



# **MSc Architectural Lighting Design**

**Master Thesis Booklet**

**2023-2024**

# Congrats! Hurrah! Grattis!

The Lighting Design division congratulates the graduates who presented their Master's theses in spring 2024 at KTH School of Architecture. The individual thesis project, 15 ECTS, concludes the one year programme in Architectural Lighting Design, 60 ECTS.

Throughout the year-long educational process, the students first answer questions formulated by teachers and supervisors. Before the start of the Thesis, the students should have learnt to answer these questions, as well as to motivate their answers and their design choices. The thesis marks a new step in the learning process; the students learn to formulate their own questions and to answer them using the most appropriate and feasible methods. In the age of continuous technological development of light sources, controls and AI, and of deep societal transformation, the skill of making and solving questions is relevant. The more than 30 students represented in this booklet developed self-formulated research questions in the lighting design field that touch the topics presented in the next pages. Most theses included an investigatory approach into the design process, either in the question formulation or in the design of the conceptual proposals. This suggests the students' need to experiment and integrate an evidence-based approach into the designers' toolkit.

Sustainability is at the core of the activities of the Lighting Design division and of KTH. Each thesis needed to address at least one of the 17 goals promoted by the United Nations in the 2030 Agenda for Sustainable Development (<https://sdgs.un.org/goals>). The goals addressed by the students are listed here:



We want to acknowledge all the tutors who offered their knowledge, experience and time to support the ALD students. And we thank the external critics (Yael Erel, Elettra Bordonaro, and ALD alumni Isabel Villar and Yousef Tavakoli) who enriched the discussion during the final presentation days. And finally the Center of Academic Writing at KTH for the excellent support.

## The course teachers

Stavroula Angelaki (Teacher)  
Ute Besenecker (Course Examiner) [uteb@kth.se](mailto:uteb@kth.se)  
Hamidreza Eizadi (Teacher)  
Federico Favero (Course Responsible) [ffavero@kth.se](mailto:ffavero@kth.se)  
Foteini Kyriakidou (Teacher)  
Rodrigo Muro (Programme Director)  
Gerhard Rehm (Teacher)

# Index and thematic clusters

The presentations were grouped in 10 thematic clusters, see below, which enabled discussion of individual and group considerations.

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# Contemplative/spiritual light(ing)

May Yee Chong

Lucie Coirbay

Ardijana Molic

# Integrating spiritual lighting within student accommodation as multifaith space

## Christianity, Islam, Buddhism

Author: May Yee Chong

Tutor: Stavroula Angelaki



Figure 1: Conceptual design visualisation

### Abstract:

This thesis stems from personal experience as an Asian student in Stockholm, Sweden, in finding suitable places for prayer or religious activities due to the unfamiliar environment. A proposal of incorporating a small multifaith space within student accommodation to address this need, providing a space for communal prayers and religious activities while also serving as a community hub. The methodology integrates qualitative methods, by focusing on selected churches in Stockholm, a Mosque, and a Chinese Temple in Asia to explore the use of light in religious settings. Specifically, it examines how light illuminates the focal point or elements of worship, creating a spiritual ambience through spatial light contrast. From those case studies and observations, the research identifies common light symbol across different religious spaces. Additionally, a survey was conducted to understand visual preference of light by international students living in student accommodation as a form of foundation, to understand the personal light preference setting in holistic spaces. By examining how light is employed in various religious contexts and its potential in spiritual spaces, this study seeks to establish foundational principles of lighting design applicable to create inclusive spiritual environments in student accommodation or similar settings. Ultimately, the goal is to use light as an imitation to foster a sense of familiarity among individuals practicing diverse religious or different spiritual backgrounds.

*Keywords: spiritual lighting, light impression, cultural integration, holistic environment, student accomodation*

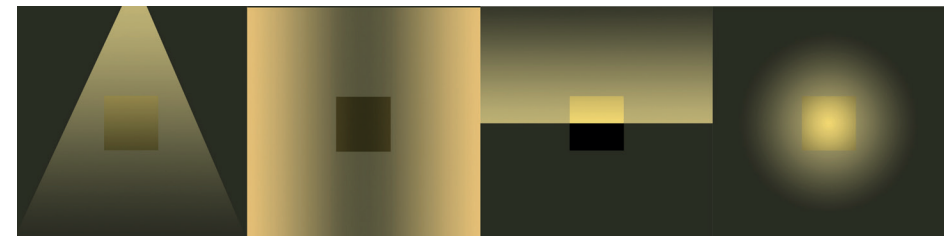


Figure 2: Figures depict various light symbols derived from case studies.

# A Modern Language for Church Lighting, balancing heritage and modern identity of churches

Author: Lucie Coirbay

Tutor: Fiorenzo Namèche



Figure 1: Reworked picture of the atmosphere inside the church – Celebration lighting

## Abstract:

The atmosphere in sacred spaces is something that fascinates me. The feeling I get inside sacred spaces is unlike any other. Light is the main factor that gives this special feeling. With this thesis, I want to investigate how to preserve that ambiance, particularly in churches. Heritage is defined as being both tangible and intangible. Churches are a testimony of tangible heritage with their architectural characteristics. They are also a part of the intangible heritage by representing religion and faith. Those two aspects are the ones that I developed. The tangible, architectural investigation is done through on-site observations. The intangible, cultural investigation is done through interviews about perception. Light is my tool to highlight heritage in its double meaning. Lighting in churches is nowadays facing a need for upgrades due to the obsolescence of light sources. This upgrade comes together with the need for a modern understanding of worship. I aim to investigate how to create a modern language of lighting that represents the visitor's needs while emphasizing the church's architectural qualities. Based on the informations I gathered throughout the process, I can design different lighting scenarios. These scenarios focus on finding a balance between lighting the architecture and creating a special experience for the users.

Keywords: Heritage, Upgrading light sources, Sacred spaces, Emotional architecture



Figure 2: Lighting plan of the existing situation during nighttime

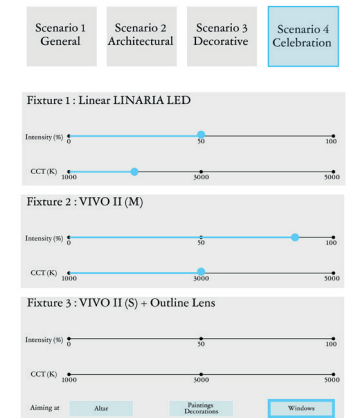


Figure 3: Luminaire settings of the designed scenarios – Celebration lighting

# Illuminating the Divine

## The intersection of light and spirituality in Islamic sacred buildings

Author: Ardijana Molic

Tutor: Viola Deti



Figure 1: Conceptual lighting design, Female prayer space, Halid mosque

### Abstract:

Muslims experience the presence of the divine by being called to the Mosque five times daily for prayer, two during sunset and night. Additionally, prayer's emotional and physical aspects are sometimes not aligned due to the space and its connection to the lighting in which it is held. Without emotional and physical aspects in sync, the connection between the two cannot be established.

The thesis aims to explore how the use of artificial lighting can affect the spiritual atmosphere of the Halid Mosque in Ulcinj, Montenegro. Therefore, the goal is to analyze the factors of artificial lighting contributing to this atmosphere and focus on areas that create this perception of a sacred space. The methodology used for the project comprises two main phases. The first phase involves a literature analysis and observing the spiritual atmosphere of the Et'hem Bey Mosque in Tirana. The second phase involves a case study of the Halid Mosque, conducted through personal observation, qualitative and quantitative study of the Halid Mosque. The results obtained from these two phases provide a basis for creating a conceptual design proposal for the Halid Mosque.

The research revealed that dark spaces within the Mosque are not allowed since darkness is considered infidelity in Islam. Therefore, one of the main key elements of the conceptual design of the Halid Mosque is to create mediums of light that strive to implement a space that fosters an atmosphere for spiritual reflection, worship, and community engagement.

Keywords: mosque; atmosphere; spirituality; emotion



Figure 2: Conceptual lighting design, Male prayer space, Halid mosque

# Immersive and safe darkness

Maria Madland

Lang Ning

Anatoli Tsaia



# Light on Darkness

**Author:** Maria Erichsen Madland

**Tutor:** Veronika Mayerböck



Figure 1: Bergsjøstølen after dark (21:19 hours)

## Abstract:

Our relationship to the light has evolved drastically since the first use of fire. So has our relation to the darkness. When I was younger, I was afraid of the dark. However, as I grew older, I started appreciating the dark Nordic evenings more, and late night walks became a part of my everyday routine.

As these night walks progressed, I found myself often trying to find new places, where there was an absence of artificial light. With a profound fascination for darkness, and a deep concern to our rapidly over-lit environments in relation to sustainability, this master thesis explores attributes of emotional affect and affordances in darkened spaces. Additionally, it investigates how we better can understand darkness in order to re-introduce its qualities into our everyday environments, to foster sensations of dwelling and immersive atmospheres allowing us to slow down. Through site investigations and explorations, factors of darkness - an interpolation of the seven factors of light (Ejhed 1996) - has been developed as a method to evaluate darkened spaces. Further, this evaluation was later tested in an experimental model to evaluate findings. Results displays a common sensation that darkness can be experienced as a desired quantity that trigger awe, contemplation and a reconnection with the inner selves.

*Keywords: Darkness Perception Affect Affordances Balance*

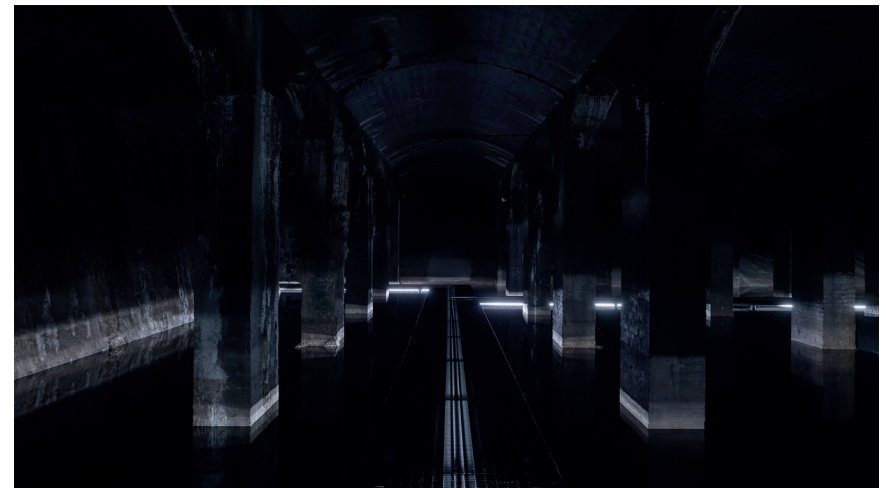


Figure 2: Investigating factors of darkness in Cisternene, Copenhagen

# Lighting without light

## A Light Intervention as bollards with reflective material in Ålesund, Norway

Author: Lang Ning

Tutor: Seren Dincel



Figure 1: Bollards visualized at the site

### Abstract:

A prototype for a reflective bollard system for a pedestrian route in Ålesund, Norway. Within the scope of NorDark research project, which intends to mitigate the adverse artificial lighting effects on wildlife, this study explores the use of retroreflective materials to replace traditional light sources for minimizing light pollution and energy consumption. The thesis is divided into two parts: the first part involves designing and testing a reflective bollard prototype through studies in a controlled environment and questionnaires to determine the optimal material and height. The second part simulates the bollard system in a digital model to evaluate its effectiveness and plan its implementation. The findings indicated that a combination of white and orange retroreflective materials applied at a height of 0.9 meters provides the best visibility for participants. The outcome of this thesis contributes to future developments of replacing conventional outdoor lighting systems by using reflective materials in combination with portable light sources. Furthermore, conclusions emphasize the importance of on-site testing to achieve refined solutions.

Keywords: Retroreflective Materials, Digital Simulation, Sustainable Devel-

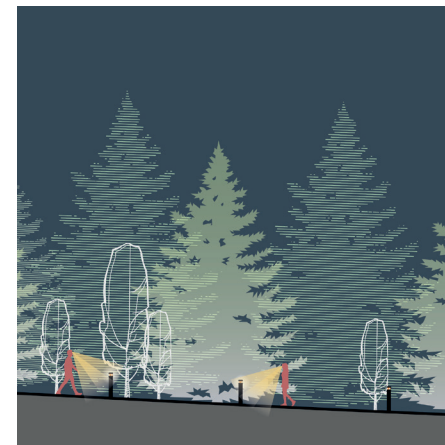


Figure 2: Site Section

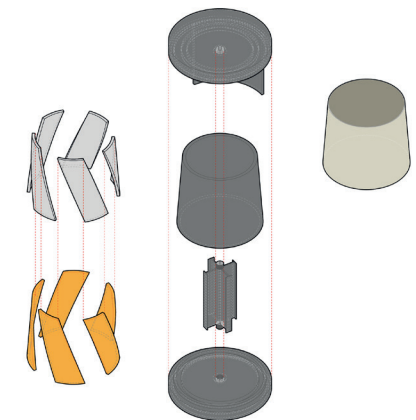


Figure 3: Axonometry of the Bollard's Head

# Illuminating shelters along nature paths

Author: Anatoli Tsaia

Tutor: Rodrigo Muro



Figure 1: Conceptual idea abstract sketch. Photo shot during on-site experiment

## Abstract:

Drawing inspiration from the Scandinavian people's appreciation for nature and outdoor activities, this thesis delves into ways to extend these experiences into the darker hours. Notably, there is a lack of people engaging in outdoor activities during the darker hours, which is especially significant in Sweden, where many days are characterized by prolonged darkness. By examining people's lighting preferences and ecological concerns, the study explores how lit spaces with warm tones of light can draw people to visit natural areas even after daylight hours. Specifically, the thesis investigates how warm lighting influences the atmosphere and emotional responses of individuals to enhance the overall outdoor experience.

The methodology comprises a mixed-method approach, including a literature review, site analysis, a user experiment, and a conceptual design proposal. During the on-site experiment, warm lighting was tested to gauge participants' responses, which revealed that it altered the area's atmosphere positively, evoking calm emotions. Informed by insights from the other methods, the conceptual design proposal focused on creating diverse nature experiences to encourage outdoor engagement. The approach encompassed testing the effects of warm lighting in a physical and visual model, leading to the proposal of warm-lit shelters. These structures aim to provide calming, and inviting spaces, incorporating sustainable solutions.

*Keywords: warm lighting, outdoor engagement, emotional responses, sustainability, after daylight hours*

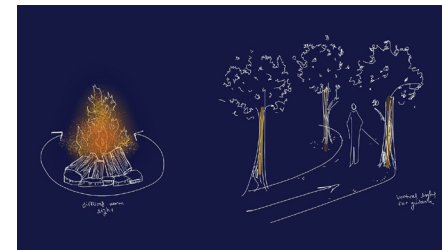


Figure 2: Initial sketches for the conceptual light proposal



Figure 3: Testing diffuse warm light with a physical model

# Immersive/Interactive lighting

Olena Kondrashevskaya

Ashwin Pherwani

Sudipti Varadharajan

# An Exploration of the User's Perception of How Light Shapes Space

Author: Olena Kondrashevskia

Tutor: Andreas Schulz

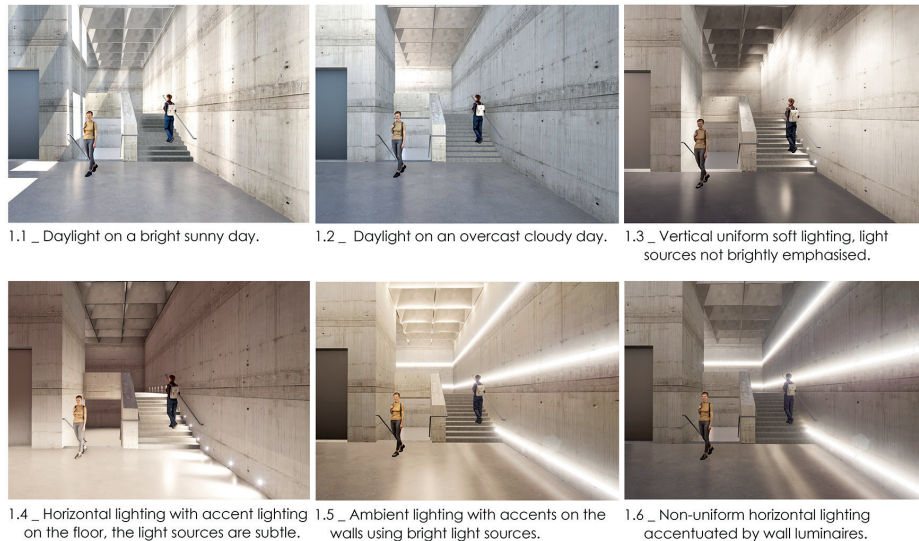


Figure 1: XX

## Abstract:

Light not only affects the geometric perception of space, but also plays a crucial role in shaping mood, atmosphere and (as I am now convinced after conducting this thesis) function. In this thesis, my objective was to identify the patterns associated with a user's perception of space under different lighting conditions. To achieve this, I selected two existing spaces and created six lighting scenarios for each space. The scenarios were presented in the questionnaire as videos, providing a more comprehensive view of the space within the given lighting conditions. A review of the responses from 44 participants revealed certain patterns in the perception of the space atmosphere under different scenarios. For example, scenarios with horizontal lighting were perceived as relaxing by the majority, while scenarios with vertical lighting were perceived as more exciting. A clearer and more defined pattern emerged when participants were asked to identify the intended function of the space: contrasting lighting gave the impression that the space was primarily intended for cultural activities, whereas with uniform lighting the majority of respondents chose the intended function as a transit zone. The influence of light on the function of a space has potential for further practical application and research.

Keywords: Space atmosphere, user's perception, lighting scenario, horizontal lighting, vertical lighting













	Visible light sources	Light sources are shielded and out of focus	Accent lighting with pronounced light sources
Horizontal uniform lighting	 scenario 2.1 Pleasant, 61% Boring, 20% Relaxed, 15%	 scenario 2.4 Pleasant, 38% Boring, 38% Serene, 15%	 scenario 1.4 Pleasant, 35% Excited, 35% Relaxed, 23%
Nonuniform horizontal lighting	 scenario 2.6 Excited, 46% Pleasant, 26%	 scenario 2.3 Pleasant, 54% Relaxed, 26%	
Vertical uniform lighting	 scenario 2.2 Excited, 45% Pleasant, 38%	 scenario 1.3 Pleasant, 44% Relaxed, 39% Excited, 20%	 scenario 1.5 Pleasant, 39% Excited, 32% Annoying, 24%
Nonuniform vertical lighting	 scenario 2.5 Pleasant, 30% Excited, 28% Relaxed, 26%	 scenario 1.6 Unpleasant, 48% Annoying, 30% Excited, 18%	
Daylight on a bright sunny day	 scenario 1.1 Pleasant, 48% Relaxed, 38%		
Daylight on an overcast cloudy day	 scenario 1.2 Unpleasant, 64% Boring, 38%		

Figure 2: XX

# The Bridge Between Concept Design and Reality

Author: Ashwin Ritesh Pherwani

Tutor: Sara Isabel Ortega Donoso

## Abstract:

A conceptual design without an execution plan remains just an idea. Lighting designers often focus more on conceptualization than on technical planning, overlooking that technology is essential to bring concepts to life.

This project studies the role of system integration, APIs, and computer networking in realizing a concept design through 'No Tree is an Island,' an interactive art installation raising awareness about deforestation, based on the Mycorrhizal network of trees. The installation is remote, with interactions occurring 5 kilometres away from the lights. The research question is answered through my personal experience during the project's three development stages and interviews with five industry professionals with at least five years of experience in technical lighting design.

The study reveals that technical constraints significantly impact concept design, altering intended effects and moods. However, it concludes that technology serves the concept design, not the reverse. It is a marriage; one without the other is of no use. Both concept design and technology are crucial. Therefore, as a lighting designer, understanding both is essential.

Keywords: System integration, APIs, computer networking, technology, concept design

Tekniska Museet

Reaktorhallen

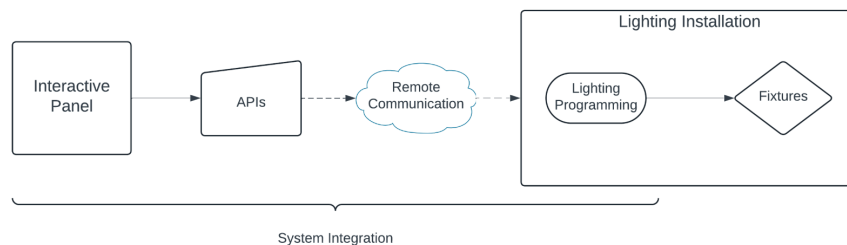


Figure 1: Block diagram of the system plan for the project

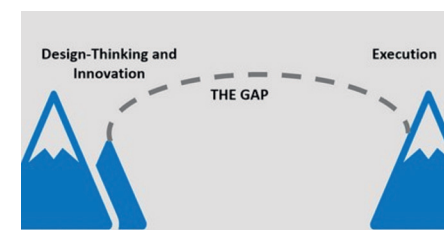


Figure 2: The gap between the design and reality

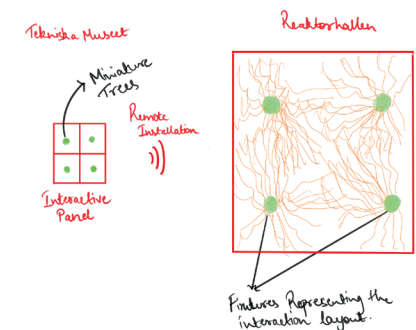


Figure 3: Sketch showing the idea to achieve the vision

# Shifting Perceptions: Static versus Dynamic Lighting in Historic Art Interpretation

Author: Sudipti Varadharajan

Tutor: Linus Lopez

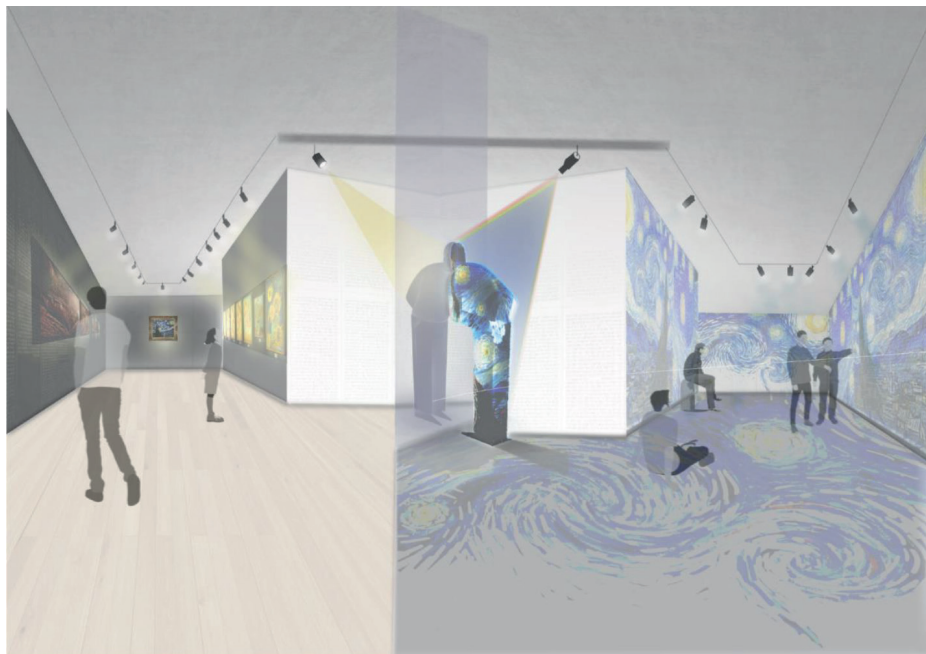


Figure 1: Illustration of perceiving Van Gogh's artwork in static and dynamic environments

## Abstract:

Historical art museums are at a crossroads, with artworks increasingly losing their original pigment colors. While LED lighting technology has made strides in enhancing these colors without damaging the art, the inevitable deterioration of artworks poses a future threat to museum organizations, stakeholders, and curators, necessitating alternative strategies to sustain public engagement. In the digital era, new solutions exist to revitalize the experiences associated with these artworks. This study explores these possibilities, specifically projection mapping, to recreate the artwork through lighting, thus overcoming the limitations of physical deterioration.

Through qualitative analysis, including surveys and personal observations, this study examines visitors' perceptions of Van Gogh's artwork in static (museum) and dynamic (immersive) lighting environments- assessing their subjective impressions, psychological responses, and preferences for digital media lighting technologies - including multisensory, interactive and immersive projection mapping that could enhance future art museum experiences. 174 visitors to these environments submitted responses. The findings reveal that most participants, 33.89%, prefer immersive, 28.01% prefer interactive lighting, and 29.41% suggest integrating these digital media lighting alongside traditional lighting for viewing original art in future art museums. The study concludes by discussing the effectiveness of these proposed solutions and the potential role of future lighting designers in curating enhanced art museum experiences.

*Keywords: Artwork Conservation and Preservation, Digital Media Lighting Technologies, Projection Mapping, Immersive and Interactive lighting*

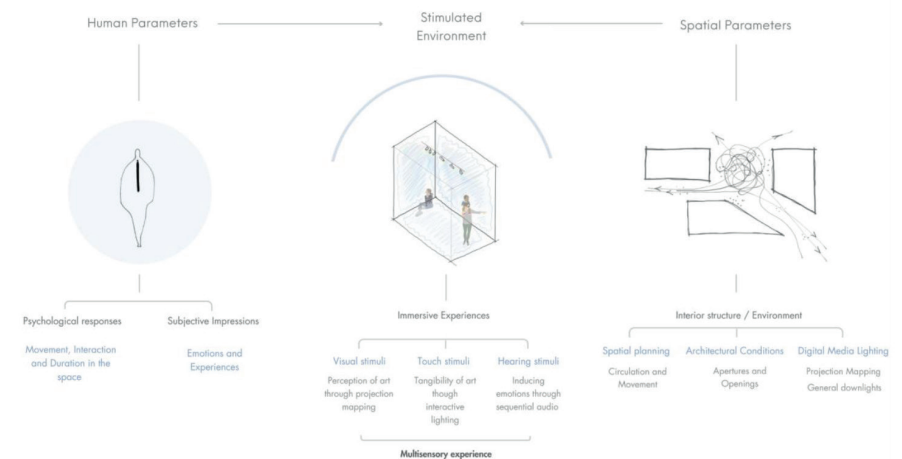


Figure 2: The factors influencing and creating a dynamic stimulated environment

## **Integrative/ Artificial lighting**

**Israa Ashraf**

**Cristina Cornejo**

**Noémi Dux**

**Nicolò Morello Benedetti**



# Optimizing Daylight and Artificial Light Integration in Glass Curtain Wall Environments within Libraries

Author: Israa Ashraf Bakr

Tutor: Isabel Villar

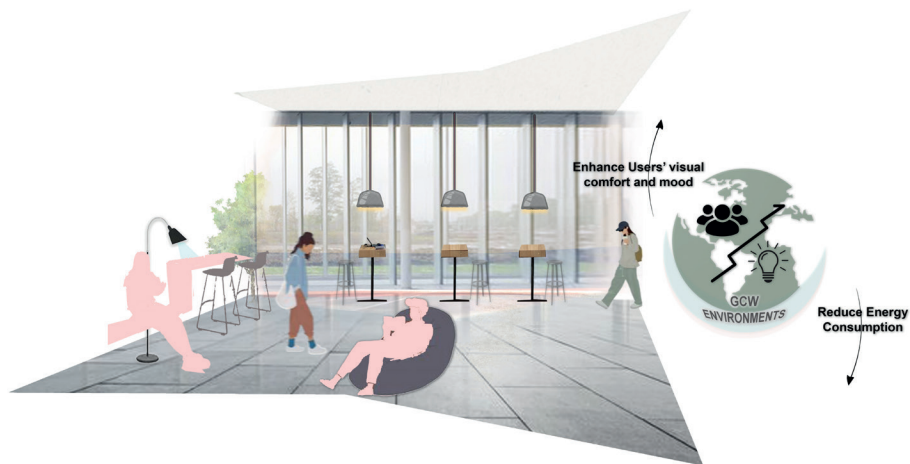


Figure 1: Illustration explains the balance to achieve in GCW environments within libraries.

## Abstract:

Glass curtain walls (GCWs) are favored in building construction for their significant daylight provision, yet they present complexities such as heat flow and visual discomfort. In libraries, the integration of artificial light with daylight further complicates matters, diminishing daylight's energy-saving potential. This arises questions if maximizing daylight in libraries contribute to energy savings, or even if the adoption of GCWs in libraries is truly a sustainable choice. This paper examines a GCW study space in KTH library, Stockholm, Sweden, to address these questions and understand how Nordic users perceive GCWs in libraries. The study involves on-site user interviews and surveys correlated with illuminance levels to validate subjective perceptions. Based on the findings, adjustments are proposed to achieve a balance between reducing energy consumption and increasing user visual comfort and mood through daylight and artificial light integration. Results indicate that Nordic users appreciate GCWs in libraries primarily for their daylight provision. Despite complexities, GCWs are viewed as sustainable especially when this balance is maintained.

Keywords: GCWs, Library Lighting, Energy Efficiency, Visual comfort, Simulations

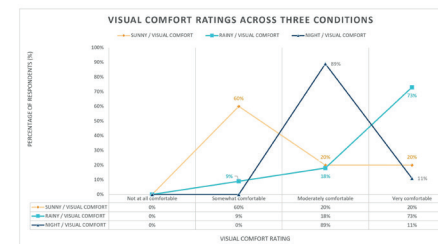


Figure 2: Visual comfort ratings during the 3 evaluated conditions in the case

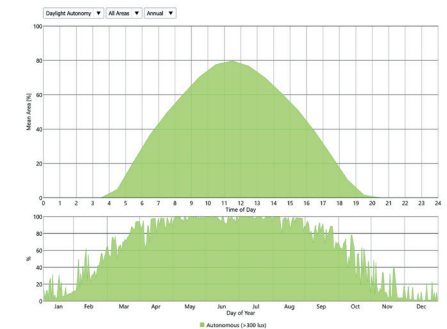


Figure 3: The annual spatial daylight autonomy (sDA) of the evaluated space

# Lighting design considerations for students' concentration in an afternoon lecture

Author: Cristina Maricela Cornejo Mejia

Tutor: Stavroula Angelaki

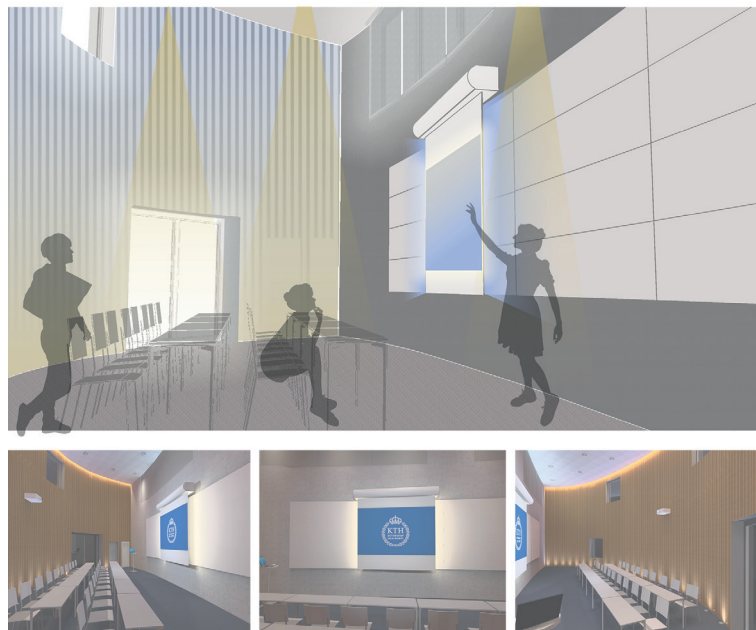


Figure 1: Room A124. Above, perspective with lighting distribution in the space. Below, perspectives of lighting simulation rendering.

## Abstract:

Have you ever found yourself trying not to fall asleep during a lecture in an afternoon? Even if the topic was very interesting for you. Could it be the lighting in the room or us? This question was the starting point for doing this study. We as humans depend on daylighting to have a healthy internal clock, but we need to expose ourselves to the variation of light every day. This study focuses on indoor spaces, where we spend most of our time. The case study is in a learning environment, a lecture hall where projection is used every day, and where the lighting scenario must have low levels and contrast to present an image with good quality. The methods used were a literature research of similar studies, lighting lab testing and a mockup to create a lighting scenario where participants could compare current and proposed lighting scenarios. The results reflected that participants were more likely to be engaged in the lecture, emotionally and mentally, if the lighting atmosphere was focused on their needs rather than setting the lighting scenario only for projector's requirements. The outcome will be a list of design directions of lighting design considerations for the space.

Keywords: Lighting design, mental well-being, correlated color temperature, illuminance, contrast.

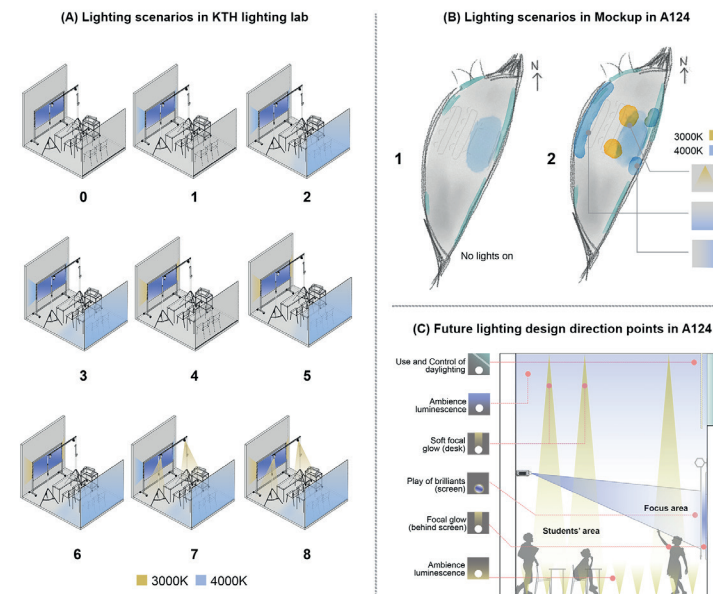


Figure 2: (A) axonometric 3D view of the lab lighting test set, 9 scenarios; (B) plan view of the lighting scenarios tested in mockup; (C) sectional view with future design

# Effect of artificial light on students while studying with limited access to daylight

Author: Noémi Dux

Tutor: Yvonne de Kort

## Abstract:

With the transition from natural lighting to artificial lighting, humans tend to spend more and more time in indoor environments. The increased time spent indoor has an effect on humans' health, mood, and performance. This study explores how artificial light designed to imitate daylight can impact student's alertness and comfort in an indoor environment with limited access to daylight. Through the testing of two different lighting designs, the student's subjective fatigue and perception of comfort were evaluated in a windowless room at KTH's library. The surveys and measurements showed considerable improvements in alertness and comfort when the lighting implemented was illuminating the space through a dynamic, uniform wall illuminance on a 4000k colour temperature. The results show clearly that the students are affected by the lighting implemented, however it can not be attributed to the CCT, intensity or even uniformity as they were confounded. It suggests that an artificial lighting following some daylight qualities (dynamic and indirect) enhances alertness and comfort.

*Keywords: Alertness, comfort, daylight, dynamic, wall illuminance*



Figure 1: Schematic drawing of the original lighting vs the experimental lighting

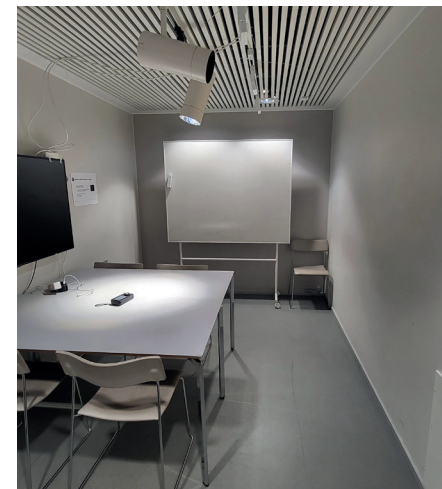


Figure 2: Picture of the experimental design at the beginning of testing

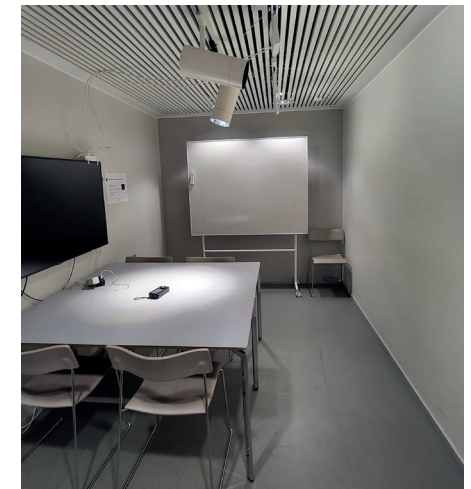


Figure 3: Picture of the experimental design at the end of testing

# Lighting design solutions for hospital wards

## The Karolinska University Hospital case study.

Author: Nicolò Morello Benedetti

Tutor: Isabel Villar

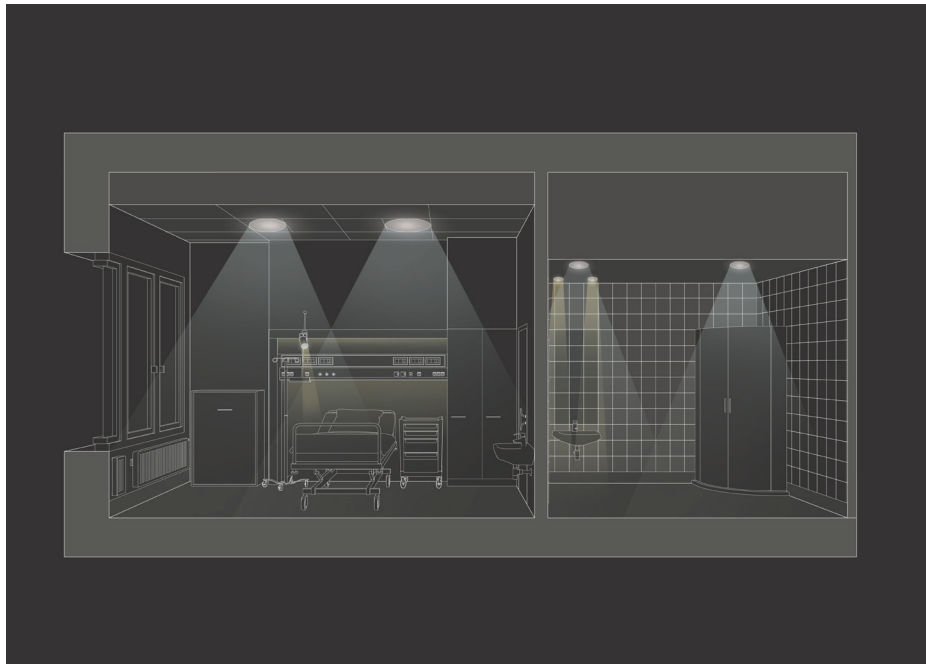


Figure 1: Perspective section of a patient's private room

### Abstract:

This research thesis aims to delve into the theme of artificial lighting design within a hospital setting, specifically within a ward block. In order to achieve this, the Karolinska University Hospital in Stockholm has been analyzed, and its lighting solutions have been critically examined.

These solutions are then compared with the principles and findings identified in scientific literature over the years. Thanks to site visits and materials obtained from the project's designers and architects, it is possible to thoroughly analyze its characteristics. Starting from a broader and more general scale, the research focuses on certain aspects of the ward plan, including the patient's private room and the corridors, to investigate the lighting solutions used, measure their quantitative values, and compare them with current standards for a hospital context. Interviews are another tool used to understand the viewpoints and opinions of medical staff and patients who frequent the department every day. From this study, guidelines and points of reflection for architects and lighting designers can be derived, emphasizing the importance of further developments and research on this topic in the future.

Keywords: Hospital Wards, Lighting Design, Health, Patients, Architecture

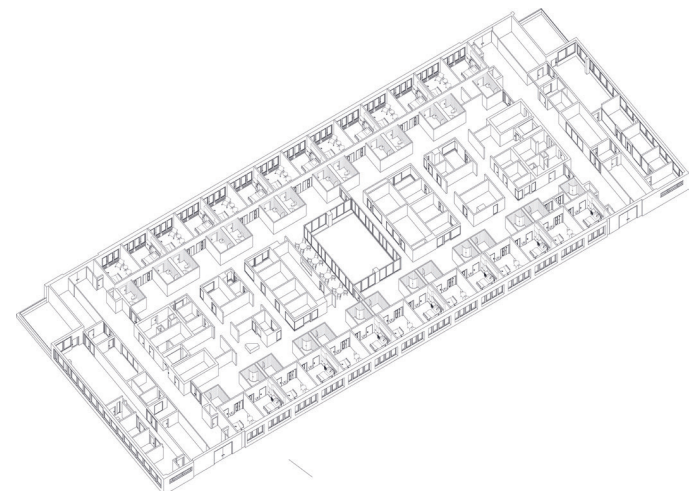


Figure 2: Karolinska University Hospital's patient ward block

# Integrative/ Daylighting

Veera Saastamoinen

Cecilia Novella Samaniego

Zhongwei Sun

# The effect of façade configuration on daylight availability in the case of Läkarhuset Odenplan

Author: Veera Annika Saastamoinen

Tutor: Federico Favero

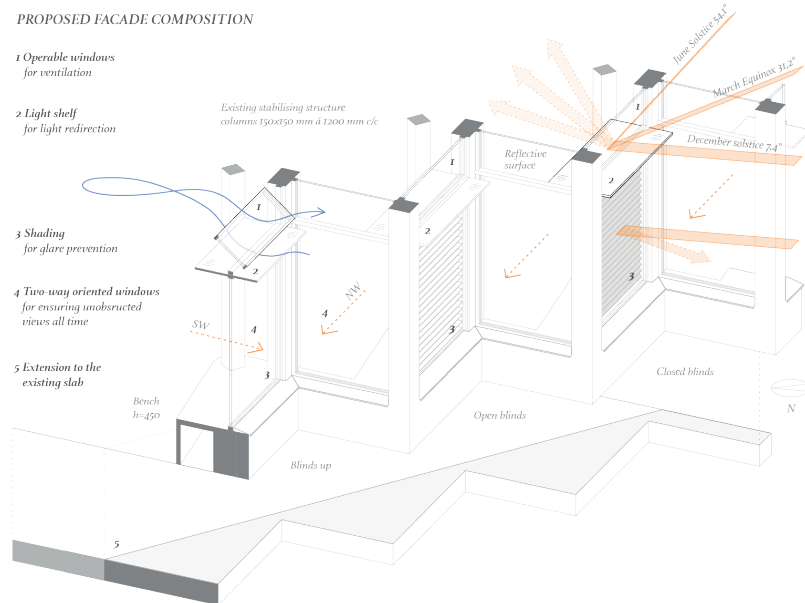


Figure 1: Proposed facade configuration

## Abstract:

Currently, a significant portion of the existing post-war building stock is facing the decision of whether to be repaired or demolished, as the service life of their components approaches its end. Outdated indoor climate conditions, being one of the most common reasons for building demolition, can lead to a discontinuation of function despite the building's structural soundness. Since daylight is found to contribute significantly to a healthy indoor work environment, façade retrofit could partially mitigate the risk of demolition if daylight availability can be improved to meet current standards. The aim of the thesis was to investigate the effect of façade configuration on daylight conditions in an existing, unmodified structural frame.

The thesis consists of both research and design work. Research includes a case study, while the design project focuses on daylight analysis of three façade configurations in the case of Läkarhuset Odenplan in Stockholm. Based on the results, a proposed façade configuration, which design solutions were derived from the given context, demonstrated significant annual improvements in several metrics compared to scenarios without daylight considerations in the design. It is concluded that facade retrofit can result in achieving current daylight standards in buildings with outdated indoor climates. However, potential measures should be evaluated individually based on the given context.

Keywords: daylight analysis, facade retrofit, indoor climate, parametric design, work environment

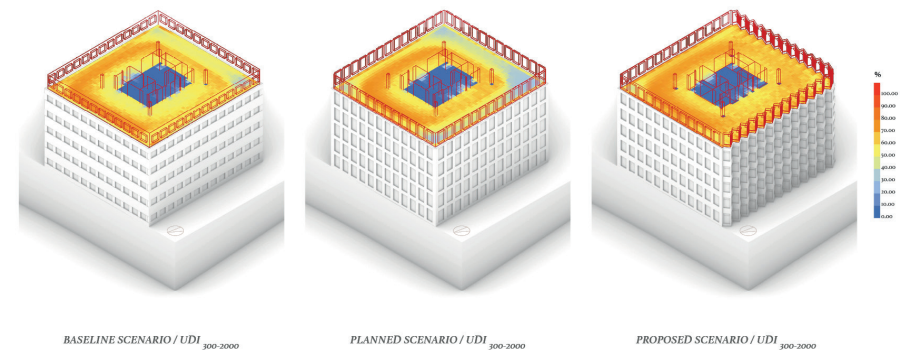


Figure 2: Annual UDI<sub>300-2000</sub> values of the three scenarios

# Skylight Shapes and Perception of Light in a Museum Gallery

Author: Cecilia Novella Samaniego

Tutor: Veronika Mayerböck

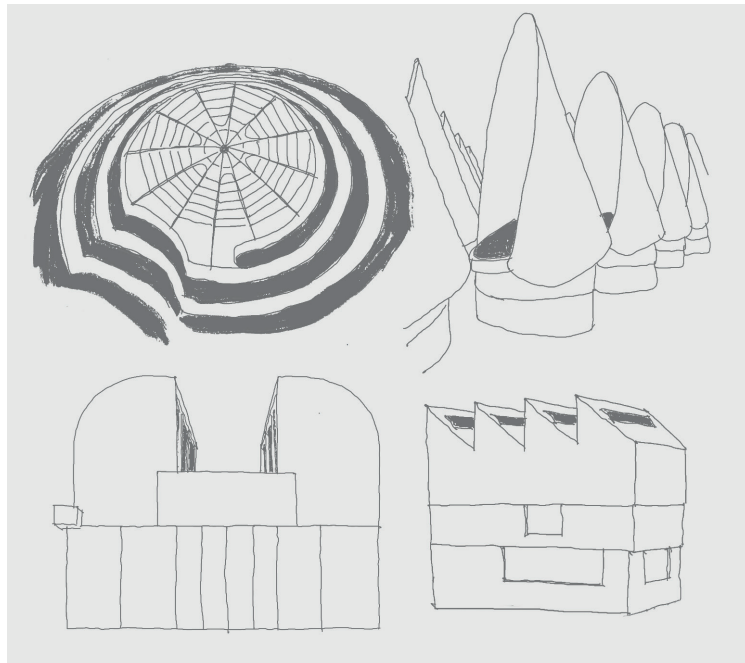


Figure 1: Skylight Sketches. Guggenheim Museum NY, High Museum Atlanta, Miró Foundation Barcelona, Jumex Museum, Mexico City

## Abstract:

This research aims to investigate how different skylight shapes affect light perception in a museum gallery. Focusing on human perception under specific conditions where the versatility of these architectural elements serves as a crucial tool for museum lighting designers. Museums architecture have changed through the past of time, and their necessities on their displays. Just so the human behavior inside these magical places. Skylights have been protagonists as link between exterior light conditions and the light the visitor perceive inside, that could be, at that precise moment, an alliance of natural and artificial light. To analyze this relationship, I studied two skylight examples: the 01:1 Gallery at the Moderna Museét and the Southern Gallery of Liljevalch+ Art Gallery, both located in Stockholm, Sweden. Through the application of qualitative and quantitative methods, intriguing findings have emerged, deepening the understanding of skylights' potential to effectively illuminate exhibition rooms and enhance the light dynamism that could be integrate to the experience during a museum visit.

his thesis suggests that the architectural elements in which light is admitted inside an exhibit space, impacts directly in the perception of light for the visitor and conditions their behavior in this temporary experience.

Keywords: skylight, spatial perception, atmosphere, integrative lighting, human perception

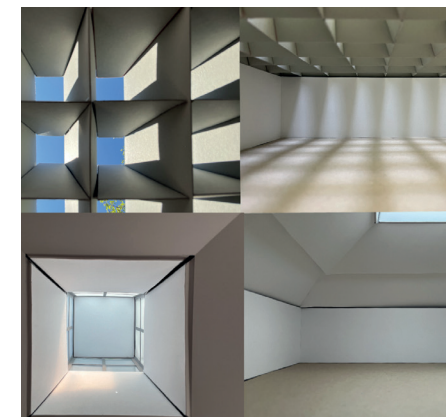


Figure 2: Skylight models

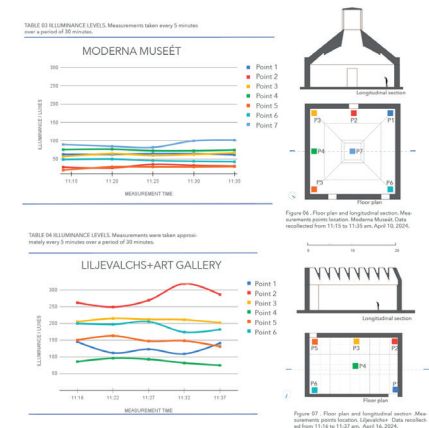


Figure 3: illuminance levels collected over a period of 30 minutes.

# Floating on Light

## A Survey of Clerestory Window Design and Daylight Qualities in Nordic Atrium Spaces

Author: Zhongwei Sun

Tutor: Nanet Mathiasen

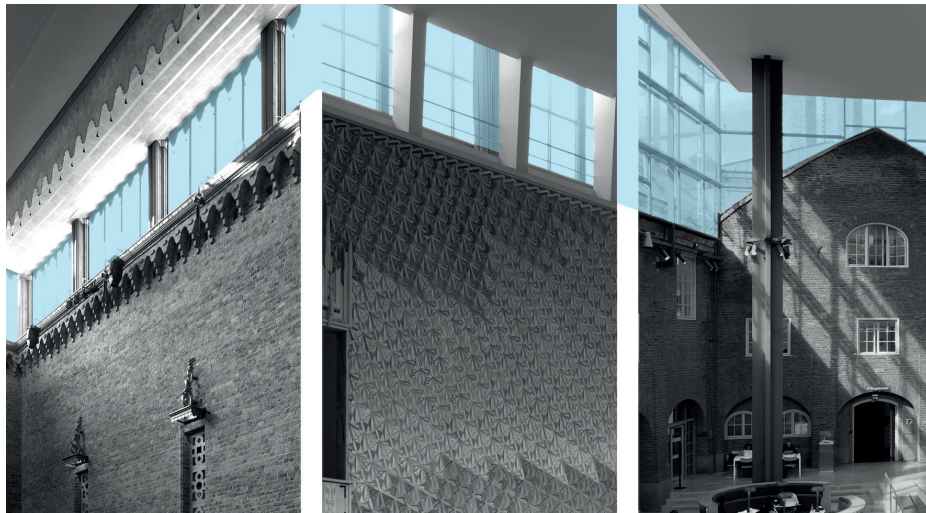


Figure 1: Clerestory Windows filter and guide daylight from the sides

### Abstract:

In the Nordic region, a special way of inviting daylight into the atrium through clerestory windows is typical and inspiring. Filtering and guiding daylight from the sides rather than above creates a unique daylight effect, an atmosphere. The thesis focuses on this daylight application and aims to answer the following research questions: What character does the clerestory window solution give to the atrium space? How are their daylight qualities? What are the typical considerations when applying this lighting solution?

The research analyzes the qualitative and quantitative impacts of light through three case studies: Stockholm City Hall, Oslo City Hall, and KTH Library. Through literature reviews, observation, measurements, and daylight simulation, the findings reveal the characteristics of this type of atrium and its daylight qualities.

The study concludes with practical and feasible design recommendations for incorporating clerestory window solutions in new constructions and renovations. It contains spatial configuration, geometrical and material considerations, and appropriate design and usage of floor, wall, and ceiling surfaces. These recommendations aim to enhance light quality and visual comfort, possibly preserving a unique daylight solution.

Keywords: Daylight, Atria, Stockholm City Hall, Oslo City Hall, KTH Library

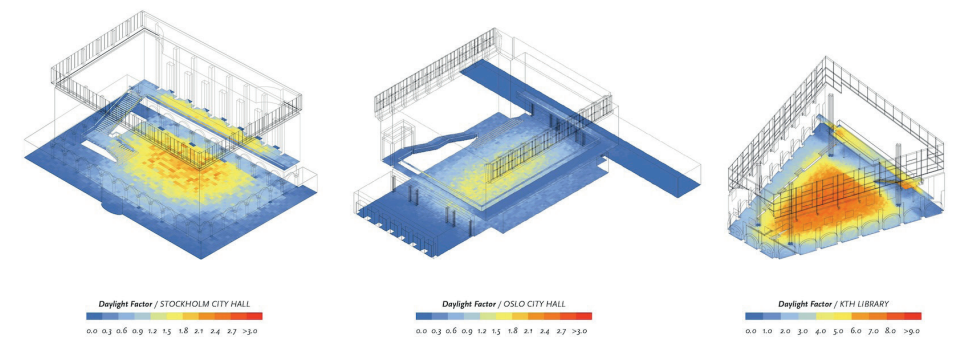


Figure 2: Daylight Factors in three cases



# Lighting educational environments

Caroline Alneskog

Junda Dietze

Emil Rohde

# Lighting Principles in Swedish Preschools

## Using Richard Kelly's principles for layered lighting

Author: Caroline Alneskog

Tutor: Patsy Bellido



Figure 1: Example of implementation of lighting principles.

### Abstract:

This thesis investigates how the lighting in Swedish preschools can be improved by adding the layered lighting principles of Richard Kelly. It addresses the questions: which lighting principles should be used to support activities and create zones in preschools, and how Richard Kelly's lighting principles can be used as a method for varied lighting in Swedish preschools.

The research methodology consists of a study visit where the lighting was subjectively evaluated, interviews with the preschool teachers working there, and a review of relevant literature on preschool lighting and Kelly's principles.

It is found that current preschools often have monotonous lighting, lacking contrast and directional light to highlight specific areas. The teachers expressed a need for flexible lighting to support different activities.

The thesis presents a list of lighting principles and characteristics that can be used as a tool when selecting new luminaires in preschools to achieve better lighting. By integrating Kelly's principles, this research proposes lighting solutions that creates a more spatial zoning as well as makes the lighting more flexible and usable with different types of lighting.

Keywords: Preschool lighting, Luminaire selection, Richard Kelly's lighting principles, Flexible lighting, Fluorescent phase out.



Figure 2: The room before implementation.

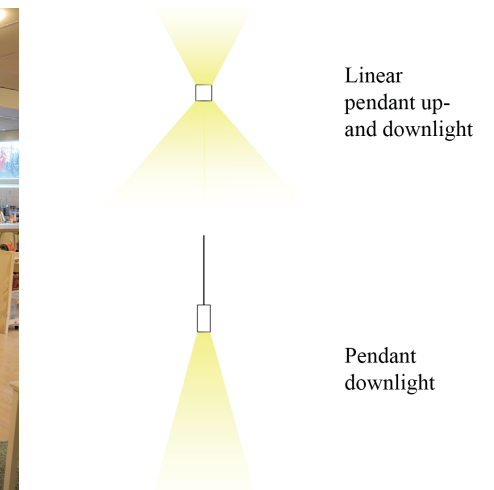


Figure 3: The lighting principles used in Figure 1

# Inclusive Lighting in Public Spaces: Challenging European Standards

Author: Junda Natascha Dietze

Tutor: Stavroula Angelaki

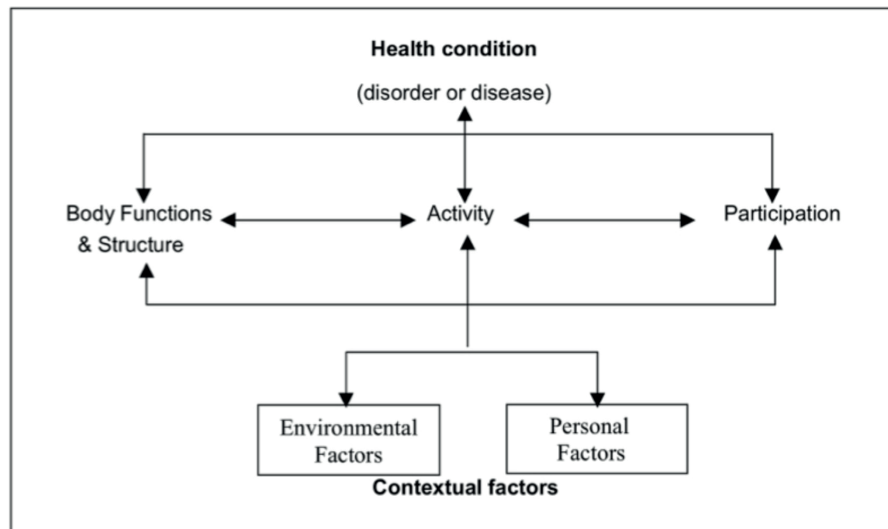


Figure 1: Complexities of Disabilities Flowchart (ICF Definition)

## Abstract:

This master's thesis addresses the inclusion of individuals with visual impairments in European Outdoor Lighting Standards and practical considerations for light designers, focusing particularly on nyctalopia (night blindness). Utilising the University Campus Höggerberg of the Swiss Federal Institute of Technology (ETH) as a case study, the research examines the current lighting situation and proposes improvements. The study reveals a lack of empirical data guiding recommendations for individuals with visual impairments, leading to inadequacies in lighting design, notably an uneven distribution of light and insufficient consideration for pedestrians with night blindness. Recommendations include implementing bollard lights, incorporating tactile markings, and prioritising glare reduction and uniform illumination. Drawing on the International Classification of Functioning (ICF), the thesis emphasises the need for inclusive design practices and public engagement to ensure equitable access to public spaces. Additionally, it highlights the importance of considering diverse disability needs and calls for further research to bridge gaps between photometry and lived experiences, ultimately promoting genuine inclusion in lighting design.

Keywords: Switzerland, Nyctalopia, Representation, Disabilities, Urban Planning



Figure 2: Focus Area Case Study: ETH Campus Höggerberg

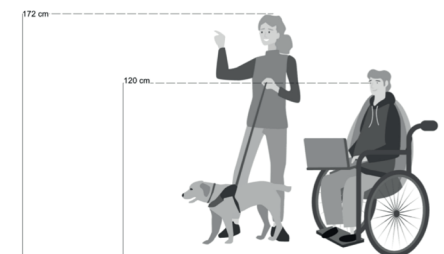


Figure 3: Average Eye Height in a Wheelchair

# The Impact of Artificial Light Distribution and Surface Colour on Students' Cognitive Functions and Perception

Author: Emil Johannes Rohde

Tutor: Stavroula Angelaki

## Abstract:

Artificial lighting has been found to influence humans in a visual and non-visual, physiological and psychological manner. It affects task performance, learning behaviour and emotional state. Such relations, however, are primarily examined regarding colour temperature, illuminance, and spectral power distribution of the light, but not its distribution. This thesis therefore investigates the impact of light distribution and surface colours on cognitive functions and perception in secondary school students. Participants were surveyed in a written examination environment with a neuropsychological screening test and a questionnaire. For the investigation, hexagonal classrooms with different accent colours, blue and yellow, and two different light distribution scenarios were chosen. Results indicate that an altered, dynamic light distribution in a mock-up scenario led to an enhanced perception of pleasantness compared to the existing, uniform classroom lighting. However, ratings of emotional state show less beneficial results in the mock-up lighting. Furthermore, no improvement of cognitive task performance in the mock-up lighting is found. Generally, yellow investigation environments are rated more pleasant and beneficial for alertness than blue ones. Although this study has generated several hypotheses, generalisations about the contribution of light distribution and surface colour to effective learning environments beneficial for well-being and performance require further investigation.

Keywords: Light Distribution · Classroom · Case Study · Surface Colours · Performance

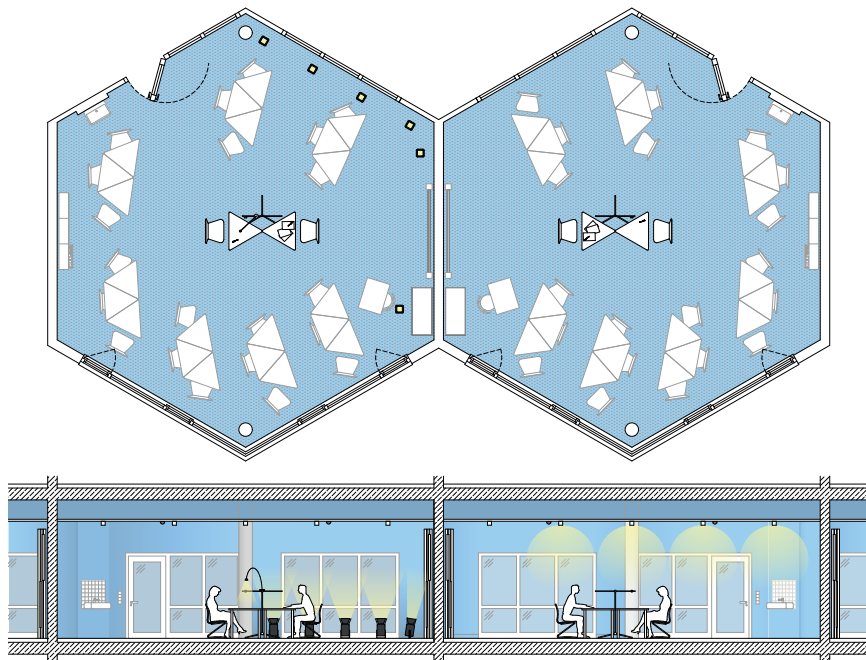


Figure 1: Subjects' workstation and test leader in Mock-up Light Installation. left, and Existing Lighting, right



Figure 2: Existing Lighting Scenario



Figure 3: Mock-up Lighting Scenario

# Lighting for co-working and co-living

Lucio Cavallari

Pegah Honarmand

Marek Kogermann

# Lighting in Nordic student housing and residents' sleep

Author: Lucio Domenico Cavallari

Tutor: Myriam Aries

## Abstract:

Exposure to light relevantly influences human circadian rhythms, affecting not only visual perception but also physical and mental health. This thesis explores the role of architectural lighting on human health and well-being within a controlled Live-in Lab environment, focusing particularly on twilight exposure and its effects on circadian rhythms and sleep patterns. Employing a combination of environmental sensors and sleep diaries, the study quantifies light exposure and investigates its association with sleep disturbances and overall daily well-being. The findings reveal a notable misalignment between the prevailing lighting conditions and the optimal settings for supporting natural circadian rhythms. This misalignment underscores the necessity for architectural designs that more effectively integrate natural light cycles, particularly in regions with relevant seasonal variations in daylight, such as northern latitudes. Based on these insights, the thesis recommends adopting twilight simulation technologies to enhance sleep quality and better align circadian rhythms with other light patterns that are not naturally synchronized with the extreme conditions in the Nordics. The research contributes to the field by providing empirical evidence supporting the development of lighting strategies that promote healthier living environments, emphasizing the crucial role of lighting design in enhancing well-being. The recommendations offered aim to guide future architectural practices in creating spaces that not only meet aesthetic and functional requirements but also foster health and sustainability.

Keywords: Twilight, Sleep Quality, Daytime Well-being, Daylight



Figure 1: Duration of Twilight Phases in Stockholm May 2024



Figure 2: ASE Sunlight Exposure on May 10th | LEED Daylight Analysis

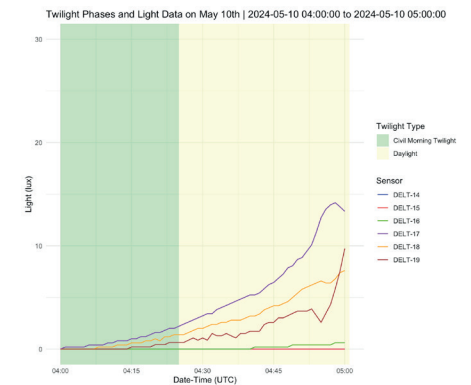


Figure 3: Twilight Phases and Light Intensity on May 10th, 2024

# Lighting to Reduce Travel-Related Stress

## Lighting Design for Tallinn Airport Gate

Author: Marek Kogermann

Tutor: Gregor Ruta

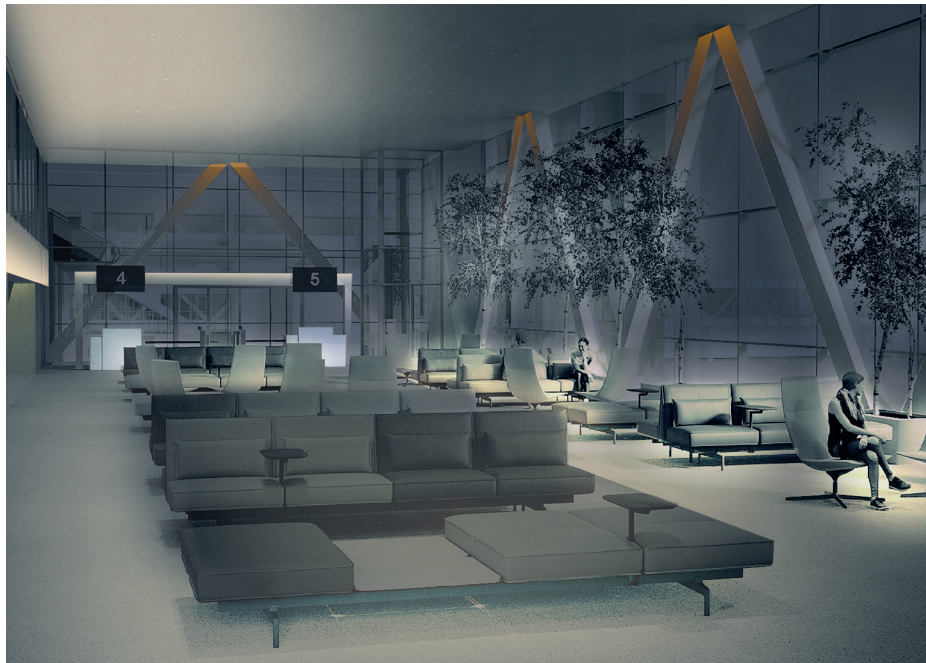


Figure 1: Stress reducing lighting design for Tallinn airport gate

### Abstract:

People experience stress and anxiety when traveling due to various factors. This means that it is important to create airport environments that prioritize passenger comfort. This thesis aims to gather information from previous research and projects and apply it to creating a lighting design concept for the Tallinn airport terminal gate with the goal to reduce stress and anxiety.

Through a literature review, various lighting design factors influencing psychological and physical well-being such as spectral power distribution, illuminance levels, color of light, and dynamic are explored.

Case studies of airport lighting design projects by Richard Kelly and by the lighting design studio Speirs Major provide practical examples of how lighting design principles can be implemented into an airport environment.

Based on the findings from the literature review and case studies, a lighting design concept is proposed for one of the Tallinn Airport gate terminal. The concept prioritizes user comfort by incorporating elements such as warm color temperatures, varying light levels, colored and dynamic lighting effects to create a soothing atmosphere. By applying user-centred lighting design principles, airports have the potential to create spaces that alleviate traveller stress and anxiety.

*Keywords: Light and emotion, user-oriented lighting design, airport lighting, reducing stress with light*

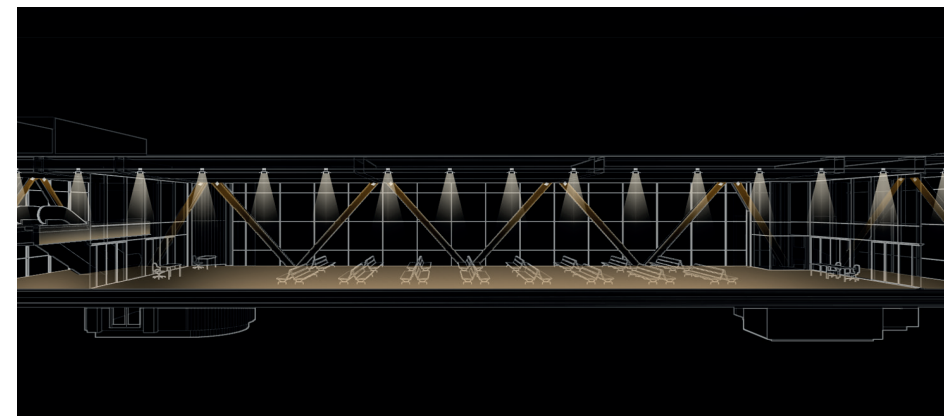


Figure 2: Sections of the lighting design implementation

# Light Distribution Dynamics

## Uniform and Varied Lighting Strategies in Coworking Spaces

Author: Pegah Honarmand

Tutor: Beata Denton

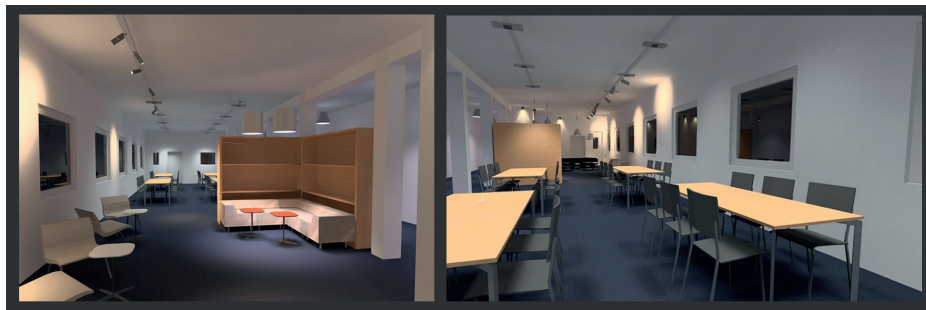


Figure 1: Two perspectives: uniform work lighting and varied meeting lighting

### Abstract:

In this thesis, I explore the role of lighting in coworking spaces, a trend re-shaping work environments recently. I examine the impact of uniform versus varied lighting configurations on work performance and comfort, focusing on their effects in multifunctional spaces. This research investigates how different lighting distributions influence user experience through an extensive literature review and empirical case studies. The study reveals that while uniform lighting is often favored for facilitating concentration and maintaining cohesion, it does not meet the diverse needs of all users in multifunctional areas. In contrast, varied lighting strategies, tailored to specific functional needs and enhancing ambiance, are crucial for accommodating individual preferences and creating a welcoming atmosphere, though they can disrupt areas requiring focused work.

My analysis underscores the critical interplay between architectural elements such as furniture layout, spatial design, and lighting strategies. The research proposes innovative lighting designs that improve both aesthetic ambiance and functional efficiency. The findings advocate for a flexible, hybrid approach to lighting design that combines both uniform and varied elements. This approach aims to support the dynamic activities typical of coworking spaces, highlighting the necessity of designing lighting that is adaptive and sensitive to these environments' unique demands.

*Keywords: Co-working Spaces, Lighting Distribution, Multi-functional Environments, Lighting Design*

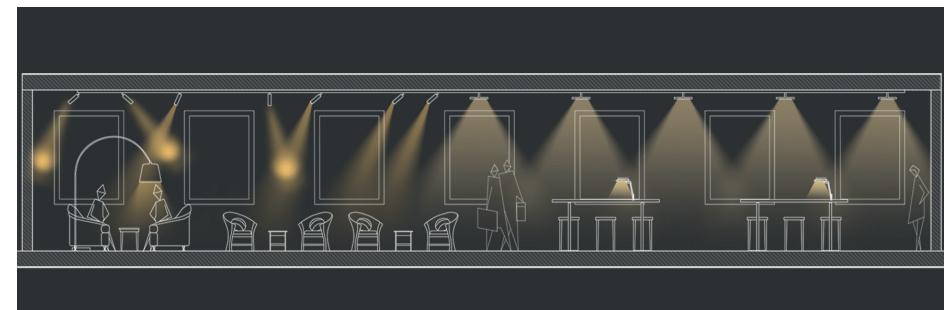


Figure 2: Uniform lighting with task lighting for work, and varied vertical lighting for meetings.



# Multi-Sensorial experiences

Valeria Corea

Inna Hakiki

# Light & Taste: The Impact of Light on Wine Taste

Author: Valeria Corea

Tutor: Johanna Enger, Henrik Scander



Figure 1: Experiment Ambiances (from left to right, Ambiance 1–4)

## Abstract:

This study focuses on the interaction between light and taste, specifically the interplay between atmosphere and wine taste. An experiment was conducted in a real restaurant environment to understand whether the atmosphere can influence the user's perception of wine taste. The experiment took place in a restaurant in Stockholm where sixteen participants with different backgrounds evaluated 100 ml of red wine through a questionnaire in four lighting ambiances. The participants were asked to describe the atmosphere and the wine in each lighting scenario.

The key findings of the Light & Taste experiment revealed a relevant influence of the atmosphere on individual preferences, taste perception, and wine intensity. However, it's important to note that it is hard to determine how the ambiance influences taste in an uncontrolled environment like a real restaurant. Interestingly, nine participants used similar values to describe ambiance and wine liking in at least three Ambiances. In other words, the atmosphere matches the wine liking of most participants.

Keywords: Impact of light, Atmosphere, Tasting, Restaurant, Multisensory Experience

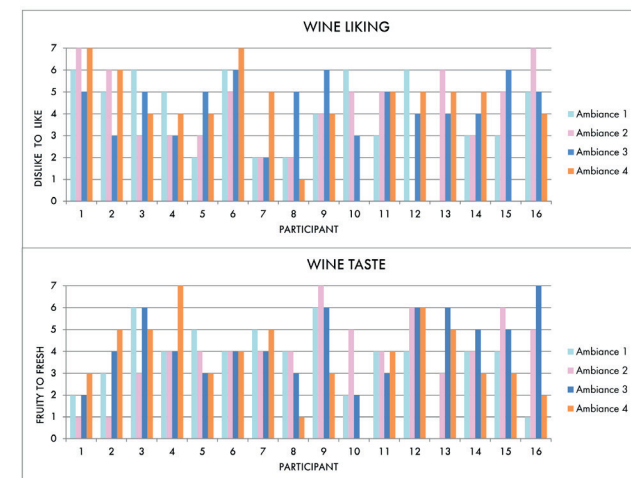


Figure 2: Data results for liking and taste of wine in Ambiances 1–4

# Visual Symphony

## Translating Musical emotion by Lighting into Visual stimuli for Hearing Impaired

Author: Inna Anzalna Larasati Hakiki

Tutor: Ines Bartl

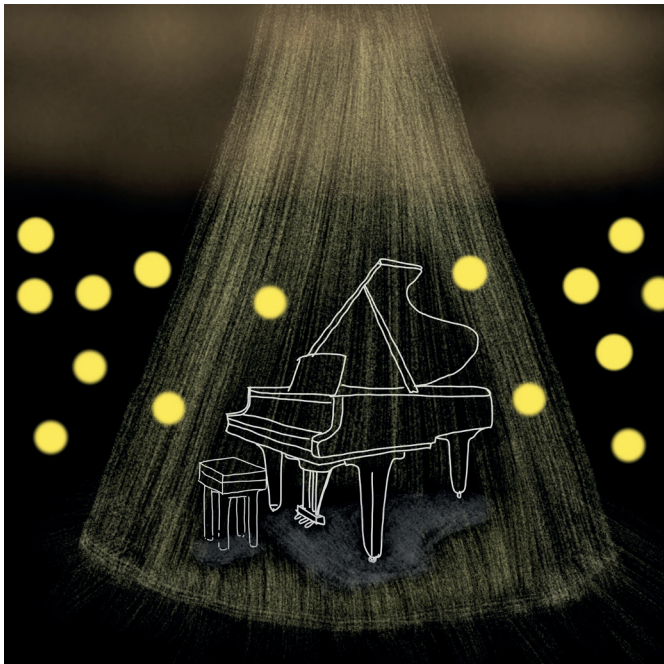


Figure 1: Illustration of Richard Kelly's Lighting Principles Applied in a Concert Hall

### Abstract:

This thesis explores the efficacy of light as a tool to enhance musical performance for the hearing impaired by visually representing the emotional content of music. This study analyses Music cues combined with lighting cues based on Thayer's two-dimensional model with Richard Kelly's lighting principle. Following an investigation of available literature this thesis proposes a set of design principles that establish the connection between music, light, and emotion. These principles are applied to the design of lighting for a concert performance. The result indicated that the lighting element significantly improved the emotional resonance of the performance for the audience. Furthermore, the study emphasises the importance of inclusive design in cultural events, aligning with SDG's number 10 to reduce inequalities. However, further research is recommended to validate and expand these findings due to limitations such as a small participant pool and brief performance durations. Overall, this study confirms that dynamic lighting can transform the concert experience for the hearing impaired, suggesting broader applications for accessible cultural engagement through sensory enhancements.

Keywords: *Dynamic Lighting, Hearing impaired, Visual music interpretation, Musical visualization*

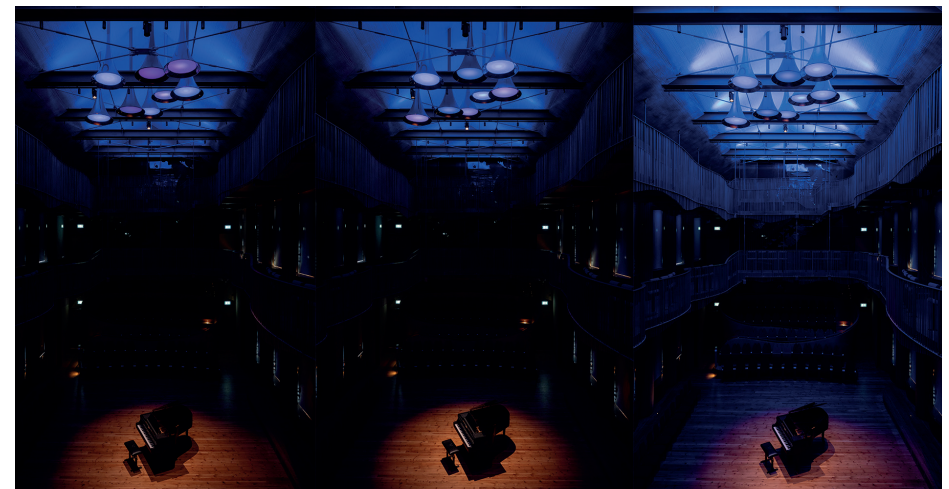


Figure 2: Lighting Scenario for a Visual Symphony at Silvia's Concert Hall

# Testing and development

Athul Avilissery Suresh

Gabriel Dos Santos

Harsh Indurkar

Rodrigo Pencheff

Christopher Lee

# Evaluating 60\*60 Panels Photometric & Melanopic Properties in Comparison with Subjective Visual Ratings

Author: Athul Krishna Avilissery Suresh

Tutor: Anastasia Angeli



Figure 1: Subjective Impressions analysis at the site

## Abstract:

This thesis investigates the photometric and melanopic properties of 60\*60 LED panels, comparing these properties with subjective visual ratings to understand their impact on human comfort and well-being. These panels are widely used in indoor lighting environments, particularly in office, commercial, and educational spaces due to their efficiency and cost-effectiveness. The study evaluates various photometric properties such as color rendering, illuminance, and glare, alongside melanopic impacts like circadian rhythm influence, using both objective measurements and subjective evaluations. Experimental setups were conducted in a controlled room called Lifi room, at Signify's office in Stockholm and the study systematically compares the performance of different luminaires with polystyrene and polycarbonate optics. Results indicate significant variations in luminance and glare which are crucial for visual comfort, with melanopic parameters suggesting that these lights can effectively support circadian health. This comprehensive analysis not only advances our understanding of LED lighting effects on human health and productivity but also highlights the importance of integrating scientific measurements with subjective perceptions to enhance indoor lighting design.

*Keywords: Image-forming pathway, Non-image-forming pathway, Equivalent Melanopic Lux (EML), Melanopic Equivalent Daylight Illuminance (M-EDI), LED Panels, Visual comfort.*

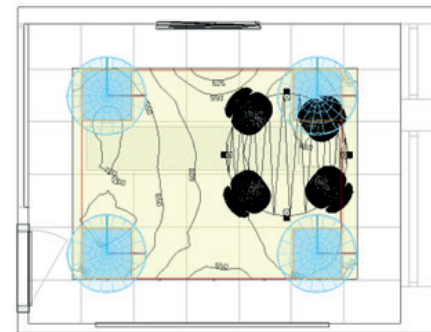


Figure 2: Luminaire arrangement

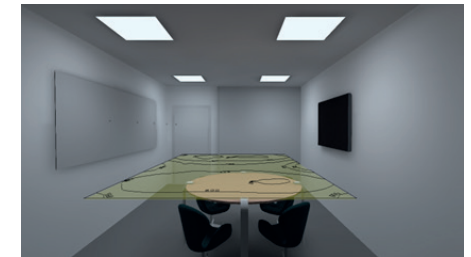


Figure 3: Calculation surface and points in Dialux software

# FAROL: Good Quality Modular Lighting for Student Housing

## Designing a Luminaire that Guides new Students through their education safely and comfortably.

Author: Gabriel Dos Santos

Tutor: Gerhard Rehm

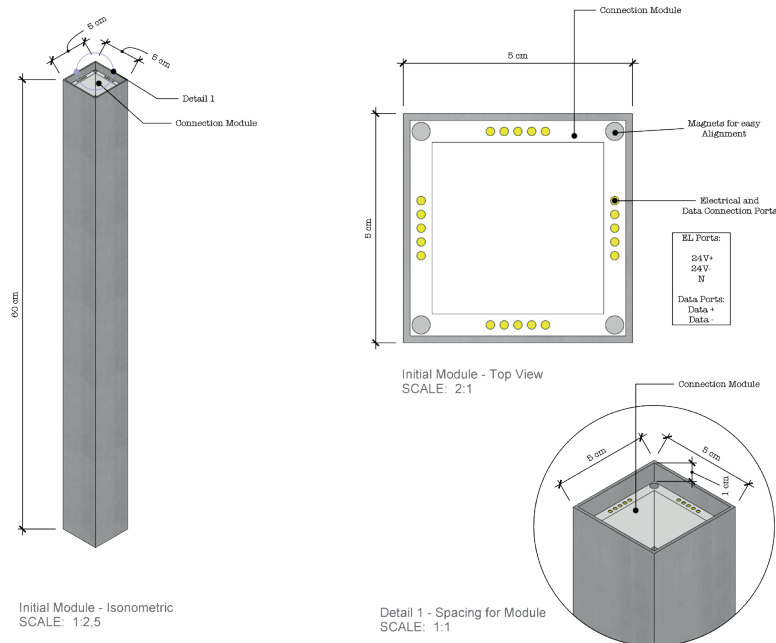


Figure 1: Representation of one of the modules of the system, with connections

### Abstract:

This thesis investigates the possibility of using modular design for a luminaire for student housing. Annually, over two thousand students make their way to Stockholm to pursue a new education. With the change to a new county, and unfurnished apartments, students are now faced with less-than-ideal lighting conditions, which can cause eyestrain and headaches and drastically reduce their experience studying. Through experiments, and some background research, I have developed a design that is suitable for lighting student housing; while also making sure recommended light levels are achieved and students can have good quality lighting while in their housing. This fixture is created using a modular connection system, which allows students to customize the lighting as they see fit and enables the user to create a unique condition that reflects their own personality. The modular system could be expanded in the future to welcome a wider variety of solutions and make each application unique.

Keywords: Light Fixture, Student Housing, Visual Comfort, Lighting Conditions, Colored Lighting



Figure 2: The proposed lighting effect caused by the luminaire



Figure 3: Livgting solution as seen by the user on the desk

# Daylight Simulation Lab: Mapping and Implementing Temporal Variation of Sunlight

Author: Harsh Indurkar

Tutors: Majid Miri, Rodrigo Muro

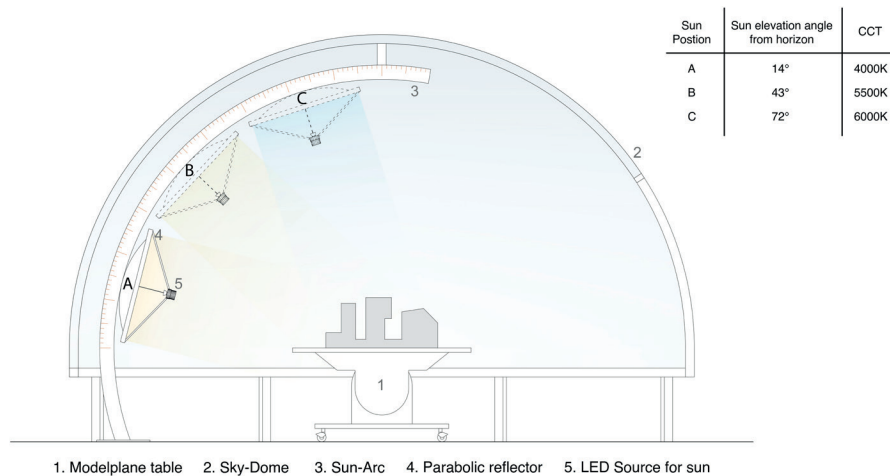


Figure 1: schematic section of the sun-arc with sun angles and changing CCT

## Abstract:

Lighting design and architecture institutions have been building and developing daylight simulation labs as a way to mimic the natural daylighting phenomenon and study its effects on architectural scale models. Natural daylight is a mixture of skylight and direct sunlight that penetrates Earth's atmosphere. This creates a dynamic effect, with the amount and quality of daylight constantly changing. This dynamicity, particularly the temporal variation of daylight, depends on the availability and elevation angle of the sun at a specific location. This study uses quantitative measurements and a literature review to identify and implement this temporal variation into a newly developed daylight simulation lab. Since most daylight simulation labs consist of two components – diffuse skylight and direct sunlight – this study focuses on developing an artificial sun. The measurements taken throughout the day revealed a gradual change in the correlated colour temperature of direct sunlight due to spectral changes. These readings were then used to synthesize into an artificial sun for the daylight simulation lab. This study opens the discussion on replicating various physical aspects of sunlight artificially, ultimately improving the capabilities of daylight simulation labs.

Keywords: Directed light, spectral change, reflected light, collimated beam, simulation

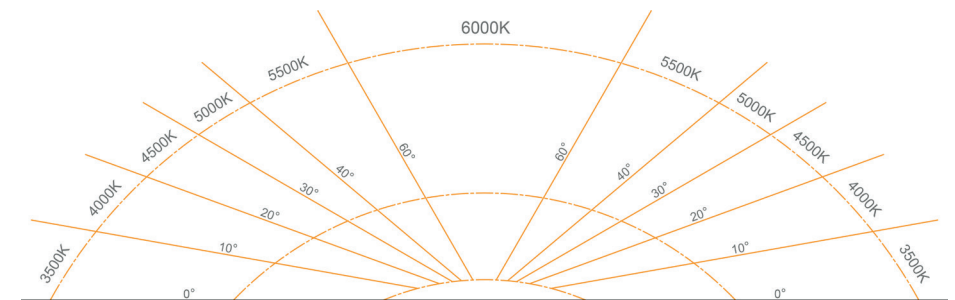


Figure 2: schematic diagram of measured CCT synthesized with sun angles

# Daylight Simulation Lab

## Design of Skylight Characteristics with Artificial Lighting for Physical Daylight Studies

Author: Rodrigo Pencheff

Tutor: Majid Miri and Rodrigo Muro

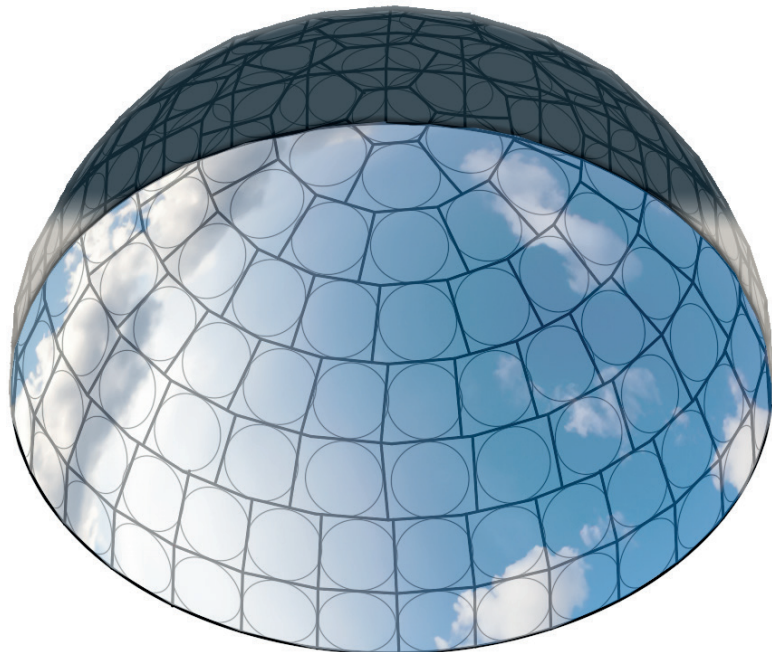


Figure 1: Interior dome sketch with segmented sky patches.

### Abstract:

This master thesis investigates the design and implementation of a physical daylight simulation lab within the architecture building at KTH. The primary objective is to replicate diffuse skylight with its natural conditions using artificial lighting systems, guided by the prevalent CIE sky type models. Utilizing the Radiance software suite, the study models complex lighting scenarios and evaluates various sky conditions, such as clear, overcast, uniform, and partly cloudy skies. By integrating the Tregenza subdivision method, the sky dome is divided into 145 patches, each contributing to the overall light distribution in the simulation. This approach allows for precise control and adjustment of luminance levels and spectral qualities for each patch, ensuring realistic daylight conditions. The research includes theoretical studies, practical experiments, and case studies, emphasizing the importance of diffuse skylight and the spectral qualities of natural light. This work aims to enhance both educational and professional practices for architects and in architectural lighting design by providing a controlled environment for studying the impact of daylight on architectural models. In parallel, a collaboration with Harsh Indurkar focuses on the simulation of direct sunlight in his separate thesis, Daylight Simulation Lab: Mapping and Implementing Temporal Variation of Sunlight (Indurkar, 2024). This collaboration ensures a comprehensive understanding of natural light dynamics, complementing the design of the daylight simulation lab at KTH, the Royal Institute of Technology in Stockholm, Sweden.

Keywords: Hemisphere, Skylight, Spectral qualities, Tregenza subdivisions, Radiance



Figure 2: Fish-eye view of sky hemisphere

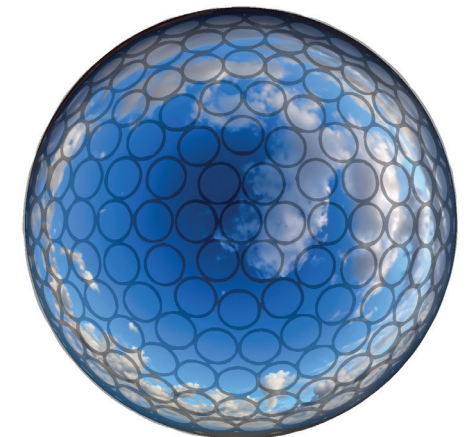


Figure 3: Illustration of Tregenza's subdivision of the sky hemisphere



# Shortening Time Perception Through Lighting in Slussen Station

Author: Christopher Lee

Tutor: Ken Appleman

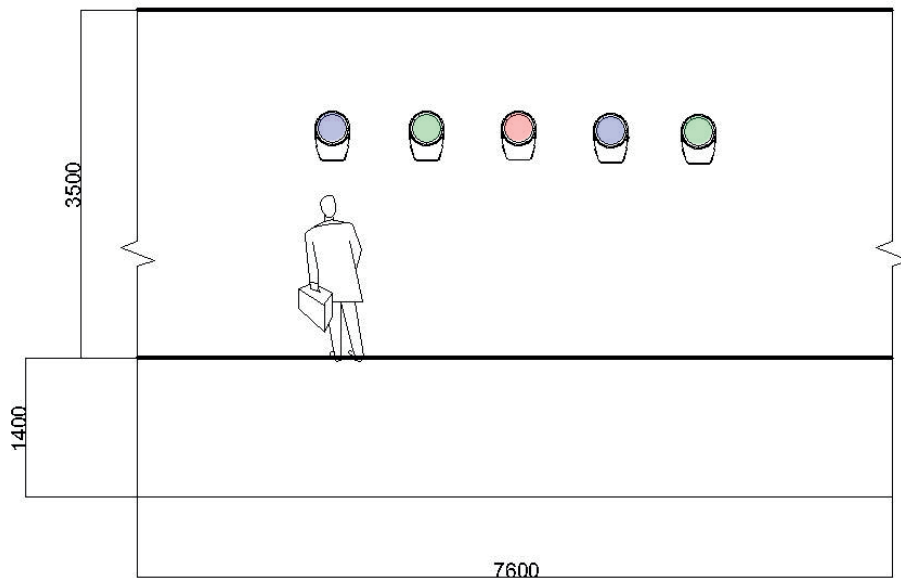


Figure 1: Running Loop of Light Installation

## Abstract:

Various studies have shown light's numerous effects on the brain. However, a number of recent studies linking human time perception and light raise the possibility of using light to speed up the perception of time. The present study focused on the experimentation and implementation of light into Stockholm's Slussen station. Evidence of a shortened perception of time when participants are exposed to a visual light stimulus is presented and the results are translated into a metro station light installation design. A better understanding of light and human relationship in the built environment could have important implications for developing strategies in lighting design.

Keywords: Lighting, Time, Neuroscience, Station, Distraction



Figure 2: Experiment Testing

## Urban heritage and social oriented lighting

Shikha Agrawal

Noura Charaf

Qingqing Gao

Paola Palma Picado

Hongjie Zhang

# Reimagining the Bhadra Heritage: Illuminating Ahmedabad's Historic Heart with Purposeful Lighting Design

Author: Shikha Agrawal

Tutor: Sivasankar Vethanayakam



Figure 1: Day and night front elevation of the fort

## Abstract:

This master's thesis aims to draw the attention of Ahmedabad's residents and visitors to the city's historic centre at night. The research focuses on developing a lighting solution for Bhadra Fort, a prominent landmark in Old Ahmedabad City that is overshadowed by the bright lights of the surrounding market and the lack of proper illumination at the fort itself. By illuminating the fort, it will be highlighted as a landmark during nighttime, thereby promoting night tourism. The proposed plan includes extending visiting hours to the fort, to allow closer observation of its architecture. Through descriptive-analytical methods and interviews with local vendors and stakeholders, the study examined the fort's history, neighbourhood, and current lighting conditions. To support the development of an effective lighting strategy, two case studies of heritage lighting in other Indian forts were analyzed. The proposed lighting design for the main entrance and front elevation of the fort aims to integrate it into the urban landscape and boost the economic growth of nearby businesses. By enhancing the visibility and attractiveness of the fort at night, this project seeks to revitalize the area and support local vendors, creating a vibrant nocturnal destination for both residents and tourists.

*Keywords: Bhadra fort, heritage facade lighting, night tourism, UNESCO World Heritage City, lighting design*

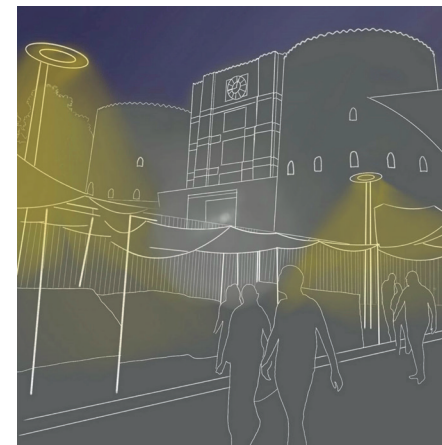


Figure 2: Sketch of current lighting conditions of the Fort



Figure 3: Sketch of proposed lighting strategy for the Fort

# Socially Sustainable Urban Spaces After Dark

## An approach for an enhanced experience for Stieg Trenters Square

Author: Noura Charaf

Tutors: Elettra Bordonaro and Luciana Martinez



Figure 1: 4 On-site informal workshop tools

### Abstract:

The planning of public spaces is typically based on daylight, with little consideration for nighttime and dark winter evenings (Boverket, 2010).

Under the assumption that the lighting conditions in Stieg Trenter Square negatively affected users' perception and failed to meet their needs, This research involved input from 52 questionnaire participants (including 4 interviews), 50 workshop participants, 3 municipality workers, and 2 shop owners, then The data was thoroughly analysed and synthesised with site analysis and literature review to understand the current situation and users' needs comprehensively. This thesis aims to employ social research methods (questionnaires, interviews, workshops, etc.) to evaluate the application of social sustainability in the urban context of Stige Trenters Square during both day and night and to explore lighting solutions that can meet users' dreams and needs in the context of social sustainability.

The study revealed that crucial elements during the daytime were either poorly lit or not lit at all during dark times, while less important elements were excessively lit, creating a stark contrast between day and night atmosphere. A set of lighting principles for Stieg Trenter Square is proposed, following the vision that lighting in busy urban spaces should promote social sustainability after dark by introducing playful lighting and highlighting architecture and landscape elements valued by users. Promoting that the urban context matters as much at night as it does during the day.

*Keywords: user's needs, contrast, social sustainability, urban lighting*



Figure 2: During an engagement with the public

# Study of Natural Light Visual Guidance and Ambiance Creation in Suzhou Gardens

Author: Qingqing Gao

Tutor:



Figure 1: The View from Mingdao Hall to the Courtyard

## Abstract:

This paper explores the aesthetic and functional significance of natural light in landscape architecture, aiming to remedy the prevalent monotony and lack of natural light-shadow harmony in modern garden design. Emphasizing natural light as a unique element, the study provides a comprehensive overview and quantitative analysis of its properties, particularly its role in Visual Guidance and Ambiance Creation. In terms of visual guidance, the study delves into how natural light influences visual focal points, defines spatial scale, and enhances spatial hierarchy within garden settings. It also examines how texture and temporal changes associated with natural light contribute to creating atmospheric qualities at both micro and macro levels, influencing the overall ambiance.

The study uses qualitative and quantitative methods, focusing on traditional Chinese gardens, especially Suzhou Garden, to investigate the impact of natural light on visual guidance and ambiance creation. Through on-site surveys, light intensity and color temperature measurements, and questionnaire analysis, the paper quantifies lighting conditions for effective visual guidance and ambiance creation in garden architecture.

By synthesizing these findings, the study proposes universal methods for integrating natural light to guide vision and enhance ambiance in garden architecture, offering valuable insights for contemporary landscape architecture design.

*Keywords: Natural Light, Traditional Chinese Gardens, Visual Guidance, Ambiance Creations*



Figure 2: Atmosphere of Natural Light in Mingdao Hall



Figure 3: The Light and Shadow through the Latticed Windows in the Corridor of

# Lighting as a brand mechanism

## Redefining the nighttime identity of Cartago

Author: Paola Palma Picado

Tutor: Paloma Plumed Martin



Figure 1: Las Ruinas of the city of Cartago at night

### Abstract:

This article presents an analysis and an architectural lighting design for the city of Cartago, Costa Rica. The main objective is to understand the historic, social and religious context to generate a lighting strategy that complements and enhances the identity of the city. Through a meticulous approach in Las Ruinas, an emblematic heritage space, and in the adjacent Plaza Mayor, a lighting plan is developed that not only preserves and highlights the historical richness, but also promotes a strengthening in the nocturnal social dynamics that take place in this urban space. This study analyzes in detail the implications of a lighting strategy focused on enhancing the brand of a place, providing a replicable and adaptable model to other spaces in the city, enhancing its perception and experience, both for locals and visitors.

Through this lighting design strategy, the project aims to strengthen the image of Cartago, reflecting its values of innovation and respect for heritage and nature. Also, it seeks to function as a reference model and provide a starting point for something that could eventually be developed in the city of Cartago or extended to other cities in the country.

*Keywords: urban lighting, urbanism, light branding, architectural lighting, public realm*



Figure 2: Architectural Heritage

# Enlightening China's Treasures

## Illuminating Ancient Splendor for Modern Audiences

Author: Hongjie Zhang



Figure 1: The Hall of Prayer for Good Harvests and the Buddhist Incense Pavilion

### Abstract:

As China's economy grows and cities modernize, the development of captivating urban nightscapes has become prominent. However, implementing night lighting for ancient buildings is a relatively recent phenomenon, leading to a need for established theories and uncertainty. Existing research primarily focuses on technical aspects, with ongoing debates about the best ways to highlight architectural features and create suitable atmospheres.

This thesis explores the significance of exterior lighting design for ancient buildings, emphasizing its role in showcasing historical and cultural importance. It analyzes the architectural characteristics of the Hall of Prayer for Good Harvests at the Temple of Heaven and the Tower of Buddhist Incense at the Summer Palace, providing in-depth examinations of their unique features.

This thesis evaluates existing exterior lighting schemes for these structures, assesses their effectiveness, and proposes suitable design principles. It also examines the impact of lighting design on visitor experiences, aiming to enhance enjoyment and cultural understanding. Based on the findings, the thesis offers recommendations for improving current lighting schemes and shaping future approaches to exterior lighting for ancient buildings.

*Keywords: Chinese ancient architecture, Facade lighting, Lighting methods, Subjective evaluation*

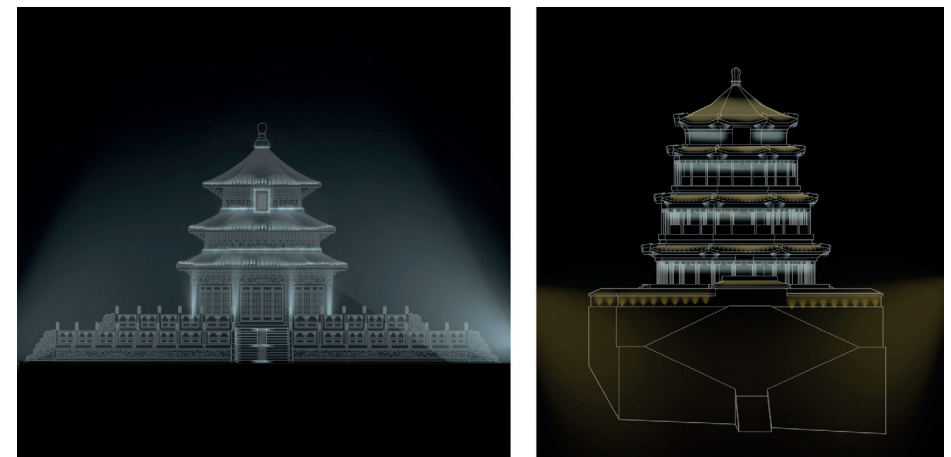


Figure 2: Lighting of the two buildings

The students in alphabetical order by surname:

Agrawal, Shikha

Alneskog, Caroline

Ashraf, Israa

Avilissery Suresh, Athul Krishna

Cavallari, Lucio Domenico

Charaf, Noura

Chong, May Yee

Coirbay, Lucie

Corea, Valeria

Cornejo Mejia, Cristina Maricela

Dietze, Junda Natascha

Dos Santos, Gabriel

Dux, Noémi

Gao, Qingqing

Hakiki, Inna Anzalna Larasati

Honarmand, Pegah

Indurkar, Harsh

Kogermann, Marek

Kondrashevskaya, Olena

Lee, Christopher

Madland, Maria

Molic, Ardijana

Morello Benedetti, Nicolò

Ning, Lang

Novella Samaniego, Cecilia

Picado, Paola Palma

Pencheff Araneda, Rodrigo

Pherwani, Ashwin Ritesh

Rohde, Emil Johannes

Saastamoinen, Veera Annika

Sun, Zhongwei

Tsaia, Anatoli

Varadharajan, Sudipti

Zhang, Hongjie



**Instagram: Lighting Design Laboratory**  
**LinkedIn: Lighting Design KTH**

