

The background is a dark, starry field of small white dots. Overlaid on this are several concentric circles. A large, semi-transparent grey circle is on the left, partially cut off by the edge. In the center, there are two overlapping circles: a larger, semi-transparent dark red one and a smaller, semi-transparent dark brown one nested within it. The text is centered over the intersection of these two central circles.

the dark side of the city

*Enhanced experience of light in the cityscape
by the dynamics of performance spaces*



CHALMERS

Master thesis project

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MPARC 2018/2019
Department of Architecture and Civil Engineering
Chalmers University of Technology*

To my late farther

ACKNOWLEDGEMENTS

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*for a constant support and motivation throughout
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for being a source of inspiration

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MY BOYFRIEND NIKLAS
for teaching me patience and dedication

SWEDISH INSTITUTE
*whose scholarship provided me with the
opportunity to pursue my dream education*

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ABSTRACT

Light and shadow are evergreen motifs and driving forces of both architectural imagination and tectonic's history. However, these principles which convey the fundamental understanding of the architectural heritage, are mostly related to the daytime. Given that the major illumination of the cityscape is a relatively recent phenomenon in a long history of city building, no wonder that a certain gap is detectable in either the interest or dedication of architectural practice to the role of artificial lighting in the process of creation of urban forms.

Thus, the principal aim of the thesis is to explore and deconstruct the concept of human interference in the natural phenomenon of night, while embracing the potentials of both light and darkness. Being observed as either mere extension of the productive daytime or as a negative phenomenon that needs to be legislatively restrained, the night functions of cities are often diminished and neglected nowadays. Close interrelation of humans in the public space with the complex traffic and communication systems in the nighttime, both situated in the direct vicinity of diverse natural contexts, results in the multilayered and sensitive field of impact of the nightlife on ecosystems and environment in general. The question of the spatial experience of darkness claims even more attention in certain climatic settings, such as winter in the Nordics.

The frequent duality of city life that takes place during a day or a night is a direct consequence of a lack of holistic approach in the design processes. This thesis thus is a counterreaction to the current practices and it will provide the result consisting of research and elaborate design proposal of an open-air theatre/performance arts/music stage, located in the city of Gothenburg. The selected programme aims to contribute to sustaining the image of the night as joyful, relaxed, lightweight, leisure time.

Research by design and partly research for design are two primary methods to be implemented in the project. Studies of relevant literature, references from both engineering and art, as well as model studies and prototype experimentation are among means of rediscovering the value of night-time for architectural practice and society in general.

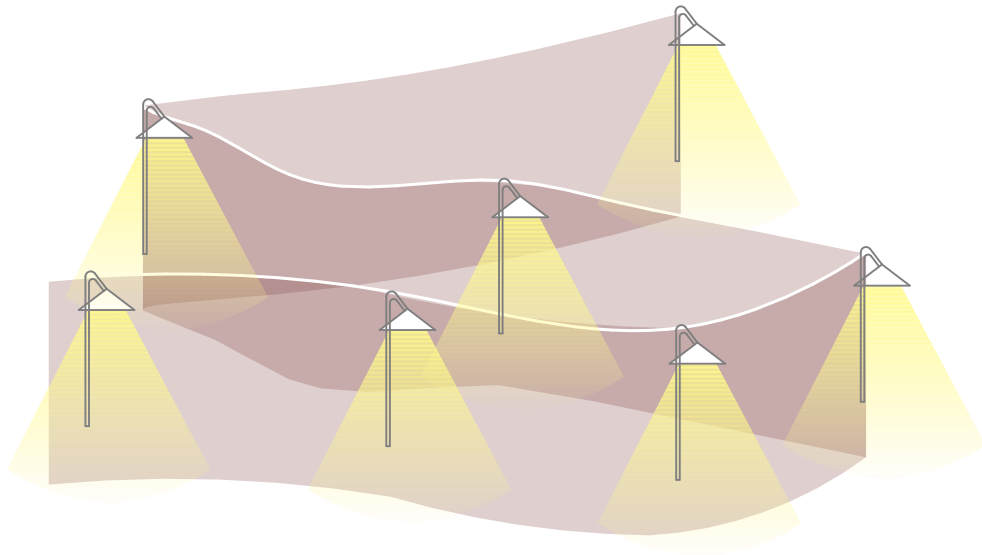
RESEARCH QUESTION

How can the urban lighting network be employed in creating attractive, inclusive and playful stages for public use?

CLAIM

After relevant literature studies, extensive personal contemplation and testing of ideas in my studio project, I acquired certain confidence to claim that general perception of nighttime is the image of unwinding and/or entertainment. This is primarily concerning the active part of the dark hours, while passive counterpart is reserved for sleep and relaxation, and for a minor part of society, it can be for work. Depending on the characteristics of the mere agents - people taking part, the phenomenon of entertainment can encompass a variety of meanings - from high to pop culture. The vitality of public life is especially pronounced in the first couple of hours after sunset. That is, therefore, the time span of particular interest for this thesis.

Light is immanently bound to every sort of spectacle. By trying to appeal to people senses, lighting is employed as a crucial atmosphere creator at concerts, festivals, shows, dancing stages, theatres, operas etc. Besides colour, it is usual practice to experiment with the dynamics of the illuminating bodies as well. Eventually, the spatial framework for the said activities is demarcated primarily by light. But the lighting elements still occupy our space. Extensive network covering our planet is claiming spatial imprint which can bear aspects of qualitative spatial experience. What happens with the in-between space?





BACKGROUND

1. Light for Cities – Ulrike Brandi

The handbook for lighting design is covering the most important characteristics of the discipline through very appealing storytelling technique. A fictional lighting designer is presenting his journey to a new project site. A series of sketches then follows particularly relevant scenes, such as night image of the urban morphology, the differentiation between the airplane sight and human perspective view, several light typologies and the way they are juxtapositioned in the city fabric etc. The book wraps up with the opulent technical information presented in the numerous case studies, mostly executed in German cities.

Key points:

- light typologies
- functionality in the section plane
- standards as mere recommendations
- two contrasting strategies: a) promotion of contemporary event culture
b) endorsement of the townscape by enduring differentiation of urban lighting

Personal notes:

"The symbiosis of light and its surroundings plays an essential role in architecture, as well as in landscape design and urban planning."

"Car interiors, including the usage of daylight, are the dinosaurs of the lighting technology."

"Car parks are often the poor cousin of the lighting design."

"The approach to the brightly lit Town Hall Square is via narrow and dark side street. Such encounters with the urban squares of Paris were likened to entering a ballroom 130 years ago."



Masterplan Jungfernstieg, Hamburg, Ulrike Brandi Licht (2007)

2. Light Volumes – Monika Gora

Monography of landscape architect Monika Gora perceives light in a completely different manner than my initial literature studies of more technical nature. Here, light is used as both a method and material of creation, encompassing the sculptural values of urban landscapes. Mostly acting as radiating object which are supposed to be seen and observed, the diverse range of approaches is giving form to urban light and challenging the existing urban contexts. The most notable work for me was The Drop of Light where the inflatable canvas structure was later reused for the wedding dress of the designer herself.

Key points:

- organic shapes present a challenge to the tectonic ideals of mainstream Western architecture
- light can be "an imaginary friend, a friend to identify with and cuddle" (light sculpture Jimmys)

Personal notes:

Exploring the materiality of light is only possible with assistance of another material - light is either illuminating the surface, object or protruding it, in order to create sensation of three-dimensionality.

What is then the real spatial imprint of individual building?

The light emitted in the night by urban and architectural artefacts, claims more public space than those physically occupy.



A drop of light, Stockholm, Monika Gora (1998)

3. Pyynikki Open Air Theatre – Reijo Ojanen

From the moment I started thinking about light as a space demarcating tool, I focused on search for appropriate programme and to my delight, I have (re) discovered the theater architecture. Given the primary field of interest being the public space, the question of the existence of open air stages in the Nordics arose. Temporality of the scenography spaces draws a clear analogy with the temporality of the artificial light. The example of the theater in Tampere, with its rotatable auditorium, is challenging the dynamics of both light and architectural form.

Key points:

- public stage as platform for social sustainability, providing space for free speech, improvisation, spontaneous meetings and collective cultural events
- challenging climate conditions of Nordic region ask for interpretation of open-air activities year round

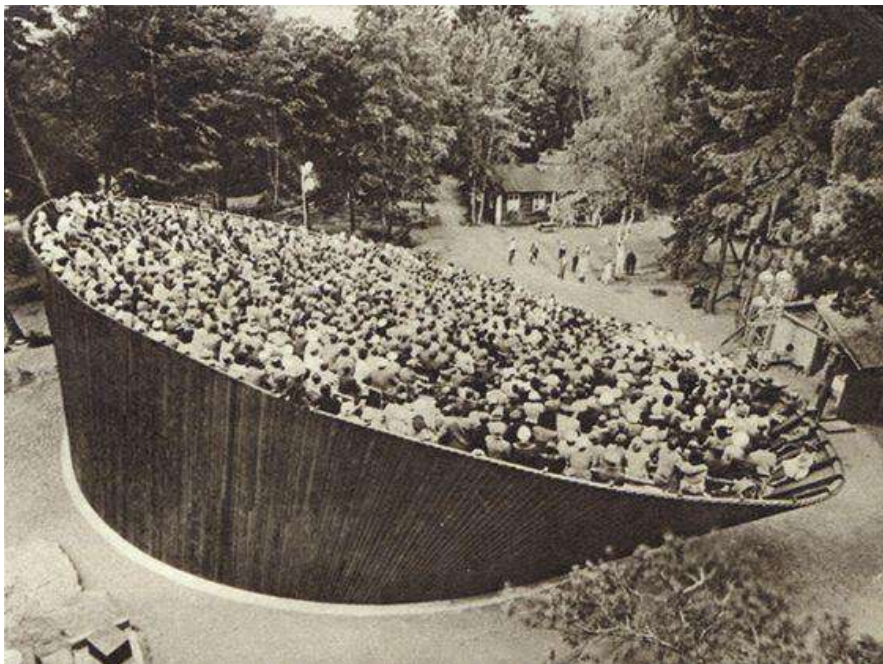
Personal notes:

"One of the most exciting in the country is the Pyynikki Open Air Theatre of Tampere, the revolving auditorium of which can be moved to face any of the natural sets."

on Theatre, Opera and Music in Finland, retrieved from <https://www.britannica.com/place/Finland/The-arts#ref393235>

Key question:

Is seldom presence of open arena typology in Nordics affecting social coherence and well being?



Reijo Ojanen, Pyynikki Open Air Theatre, Tampere Finland (1969)

4.Theatre du Mouvement Total – Jacques Polieri

Stage design as a relevant architectural discipline bears a rich history of spatial experiments. The temporary notion of installations is opening wider field of creativity in comparison to more or less permanent nature of city building. However, as a practice, both architecture and urban design should strive for pushing the boundaries and challenge complexities of all spatial experiences. The concept presented here is very innovative, yet not developed by an architect. Polieri Was a theater director.

Key points:

-experimentation within stage architecture and design from the middle XX century provides visionary space ideas which are substracted from academic architectural narrative

Personal notes:

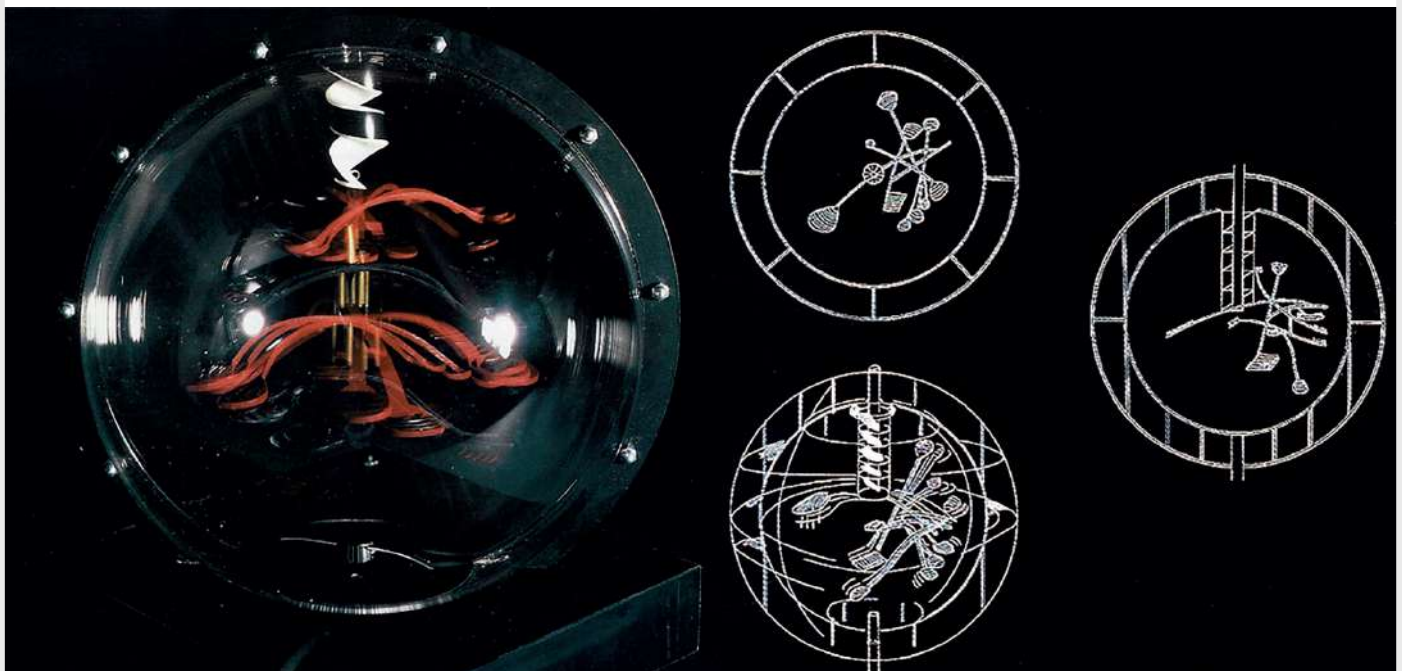
"Inspired by a small model of a mobile by Alexander Calder and various photographs of his work, Polieri proposed a series of moving platforms suspended from a central mast, which hooked to the roof and subject to a rotating motion, would house communications and services.

The spherical volume would accommodate 1000 people in a joint kinetic performance with the aim of moving mobility and three-dimensional virtual reality of emission and reception of acoustic and visual data to a spatial form through the dynamism provided by mechanics."

retrieved from: Prieto, J.I. "Jacques Polieri: kinetic theatre space". VLC arquitectura (2015) Vol. 2(2): 31-42. ISSN: 2341-3050

Key question:

What is the potential of combined dynamics of spatial "stage" elements and the light within urban design sphere?



Jacques Polieri, Théâtre du Mouvement Total(1957)

5. LUMEN – Jenny Sabin

After detecting the programmatic area I would like to work with, the question of structural integrity led to discovery of variety of numerous projects and materials, whose focus is set on reinterpreting the existing infrastructure. Every light pole is occupying a part of space which contains potential for spatial experience. The peculiar relation between light-weight structure and light itself in project named LUMEN has won 2017 MOMA's Young Architects Program.

Key points:

"Lumen is a feminine form that offers luminous interiorities, informal networks, social fabrics, and fibrous assemblages that are pliable, transformative, and playful."

"Lumen is a socially and environmentally responsive structure that adapts to the densities of bodies, heat, and sunlight. A lightweight knitted fabric of responsive tubular structures and a canopy of cellular components employs recycled textiles, photo-luminescent and solar active yarns that absorb, collect, and deliver light. This environment offers spaces of respite, exchange, and engagement as a misting system responds to visitors' proximity, activating fabric stalactites that produce a refreshing micro-climate."

retrieved from [http://www.jennysabin.com/lumen?](http://www.jennysabin.com/lumen?fbclid=IwAR1UOGVV1lWE-gmrB-onGUR1lj8On6KpPVb7hnUpfq7olrUCQFZ9RwMkrk)

fbclid=IwAR1UOGVV1lWE-gmrB-

onGUR1lj8On6KpPVb7hnUpfq7olrUCQFZ9RwMkrk

Personal notes:

What is the relationship between light and constructive system in architecture nowadays and historically?



LUMEN was on view at MoMA PS1 from June 29 to September 4, 2017

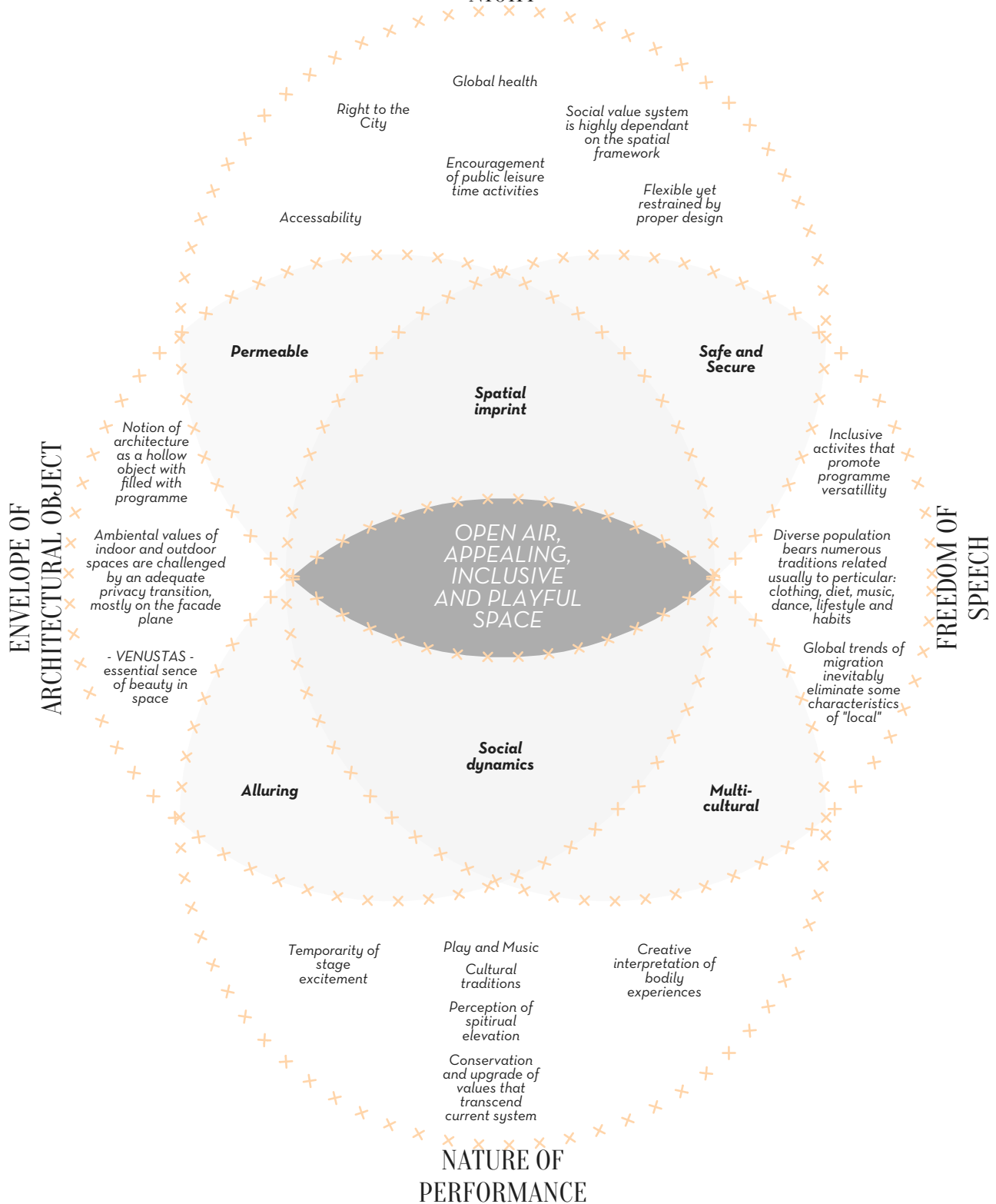


RELEVANCE

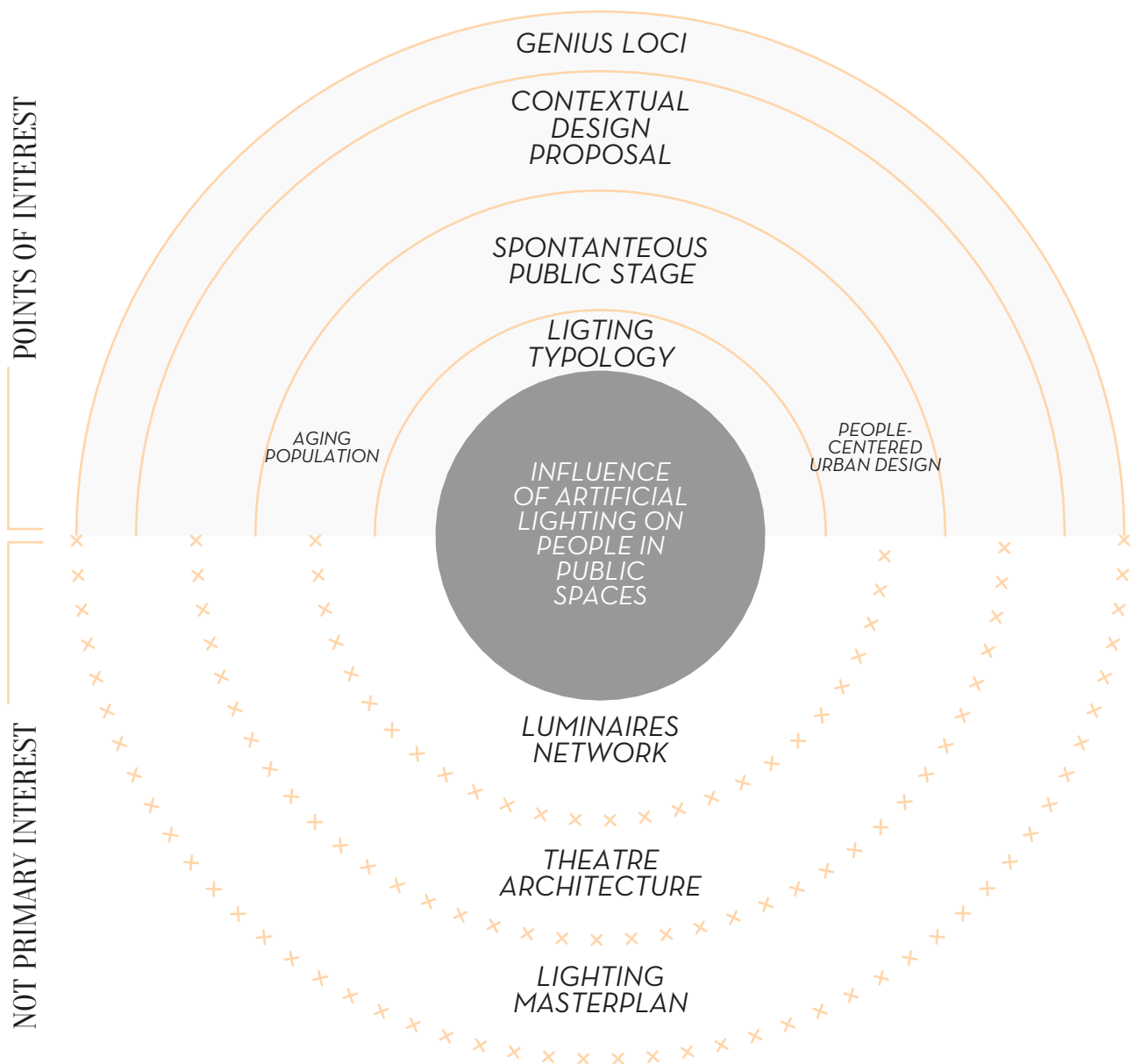
DISCOURSE

CITYSCAPE

DAY VS NIGHT



DELIMITATIONS



The thesis project's primary concerns are the dynamics of nighttime, light and performance arts. Therefore, this work will not be:

- *Inventing new lighting elements such as luminaires, but it may propose new light typology in service of proposed public space*
- *Providing the city of Gothenburg with the new theatre, on the contrary, the intention is to reinterpret stage spaces and re-engage them in the public life, via urban design formats rather than building tectonics*
- *Aiming for the universality/modularity of the proposed structure, but instead, make it highly contextual and only then draw conclusions which disseminate the idea further on.*



DECONSTRUCTED

KEY CONCEPTS

LIGHT TYPOLOGIES

Functional requirements give form to lighting typologies that interact not only with the built environment but also with the different modes of flows - traffic, information flows, navigation, advertising etc.

WORK WITH THE
EDGES OF THE SITE

LIGHT AND STRUCTURE

In terms of spatial imprint, light is a powerful tool to create a hierarchy. Infrastructure is characterized by the selective access but in the night-time, it often becomes a landmark. Examples of illuminated bridges or road structures give a fresh perspective on the mono-usage of these objects and at the same time open possibilities for interactions at large distances and within different mediums, such as water.

LIGHT AND SCENE

As an evitable driving force of performance arts, the light setting is a basic framework for activities that are propagated by the actors and the audience. The balance between illuminated and dark spaces is an obvious and sufficient demarcation of zones for the said activities.

WORK WITH THE
INNER SPACE OF
THE SITE

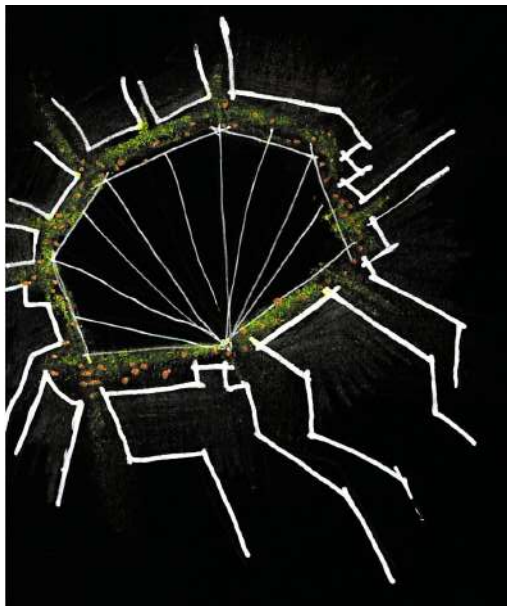
DYNAMIC STAGE DESIGN

Narrowing down to the more concrete points of architectural interest, this thesis is interested in reinterpreting the relation "observer-performer". Furthermore, it aims to tackle the influence of lighting in such scenarios and observe both people's behaviour and perception accordingly, when exposed to the different lighting modes.

Light Typologies

Lighting master planning is 80% education. 10% psychotherapy and 10% technology.

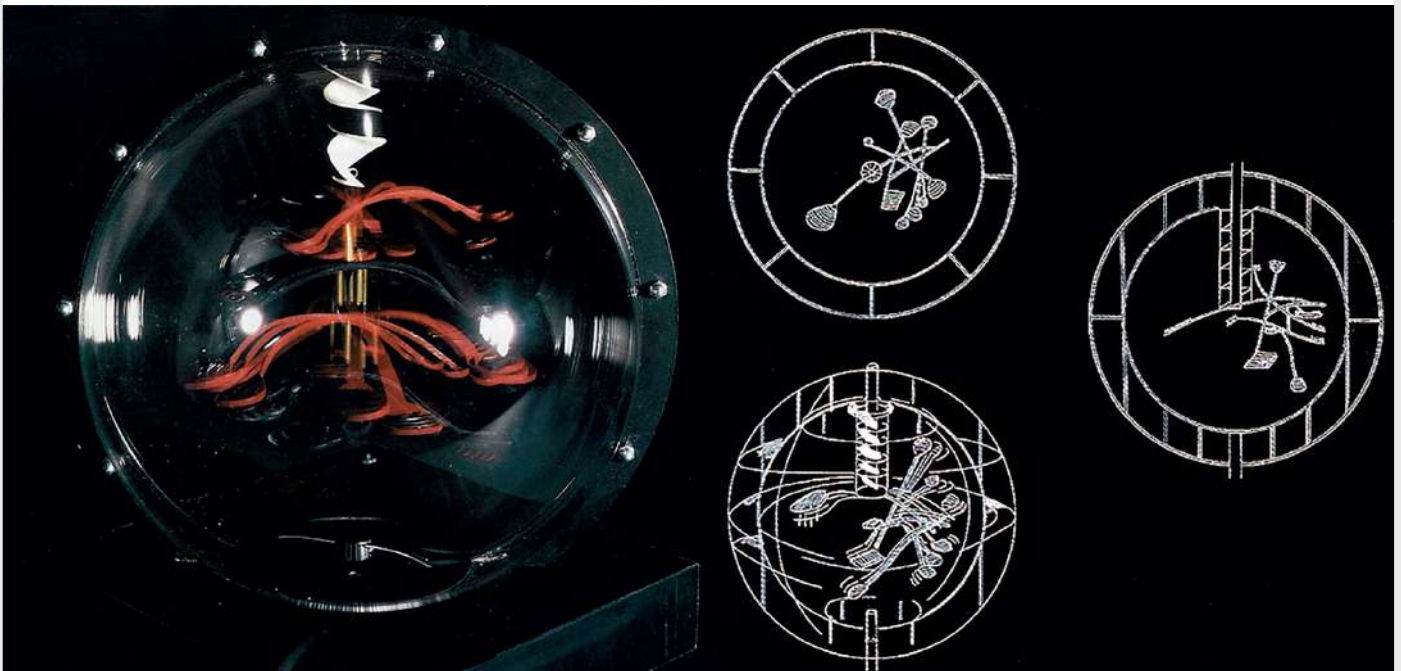
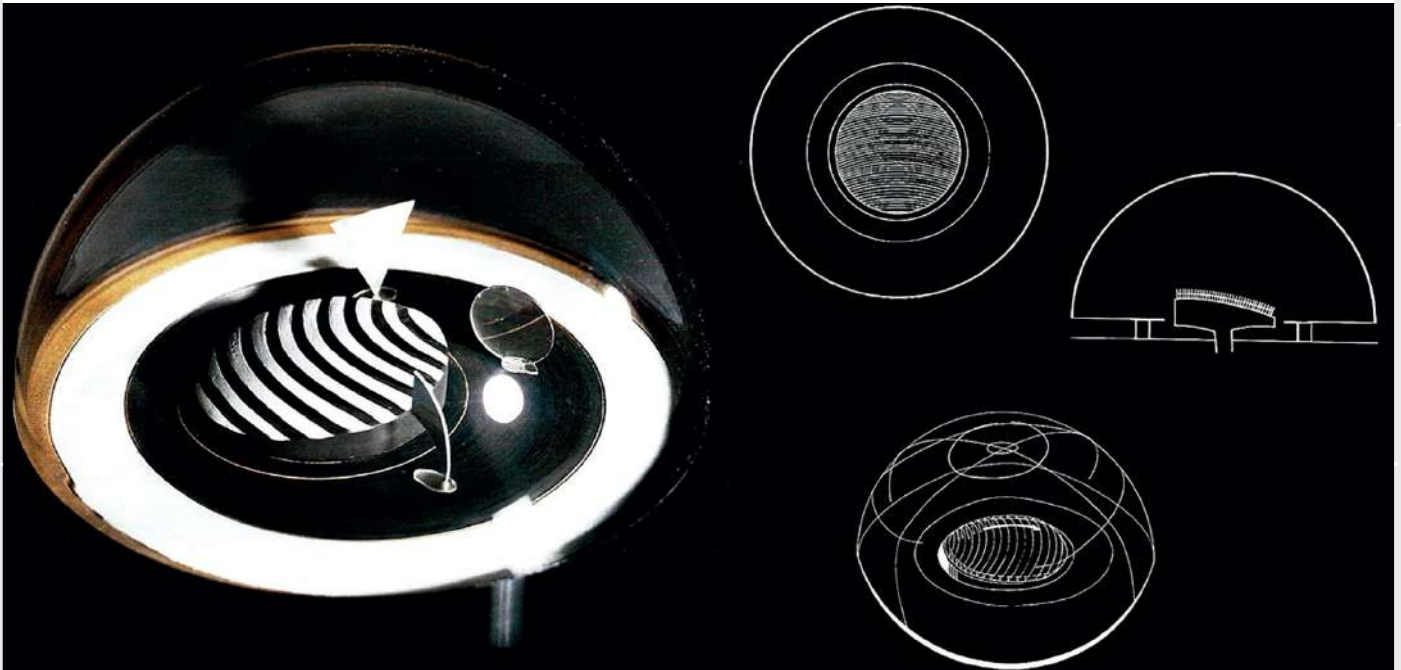
Bokern A. (2018) Die Nacht is etwas Fantastisches: Night is Something Fantastic: Die Nacht gestalten» Lichtmasterpläne für Städte. Detail 11.2018



Own sketch distinguishes the edges from the "body"

Light and Scene

Dynamic stage design



Jacques Polieri, Théâtre du Mouvement Total (1957)

The architectural aspects of the film are a valuable source of knowledge for the practice. Methods employed in framing the image and shaping perception are common for both disciplines. In addition, light is of utmost importance for the creation of the desired atmosphere. Relying on the directed flow of action, one becomes aware that space is nothing more than the sequence as well. We only perceive object as moving/idling if compared to the chronological relation to the moment before and after. A human impression of architecture and public space is the image between preceding and following place.

"We place our feelings, desires and fears in buildings. A person who is afraid of the dark has no factual reason to fear darkness as such; he is afraid of his own imagination. or more precisely of the contents that his repressed fantasy may project into the darkness."

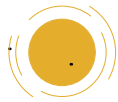
Pallasmaa J. (2001) The Architecture of Image - Existential space in cinema, The logic of emotions, p. 31



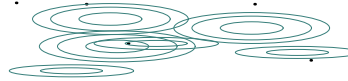
Stalker, Andrei Tarkovsky (1979)

DEDUCTION, ABSTRACTION AND INTERPRETATION of Light and Scene

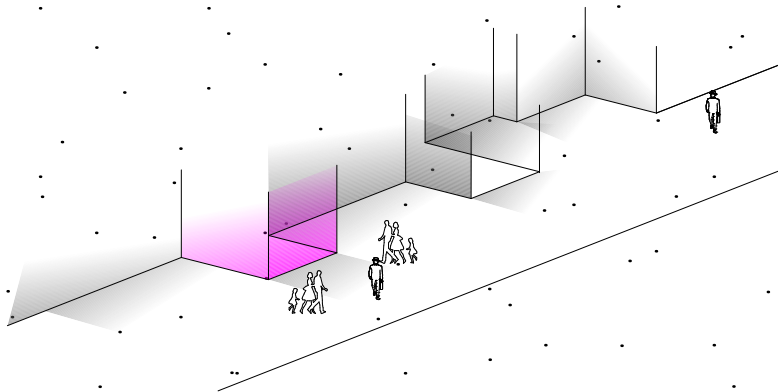
AGENTS:



GÖTA ÄLV

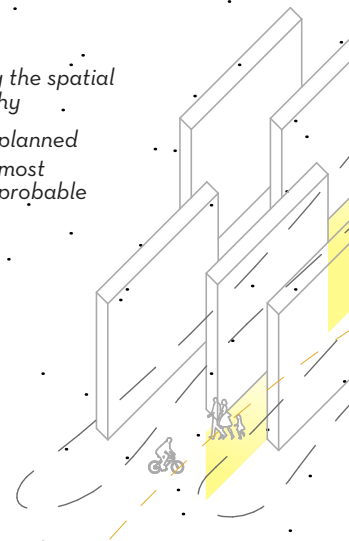


element of surprise,
exploited in
commercial
markets



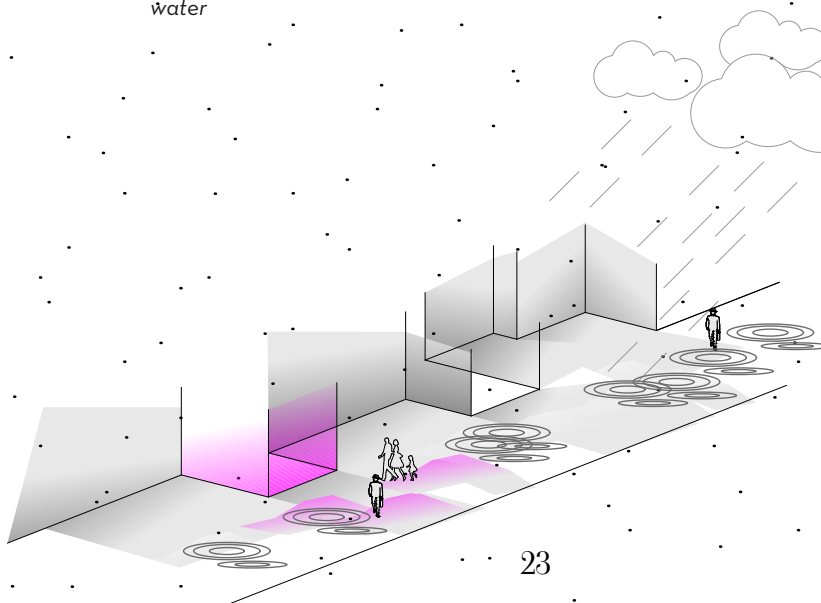
altering the spatial
hierarchy

— planned
— most
probable

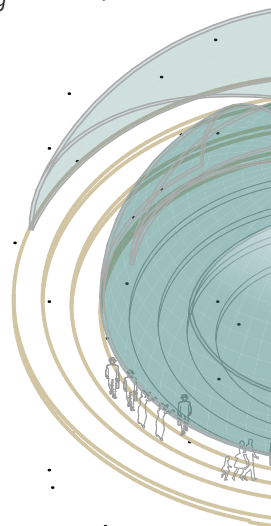


+ (X) + (YZ)

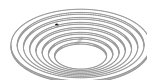
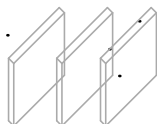
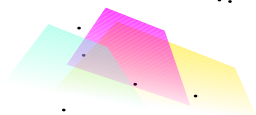
conditions of rain
and presence of
water



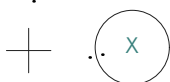
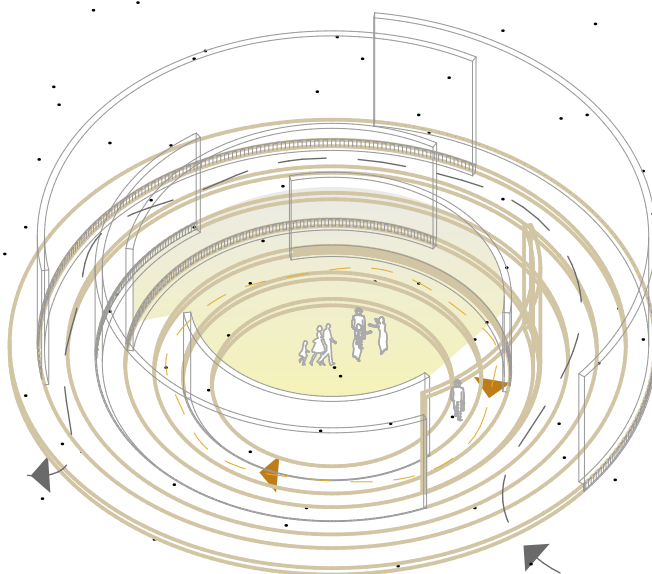
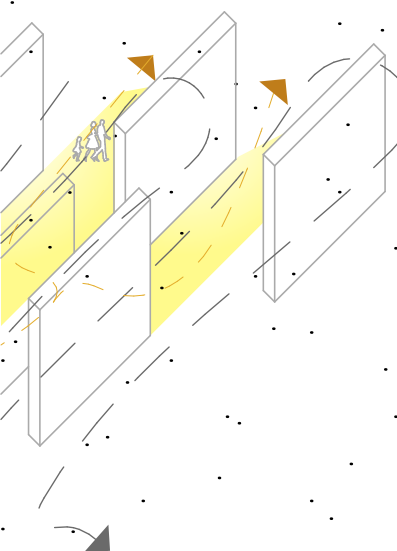
grasping the
existential space
-association with
religious feeling



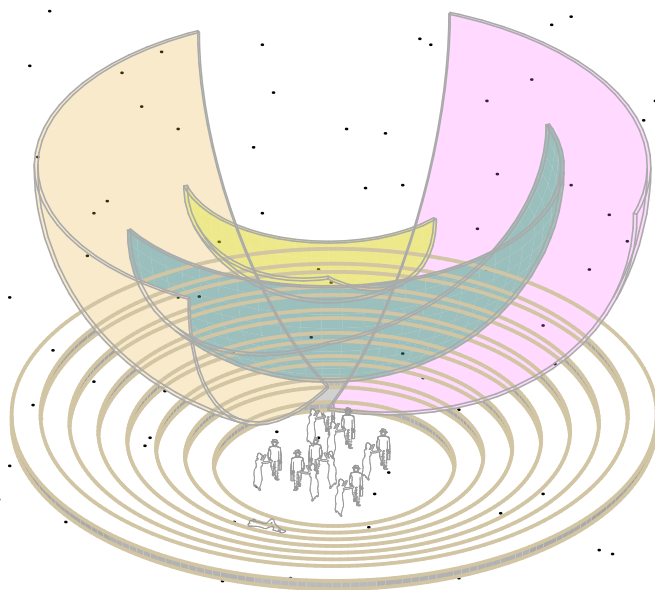
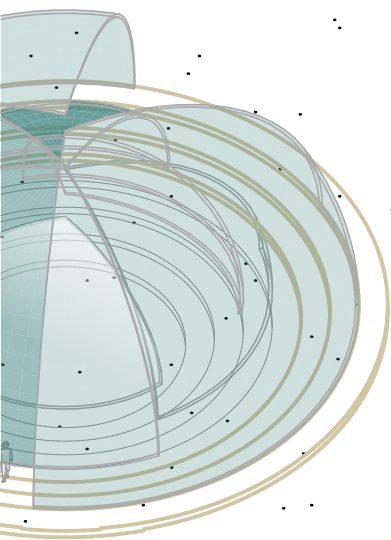
ELEMENTS:



enhancing the sense
of
community
"a cave fire" archetype

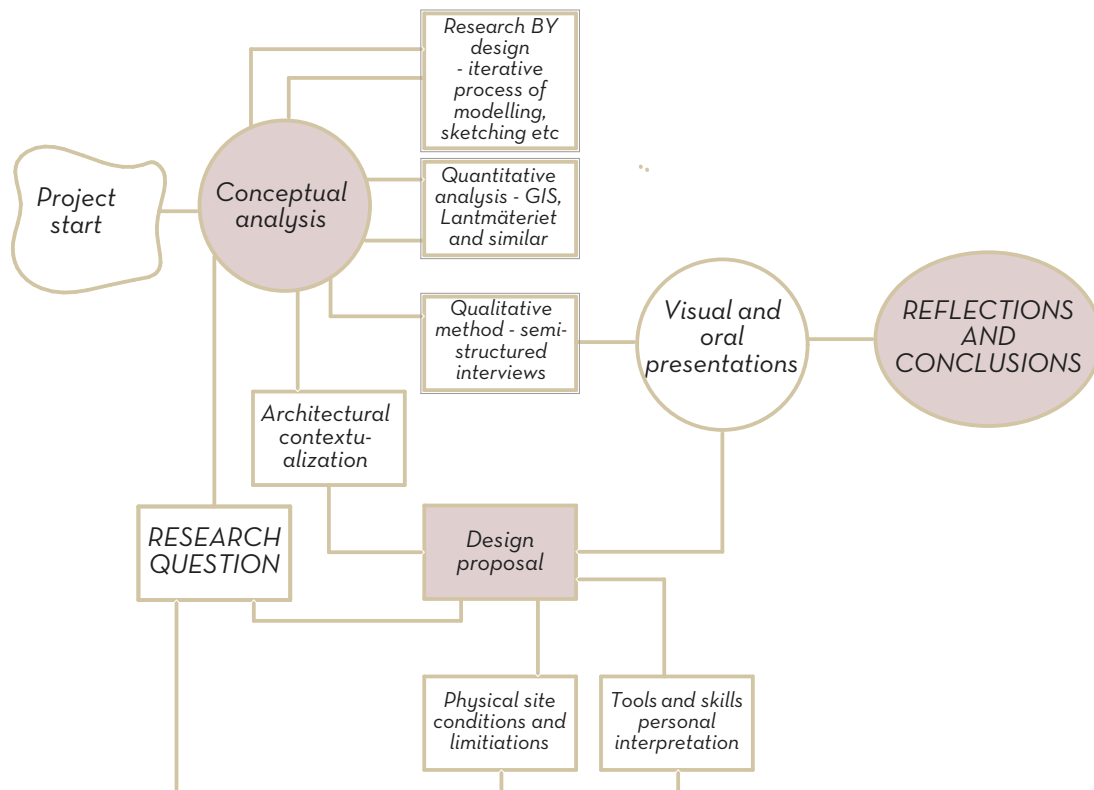


visual appeal
- entertainment

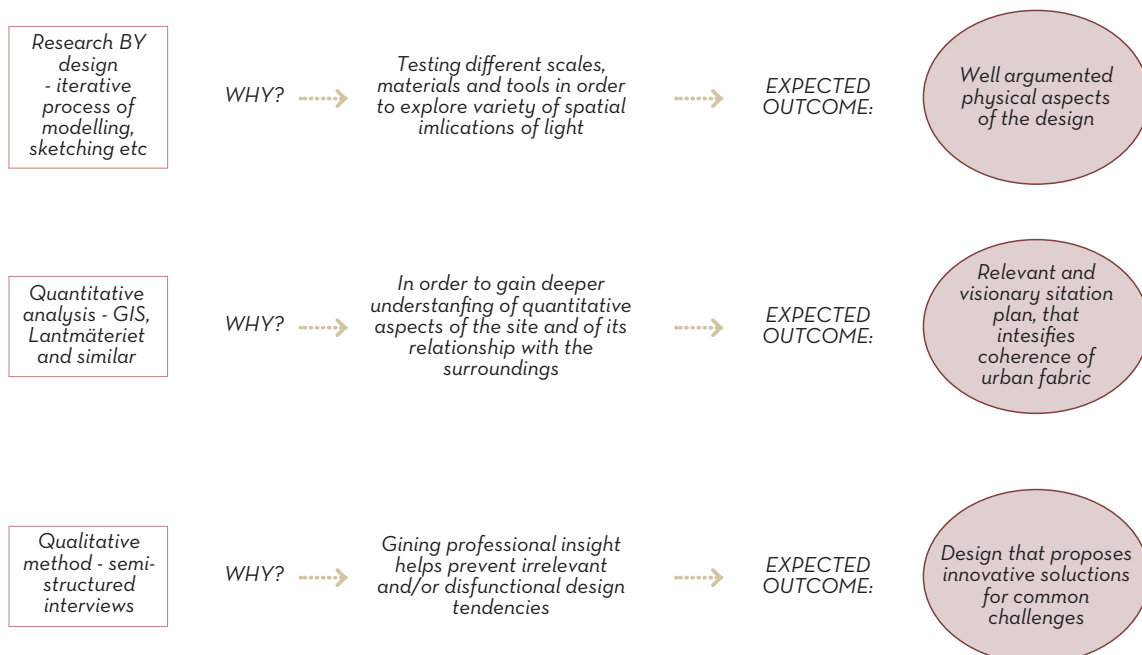


KEY METHODS

OVERALL PROCESS DIAGRAM



METHODS DIAGRAM



CONTEXTUALIZATION

SITE INTRODUCTION



Stigbergstorget och Masthuggsbergen. 1950 retrieved from:
<http://klippan.hagmanstorp.com/Fotogalleri/Majornakort/pages/Stigbergstorget%20och%20Masthuggsbergen.%201950.html>

Stigbergstorget

Stigbergstorget is a square in the city district Majorna in Gothenburg. Closely related to the harbour, the leaned plateau makes the top part of steep street Stigbergsliden.

"For the locals interested in history, Stigbergstorget is one of the city's most enjoyable places. Here, not only is the Maritime Museum - between the trees in the left edge of the site - but also some examples of the genuine rounded cobblestones (referring to the massive stone fortification of the old city) that are now almost extinct in Gothenburg inner city. And the Gathenhielska house is almost the only remaining example of the 18th-century houses of wood that have been intentionally built to resemble more stone-built houses." Retrieved from: <https://www.gp.se/nyheter/g%C3%B6teborg/stigbergstorget-nu-och-d%C3%A5-1.461442>

Next to the Maritime Museum, another important landmark is protruding into the skyline - Sjömanshustrun.

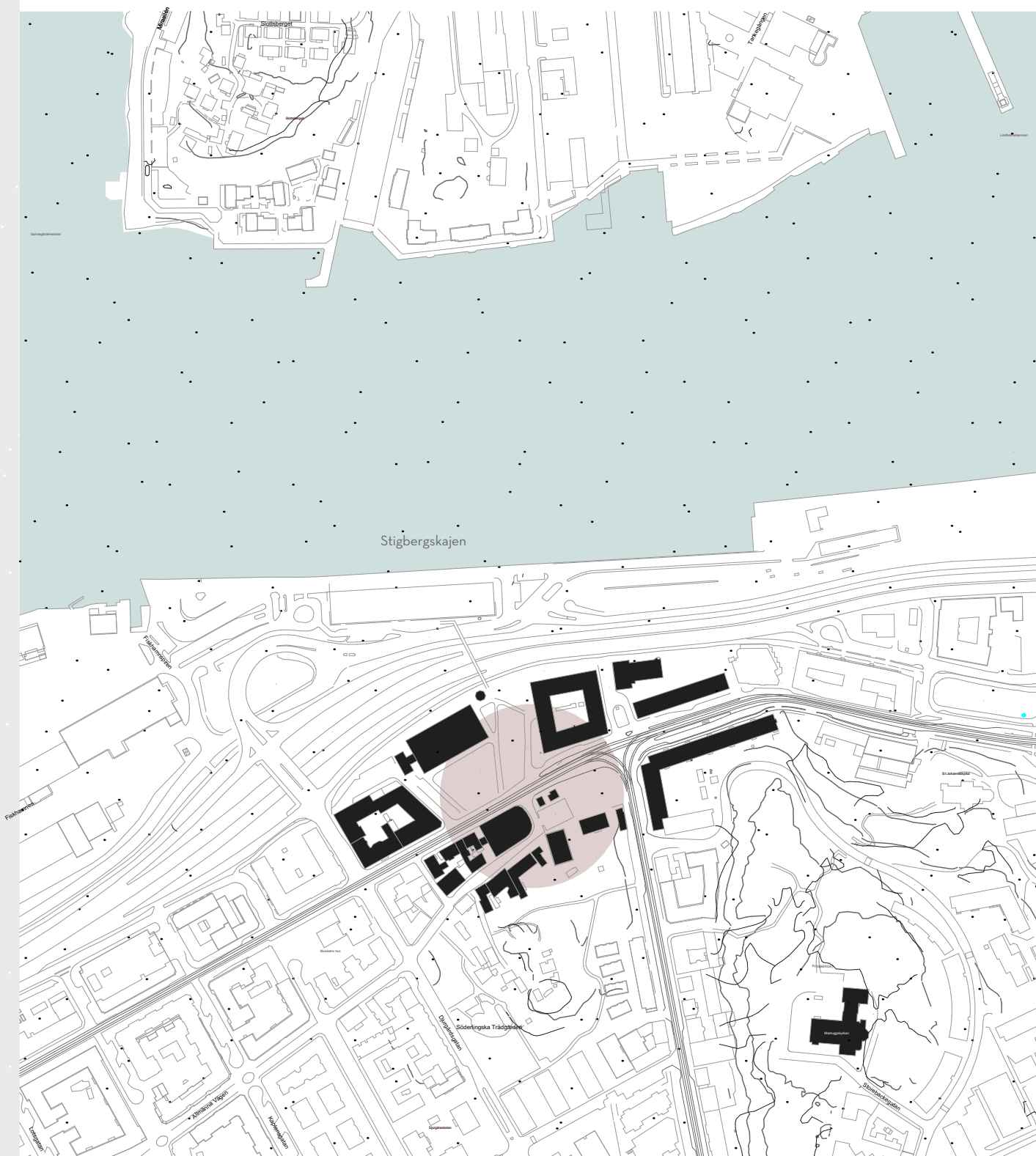
"The seaman's wife, who is also called "Woman by the sea", is reminiscent of all the Swedish sailors who died during the First World War. On the foot of the tower are all their names and also the names of the ships. You see her clearly from the harbour. She represents so many people's suffering - the sailors' wives, mothers, children and relatives." Retrieved from:

<https://vartgoteborg.se/sjomanshustrun/?OpenDocument>

SITE SELECTION CRITERIA

The presence of the cultural artefacts, as well as a close connection to the waterfront, challenging landscape and programmatic values, were the reasons for selecting Stigbergstorget as a testing ground for this project. In the direct vicinity of the square are two former cinemas, Maritime Museum, culture house Oceanen and just hundred meters away - a music school.

In addition, the personal experiences of the place and its appealing architectural conditions were relevant factors. The overall slope of the plateau is leaning in midst of such a diversity of architectural expressions, mostly of housing blocks from several epochs complemented with before mentioned public facilities and important sacral landmarks, such as Masthugskyrkan.



Stigbergstorget and surroundings





LEGEND

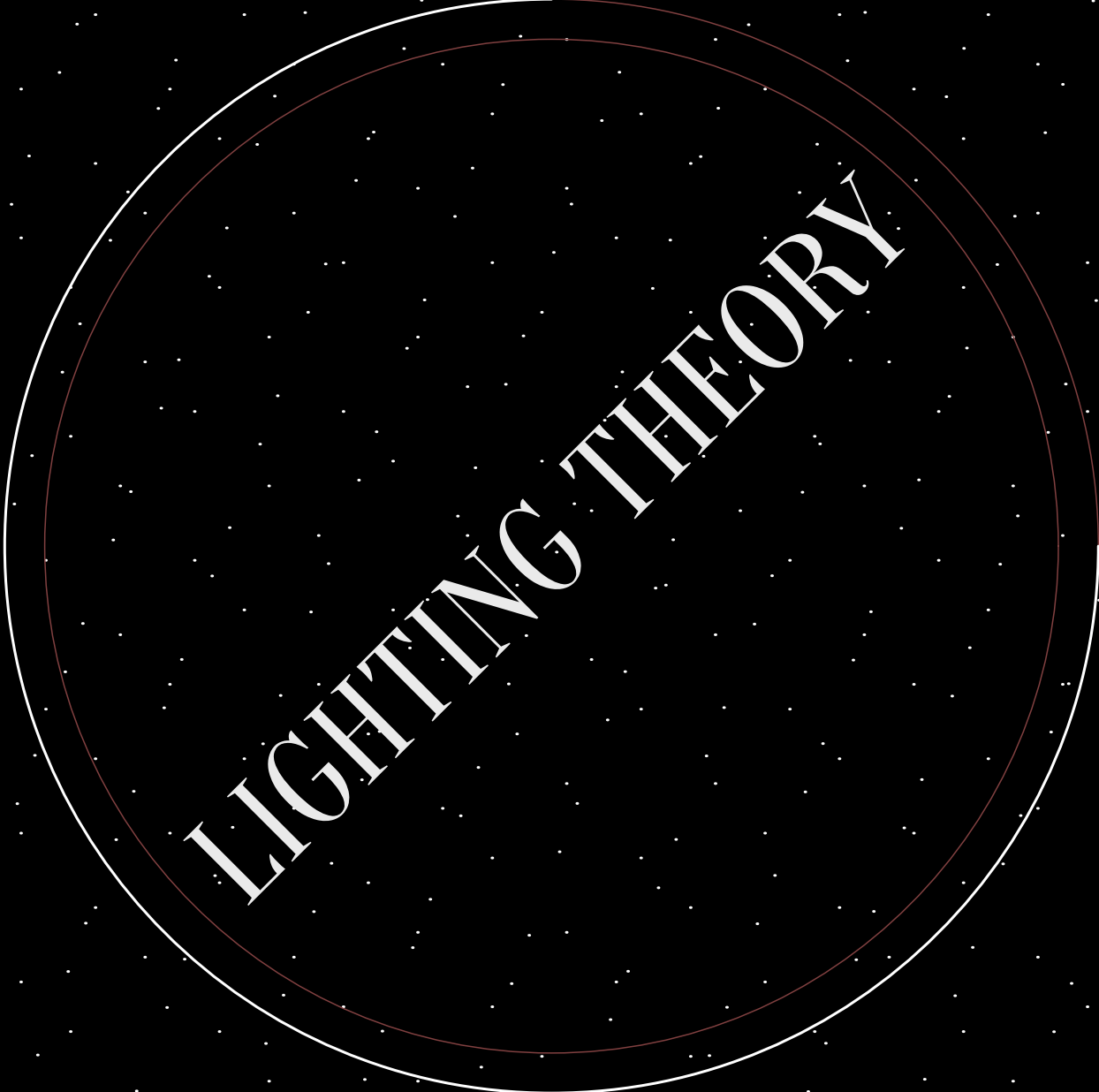
- 1 Gathenhielska Huset
- 2 Oceanen Culture house
- 3 Former cinema Kaparen
- 4 Maritime Museum
- 5 Pillar with the "Waiting wife" sculpture
- 6 Former cinema Fyren, within courtyard housing building
- 7 Musikens Hus
- Important viewpoints to the riverfront
- Extruded section
- Typical flow lines
- Tram stops
- Trees

EVALUATION

The reinterpretation of the existing formal values of the site is providing the new proposal with the sense of continuity of building heritage. The peculiar round form and inviting portal of Biograf Kaparen, has been one of the most inspirational facades which in the city of Gothenburg, even before the thesis project. The presented building has come along way from being a renowned cinema, then a supermarket Lidl, to not being utilized at all nowadays. The proposal which is to be conceived in this work os reflecting back to the history and takes film screens back to use. But the main focus of the project remains the urban face right in front of this interesting building. Therefore, the next few chapters are aiming to explore the phenomenon of light and its influence on people, in order to prepare the ground for informed design decisions.



Stigbergstorget cinema Kaparen, retrieved from:
<https://kinnegbg.wordpress.com/tag/stigbergstorget/>



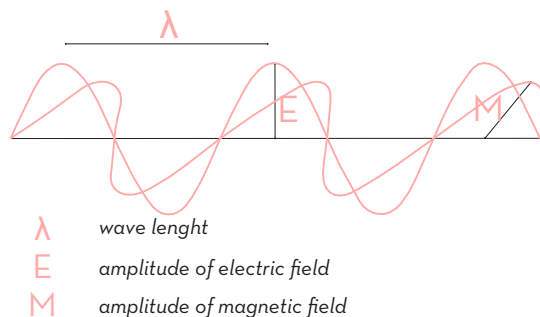
LIGHTING THEORY

LIGHTING THEORY ESSENTIALS

by Phillips Lighting University

I Electromagnetic waves

- Simplest theory of light given by Maxwell: Light is electromagnetic radiation consisting of waves, that travels from its source in all directions. Wavelength is marked by λ .
- Sound waves are particle waves propagated in the elastic medium, such as air. Light waves are radiation, visible to the human eye in the following spectrum: 380 to 740 nm wavelengths. The numbers coincide with short length UV waves and long infrared waves respectively. Because the fact that light waves do not consist of particles, light can travel through vacuum.
- Conclusion: Light waves do not require material medium for propagation.



II Gas discharge lamps

In general there are three ways to generate light, namely by using:

- incandescent lamps** - the traditional lightbulbs where the visible light is created by sending an electric current through a filament wire
- LED** (light emitting diode)- generated by diodes that emit light when connected in the circuit
- gas discharge lamps** - generate light by creating an electric discharge between two electrodes inside a transparent tube, filled with ionised gas (a principle similar to lightning strike during a stormy weather)
 - There are 2 types of GDL - low pressure and high pressure DL
 - Low pressure GDL - **fluorescent** (characterized by a small amount of mercury gas filling) - typically produce UV radiation and some blueish light; by applying a phosphor layer UV radiation is converted into visible light, and **SOX lamps** - sodium vapor lamps (using sodium in excited state to produce a characteristic wavelength of cca 589 nm, which results in a particularly yellow light)
 - Among high pressure GDL or HID we differentiate between three different concepts: a) HPL based on mercury (white light - poor energy efficacy) b) SON based on sodium (yellowish light) and are mainly used for functional outdoor lighting c) MH metal-halide lamps (white light - high energy efficacy with perfect colour performance) - in all three the light is generated by the direct radiation of the gas discharge
 - HID differs from Fluo in sense that it produces higher pressure and work temperature, thus higher discharge, which results in much more compact light sources

Additional information on GDL, retrieved from https://wikivisually.com/wiki/Gas-filled_tube

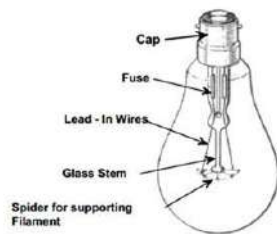


Figure 1 - Incandescent lamp

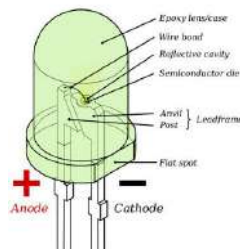


Figure 2 - Light Emitting Diode



Figure 3 - HID gas discharge lamp

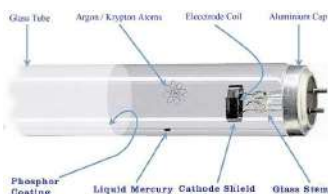


Figure 4 - Fluor gas discharge lamp

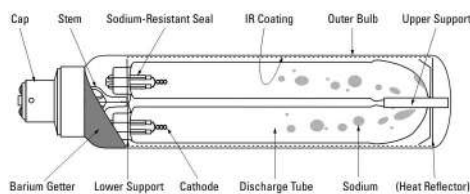


Figure 5 - SOX gas discharge lamp

III Incandescent and Halogen Lamps

Incandescent lamp with colour temperature from 2700K to 2800K, emits most of its energy in the form of infrared radiation or heat. Only roughly **5%** of the energy consumed by this type of lamp is converted into visible light.

In addition, the material of the filament evaporates relatively quickly, so the lamp has a short lifetime up to 1000h.

- In halogen incandescent lamps the temperature of the filament is increased to 3000K, and the evaporated filament particles react with halogen, which results in partial return to the filament again. This is known as the halogen cycle. Therefore, the lifespan of such a lighting body is prolonged, from 2000 to 4000h.

IV Light Emitting Diode - LED

LED are small point sources of light that can be used independently or gathered in chips. The LED chip which produces red, green and blue light simultaneously, gives a white light as an outcome. RGB LED 12 has four pins, one for each colour and a common cathode.

Good quality white light can be obtained by using a combination of blue LED chip and yellow fluorescent material -phosphor. This is called a white phosphor LED.

Benefits of LED are:

- long life span - 75 000 hours for professional luminaires and for consumer retrofit cca 20 000h
 - energy efficient light sources, as around 6 x as regular incandescent lamps
 - light emitted from LED **does not contain** any UV or IR radiation, therefore it is technically safer, but the most recent research indicates that the production of melatonin among terrestrial mammals (humans included) can be altered by the exposure to the short wavelengths. (2015) Haim A. Zubidat A.E. LED light between Nobel Prize and cancer risk factor
- Consequently, the impact of LED on the circadian rhythm is to be presented in the following chapters.

V Luminous Flux

It is the amount of light radiated by the light source per second. The unit is lumen, and symbol Φ . It specifies the amount of light emitted by the lamp, but it doesn't specify the directions in which this light is radiated, as defined by IEC - international standards agreement. The ratio between luminous flux and energy consumed by the lamp is called **luminous efficacy**. Unit is lm/W - values: 10 lm/W per incandescent lamp, 100 lm/W for fluo tube, 200 lm/W low pressure sodium lamp etc.

VI Luminous Intensity

It is the quantity of light emitted per second in the specified direction. The unit is candela - cd. It is defined as a luminous flux in a specified direction, radiated per unit of solid angle. A solid angle is an opening angle of a light cone.

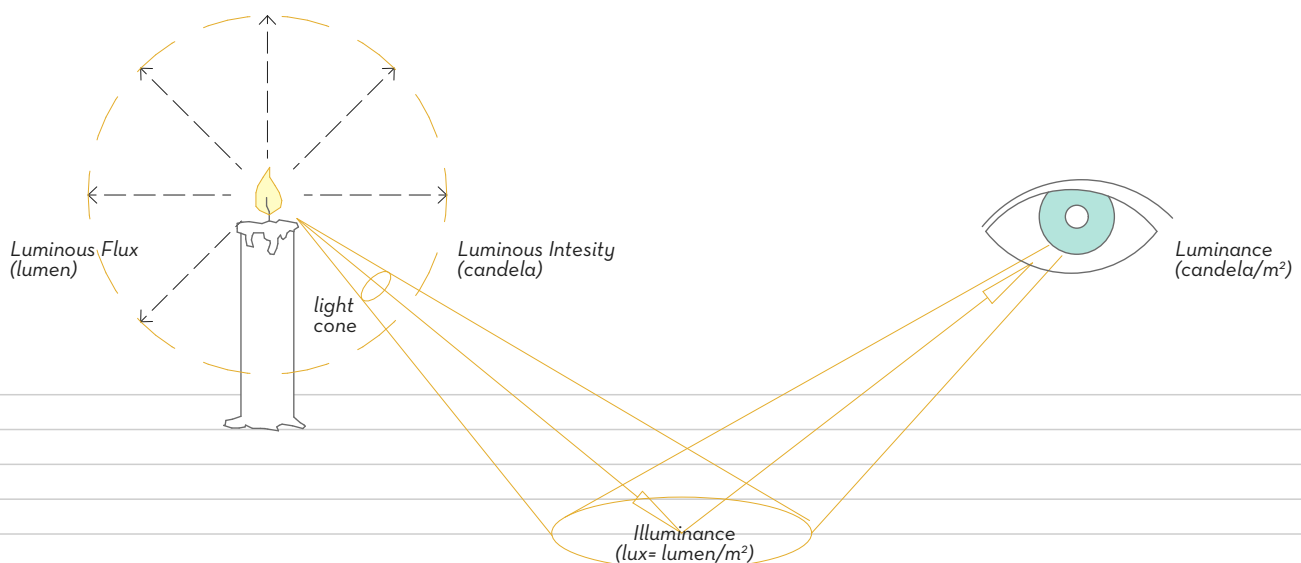
VII Illuminance and Luminance

Illuminance is a quantity of light or luminous flux **falling** on a unit area of a surface. The unit is lm/m^2 or **lux**. The values of illuminance of natural sunlight are variable even within the same physical conditions - for example the summer view of a place at noon, under the clear vs cloudy, overcast sky. The two images can differ radically.

Luminance is a luminance intensity emitted per unit of apparent area of the surface, in a specific direction. The unit is cd/m^2 . Example is a road surface under artificial lighting, where the medium of reception is human (driver, pedestrian...) eye.

Mutual relation: illuminance is independent of the type of surface. For perfectly diffusing surfaces, a relationship exists between illuminance on the surface, the surface reflectance and the luminance of the surface.

Additional reading: <https://www.ledwatcher.com/light-measurements-explained/>
<http://mysite.du.edu/~jcalvert/optics/lumens.htm>



V III Color Rendering

Color rendering is the ability of the artificial light to reproduce or render faithfully the colors of objects. It is important to realise that true colors do not exist. Two lights that appear the same white may be the composition of the different wave lengths. Therefore, the general color rendering index Ra exists. Ra is used to classify light sources according to their light rendering quality. CRI is color rendering quality versus the Ra range of 8 standardized colors. Values vary from 0 to 100, light sources with lower CRI are often more efficient than those with the higher one.

IX Color Temperature

It is used to objectively describe the white tone of the light source and is expressed in Kelvin. The lower the color temperature is, the warmer, more redish is the color of the light. And the opposite, the higher the color temperature, the cooler, more blueish the light will be. Choice of color temperature depends on the activity taking place in the room. Warm white light creates relaxed ambience, cool white makes people more active. Further, the furnishing of the room - wooden furniture will look better under the warm light, grey and white will look better under cool light. Climate is the next influence. People living in a warmer climate, generally prefer cooler light. Warm light is preferred in the colder climate regions.

X Glare

Glare is a negative sensation produced by luminance in the visual field which is so much greater than luminance to which the eyes are adapted. It causes discomfort and/or reduced visibility. It can take either of two forms: discomfort glare or disability glare. There two types of glare in particular - direct and indirect glare. The former is caused by the high luminance of the light source present in the field of view, while the latter is a result of the reflection of light in high brightness on the polished surface in the field of view - ex. reflection of the sun in a mirror.

COLOR TEMPERATURE	COLOR APPEARANCE
Less than 3300K	Warm yellowish white
3300K -5000K	Neutral intermediate white
More than 5000K	Cool bluish white

Light density is another term for luminance. One of its important regulators in the mounting height of the light source. Optimum pole height thus is important for the correct lighting density. As the height of the mounting pole increases the footprint of the light increases but light density decreases.

Retrieved from: <http://www.smart-solar-lights.com/info/guide-to-led-street-lights-20219822.html>

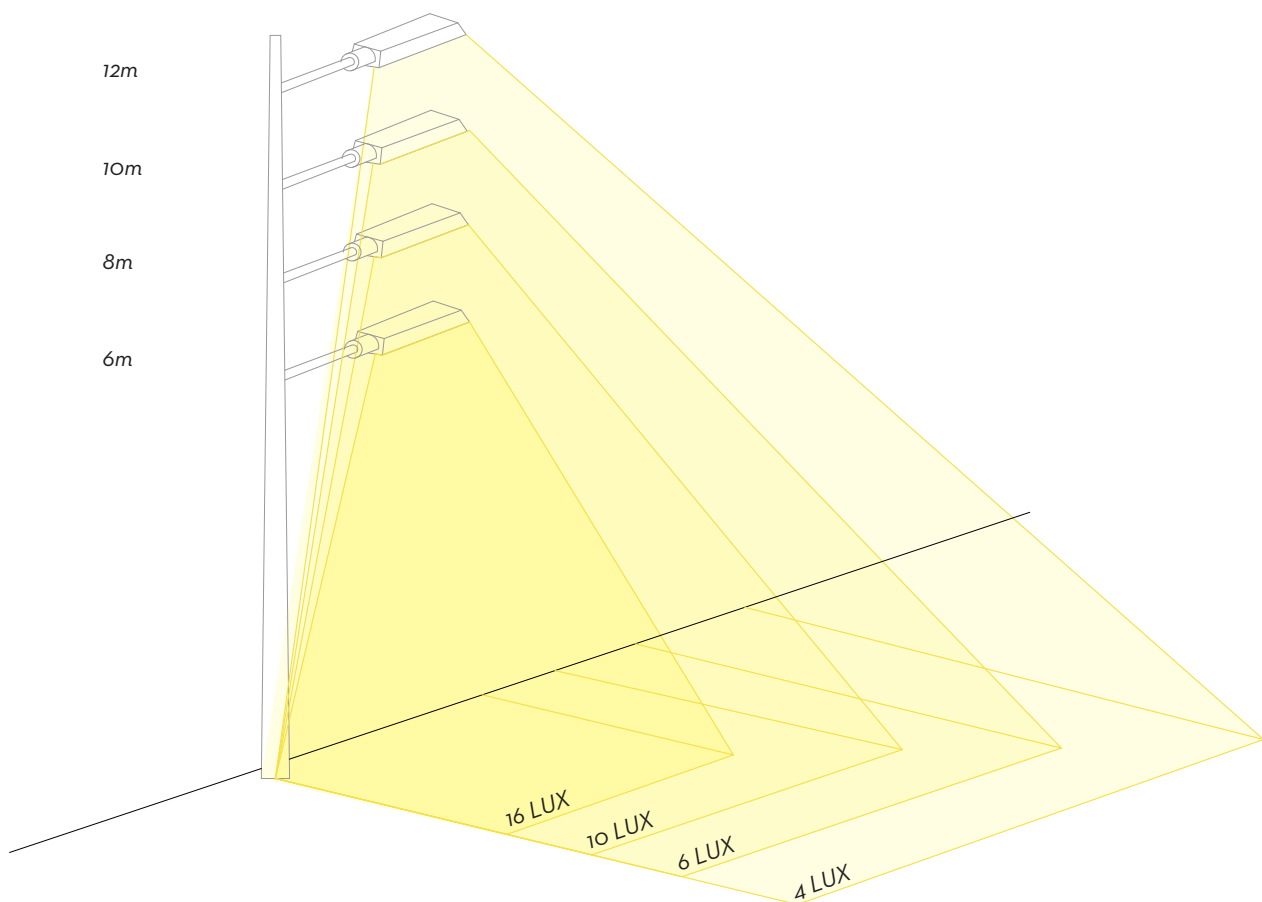


Diagram depicts the fluctuating light density (the amount of light that actually reaches the surface and gets reflected in the human sight field), in terms of different mounting heights values. Observe that the light source is not changing!

Light and Aging

Bearing in mind one of the principals of the thesis project, which is interested in direct human interaction with artificial lighting, this chapter shifts focus from the general to a rather specific aspects of the light phenomenon. As a test target group, a senior population is chosen in order to understand a natural metamorphosis taking place in time span from fully functional sense of vision to aging sensory apparatus, and its implications on architectural and planning practice.

Light reaching the retina is impacting:

- visual system
- circadian system
- perceptual system.

The aging visual system is experiencing inevitably two primary categories of changes: optical changes before year 65; and neural changes in years after. As the death of photoreceptors in human eye is not preventable over time, appropriate usage of light can only affect the former set of transformations - those of optical nature.

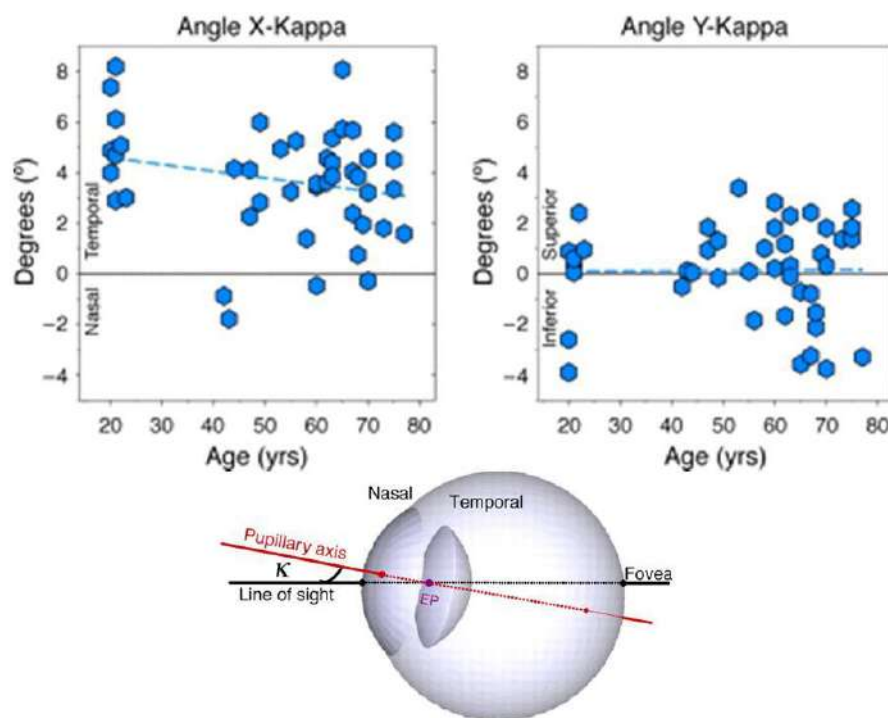


Figure 6 - Diagram showing relation between angle kappa and the absorption of light on retina surface, retrieved from <http://pabloartal.blogspot.com/2011/03/optics-of-eye-in-old-people-is-not-as.html>

Angle Kappa is the angular distance (in the object space) between the line of sight and the pupillary axis. Artal P. (2017) Handbook of Visual optics. Since the value of the angle K tends to be constant in chronological sense, what causes the age related changes in vision is the distortion of the eye lense. As one gets older, the actual lens thickness increases and the lens itself becomes yellower. This directly results in higher sensitiveness to glare. In short, while being exposed to the same visual information as the person in their 20s, an eye of a man which is 60 years old absorbs only the thirs of radiated light.

Neural changes are the consequence of reduced neuron density in older age. A study on involvement of older people in traffic accidents has shown a direct relation between the crossroads and age of the actors in the accidents. Philips Lighting University Webinar: Lighting for visual performance, circadian health and safety in older Adults This is to show that elderly population due to the said changes in neuron density has worse peripheral view. In order to have the same evaluation of the space and orientation, elderly need more light, higher contrast and less glare. The two former values are contradicting each other when superimposed. Considering the demographic trends of overall aging population around the globe, and especially in the west, how can urban designers, planners and architects include this phenomenon as a design factor in the early stages of the design process? An insight into circadian rhythm is needed.

Light on the retina is the primary synchronizer of circadian rhythms to local position on Earth - light-dark cycle. In that sense, light can also act as a major disruptor if it is not aligned with the natural processes. In the article Systematic review of light exposure impact on circadian rhythm, Leena Tähkämö, Timo Partonen & Anu-Katriina Pesonen (2019), Chronobiology International, following findings are exposed: "In humans, non-visual information of light is detected by the eyes. The non-visual stimulus is detected by the intrinsically photosensitive retinal ganglion cells (ipRGCs), which contain melanopsin as well as pituitary adenylate cyclase activating polypeptide, and is transmitted directly to the suprachiasmatic nucleus (SCN) of the hypothalamus (Hannibal et al. 2004). The SCN acts as the master circadian clock that organizes the daily recurring physiological functions, such as hormone secretion (e.g. melatonin, cortisol) and body temperature. The master circadian clock is synchronized by the light-dark transitions perceived by the eyes, but it can be disturbed by changes in the light-darkness pattern caused by the artificial lighting especially at night. Furthermore: To avoid unwanted changes in the circadian phase or night-time sleep, light exposure in the evening and at night as well as in the morning needs to be controlled, as even the longest wavelengths (631 nm) or intermittent light exposures do induce circadian resetting responses. Circadian responses were also found when sleeping in home setting with low night-time light level with eyes closed, indicating that even low light levels are relevant for human circadian rhythms." A plastic spatial example is the constant presence of dimmed light in housing for elderly will assist before mentioned neural changes and therefore influence sleeping disorders. In contrast, appropriate usage of light which mimics natural surroundings can significantly affect the symptoms of sleep pattern related disorders to reduce. This is known as a lighting therapy.

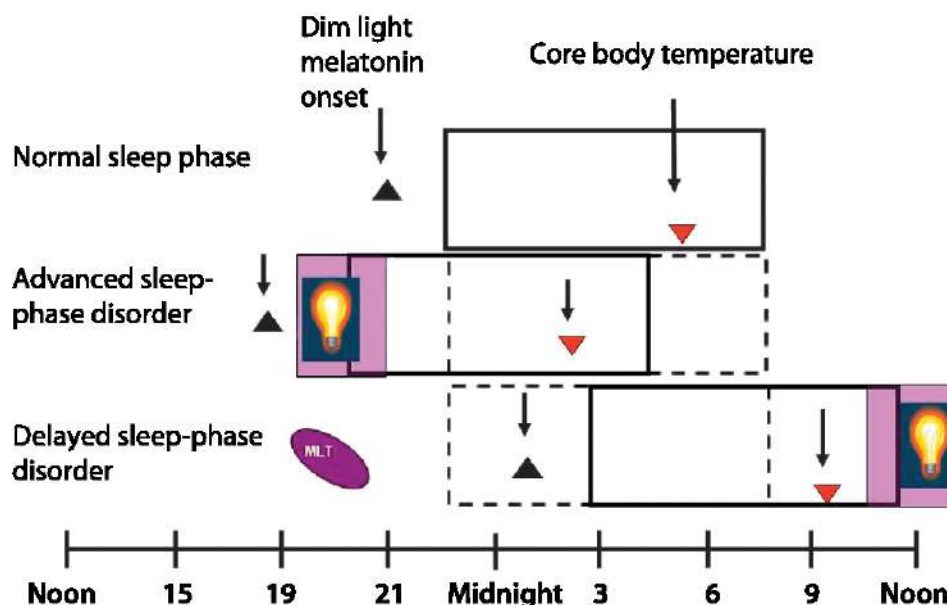


Figure 7 - Summary of treatment approaches for delayed sleep-phase disorder and advanced sleep-phase disorder. Bright light administered before the nadir of body core temperature is a potent stimulus for delaying the circadian phase, retrieved from: <https://www.semanticscholar.org/paper/Circadian-rhythm-abnormalities.-Zee-Attarian/ba0b8cb8799b64109c59dd6ceb8a284158eac710/figure/3>

Conclusion:

The light in the exemplary setting of elderly housing should be providing **two different kind of functions:**

- high circadian stimulus during daytime, achieved by using blueish, cool light; and
- low circadian stimulus during evenings, achieved by using reddish, warm light, mimicking natural twilight.

In addition, appropriate lighting can affect postural control, which involves orientation in stability in old age. This is a situation where indoor environment directly reflects on outdoors behavior i.e. most common public accidents - falls.

Additional design guidelines for elderly housing interiors are:

- more light on the task area
- increased contrast
- soft shadows
- minimize the glare

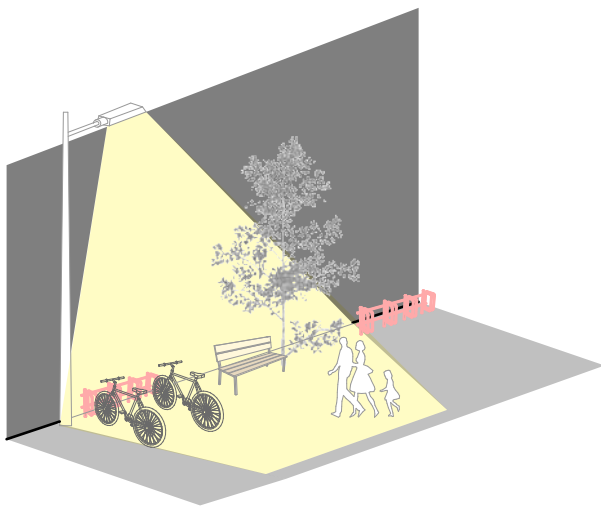
The said guidelines are derived from following **Webinar: Lighting for visual performance, circadian health and safety in older Adults**, retrieved from:

<http://www.lighting.philips.com/main/education/lighting-university/lighting-university-browser/webinar/lighting-for-older-adults>

Light in Public Space

In terms of lighting infrastructure, public space is an outdoor room. Understood like this, the illumination of space in the city room is highly dependent on fenestration, lighting network and traffic signage. Therefore, the image of the night in the cityscape is opulent with different light typologies, colors and temperatures. But in the purely functional sense, criteria of safety and security are primary factors for outdoor lighting design. The former is referring to actual human perception and the latter on the certainty of movement through the dark places. These findings are confirmed by the study Lighting modes and their effects on impressions of public squares (2016) Jack L. Nasar & Saleheh Bokharaei (The Ohio State University, United States, Shahid Beheshti University, Iran).

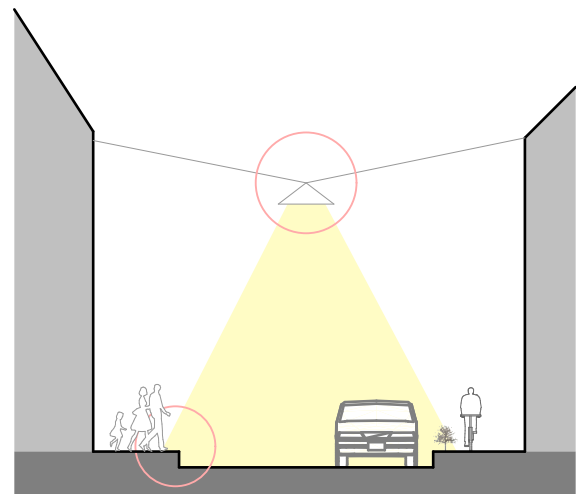
NOTE: There is, however, incredibly limited research data on the influence of lighting on the public space, probably due to the challenges that every public space presents - its versatility, complexity and many variables included - from climatic, to social and economic conditions.



The notion of **safety** is characterized by:

- personal perceptions
- emotional image of the surroundings
- ability to predict one's trajectory at every moment in time
- good orientation

Example: Well illuminated bench by a tree or a bike parking place, feel safe as one clearly observes intermediate surroundings and points of interest/property.

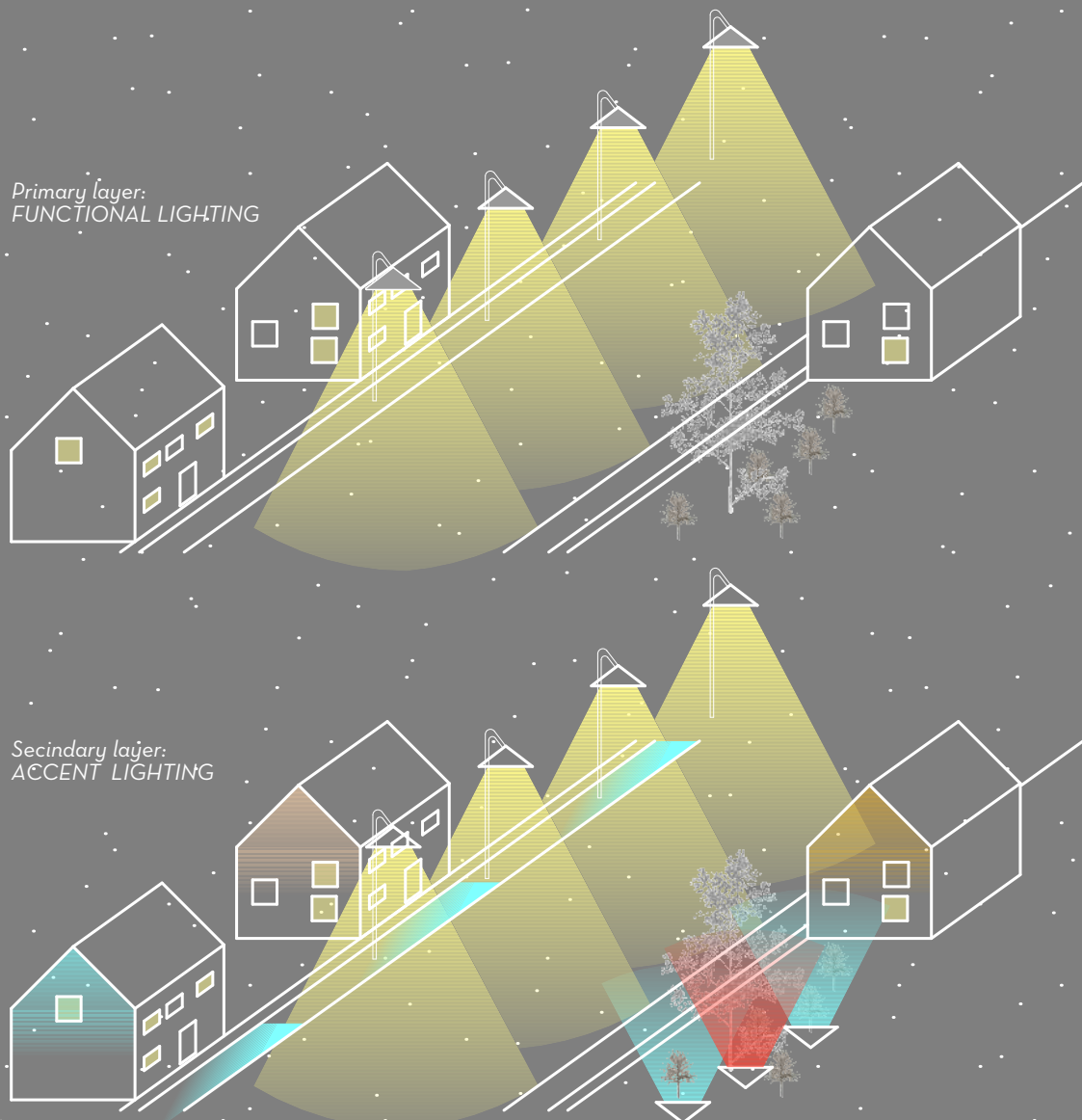


The notion of **security** is characterized by:

- technical conditions of the environment such as appropriate width of a road, denivelation between sidewalk/motorway/bicycle path
- mounting heights of lighting
- distance between buildings
- other factors that ensure unhindered movement of all actors in the public space

Example: Typical street profile with differentiated areas for vehicles and pedestrians, both in plan and in section.

The major task of lighting infrastructure at night is to preserve spatial hierarchy in the townscape according to its daytime rhythm. (2016) Nikolic B. C2 Light and space Outdoors, KTH Architectural Lighting Design This is nonetheless hard to control and achieve, because of the fundamental perceptions of two different times of 24h span. People associate daytime with work, studying and other activities that sustain the economic survival. On the other hand, the night time is mostly perceived as leisure, relaxing, unwinding period, where everybody's schedule is usually more flexible and less dependent on a social system.













Square A		Bright	Dim
Overhead	Uni form		
	Non-Uni form		
Peripheral Slanted in	Uni form		
	Non-Uni form		
Peripheral Slanted out	Uni form		
	Non-Uni form		

Figure 8 - Square A was a 12 m x 12 m natural environment with light poles 5 m apart.

The before mentioned study tested different light modes and scenarios on the generic space of two squares. They experimented with the orientation of light, type, temperature and directions. The results of the study confirmed what was the initial hypothesis - the primary condition for people to thrive in the night is to be able to observe and/or predict their own position at any instance of time, in any little corner of the space, and thus to preserve their physical integrity.

"For preference, as a composite of pure evaluation, restfulness, excitement, and behavioral intent, **the uniform, bright, or overhead lighting achieved higher scores than did the non-uniform, dim, or peripheral lighting.**"

Lighting modes and their effects on impressions of public squares (2016)

Jack L. Nasar & Saleheh Bokharaei (The Ohio State University, United States, Shahid Beheshti University, Iran)

Further argumentation explains:

"Non-uniform lighting has dark spots that offer places of concealment; dim lighting hinders one's ability to see; and peripheral lighting hinders one's ability to see what lies further ahead. In contrast, uniform, bright, and overhead lighting more closely approximates daylight conditions and may offer clear views of what lies ahead. Thus, the preference associated with the uniform, bright, and overhead modes may arise in part from heightened uncertainty or fear of crime after dark."









Square B	Bright	Dim
Overhead Uniform		
Non-Uniform		
Peripheral Uniform		
Non-Uniform		

Figure 9 - Square B was a 24 m x 24 m built environment with some planting and light poles 7.5 m apart.





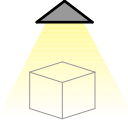
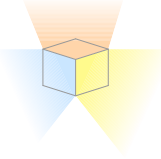


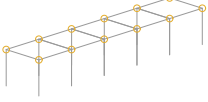
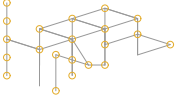
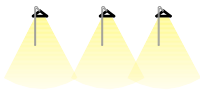
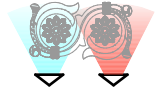
Besides solving the functional safety/security requests, appropriate lighting systems could be utilized for distracting people from these primary concerns. Similar to carefully orchestrated landscape design versus raw nature, aesthetical qualities of urban lighting are bringing up the playfulness and attractiveness of public spaces, and by doing so making them more inviting and socially inclusive. At this point, it may be credible to claim that perception of personal safety is depending mostly on the trust - to both public and individual social units. In addition, considering the overall image of the night as leisure time, it is no surprise that playful space configurations also increase perceived safety levels and strengthen community trust.

Furthermore, the said authors state: "The effects of lighting in urban squares may also vary with factors not studied here. It may vary with different kinds of public spaces, such as sidewalks or parking lots, or in squares in different contexts (such as the openness, the neighbourhood, the size and type of building nearby, and the number of occupants). Perhaps a more diverse range of squares having desirable features, such as sitting space, more vegetation, food vendors, and some form of triangulation (such as sculptures) would lessen the emphasis on safety and bring out other aspects of evaluation."

This leads to a conclusion that space which contains more programmatic values than solely the primary layer of infrastructure, (namely a complementing type of accent lighting as well), is more likely to attract peoples' attention and thus activate the public space. In certain climatic settings, such as pronounced north or south orientation, which experience long hours of winter darkness, the features of quality public lighting are especially appreciated.

Duality of Lighting typologies

Comparison

FUNCTIONAL LIGHTING		ACCENT LIGHTING
<i>permanent</i>		 <i>usually temporary</i>
<i>homogeneous</i>		 <i>heterogeneous</i>
<i>illuminates the object/place</i>		 <i>light itself is an object</i>
<i>light source is not observed</i>		 <i>light source is observed</i>
<i>urban design 's component: necessary</i>	<div>YES — YES</div>	<div>YES — NO</div> <i>urban design 's component: optional</i>
<i>network type: rigid</i>		 <i>network type: flexible</i>
<i>perceived as: infrastructure</i>		 <i>perceived as: ornament</i>

INTERVIEW WITH LIGHTING DESIGNER ÅSA HOLZ

As one of the methods in the early phase of research, a semistructured interview was conducted with Åsa Holtz. Being a lighting designer and the local, she helped me clarify the understanding of basic lighting rules for the stage and performance arts. The main body of her work is situated precisely in the theatres or dance stages, but the overall conversation was fruitful and informed me about the importance of the following:

- When designing stage lighting, the first questions to ask are **"Where does the audience come from? Do actors/performers want to be seen? What is the position of the seating auditorium in relation to the stage itself (in level, below, above...)"**?"

- The colour of lighting is a sensitive aspect and often misused. People have preconception how romantic scene should be presented, or violent one etc. **Experimentation with the colour gives the best results when it is very subtle fluctuation from a standard white light.** In particular, blueish light is claiming attention and putting more emphasis on the task/stage.

- It is easier to control all the parameters of light when one works inside, so within the urban realm certain considerations change: first and foremost the profile of the street determines the choice of different functional solutions, then the type of permanent installation of lighting bodies calls for special attention in incorporating those into the urban fabric, and finally, the mere form should be speaking to people and interpreting the vernacular plastic values of what we know as "a lamp". One good example was noted in the same neighbourhood where Åsa lives and the thesis site Stigbergstorget is located - Majorna. The classical table lamp form is here taken to the street level and supported by the appropriate illumination of urban furniture, bike parking stands etc.



Own photo, Lamp post at Mariaplan, Majorna 07/02/2019



SYNTHESIS

HOW?

*The power of architectural practice is the way discipline transcends the boundaries of a drawing medium and materializes our imagination. Spatial correlations which architects envision before transferring them to paper could be referred to as a peculiar method, commonly known as **research by design**. This practice, often praised by other disciplines, provides the architectural design with successful concepts which emerge from the usually long process of presenting, visualizing and iterating spatial conditions.*

In the architectural experimentation on my own, I have tried to control and plan the outcome of the studies, but inevitably some of the findings caused feelings of suspense, surprise or even delight. The five generations of model studies encompass models of different levels of craftsmanship, details and scales. Nonetheless, each one of them bears a specific knowledge which I have tried to embed as cornerstones of the design proposal.

Departing from the fenestration in the cityscape, the first sketch model (generation 01) is illustrating the simple relation between the façade openings and a source of light. The lower the lamp is set; it will result in longer shadows. The outcome image will bear a texture of the perforations. The model was intended to be a basic impression roman theatre configuration, in which it did not succeed. Nonetheless, it has inspired the next generation of the models simply by triggering the question of the plan versus section/elevation.

The principal purpose of the model studies is to explore light features, but at the same time to consider the situations from the physical site. That is why the model generation 02 makes a conscious effort of reducing the building elements, in order to enhance the perception of the void. Six different section planes are set in the configuration of five parallel positions and the longitudinal axis - the sixth section. Together they form a spatial structure which is perforated in form of the important demarcations of Stigbergstorget, such as 12 trees residing on the square, windows of nearby lamella housing and the entrance portal of the cinema Kaparen. Conceived this way, the model addresses the importance of scenographic design approach where an urban designer is seen as a director, which carefully frames the perceptions of the spatial sequence.

Generation 03 and 04 are direct descendants of the previous model work. Since the lighting of the void proved to be a successful formal experiment, the question of architectonic volumes and the possible programme came to mind. The primary set up of the elements is same - interconnected section planes, activated by light. However, in this step, a scale was considered a more relevant parameter. In addition, the variations of openings, their depth and dimensions were tested. The overall slope of the Stigbergstorget square was projected in the leaned plateau for possible seating arrangements. The outcome of the experiment became reminiscent of constructivist aesthetics. Of course, the materiality of the structure is a crucial factor in determining the said aesthetic expression. That is why the model was eventually painted black, in order to focus on the lighting outcome. This enabled a new perception of the same structure which is a reminder of the importance of the colour of an illuminated object. In terms of black surfaces, we are affirming the primary perceptive change humans experience in the nighttime - the change of depth of the visual field.

The impact of the black and the altered perception, are followed by a more elaborate generation O5 which challenges exactly the mentioned depth of the visual field as well as the traditional architectural representation techniques. The method is inspired by hand drawings where in case of presentation of urban agglomeration, image consists of the front plan, second plan and the background – the third plan. In the same fashion, what emerged to be eventual site model is in this case presenting three layers / plans of space: a) Stigbergstorget with trees and its immediate contact buildings, b) tram railway with the nearby facilities of housing and Maritime Museum and at least c) the motorway E45 along the riverfront of Göta Älv.

LIGHT SETTING

The overview of the lighting configuration photographed in each of the model phases is the following:

- a) generations O1, O2, O3, and O4 are primarily depicted in the setting of the white backlight with some images in the overhead light
- b) generation O5 and its derivatives are photographed in a vast variety of colours, light temperatures and intensities. This is achieved by using Philips Hue LED Lightstrip Plus, controllable by the Phillips Hue app.

Why LED strip?

Since the initial phases of experimentation provided the richness of architectural qualities, in a very scarce variation of lights (dependant on the infrastructure at school) the need for more flexible and controllable light source emerged. Firstly I intended to build a DMX “the Digital Multiplex (DMX) protocol also known as DMX512 or DMX512-A, is an industry-standard method of achieving lighting control, both manually (using a control panel) and for lighting automation (using a PC). It finds uses in nightclubs, restaurants and theatres”, retrieved from

*<https://www.element14.com/community/groups/open-source-hardware/blog/2017/08/24/dmx-explained-dmx512-and-rs-485-protocol-detail-for-lighting-applications>. Considering the time frame and the more programmatic aspects yet to be solved, I have decided to embed a readymade product in my models which will provide me with the range of possibilities for altering the light colours and intensity. In addition, lights are **not scalable**, so working with a thin linear element such as LED strip was very convenient in 1:X scale. The product itself is designed for use in different interior spaces.*

ARCHITECTURAL EXPERIMENTS

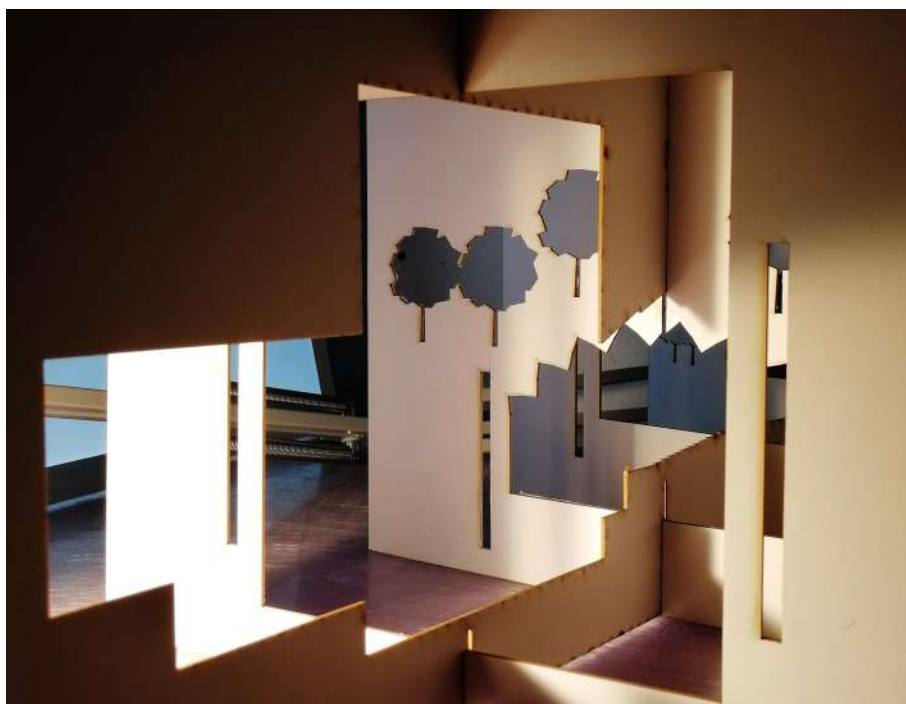
Physical model studies



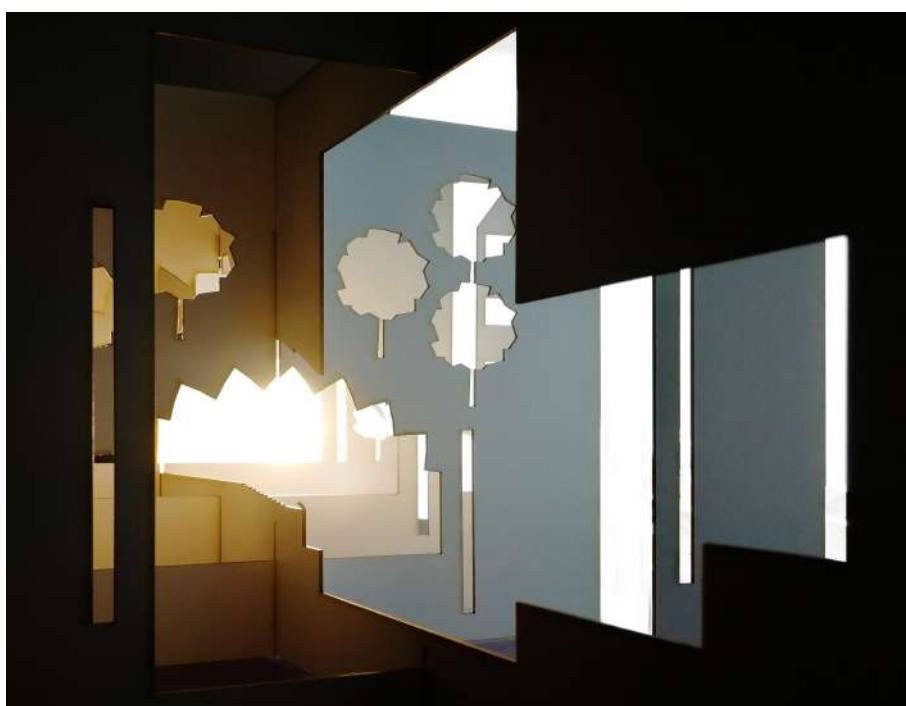
generation 01



generation 02



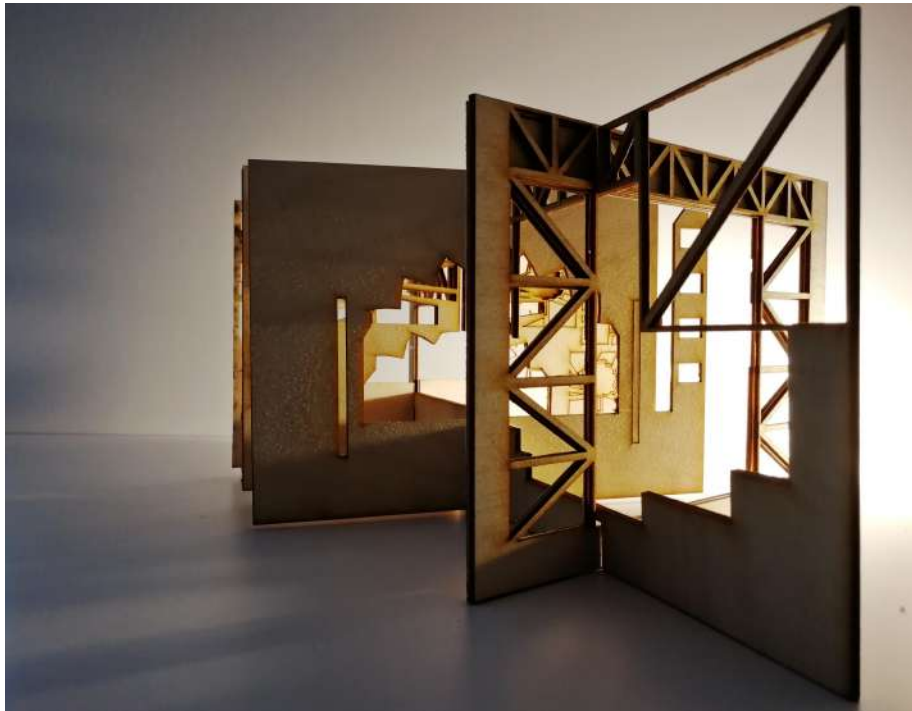
generation 02



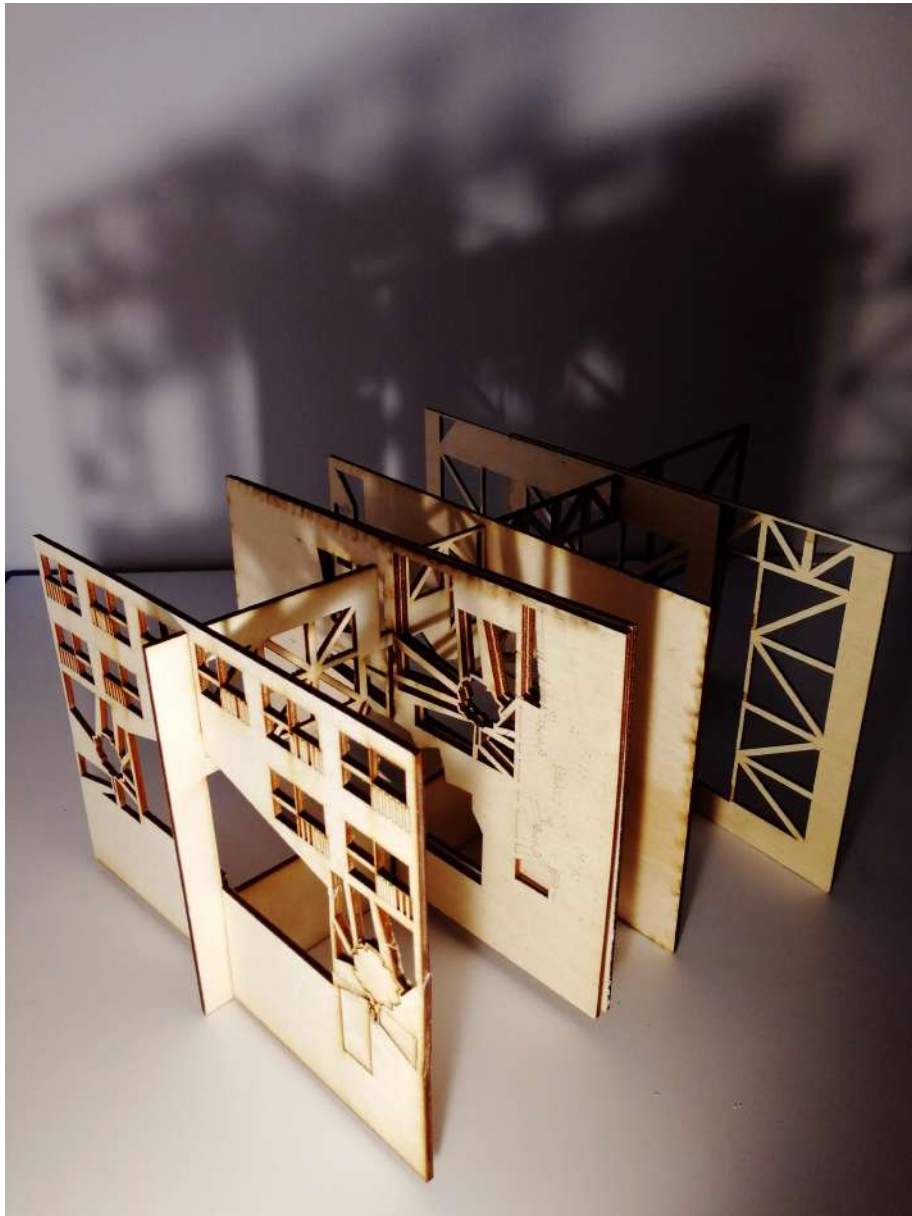
generation 02

In order to comprehend the relationship between light and the open space, and taking into consideration proposed programme of a public stage/scene/open air theater, the early stages of model making are aiming for:

- a) reducing the building elements to the mere section planes*
- b) using the light as a primary space demarcation tool*

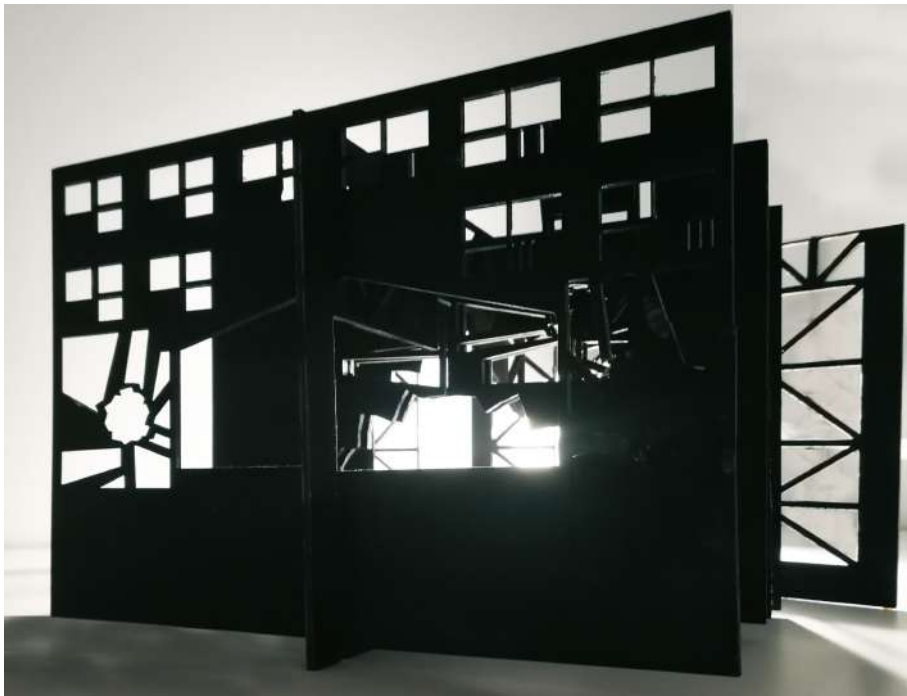


generation 03

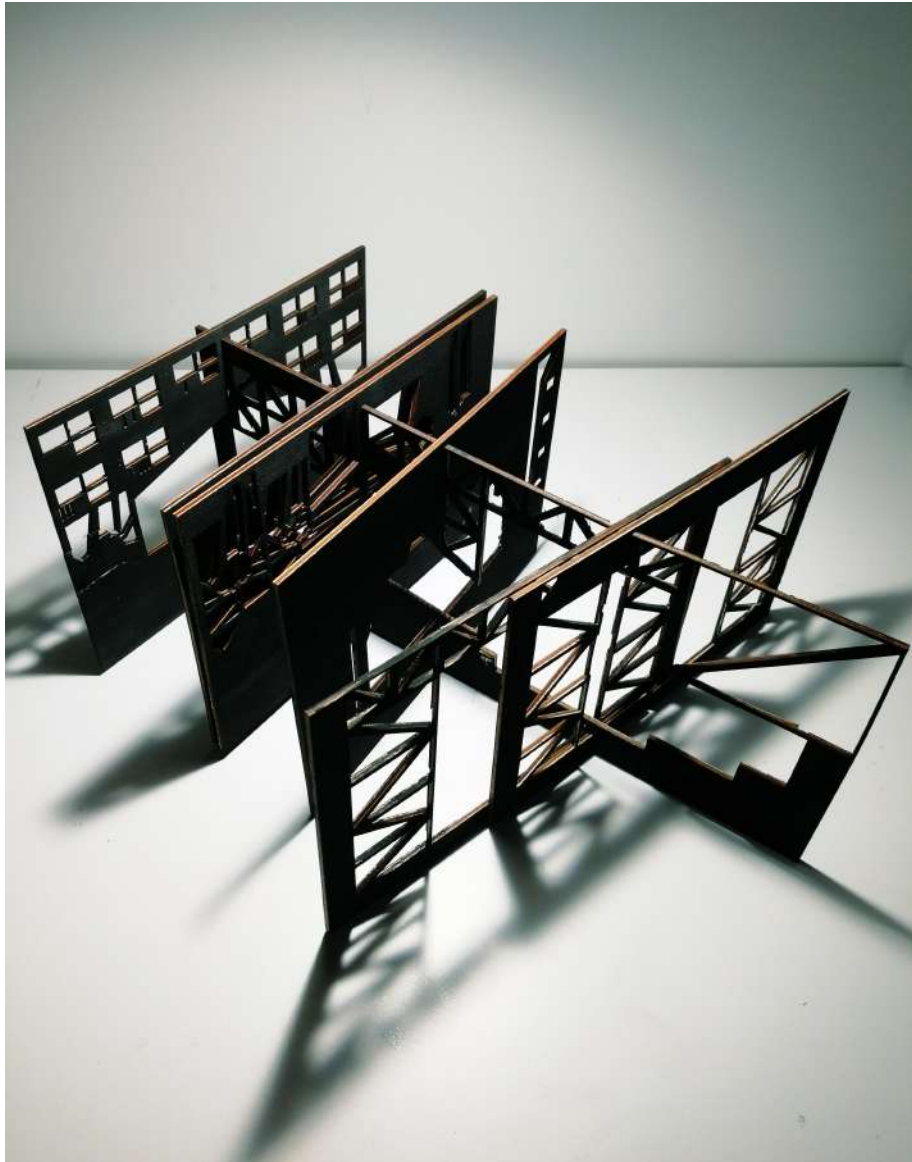


generation 03

Depending on the chosen approach: light ON the object or light AS an object, the physical structure imagines the five sections of the Stigbergstorget in Masthugget, Göteborg. Considering that this is an initial phase of the design, section planes try to include the most important aspects on the site without considerations for actual scale, subtracting the characteristics such as fenestrations of the nearby lamella houses or the presence of 12 trees on the square at the moment. By painting the model black, the sensation of the depth of the field is annulled, thus giving an opportunity for more accurate assessment of the lighting.

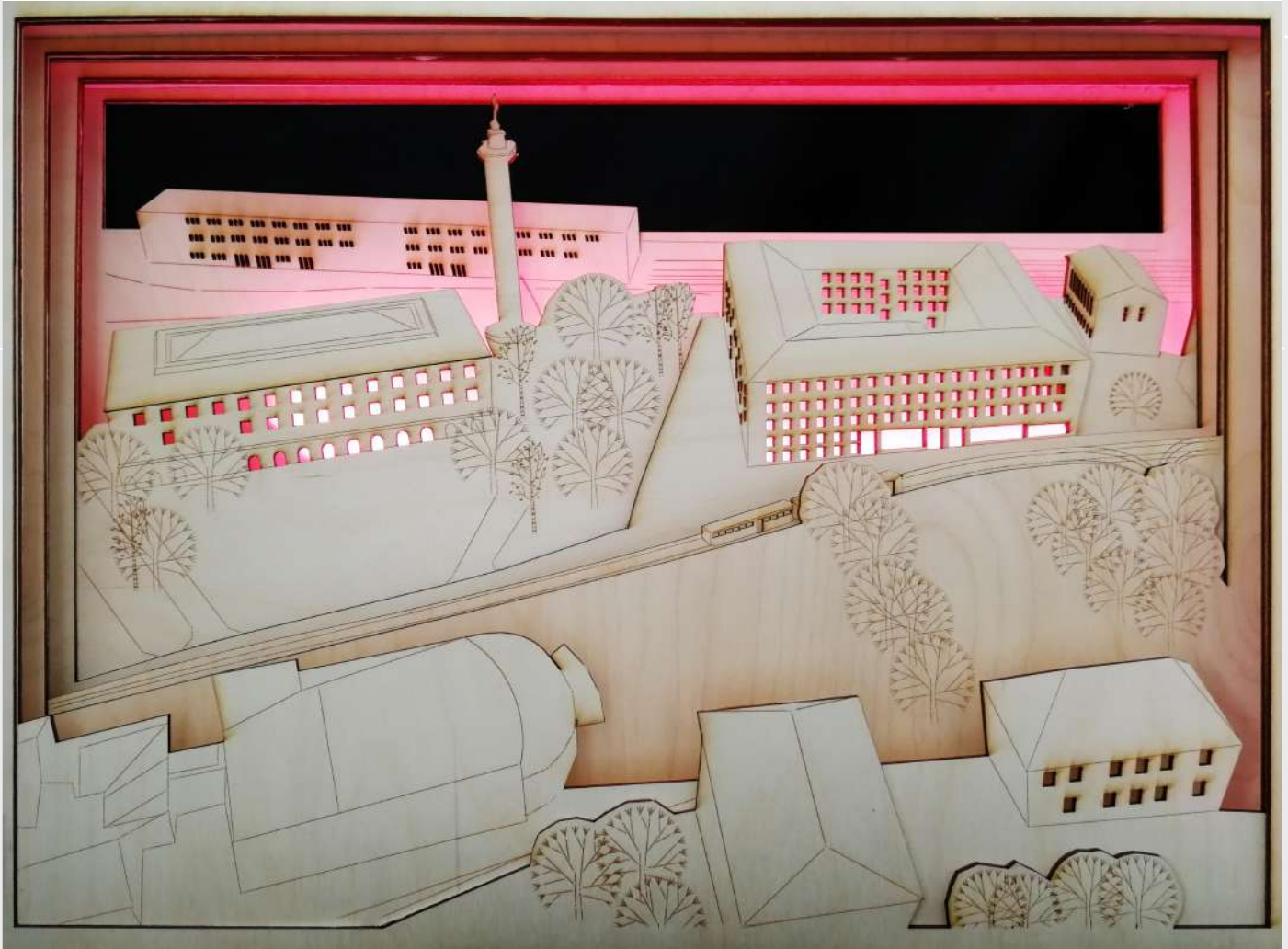


generation 04



generation 04

Site Model 1



generation 05

Three plans of perception




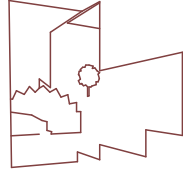
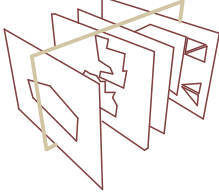
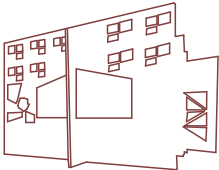
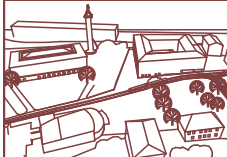
*SPATIAL LAYER 3
Highway E45 by the riverfront*

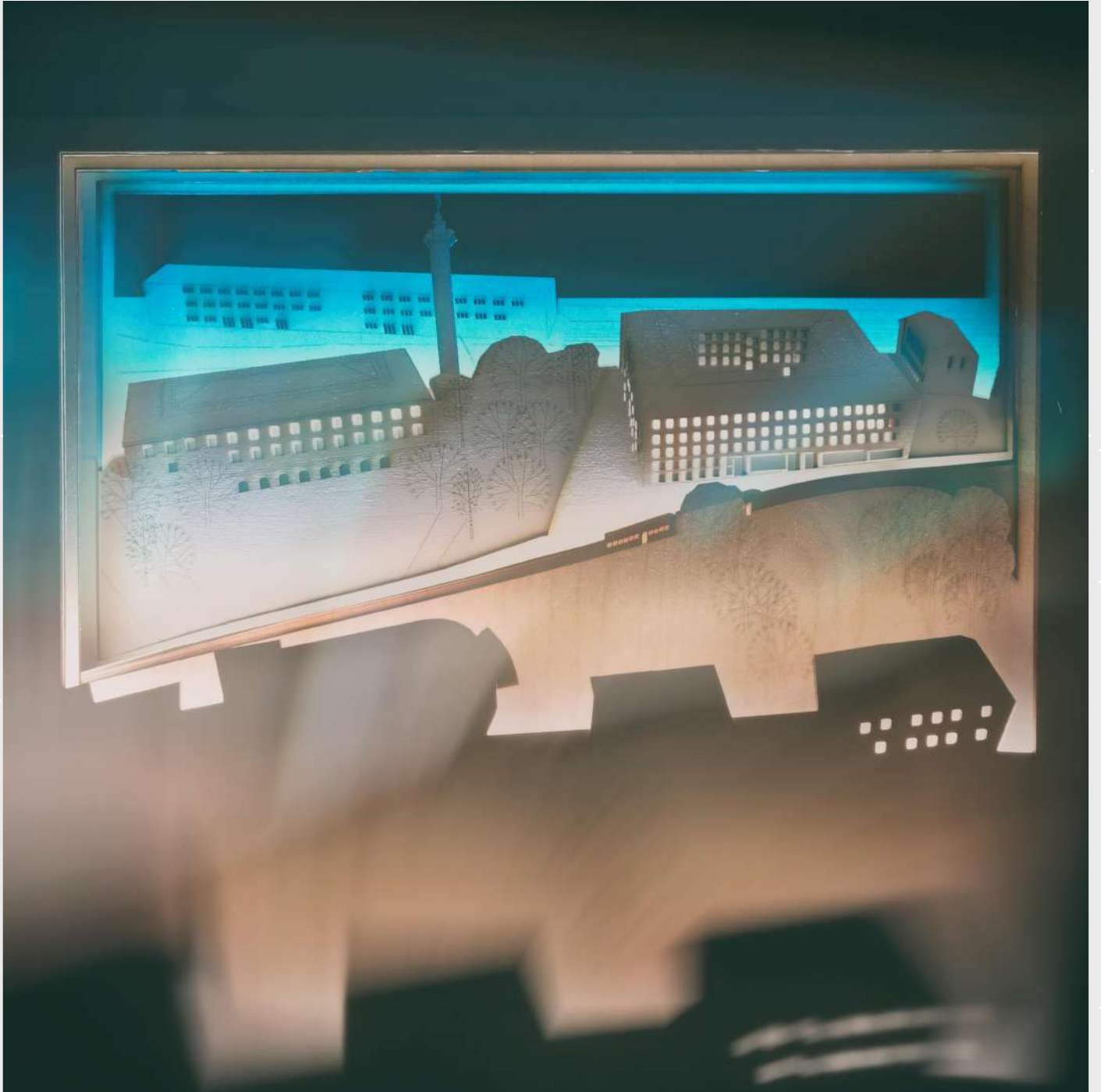
*SPATIAL LAYER 2
Maritime Museum and housing area
separated by the tram rails
from the rest of the site*

*SPATIAL LAYER 1
Stigbergstorget with primary
occupants - 12 trees and relevant
buildings - Oceanen, Gathenhielska
Hus and Bio. Kaparen*

generation 05

Timeline of experiments

	AIM	METHOD
generation 1 week 3	 explore the texture of the shadows, the permeability of the membranes/envelopes	a sketch model of the roman thathre structure with the radial load bearing linear elements and the seating spaces on top of them - use perforated paper and wooden sticks, photograph with the backcast light
generation 2 week 4	 represent the characteristic sections of the site and use only light to mark the spatial void	a model consisting of 6 different sections, corresponding the dynamics of the square which is in constant slope in various directions - include the most relevant aspects of the context as openings in the frame of section, such aas lamella hoousing windows, bio Kaparen 's entrance portal, 11 existing trees on the site etc.
generation 3 week 5	 inhabit the sections, test the variations of depth, height, fenestration etc	a more elaborate model consisting of 5 different sections, slightly altered from the previous genration, made in plywood - make a digital model in paralel in order to understand possibilites for variations of the dimensions but taking into account the scale, size of the sqare and programm requirements
generation 4 week 8	 test the perception of the depth of space by painting the previous model black	previous model, when painted black, gives a different impression of spatiality, primarily by reducing the sensation of depth and further enhancing the openings - photohraph in the backcast lighting
generation 5	 experiment with light color and intensity, in different spatial layers	a model which tests the depth of visual field but in a new manner -an axonometric view of the site is "sliced" into 4 layers where each claims different light solutions; they nonetheless form a compact three-dimensional image



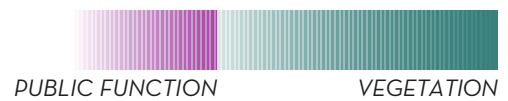
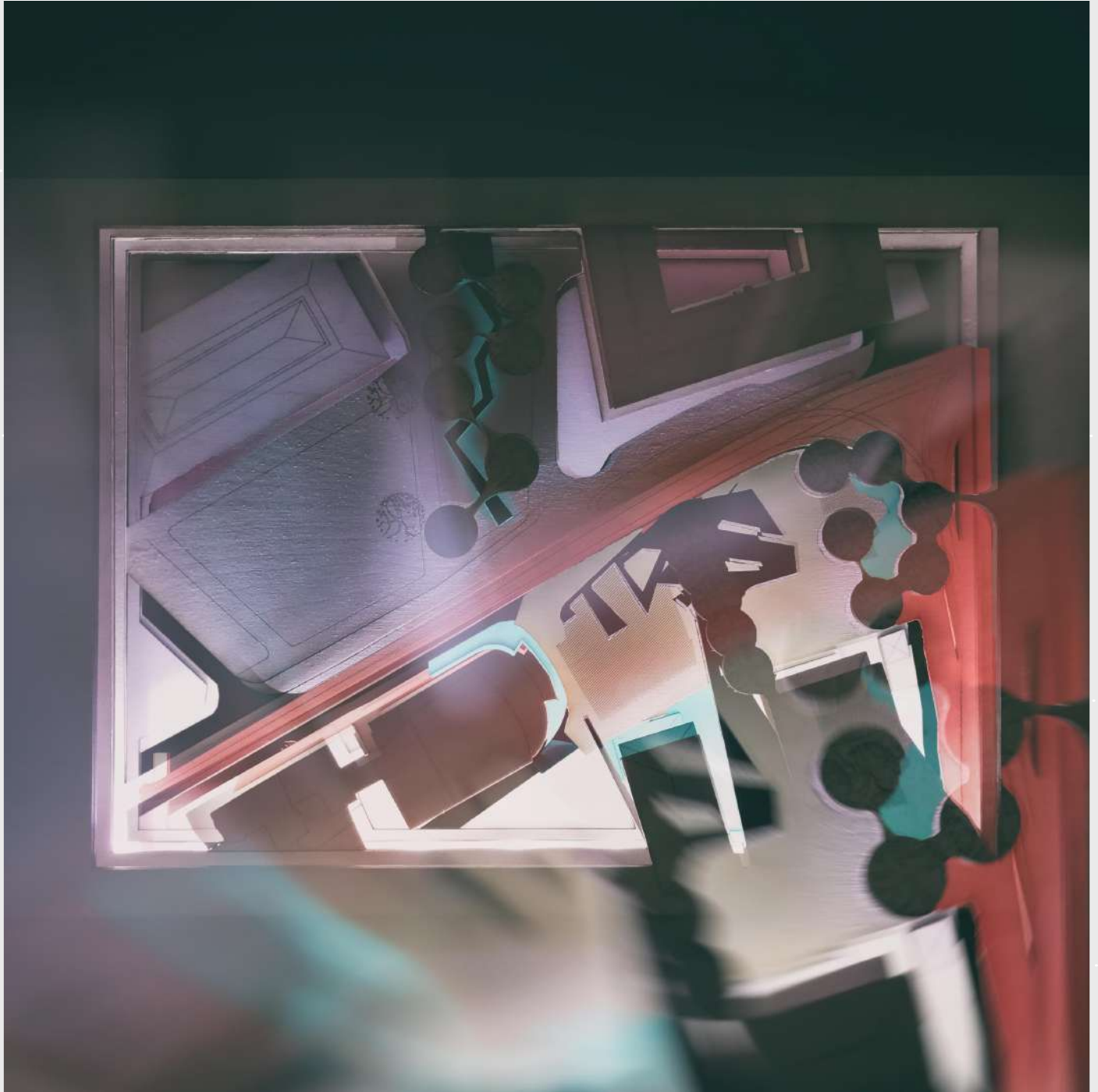
3 PRIMARY LAYERS OF PERCEPTION IN THE SITE MODEL



NEAR



FAR

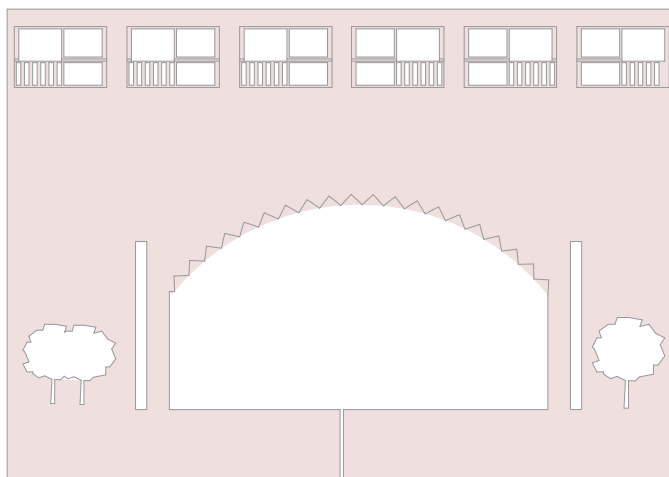
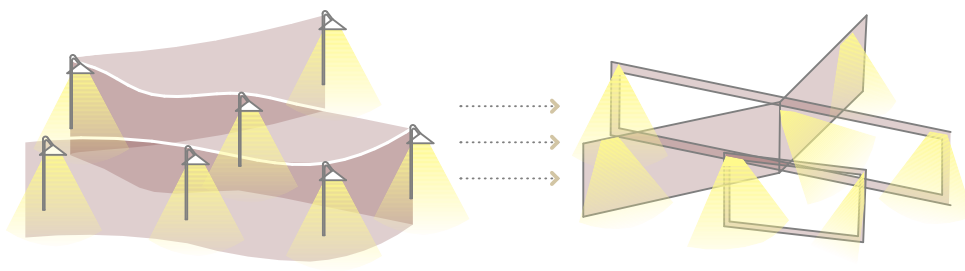




DESIGN PROPOSAL

Design Strategies

*FRAME THE SPACE
between the units of the lighting network*



The requirements of:

1. **Lighting** (built in lamps that illuminate the space)
2. **Scenography** (playful arrangement of frames in space create opportunities for various types of activities to happen)
3. **Context** (openings correspond to the existing built structures, such as windows of the nearby Lamella house, trees inhabiting Stigbergstorget, the canopy portal of the cinema Kaparen etc.)

Programme Overview

	PROGRAMME	PHYSICAL ASPECTS	LIGHTING CONDITIONS
place 1	stage for: gatherings, concerts, plays, having lunch, street/flea market, philosophical dialogues	the former parking lot, a plateau which is not modified by any means except for being framed with a gallery on north, while street kitchen objects are removed cca 20x30m	primarily cool blueish light offering a clear overview of the stage space, additionally accent lighting with color variations and lower luminance for the surrounding frames - the screen and gallery
place 2	more quiet zone: possible backstage, place to sit, unwind, talk, exchange books, read, do yoga	consist of two parts - "elderly" pavillion pampered among the first group of trees; and existing open space framed by the portal cca 20x25m	the pavillion as a closed structure is planned as a space with minimal glare, increased contrast, light on the task areas; square space is more illuminated by dimmed primary light, while the accent is put on vegetation and the plasticity of surrounding buildings
place 3	very quiet zone: a linear structure offers the space for observing the riverfront, nearby park of Maritime museum and Stigbergstorget	a linear gallery departing from street line through the trees, which generates height difference 0-3.4m cca 55m long	lighting is more experimental, it can be positioned directly above or below the gallery platform, and provide for interaction with people, (smart lighting) as it is not high enough to affect the nearby housing and museum buildings and cause privacy conflicts

the gradient of privacy

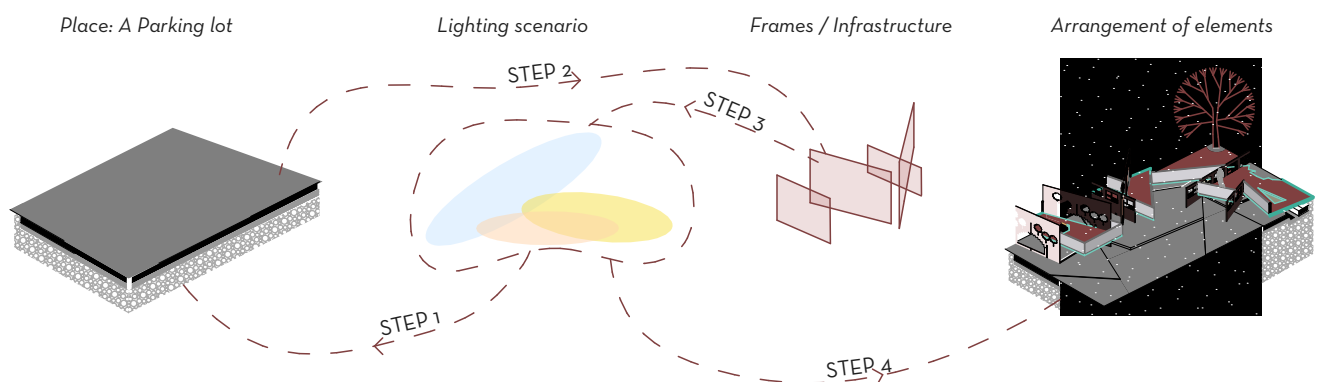
Digital Modelling

The establishment of the design proposal was running hand in hand with the research. Still, given the challenging nature of the task - defining programmes according to the appropriate lighting environment, the formal expression of the work changed several times (see Appendix). The core of the final proposal is equally leaning on physical and **digital models**. The latter was of utmost importance for defining the arrangement of elements in space.

Usual design flow is consisting of the following steps:

- 1) define the lighting scenario for the desired activity and visualize it in a 3D rendering engine (great help and reference in this phase was *Light for Cities* - Ulrike Brandi, see Background chapter)
- 2) Extract the information on the mounting height of lights, their intensity, colour and the opening angle of the cone. This is to be a base for determining the placement of frames in space, their height and width.
- 3) Render the image again, now with the frame elements and their materialization.
- 4) Evaluate the tectonic values of the structure and proceed with physical models again.

This process was repeated multiple times until the three main places of interventions were defined. Those are the main stage, backstage with elderly pavilion and the gallery among the trees.

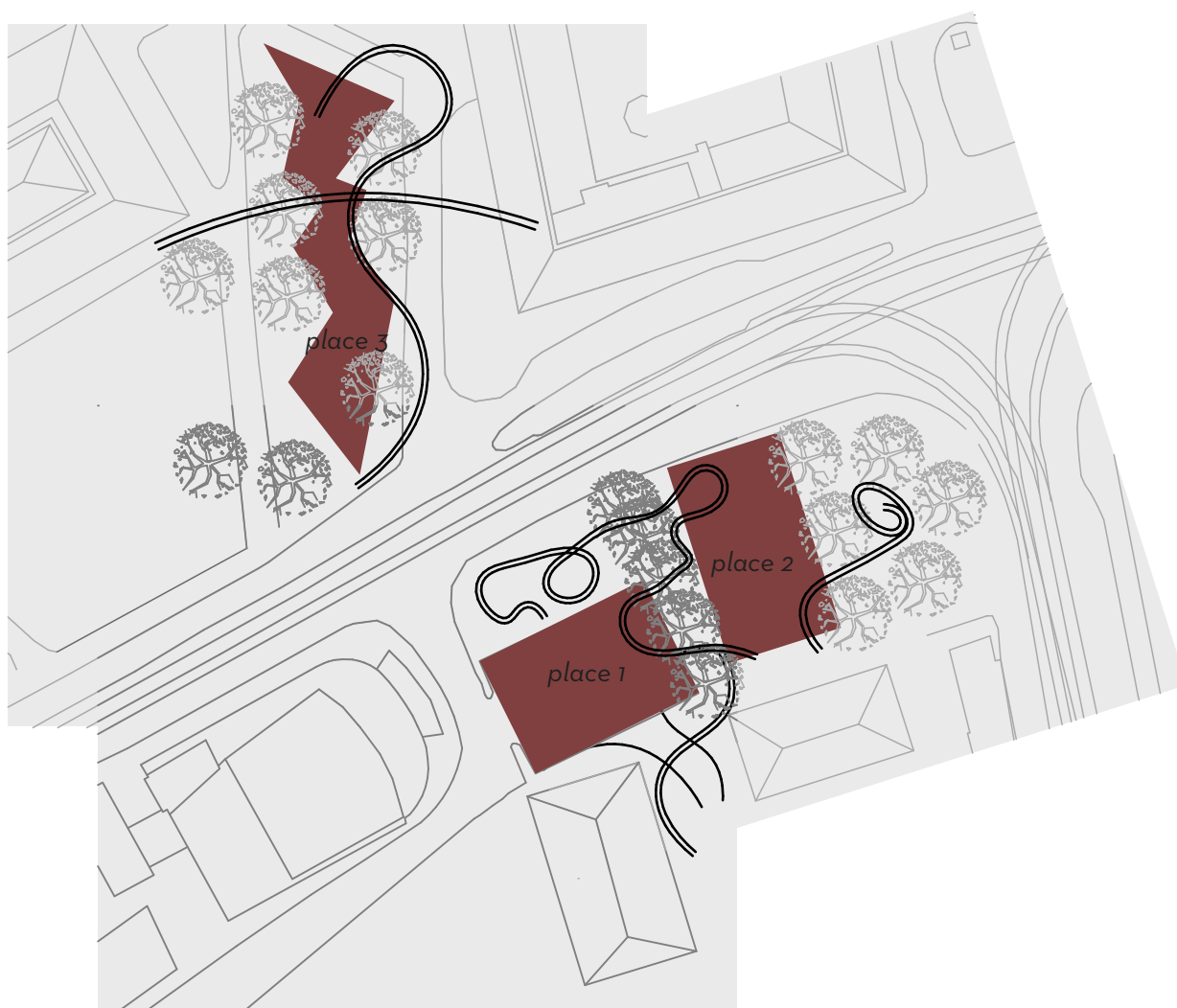


1) A parking lot in front of cinema Kaparen

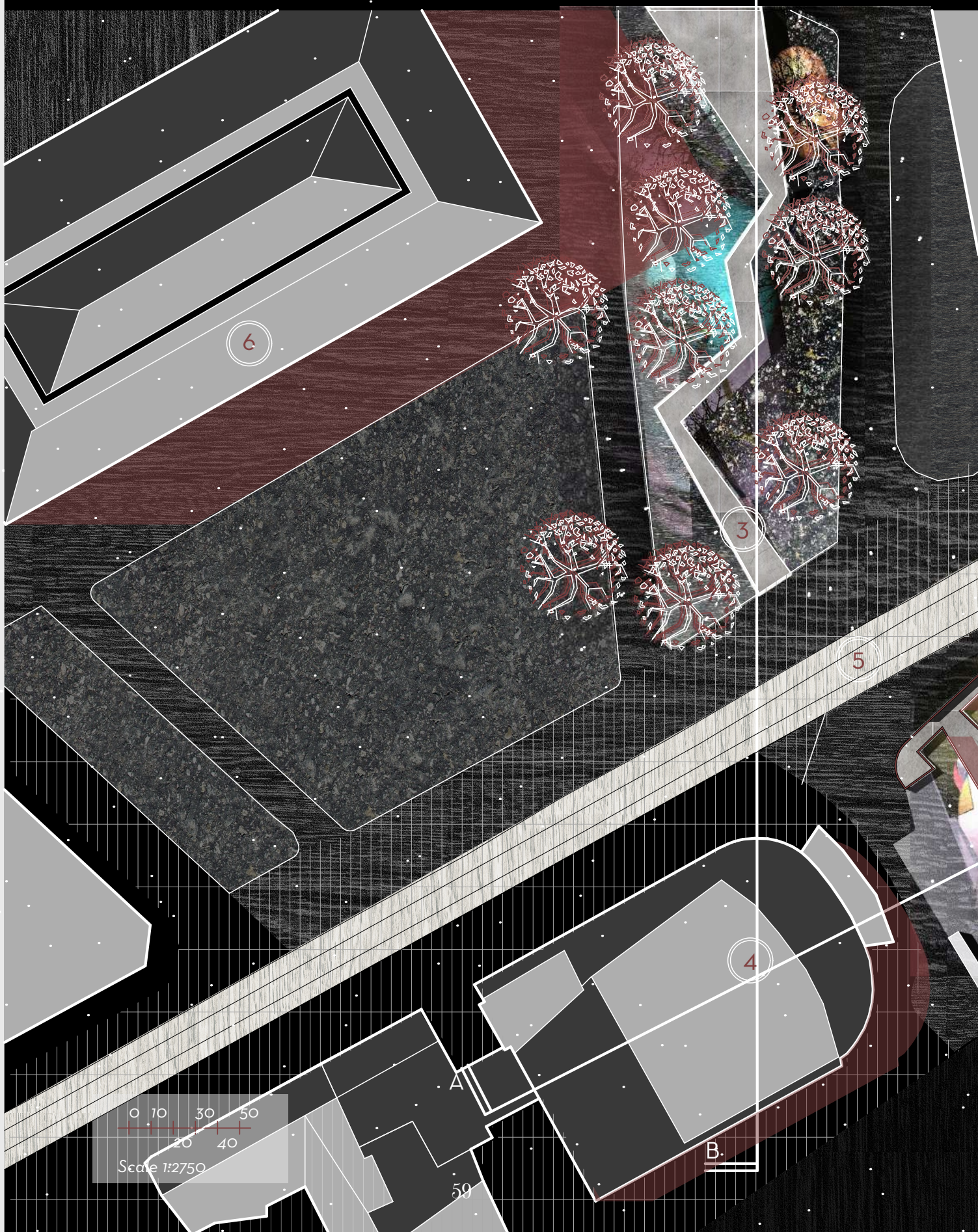
2) Square space facing Gathenhielska Huset, an outdoor room in between two layers of trees

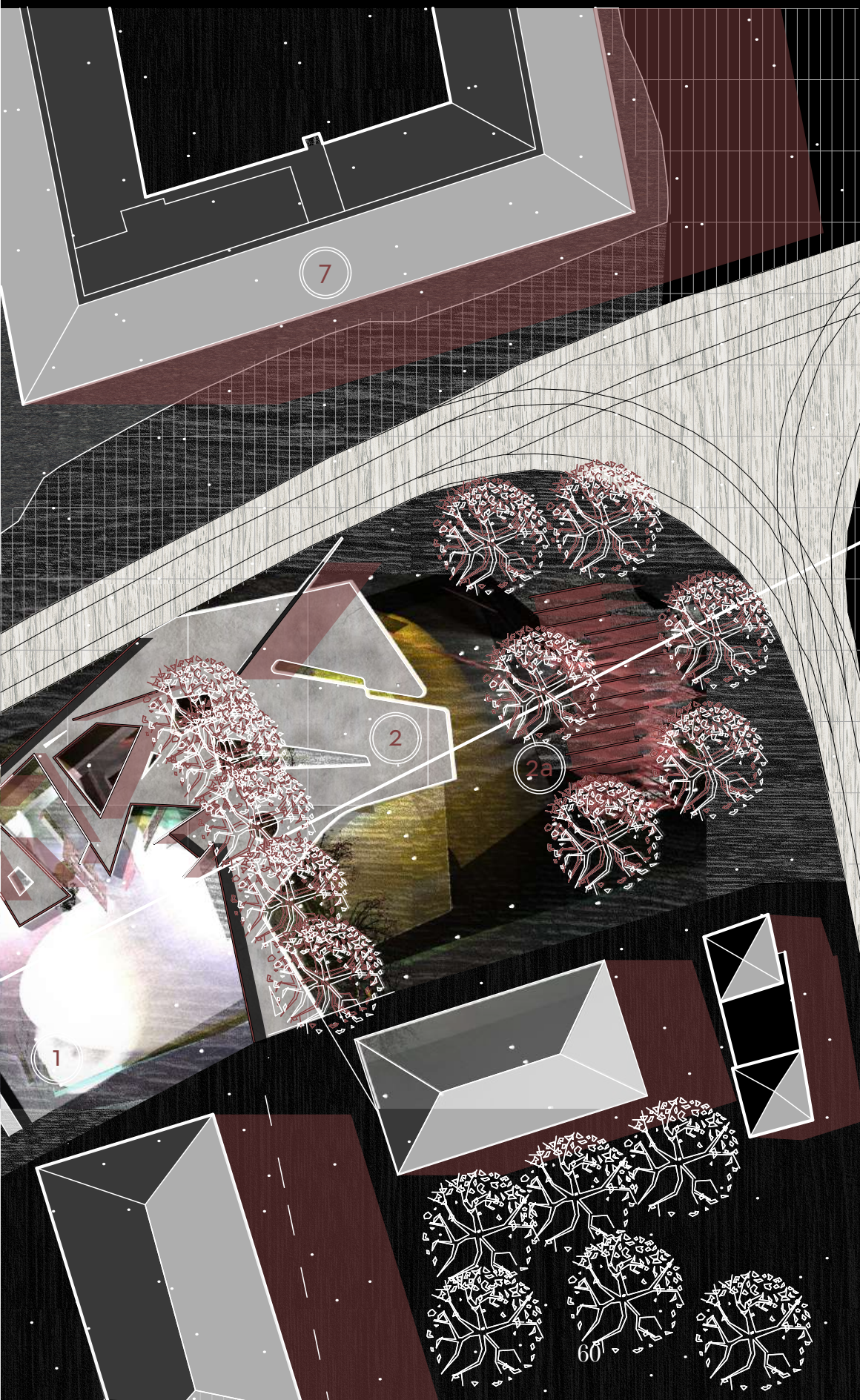
3) a cluster of trees on a sloping green area

The black curves represent planned flows of people.



Stigbergstorget Situation plan





A

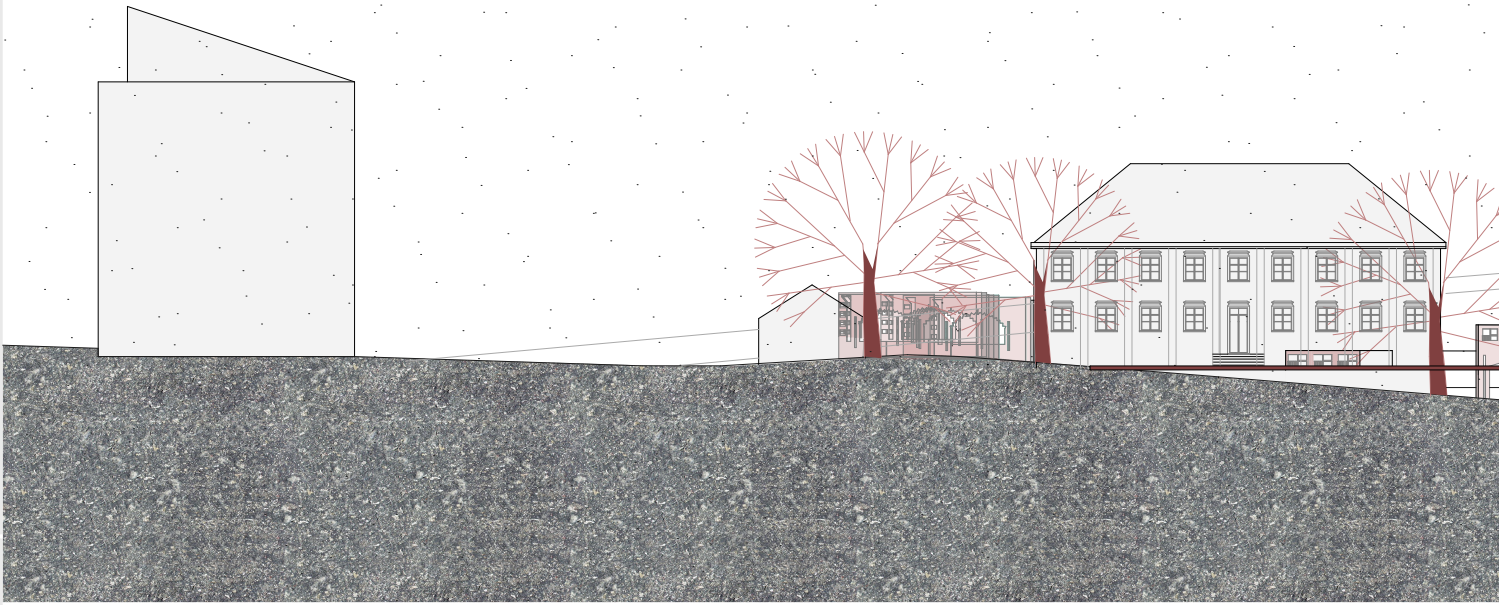


LEGEND

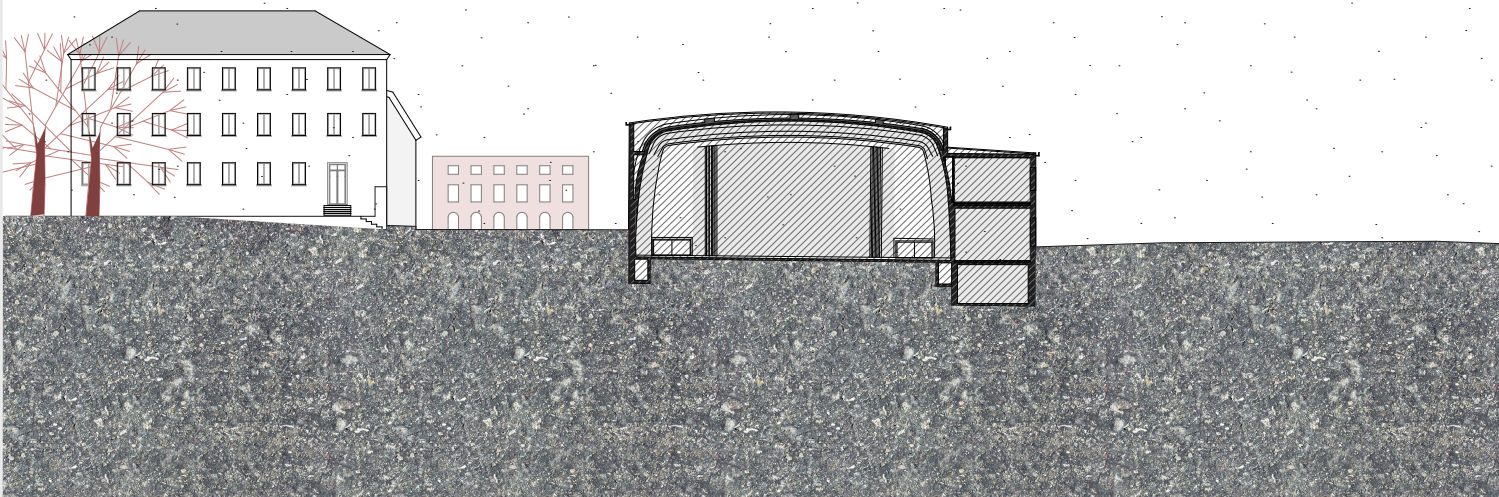
- 1 The main stage
- 2 The "back" stage
- 2a Pavillion for elderly
- 3 The tree gallery
- 4 Bio Kaparen
- 5 The tram rails
- 6 Maritime Museum
- 7 Bio Fyran/Bengans

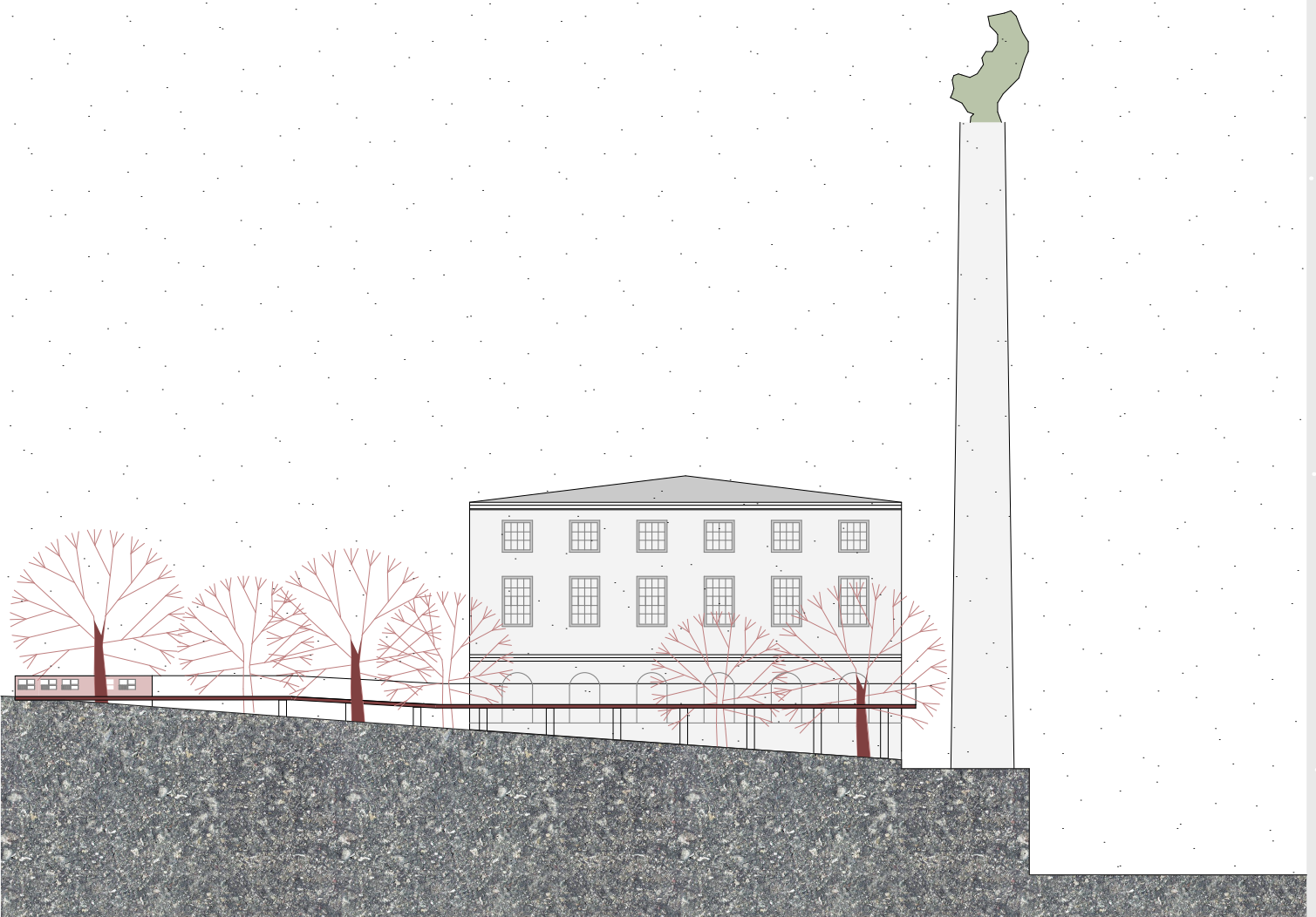
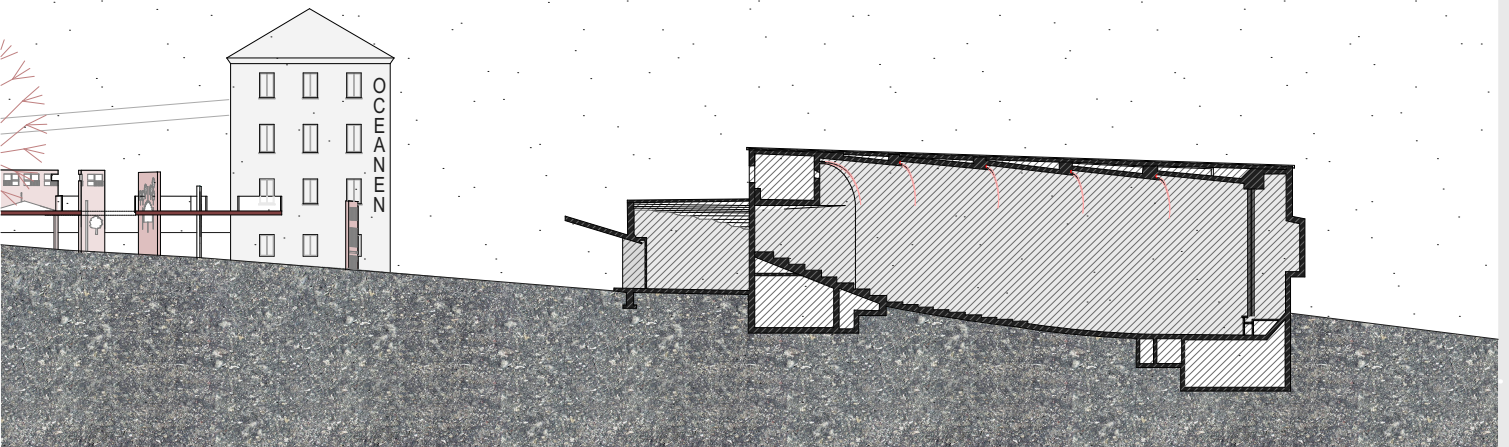
Stigbergstorget Longitudinal Sections

A-A



B-B

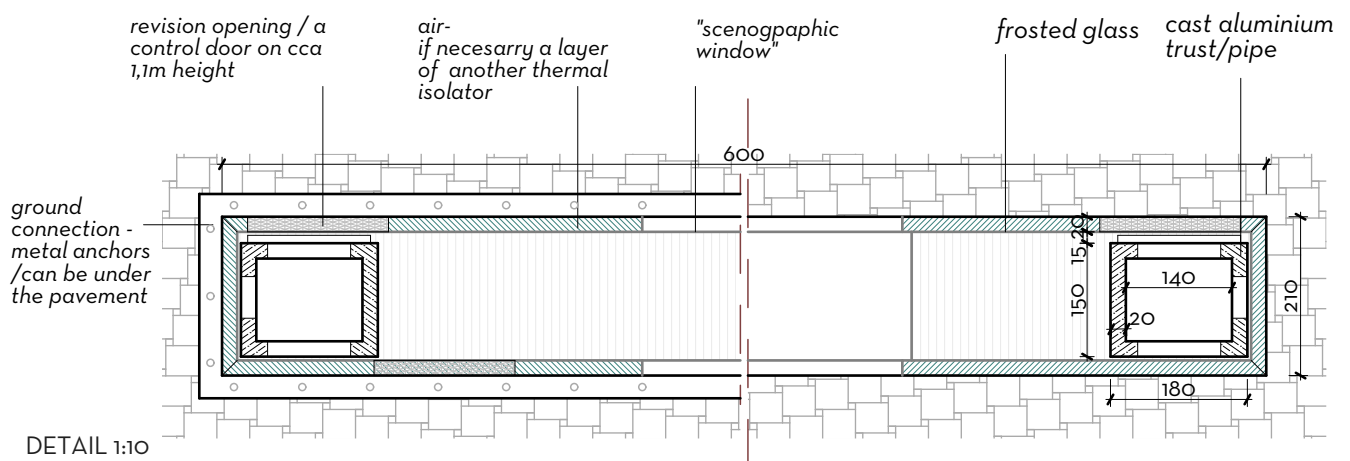




The frame 1



ELEVATION OF THE FRAME at place 2



Backstage

Atmosphere

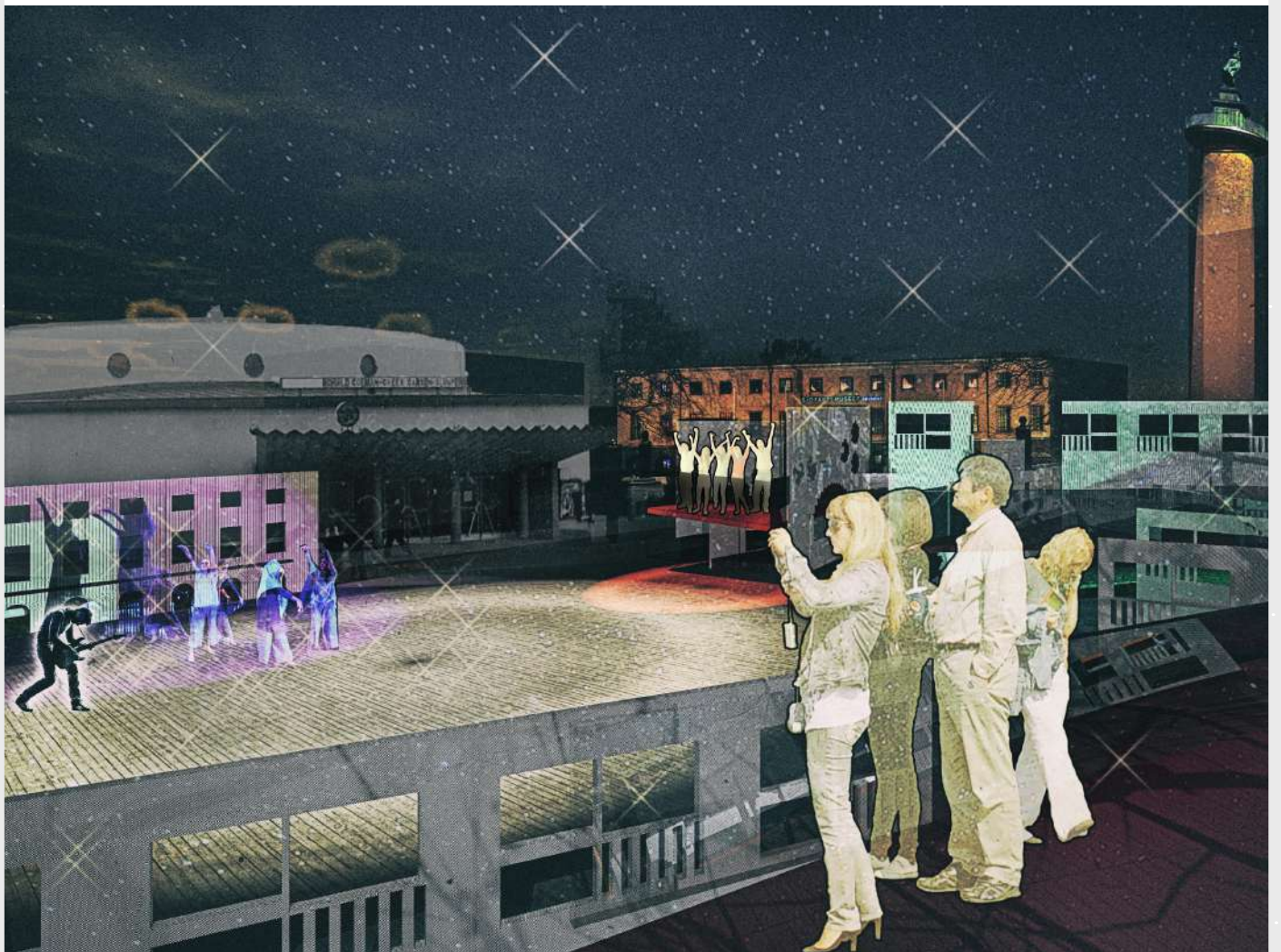


Main Stage

Atmosphere



PHYSICAL MODEL



DIGITAL MODEL

Backstage



PERSPECTIVE DAY



PERSPECTIVE NIGHT

Human Perspective





LIGHT/DARK BALANCE
APPRECIATION OF THE DARKNESS

Programme Outcome

Derived from the architectural experiments and the digital models, the overall design strategy was to meet appropriate lighting settings for scene and performance art by using one element.

It this case it is **a frame** which is acting as:

- a) piece of infrastructure bearing the luminaires,
- b) an urban furniture artefact which provides seating places and observing platforms, as well as
- c) a scenographic structure whose playful arrangement of frames creates opportunities for various types of activities to happen.

To deduct it even further, the proposed spatial element is intervening in two planes - vertical one - consisting solely of frames and the horizontal one - a flat gallery surface that exploits the prominent slope of the site and the height differences which are up to 3 m. Modular character of the proposal is reflected in the frames which can be dismantled and placed somewhere else, while highly contextual aspects are linked to the flat gallery hovering above the sloping plateau.

The design is, therefore, focusing on three scales: **urban**, addressing lighting infrastructure

network, **place** - making the spaces for a variety of activities and provide for urbanity to be sustained 24h a year round, and finally the **detail** scale, where the understanding of relations of different actors in space such as frames, their connection to the ground, the trees, mounting openings for lights, their height, angles poisoning etc.

The core of the final proposal is equally based on physical and digital models. The latter was of utmost importance for defining the arrangement of elements in space. For example, in the visualization here, is presented the light setting of the backstage. Between the two layers of trees, a dimmed light is employed in order to direct observer's attention to the vegetation / with the landscape red light, or the places where the activities such as musical or dance performances are happening. This makes it easy for a possible audience to detect its position in relation to the event, by staying in the darker zone. That is how light is demarcating space for observers and objects to be observed.

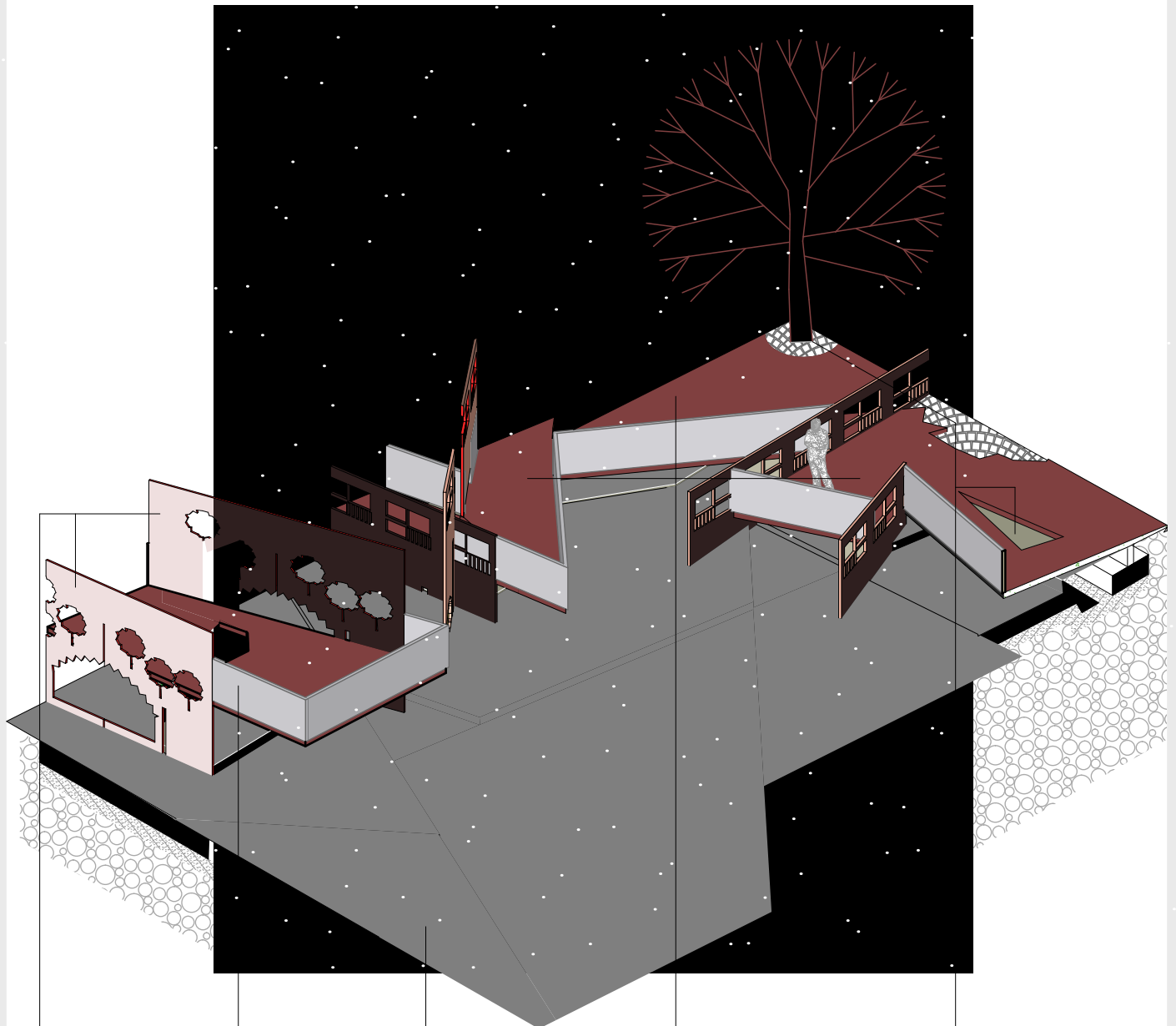
In terms of the programme, the design is proposing the space for:

- The main stage at today's parking lot
- The backstage in between two layers of trees
- The elderly pavilion which is situated in the midst of the first cluster of 6 trees
- And the gallery for observing the riverfront, located on the opposite side of the street, between the Maritime Museum and the housing block.

But what do these zones of programme, such as the elderly pavilion in this context mean? Well, the elderly pavilion is envisioned almost like an interior space which is characterized by the soft shadows, light on task environments, smooth transitions from dark to bright zones, increased contrast but reduced glare. It is designed for a certain age group but in terms of architectural content, it can house a street library, open market or just a meditative space where one could read in silence. Since the interest of the design was to reconnect Stigbergstorget with its subzones, the gallery among the trees aims to bring more attention to the greenery, landscape and riverfront.

The atmosphere is varying in the different places of the site. A person taking a tram down Karl Johansgata or Stigbergsliden could encounter the bright lights of the main stage, dimmed low lighting of the backstage, soft glow of the elderly pavilion and more expressive lighting below the gallery among the trees.

ZOOMED IN



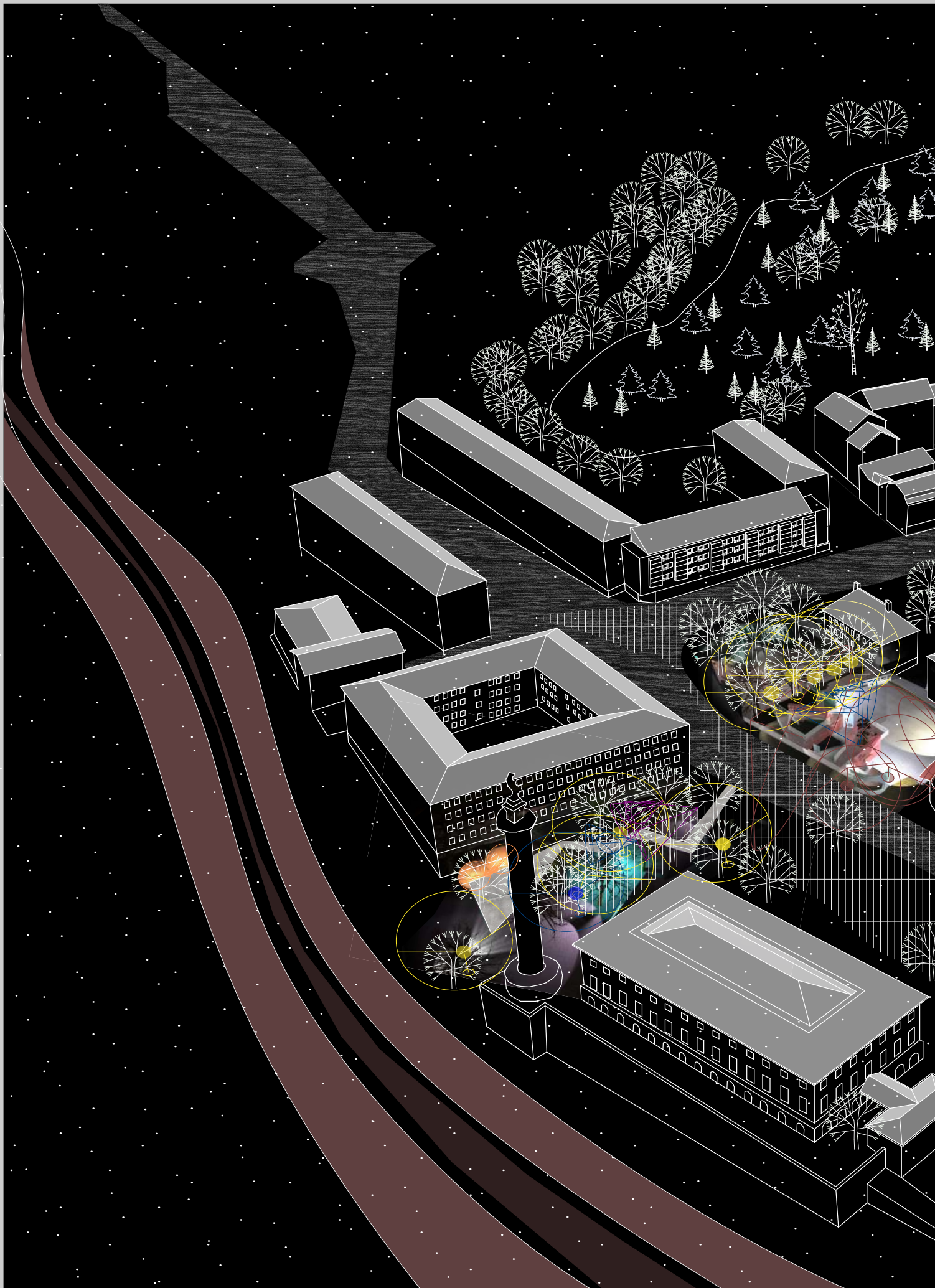
*The frame
- lights bearing cast
aluminium structure
with the fiberglass
envelope*

*Reinforced glass
panel - in the
service of gallery
fence*

*Concrete - finishing
surface of the main
stage - not
modified from
today's appearance*

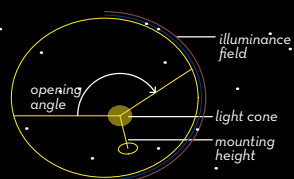
*Solid wood paving -
impregnated with
iron sulfate or
treated with
characteristic
swedish red wood
paint*

*Stone paving - in
the slab openings
the current aspects
of site are
expressed such as
stone paving or
gravel around the
trees*



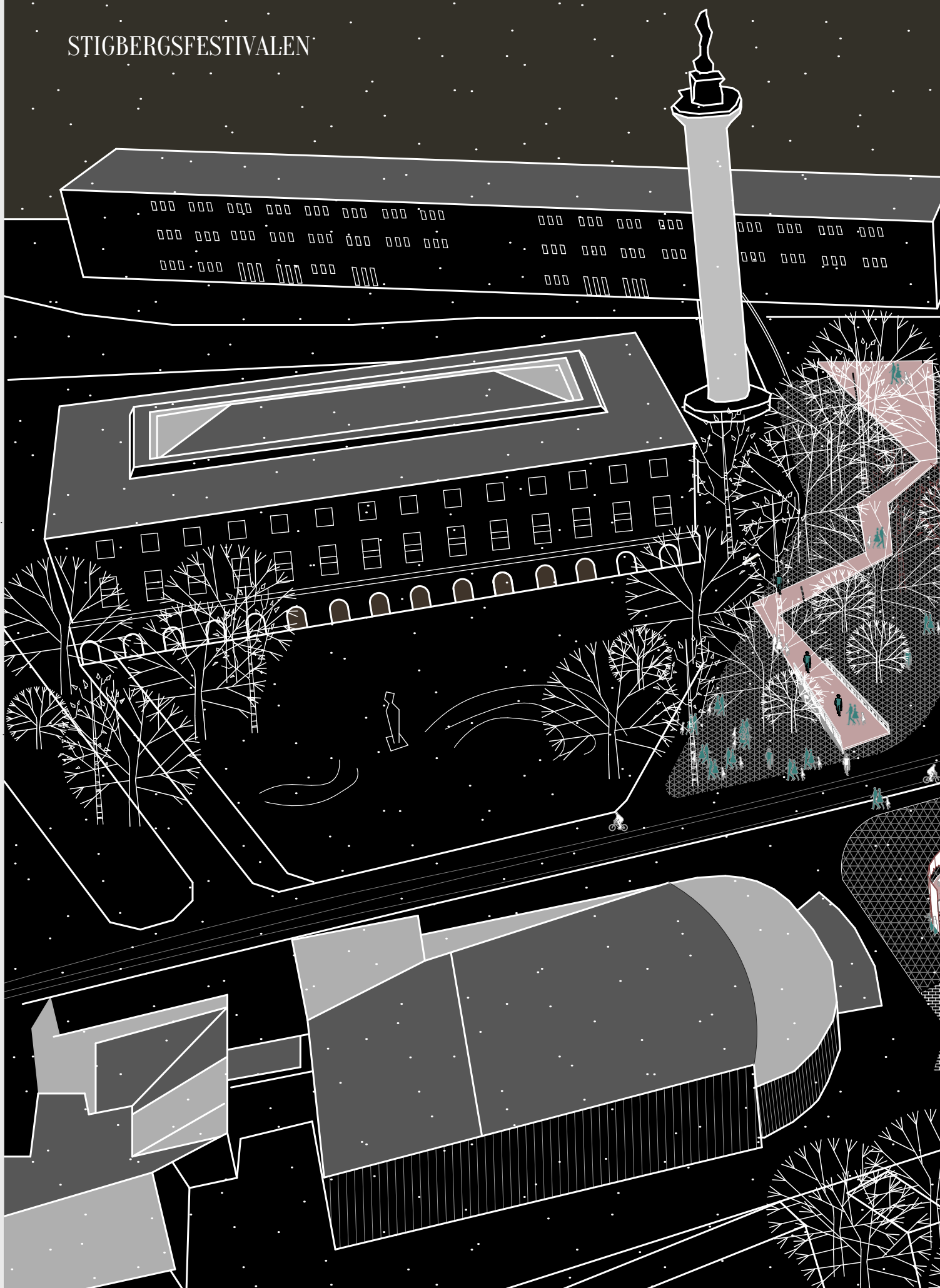


LEGEND



NOTE:
 - The color yellow corresponds to the low color temperature, blue is the opposite - higher color temperature thus the cooler light
 - Lighting cone is marked with color only if the light source is pointing upwards towards the "camera"

STIGBERGSFESTIVALEN







CONCLUSION

As stated in the initial chapter on the lighting theory, light does not require a material medium to be propagated. Similarly, the primary concern of architectonic values is to provide for the integrity of the void. In other words, the empty space is what matters, both in the interior architecture, public space and therefore, the lighting network as well. Nonetheless, the network itself could and should be questioned, reinterpreted and reconstituted in consideration for the functional requirements of our ever-changing environment. The social metamorphosis is by default taking place faster than its spatial imprint, but the consequences of the change are inevitable.

Firstly, the challenge of the energy consumption worldwide will lead to restructuring of the lighting network infrastructure around the globe. Considering that governmental management is accountable for implementation of the said reforms, as every matter of the public interest, a shift towards more sustainable methods of illuminating our cities will be gradual and slow. The time spent should be however seen as an additional challenge to promote global environmental health and try to use smart lighting systems for long-term improvements. Examples of possible uses are numerous, most commonly addressing the need for embedding sensors in the luminaries which will be collecting data on the air pollution, traffic frequency, flows of people and other living beings, etc. "Smart street lighting is gaining momentum as cities and service providers recognize the value of intelligent, connected and energy-efficient lighting." Webinar: Smart Cities Lighting, Philips Lighting University

As a second point, the architectural programme related to the nighttime can be further explored and even revolutionized. Not only should the planning practice start to prioritize the night image of the city, but also try to establish permanent development strategies. What if we start to design vice versa? From the night function to the daytime. Would the urban fabrics still maintain the same morphological values? Considering the self-driving future, what will we do with the parts of the vast lighting network that might not be a necessary infrastructure quite soon? Can we utilize that space somehow?

Given the unusual design process conducted in this thesis, the answer to the latest question is: certainly so! The creative motivation for many emerging professionals including lighting designers, product and industrial designers, architects and urban planners, can be derived from the uncertainty of the outcome. Since the technology and the major stakeholder - transportation industry are changing, the moment should be utilized to resurrect the spatial paradigm of cities for people. In that fashion, shouldn't our lighting become more individual, formally adapted to the certain cultural milieu and most importantly inclusive? Tackling the problems of social exclusion and different types of segregation are obvious parts of the wider discourse of the thesis and therefore would require additional studies or public atmospheres orchestrated by light.

Reflecting on the design proposal, I cannot resist asking what outcome could have been generated by challenging the static nature of public lighting. The technological advancement is surely more tangible in the interior space and a range of very intuitive, fun and useful products is available on the market. But in terms of public scale, this is not the case yet. Taking into account the self-driving future of transportation, it is implicit that the light should be also planned for humans again. Is it going to become more customized, individual even portable? How can our built environment adapt to mobile lighting? Facades, pavements, roofs, urban furniture and so on could all be impregnated with the lighting assistance character. Thinking holistically about the space is the key to the synthesis of the human experience and formal expression of the urban forms.

Concerning my personal development, I have to point out that this thesis has inspired many new questions which I will aim to resolve in the future. Among others, I would aim to dig deeper into the atmospheric values of different lighting scenarios and the more innovative methods of giving a plastic form to light. The major moral of the story is emphasizing the importance of transdisciplinary approaches in planning and architecture. Learning from a lighting designer, artist, engineer or philosopher, in a self-conscious design process will lead to the conclusion that there is a common logic in every kind of creative thinking and engagement.



René Magritte, La Bonne Aventure (Good Fortune), 1919



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