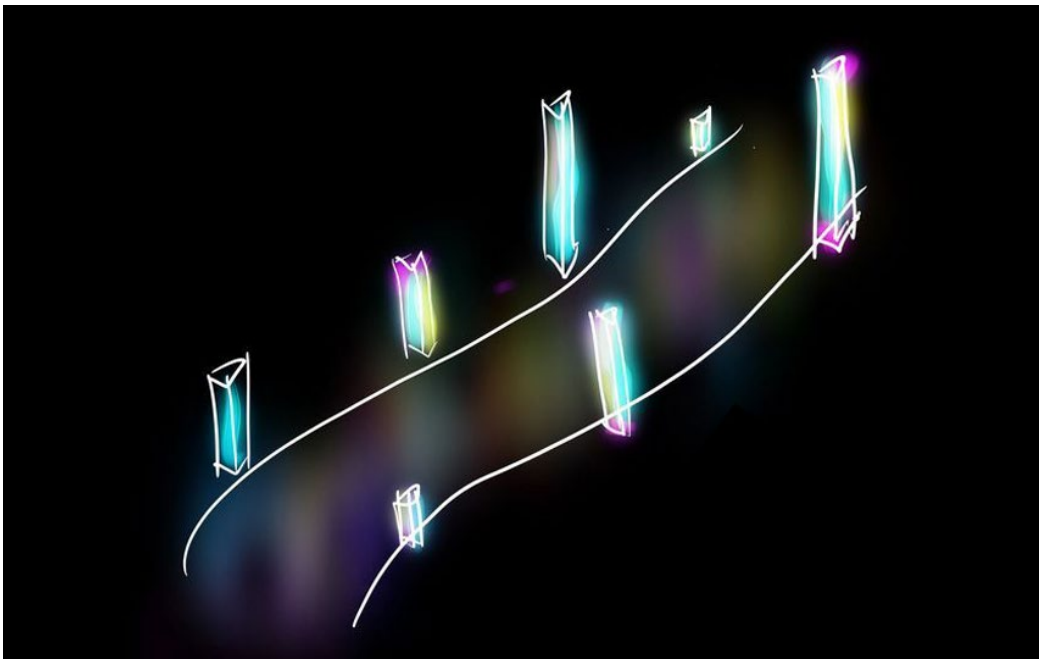


Figure 23 Lighting lines and bollards to guide people.

Incorporating the principles of wayfinding psychology, theoretical approaches might focus on creating lighting schemes that evoke a sense of familiarity and comfort. Lighting can mimic natural patterns, such as moonlight filtering through trees or sunlight casting shadows, tapping into the human psyche's ingrained understanding of environmental cues. This approach recognizes the importance of adaptability. Dynamic lighting systems that adjust based on the time of day, weather conditions, or events can enhance the guiding and orienting experience. For example, gradually dimming lighting as the night progresses can signal to individuals that the area is transitioning to a quieter phase, aiding in their navigation decisions.

In essence, the theoretical framework of using lighting to guide and orient people in urban spaces rests on the synthesis of design, psychology, and practical functionality. By thoughtfully integrating lighting elements, designers create an environment where visitors can effortlessly understand the spatial layout, make informed decisions, and feel a sense of security and belonging. This holistic approach transforms urban spaces into dynamic, navigable, and engaging environments that cater to the innate human desire for exploration and connection. For example, the use of illuminative lighting

to alert and guide people, including traffic lights, is a critical aspect of modern urban infrastructure. Thoughtful lighting design serves as a paramount safety measure, efficiently directing traffic, guiding pedestrians, and keeping the public informed in various scenarios, ultimately fostering a safer and more organized environment.

4.5. Prescribing

State authoritatively or as a rule that (an action or procedure) should be carried out is a definition of prescription. Using light as a prescribing tool to impose, oblige, or forbid behaviours in the urban environment involves a strategic approach to shaping human actions and responses through the manipulation of lighting conditions. This concept centres on the idea that light, when applied in specific ways, can influence individuals' behaviours, encouraging certain actions while discouraging others, ultimately contributing to the desired order and functionality of urban spaces. This approach recognizes that light serves as a powerful symbol of authority and guidance.

Lighting can be employed as a signalling mechanism to communicate rules and regulations. For instance, areas with prohibited activities could be shrouded in dim or coloured lighting, visually indicating the restriction without the need for explicit signage. Bright and uniform lighting in designated zones can signify permissible behaviours, reinforcing the notion that certain actions are expected and accepted within those spaces. It is essential to recognize and raise ethical considerations for light to manipulate behaviours that should be aligned with societal values, respecting personal autonomy and ensuring that any restrictions imposed through lighting are reasonable and justifiable.

Figure 24 Traffic Lighting Prescribing Pedestrians and Vehicles

In summary, the notion of light as a prescribing tool to impose, oblige, or forbid behaviours in the urban environment underscores the influential role of lighting in shaping human actions. By strategically applying lighting conditions, designers can create environments where desired behaviours are naturally encouraged, fostering functional and harmonious urban spaces while respecting individual rights and ethical principles.

4.6. Ta'-healing

"Ta'-heal" "تأهيل "is an Arabic word that has the same meaning as healing or therapying which means "to treat intended to relieve or heal a disorder." specifically for therapeutic some traumas or bad habits in societies. Lighting can be considered a therapeutic instrument by harnessing its potential to impact human well-being, emotions, and physiological responses in positive and healing ways, this approach envisions the deliberate use of lighting to create environments that promote psychological, emotional,

and even physical well-being, aligning with principles of human-centred design and holistic health.

Figure 25 Using Lighting to Create a Pleasure and Homey Vibes

The theoretical framework acknowledges that light plays a significant role in regulating the body's circadian rhythm, which influences sleep patterns, hormonal balance, and overall physiological functions. Designing lighting systems that mimic the natural progression of daylight can help regulate individuals' internal clocks, promoting better sleep quality and overall health. Furthermore, the concept recognizes the profound influence of light on human emotions and mental states. Therapeutic lighting scenarios could involve creating environments with specific colours, intensities, and dynamic lighting patterns that evoke feelings of calmness, relaxation, or even stimulation. Soft, diffused lighting with warm tones might be employed in spaces designed for relaxation and meditation, while brighter, cooler lighting could energize and invigorate individuals in spaces intended for productivity or physical activity. Also extends to the realm of specific therapeutic applications, such as light therapy for seasonal affective disorder

(SAD) or other mood-related conditions. On the other side, the functional purpose, enveloping congregants in an aura of spiritual healing and tranquillity in the houses of worship plays a profound role in elevating the spiritual experience, fostering an atmosphere of relief and reverence that allows worshippers to find peace within these sacred spaces.

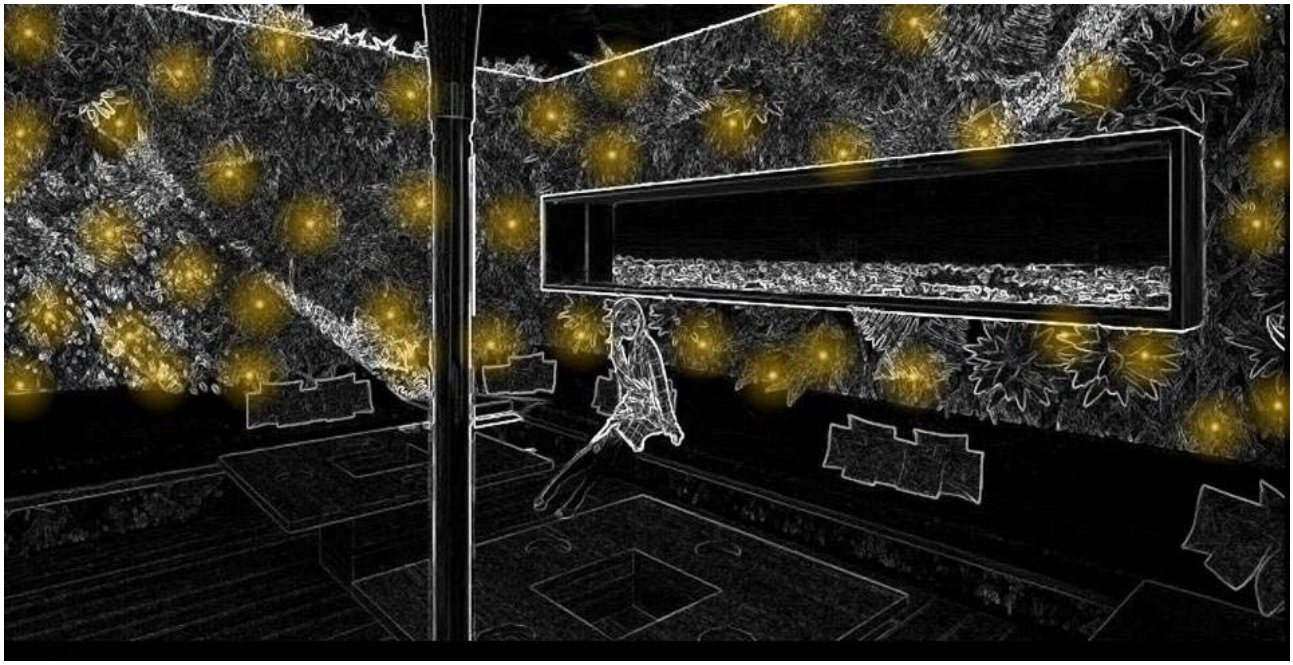


Figure 26 Illuminated Wall Enhancing the Therapeutic Spa Experience

The concept of using lighting as a therapeutic instrument anticipates a future where lighting design goes beyond functional illumination to actively contribute to human well-being and healing. By understanding and harnessing the intricate relationship between light, physiology, and emotions, designers can create environments that support holistic health, elevate mood, and enhance the overall quality of life for individuals.

4.7. Safetying

Think about lighting from the perspective of a safety tool that improves visibility, mitigates dangers, and fosters safe environments. The focus of this idea is on

utilizing lighting's capacity to reduce risks, avoid accidents, and foster emotions of safety in many kinds of situations particularly during dim conditions or nighttime, from urban environments scale to enclosed spaces.

Theoretical scenarios may feature dynamic lighting systems that react to urgent situations. For instance, during a fire alarm, lighting could automatically guide individuals towards safety exits by illuminating pathways or signs, streamlining evacuation and curbing panic. This approach also factors in the fusion of technology with safety-focused lighting design. Smart lighting setups might employ motion sensors to trigger illumination in response to movement, thereby fortifying security and alerting people to potential intruders or unusual occurrences.

Figure 27 Illuminating Street for Pedestrian Passersby

In summary, envisioning lighting as a safety tool revolves around prioritizing visibility, repelling risks, and instilling a pervasive sense of security. By thoughtfully weaving lighting elements and innovative technologies, designers can forge environments that curtail dangers, prevent accidents, and foster a prevailing sense of

safety as individuals traverse diverse spaces. Strategic implementation of exterior lighting in dark alleys is a pivotal aspect in promoting safety, preventing crimes, and ensuring clear vision within urban environments. Thoughtful lighting design transforms these shadowed passageways into well-lit streets, acting as a deterrent to potential wrongdoers and providing pedestrians with confidence even in the darkest hours.

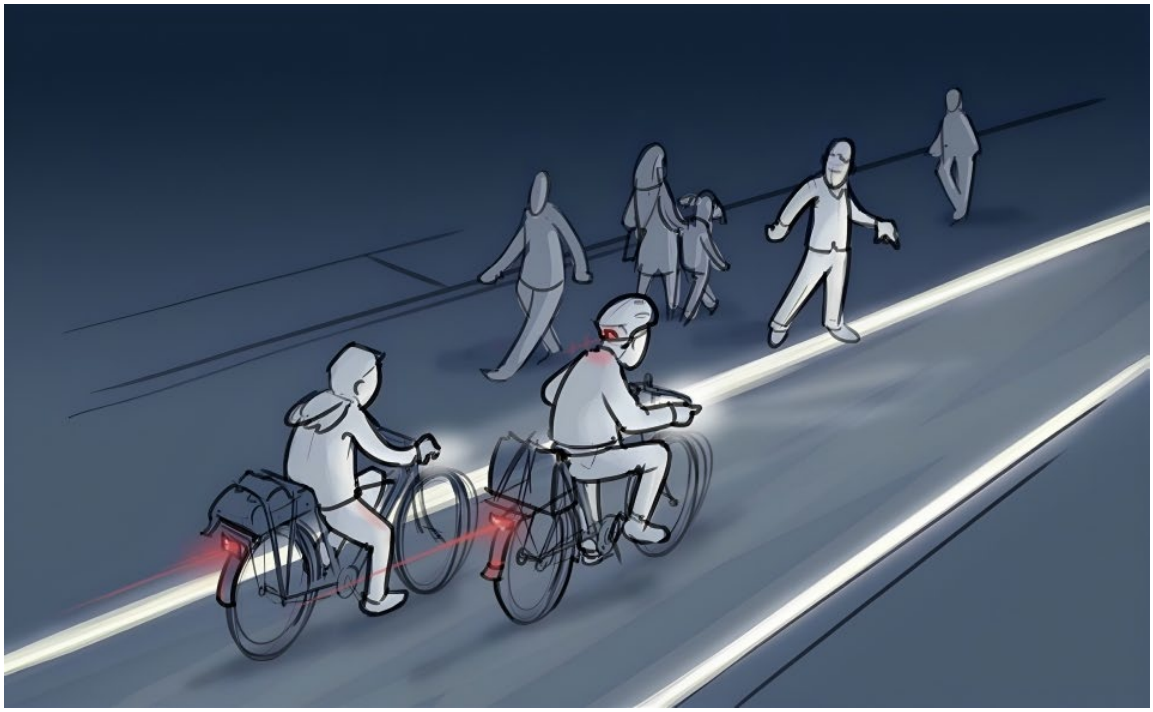


Figure 28 Separation between Bike Lane and Pedestrian

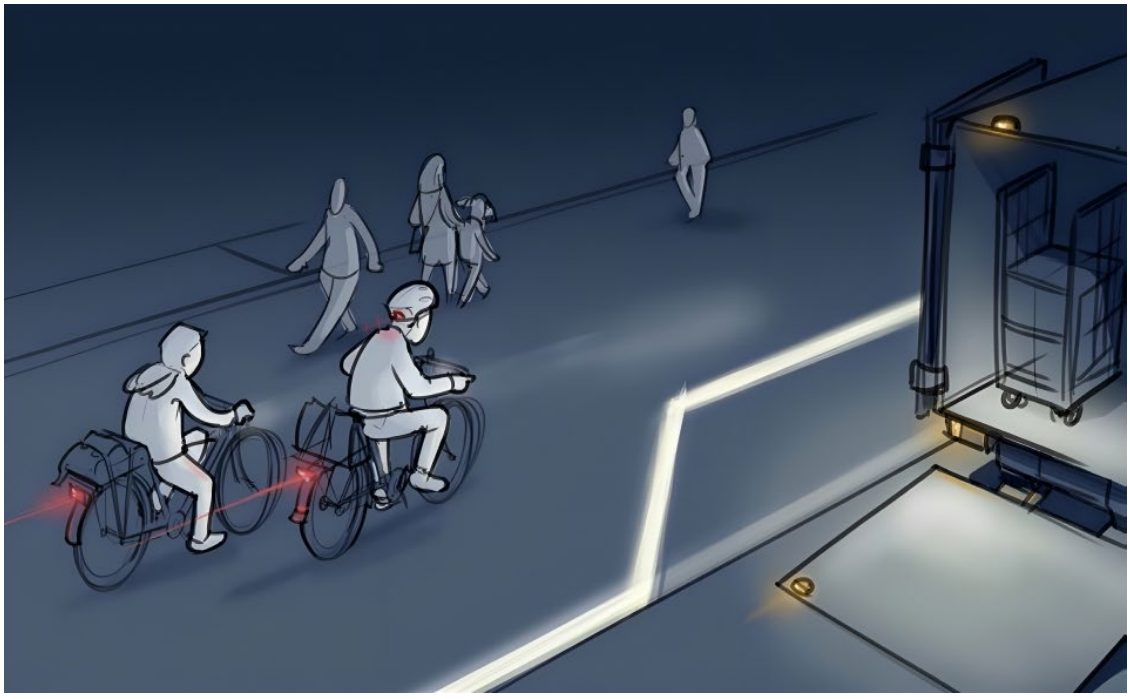


Figure 29 Good Visibility and Separation between Bike Lane and Vehicles

From all the various categories explored, we can draw the conclusion that people communicate through diverse languages: spoken and written words, visual representations like drawings, and even unconventional tools like lighting. In this thesis, we examined a broad range of examples from various urban environments, such as architectural wonders, interior spaces, and larger urban areas surroundings. The research carried out how lights may be manipulated to regulate human thoughts and behaviours without imposing strict regulations. The real potency of lighting's visual impact takes centre stage in this exploration Aspects like colours, brightness, shadows, and movement all contribute to conveying explicit messages. What's fascinating is how lighting can function as both a guiding force and a subtle influencer - think of the moon's role in the night sky, guiding and shaping behaviours and paths. this duality allows lighting to gently guide movement in vast open areas and neighbourhoods.

5. A practical approach of non-conventional rules through lighting

5.1. New Approach for Urban Lighting Design Implementation

5.1.1. Institutional regulations for public lighting design

Making the specific scope for the process of design depends on the city structures as well as cooperation traditions in the country and city. One of the tools in the early process is the lighting master plan. Since a lighting plan would normally be initiated by the city with a legal obligation, the form and content varies a great deal. Many cities around the world have been creating and implementing urban lighting master plans with some general characteristics. The master plan comes into play at the early stages in renewing the city lighting, and the work on shaping the master plan involves multiple stakeholders both inside and outside the departments in the municipalities, not least politicians and citizens. It delivers an analysis of the existing situation for the city and its infrastructure, including characteristics of neighbourhoods and urban spaces and aspects of how people are using the city. In that analysis the structure of roads, paths and spaces are characterised. Following the strategy and analysis, the future lighting needs to be defined - both on the overall technical specifications and on the design, as well as for the city as a whole and for each type of road and path and maybe for each neighbourhood. Some cities add recommendations on other light sources in the city, not run by the municipality, such as shops, parking lots and housing. Co-creation between departments and with the citizens add great value to the lighting planning.

In many counties like Sweeden, Germany, Latvia, Finland and Estonia as mentioned in Interreg report (Sif, 2021) the "Law on Development Planning System," which defines the hierarchy of development planning documents, and requires local municipalities be the competent public authorities responsible for the development and implementation of local long-term development strategies and medium-term development programs . Thess rules

have been further specified in a series of regulations approved by ministers, and discusses all municipal or regional documents that are legally enforceable, such as: municipal sustainable development strategy, municipal development programme, local plan, and detailed plan.

Many regional planning documents and initiatives focus on energy, environment and climate change. After many decades lighting experts have transformed the nighttime by brightly illuminating streets, buildings, skylines and landscapes. As this became the norm, a dual view of the night emerged and visual pleasure for tourists after sunset took precedence over naturally occurring nocturnal landscapes. Professionals, as well as lighting designers, need to be aware of theoretical research, practical approaches, and local policies to understand the current debates and discussions, and also be in a position to influence policies that directly influence lighting.

5.1.2. Role of lighting designer

Professional and lighting designers should consider the diversity of the communication mode, people communicate through various languages, including spoken and written words, visual representations, and unconventional tools like lighting. It can be manipulated to influence human thoughts and behaviours without imposing strict regulations. Aspects like colours, brightness, shadows, and movement play a significant role in conveying explicit messages. Also, lighting serves as both a guiding force and a subtle influencer. It can guide movement in open areas and neighbourhoods, like the moon's role in the night sky. Here are the principal findings proposing a design approach for the lighting designer:

- Integrating Multimodal Communication: Urban planners and designers should consider incorporating diverse communication modes into their

projects. This includes clear signage, visual cues, and well-designed lighting systems to cater to a wide range of communication preferences.

- Strategic Lighting Plans: Designers should create lighting plans that strategically guide inhabitants through urban areas. Emphasis should be placed on key landmarks, safe routes, and areas of interest to enhance orientation and safety.
- Emphasis on Pedestrian-Centric Design: Urban planning should prioritize pedestrian-friendly spaces. This involves widening sidewalks, creating pedestrian-only zones, and establishing walkable promenades to encourage walking as a primary mode of transportation.
- Utilizing Smart Lighting Technology: Integrating smart lighting systems can enhance safety and efficiency. These systems can adapt to real-time conditions, always ensuring well-lit areas, which is crucial for both safety and comfort.
- Creating Aesthetic and Functional Landscape: Urban beautification projects, including green spaces, public art installations, and aesthetically pleasing architecture, should be incorporated. These elements not only attract people but also contribute to a sense of community pride and belonging.
- Designing for Well-being: Incorporate elements that promote mental and emotional well-being, such as therapeutic lighting schemes, green spaces, and calming visual elements. This can contribute to a healthier and happier population.
- Emergency Preparedness and Communication: Implement robust emergency alert systems with visual and auditory signals for immediate response in case of natural disasters or other emergencies. Quick and effective communication during emergencies is crucial for public safety.
- Community Engagement in Planning: Establish channels for residents to provide feedback on urban planning and lighting design. This collaborative

approach ensures that policies and projects align with the needs and preferences of the community.

- Regular Maintenance and Safety Audits: Ensure that lighting infrastructure and safety features are well-maintained through regular checks. Well-maintained urban spaces and lighting systems are essential for long-term safety and functionality.

By incorporating these findings into design and planning processes, urban environments can be created that are not only safe but also engaging, aesthetically pleasing, and conducive to the well-being of their inhabitants. This holistic approach considers diverse communication modes and leverages the power of lighting to create spaces that cater to the needs and preferences of the community.

5.1.3. Urban Lighting Design Frameworks

Design frameworks help to organize how users experience cities, and the research and background are vast. Three urban design methodologies have therefore been selected that are applicable and inspirational for lighting design within an urban context. These general approaches can be used as both tools to understand the city and ways in which to communicate with urban designers. This of course is not an exhaustive list, but rather as a start in approaching strategic designs. Design frameworks play a role in organizing how users interact with cities, and their research context is extensive. As a result, four urban design methodologies that are relevant and inspiring for lighting design in an urban environment have been chosen. These basic methods may be utilized as both tools for understanding the city and means of communicating with urban planners. This compilation is not exhaustive, but it provides a foundational framework for approaching strategic concepts, as outlined below:

The Image of the City[2] is the first and most widely used urban methodology, this valuable publication provides a set of organizing principles for the city, including landmarks, edges, nodes, districts, and routes (Lynch, 1969). Lynch's methodology can be used in the design of urban lighting to consider the different elements of the city, even if limited in terms of character or nature. It also does not involve people and their use of the city but rather considers the city as a collection of built elements.

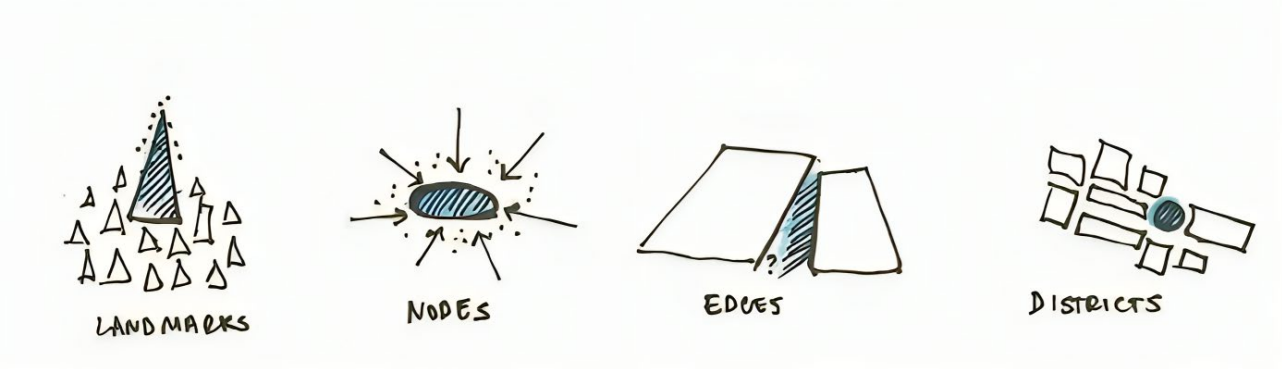


Figure 30 Human Perception of City

The Uses of Sidewalks: Safety in the book From the Death and Life of Great American Cities[3]. About cities as a neighbourhood activist rather than as a designer or trained professional, as a result, there are very practical and based on observation rather than pedagogical theories. One element of her work that is applicable to cities after dark is the concept of "eyes on the street" and natural surveillance (Fuller & Moore, 2017). A street is not safe, regardless of lighting levels, if there is no element of natural surveillance or A to B movement. This is something we are often confronted with as urban lighting designers, namely that higher illuminance levels do not necessarily lead to a higher sense of safety.

[2] Kevin Lynch argues that for any given city, a corresponding set of mental images exist in the minds of the people who experience that city. Contributing to those images are five qualities which Lynch identifies as Paths, Edges, Districts, Nodes, and Landmarks.

[3] Jane Jacobs' seminal work The Death and Life of Great American Cities and the way she 'looks' and 'observes' urban form and city life, and create ' "urban lenses and images of the city" goes from & beyond the specific points urban of view as well as the analysis of her famous "complexity of the urban".

Urban Form[4] explore the attempts to investigate and define the nature of urban form, both structurally and morphologically. One aspect of this methodology is the three different levels at which we experience urban spaces in the form of near, far and distant views. This cannot simply be represented on a plan, but rather than using perspectives at different scales (Krier & Rowe, 1979).

5.1.4. Lighting in self-governed communities

The idea of lighting in self-governed communities in urban environments centres on granting individuals and communities the authority to actively influence and oversee their surroundings by leveraging lighting as a transformative tool. This approach embodies a paradigm shift towards a more participatory and community-driven urban design. Through the strategic deployment of lighting, inhabitants are empowered to make decisions that directly impact their quality of life, safety, and overall well-being. Several self-governance concepts are put into action through lighting interventions. These contain initiatives such as community-led lighting projects, where residents collaboratively design and implement lighting schemes tailored to their specific needs. Additionally, participatory budgeting processes allocate resources for lighting improvements, enabling citizens to prioritize projects that align with their preferences and requirements. Moreover, educational programs on lighting design and energy conservation empower individuals to make informed decisions about lighting usage, further enhancing self-governance.

- Community-Led Lighting Projects: In this concept, local communities are granted the authority to initiate and oversee lighting projects in their respective neighbourhoods. It involves providing the necessary resources, expertise, and support to residents, empowering them to design and implement lighting solutions that cater to their specific needs and preferences.

[4] Rob Krier (1975), pp. 20-22 is a Luxembourgian sculptor, architect, urban planner and theorist living in Berlin his work refers to his desire to create space and communal focal points that are invested with functions.

- Citizen-Managed Lighting Initiatives: This approach entails the establishment of community-led committees or organizations responsible for managing lighting resources and policies within a neighbourhood or district. By entrusting residents with decision-making power regarding lighting design, maintenance, and energy efficiency, a sense of ownership and responsibility is cultivated.
- Lighting Cooperatives: Lighting cooperatives are collaborative models where community members collectively manage and finance lighting infrastructure. Residents pool their resources to invest in lighting technology, maintenance, and energy-efficient solutions, promoting a shared sense of responsibility and self-sufficiency.
- Crowdsourced Lighting Data: Engaging residents in the collection and analysis of lighting data is key to this concept. It involves the use of digital platforms or applications that allow community members to report lighting issues. This input provides valuable insights for decision-making and resource allocation, ensuring the community's voice is heard.
- Neighbourhood Lighting Guidelines: Collaboratively developing and enforcing lighting guidelines specific to each neighbourhood's character and needs is central to this concept. Residents, designers, and local authorities work together to set standards for lighting levels, aesthetics, and energy efficiency, allowing for customized solutions that align with the community's vision.
- Lighting Demonstrations and Workshops: Educational opportunities are provided to residents in this concept, enabling them to learn about lighting design and technologies. Workshops, seminars, or demonstrations are organized to empower community members with knowledge about lighting principles, enabling them to make informed decisions about their urban environment.
- Temporary Lighting Installations: Communities are encouraged to experiment with temporary lighting installations in this concept to assess their impact and gather feedback. Resources are provided to residents to create temporary lighting

interventions and address social problems, allowing them to actively participate in the design process and evaluate potential improvements.

For example, In collaboration with the cultural association "Via Padova è meglio di Milano" (Via Padova is better than Milan), came together to create an annual lighting event and installation which focused on the urban renewal and revitalization of Via Padova, a well know area for criminality issues and high immigration rate.

Figure 31 Via Padova Temporary Lighting Installation (Scuderi & Uva, 2021)

The given place for the installation was a green roof of the waterworks of Milan, a neglected area of which no one knows the function and where access is not allowed. With those installations, the purpose was to underline how sometimes, in the most difficult places, communities are more closed, active and helpful in facing daily problems. Jellyfish Invasion, "Il giardino che non c'è" and "Piazza La Luce" are a sign and a dream for a fragile area, but full of energy and enthusiasm, characterized by a multicultural and real supportive community.

- Community-Driven Light Art Projects: This concept promotes residents' engagement in light art installations that enhance the aesthetic appeal of public spaces. Support is offered for artistic endeavours that utilize light as a medium, allowing residents to express their creativity and influence the ambience of their surroundings.
- Smart Lighting Technology Access: Communities are equipped with access to smart lighting controls and data in this concept, facilitating self-monitoring and adjustment. User-friendly interfaces for adjusting lighting settings are provided, allowing residents to customize lighting conditions based on their preferences and needs.

In conclusion, the concept of self-governance through lighting signifies a departure from top-down urban planning towards a model that places power and decision-making in the hands of those who intimately understand the unique dynamics of their community. By embracing these concepts, urban areas empower their residents to actively shape the lighting environment, fostering a sense of ownership and community pride. This participatory approach leads to more vibrant, safe, and inclusive urban spaces that cater to the unique requirements and aspirations of the community.

5.1.5. Practical application in the real-life scenario

The multifaceted functions of light offer a wealth of practical applications in real-world scenarios. It may help to reduce operation cost or minimize the communication and instructions in many places, For instance:

In the realm of retail marketing, dynamic lighting displays serve as a powerful tool for capturing the attention of potential customers and strategically highlighting specific products or promotions. By employing dynamic lighting techniques, retailers can create visually engaging displays that draw in passersby and direct their focus towards featured merchandise. This application of dynamic lighting holds the

potential to significantly reduce the costs associated with traditional promotional methods. Unlike static displays or extensive advertising campaigns, dynamic lighting allows retailers to achieve a captivating visual impact with a relatively lower investment. Furthermore, this approach enables a streamlined and simplified marketing process. Rather than relying on elaborate setups or costly promotional materials, retailers can leverage the dynamic capabilities of lighting to achieve the desired visual impact. Adjustments to the lighting scheme can be easily made to accommodate changing promotional strategies or to highlight different products based on seasonal trends or customer preferences. This level of adaptability provides retailers with a versatile and cost-effective means of effectively reaching their target audience.

In large-scale gatherings such as festivals or concerts, the thoughtful use of strategic lighting is like to arrange the entire experience with finesse. This is particularly crucial when the attendees come from diverse cultural and societal backgrounds lighting serves as a cultural bridge, speaking a language that everyone can understand. By minimizing the need for information points and guides, lighting becomes the silent yet effective host, effortlessly leading attendees through the event. Imagine a bustling festival with people of various origins and languages. Here, lighting takes on the role of a universal communicator, making sure everyone feels the pulse of the event. Lighting can acts as a skilfully guiding and director the crowd towards key focal points. Picture stages, vibrant attractions, and popular spots illuminated with a captivating glow.

In therapeutic environments, carefully calibrated lighting with specific colour temperatures and intensities can create calming and healing spaces, aiding in patient recovery, in specialized treatment areas like therapy rooms or mental health units, lighting may be tailored even further. For example, a therapy room for patients with anxiety or stress-related disorders may have soft, diffused lighting to create a calming environment. This type of lighting can help patients feel more at ease during their sessions. In pediatric wards, lighting can be designed with playful and colorful elements to create a cheerful and comforting

atmosphere for young patients. This not only aids in their emotional well-being but also distracts them from the clinical environment. The lighting design in these therapeutic environments, healthcare providers can positively impact patient experiences and outcomes. It goes beyond simple illumination; it becomes an integral part of the healing process. In this way, lighting becomes a practical tool in enhancing patient well-being and aiding in their recovery journey.

Imagine a bustling transportation hub, like a busy airport or a major train station, where thousands of passengers are navigating through terminals. This is where strategic lighting becomes a crucial element in ensuring a smooth and hassle-free experience for commuters. For example, bright and prominent lights can be installed along main walkways and corridors, gently guiding passengers towards key areas like ticketing counters, gates, and exits. In addition, lighting fixtures can be strategically positioned to highlight important points of interest, such as ticketing counters and information desks. This helps passengers easily locate essential services, reducing the time and effort required to find the assistance they need. For new or infrequent commuters, the well-planned lighting scheme acts as a virtual guide, offering a clear and intuitive path through the transportation hub. It minimizes confusion and uncertainty.

In urban settings, well-lit areas enhance safety by providing clear visibility, deterring criminal activity, and ensuring that emergency exits and call boxes are easily identifiable. Architectural landmarks can be illuminated to emphasize their unique features, attracting attention and enhancing their significance within the urban landscape. In smart homes, lighting can adapt to occupants' preferences and needs, emphasizing task-oriented areas, guiding individuals through the space, and enhancing overall safety. These examples illustrate how leveraging the diverse functions of light can lead to practical benefits in marketing, event organizing, healthcare, urban planning, and various other domains, showcasing its remarkable potential as a versatile tool in influencing behaviour and experiences.

5.1.6. Public and private suggestions

To enhance the existing urban environment through lighting design, several policies and strategies can be implemented. These policies aim to improve safety, aesthetics, functionality, and overall quality of life for urban residents. Here are some urban lighting design policies that can be applied These policies aim to create urban environments that are not only safe but also inviting, engaging, and conducive to the well-being of inhabitants. By incorporating diverse elements, including lighting, signage, and green spaces, cities can foster a sense of community while ensuring the safety and comfort of their inhabitants and communities as follows bellow:

Table 4 Strategic Public and Private Policies and Rationales

Strategic goal	Policies and Rationale
Guiding Through Lighting Design	P: Implement strategic lighting plans that guide people in urban areas, and emphasizing key landmarks and safe routes.
	R: Properly designed lighting can provide a clear path and highlight important landmarks, enhancing safety and orientation.
Orienting Signage and Visual Cues	P: Install clear, multilingual signage and visual cues at key points to assist residents and visitors in navigating the area.
	R: Effective signage reduces confusion, ensuring that people can find their way around easily.
Attractive Public Spaces	P: Invest in urban beautification projects, incorporating green spaces, public art installations, and aesthetically pleasing architecture.
	R: Attractive environments tend to attract people, fostering a sense of community pride and belonging, and enhancing tourism.
Alarming Systems for Emergency Situations:	P: Implement a robust emergency alert system that includes visual and auditory signals for immediate response in case of natural disasters or other emergencies.
	R: Quick and effective communication during emergencies is crucial for public safety.
Safetying Through Smart Lighting	P: Integrate smart lighting systems that adapt to real-time conditions, ensuring well-lit areas in all circumstances.
	R: Smart lighting enhances safety by providing adequate illumination, even in low-visibility situations.
Therapeutic Environments for Well-being	P: Incorporate elements like green spaces, calming visual elements, and lighting schemes designed for relaxation and well-being.
	R: Creating environments that promote mental and emotional well-being contributes to a healthier and happier population.
Community Engagement and Feedback Mechanisms	P: Establish channels for residents to provide feedback on urban planning and lighting design, encouraging a collaborative approach.
	Rationale: Involving the community ensures that policies and projects align with their needs and preferences.
Regular Maintenance and Safety Audits	P: Conduct regular maintenance checks on lighting infrastructure and safety features, addressing any issues promptly.
	R: Well-maintained urban spaces and lighting systems are essential for long-term safety and functionality.

5.2. Future of Urban Lighting and Smart Cities technologies

Predicting the future of urban lighting in smart cities involves envisioning how technological advancements, urban planning strategies, and societal priorities will shape the way light is utilized in urban environments. While specific outcomes cannot be guaranteed, we can make informed projections based on current trends. Here are some potential developments in the future of urban lighting:

- Integration with Advanced Technologies: Urban lighting will be seamlessly integrated with other smart city technologies, such as IoT, data analytics, and artificial intelligence, to create dynamic, responsive lighting systems.
- Energy Efficiency and Sustainability: There will be a continued emphasis on energy-efficient lighting solutions, with a shift towards renewable energy sources and the use of sustainable materials in lighting fixtures.
- Human-Centric Lighting: Lighting designs will increasingly prioritize human well-being, incorporating circadian lighting principles to support natural sleep-wake cycles and enhance overall health.
- Li-Fi Technology: Light Fidelity (Li-Fi) technology may become more prevalent, providing wireless communication through light waves, and potentially revolutionizing urban connectivity.
- Artificial Intelligence and Machine Learning: AI algorithms will be employed to optimize lighting controls, making adjustments in real time based on data inputs and user preferences.
- Dynamic Public Spaces: Public spaces will be transformed through dynamic lighting installations by motion sensors, creating engaging and immersive environments for social interaction, events, and cultural experiences.
- Augmented Reality Integration: Lighting will play a role in augmented reality (AR) experiences, providing dynamic visual enhancements for AR applications in urban environments.

While these projections offer insights into the potential future of urban lighting, it's important to remember that technology and urban planning will continue to evolve. Flexibility, adaptability, and a commitment to sustainability will be key in ensuring that urban lighting continues to enhance the quality of life in smart cities. Lighting systems will become more interactive, responding to user behaviour, environmental conditions, and specific needs to create personalized and adaptable lighting experiences.

6. Conclusion:

This thesis takes a fresh approach to urban lighting design, seeing it as more than just providing light. It's a flexible tool that can shape how we behave and communicate in cities. By studying how people feel and experience nighttime spaces, we uncover new ideas while also examining the usual ways we design urban lighting. One key goal is to create a clear list of different roles that lighting can play. This includes emphasising, attracting, guiding, alarming, ta'-heeling, and finally safetying. This research also introduces a new way to think about lighting: as a kind of language. Just like words and gestures, light can send messages and create moods. Sometimes, light speaks in a way that everyone understands, like how we all know what red, green, and yellow traffic lights mean. Other times, it's more like a personal language, understood in different ways depending on where we are and who we are.

In short, this study aims to reshape our view of urban lighting not just about giving light; but also about influencing how we experience and interact with our cities. We want to create a clear guide for using different aspects of urban lighting, like signs and actual light, in a way that suits each unique space. And let's not forget how lighting can impact our emotions, making spaces feel welcoming, exciting, or even calming. Furthermore, we propose a new way to think about lighting in urban smart cities, how policies and strategies shape new approaches to design, and the future opportunities for organized cities.

In conclusion, this research urges a shift in how we perceive urban lighting. It's not merely about providing illumination; it's a dynamic tool that shapes our urban experiences. By recognizing its potential for regulation, communication, and emotional impact, this thesis lays the groundwork for a future where urban environments are not only well-lit, but also enriched, engaging, and attuned to the needs of their inhabitants.

7. Annex:

7.1.Urban Regeneration - Chrisp Street - London

Figure 32 The commercial market of Chrisp Street is where tomorrow's Chrisp Street area

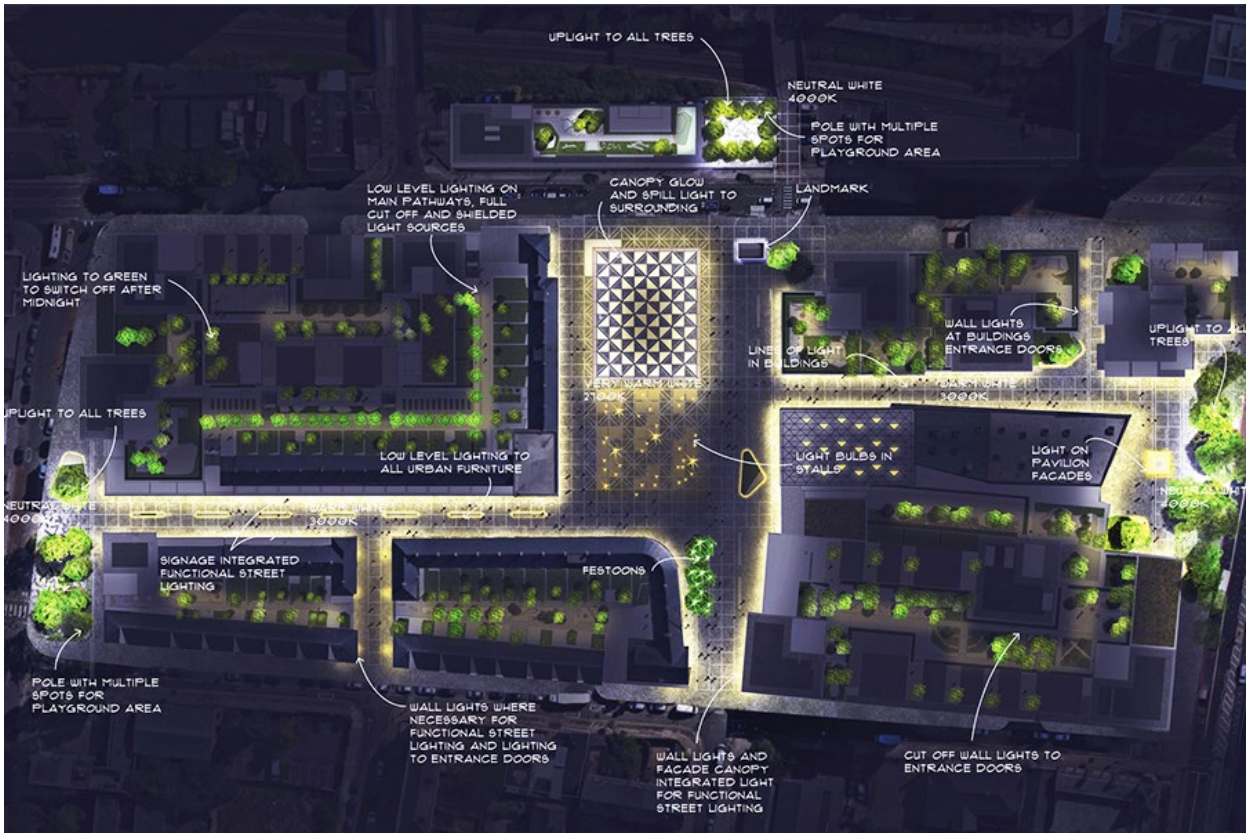


Figure 33The Center of the Market Located in the Heart of Tower Hamlets with a catchment area

Figure 34 The Canopy's Construction Material to Welcome Shoppers

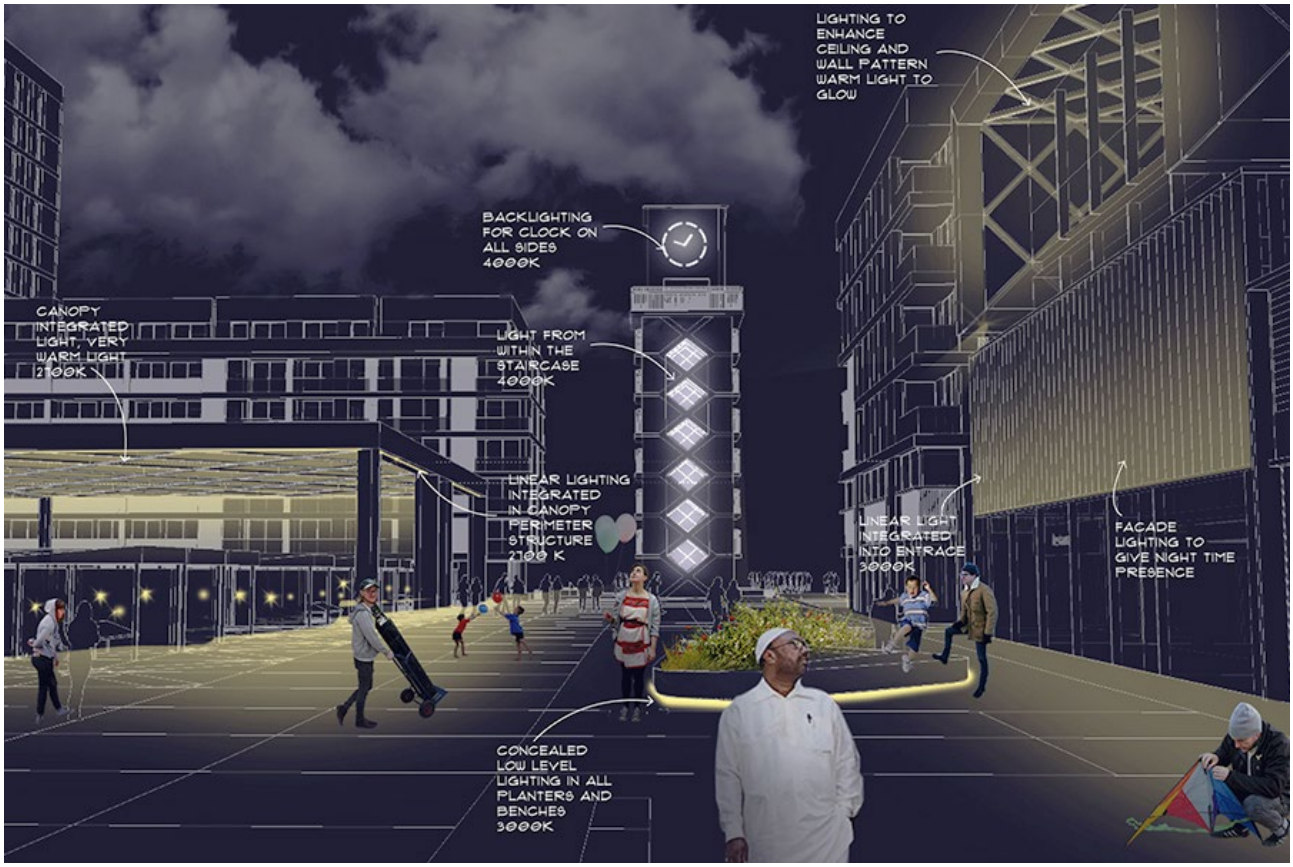


Figure 35 Glowing Light of Tower on the New Glass Building

7.2.Palermo di Luce

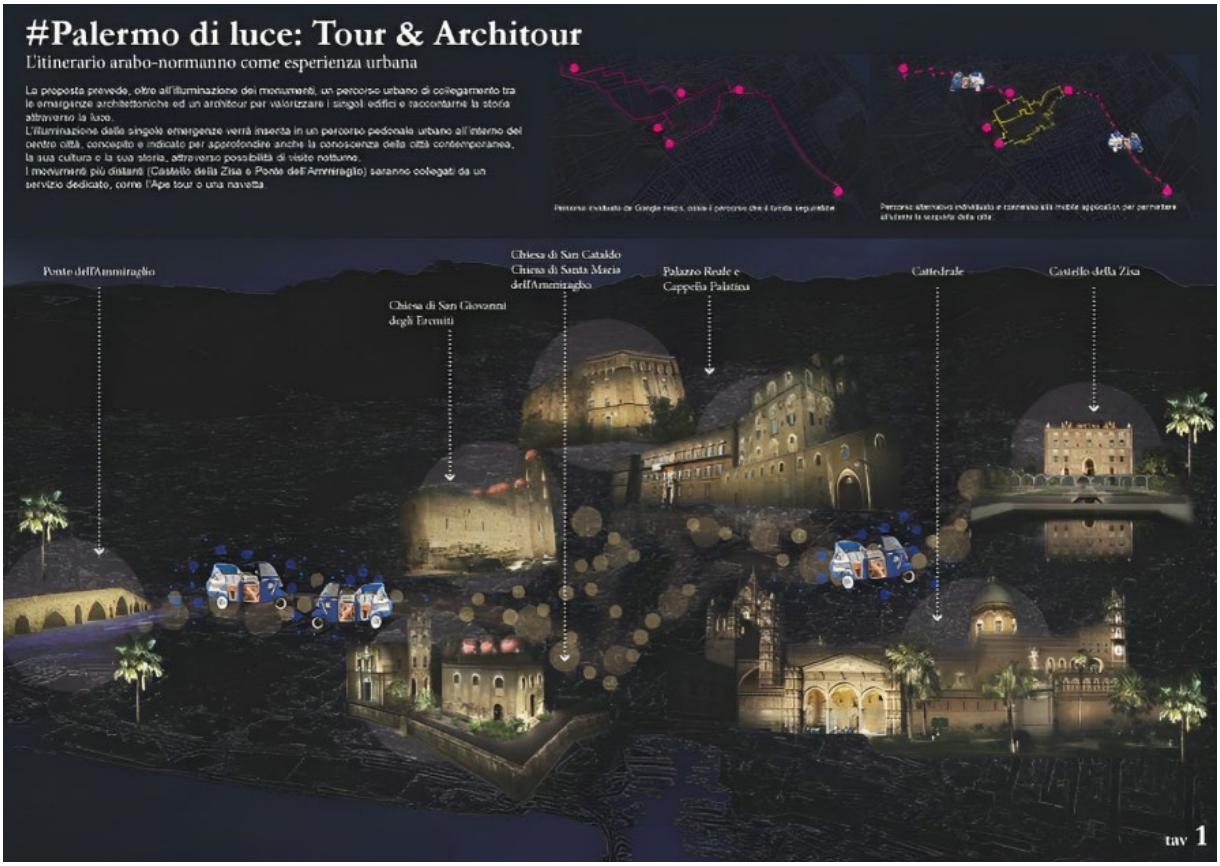


Figure 36 Lighting Concept for Palermo's Arabic Heritage Landmarks

Figure 37 Touring Experience

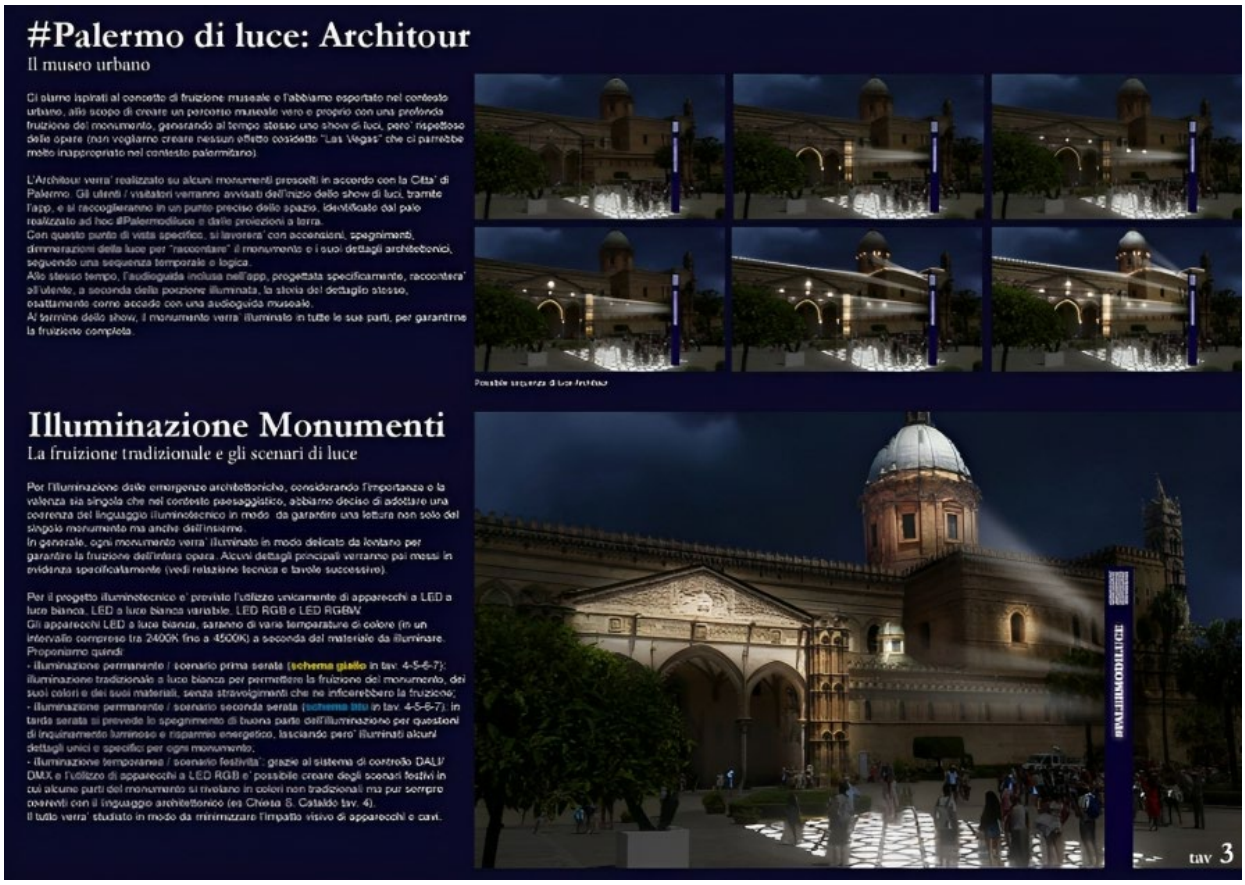


Figure 38 Monuments Illumination

Figure 39 Chiesa di San Cataldo

Figure 40 The Cathedral

Figure 41 Palazzo Reale e Cappella Palatina

7.3.Nicosia Commercial District

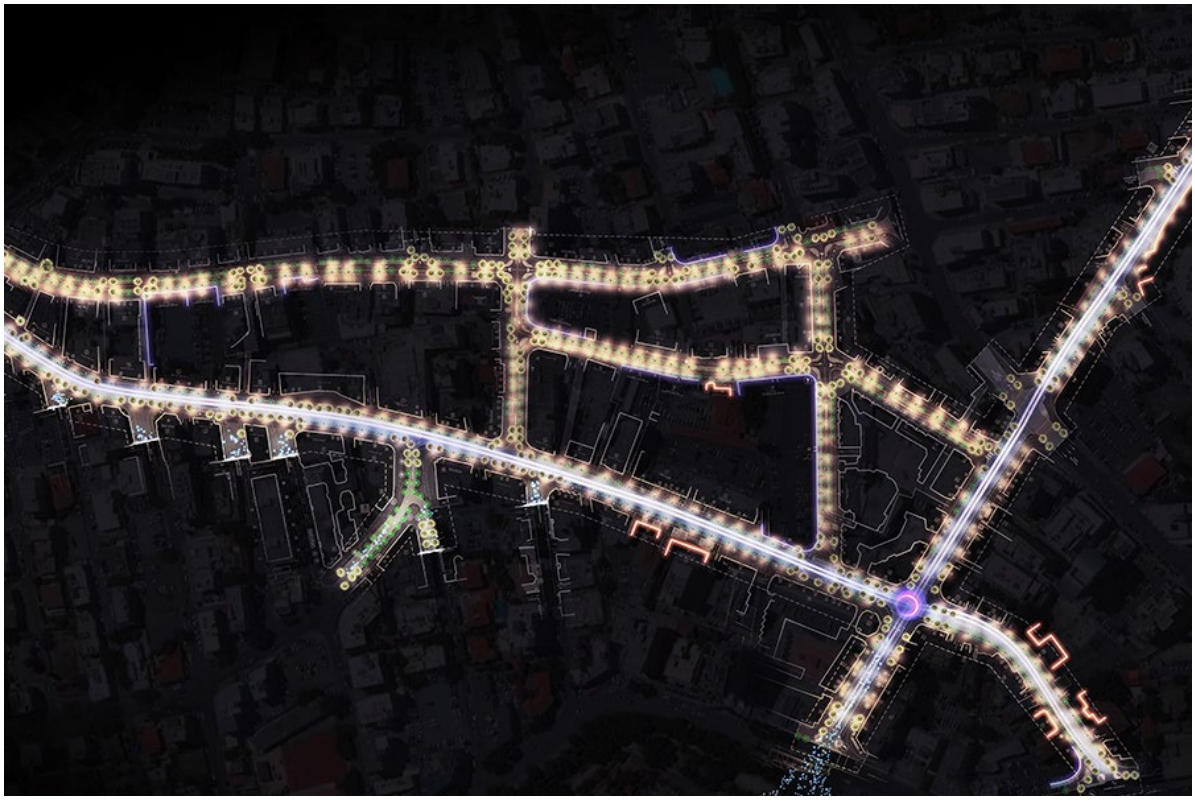


Figure 42 Lighting Masterplan

Figure 43 People's Experience in the Neighborhood

Figure 44 People's Experience in the Commercial Zone

Figure 45 People's Experience in the Downtown

7.4.Collage Road - London

Figure 46 Enhancing Landscape by Lighting

Figure 47 building's ground level design as well as facades with a flexible lighting scheme

7.5.Royal Albert Dock

Figure 48 Royal Albert Dock for Asian and Chinese Business

Figure 49 Pedestrians and Users' Experience

Figure 50 Pedestrians and Users Experience

7.6.Whitecross Workshop

Figure 51 Inhabitants Participation for Better Understanding

Figure 52 Engage Dialogue with Society

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