#### Dedication

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A nagyszüleimnek és szüleimnek, akik támogattak és óvtak az utamon. Mert gyakran akkor értékeljük legjobban a családunkat, ha távol vannak.

Kochanemu dziadkowi Marysiowi, za cały ogrom miłości, wsparcia i wiary we mnie przez te wszytskie lata dane nam razem. Aalborg University Copenhagen

Title: Nature inspired lighting design for a green urban area in Saint Petersburg, Russia



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#### Abstract

Project done in collaboration with ITMO University in Sankt Petersburg Russia, as lighting design proposal for Sad San Galli park within the complex Development Program of the city St. Petersburg as the center of lighting culture for the period 2018 – 2030. Based on decent analysis of the space and its users with the use of anthropological and urbanistic tools, taking users opinion into consideration. Biophilic design capturing with light the phenomenon of a sun sparkling on the water surface was developed to address the areas of improvement found during analysis. Innovation was introduced to the park through the custom fixture, modular system combining functional and effect layer with uplight highlighting trees, resulting in elevated aesthetics, increased feeling of safety. Design inspiration taken from nature aim to remind people of a value of a green oasis in the city, invite diverse users to the park after sunset and encourage to feel mental ownership of such a unique public place. Uniqueness of a lighting design for Sad San Galli has a source in the use of colored light along with traditional white. Research in existing knowledge pointed to the colored light as a tool to create nighttime identity of a space but in order to achieve desired effect test exploring the human perception of coloured light was conducted. Final design is a nature inspired lighting giving a Sad San Galli user a chance for a valuable, restorative experience in the green urban area.

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First chapter of this report has an important role to introduce the reader to the context in which the project was realized. This project, being the master thesis of two students who have been working together around the topic of nature inspired light over the year before the thesis semester started, is a development of the Sensitive Organism semester project, done by us and introduced in **CHAPTER 1.2**.

Prior, in **CHAPTER 1.1** we explain, why we decided to continue with the Sensitive Organism idea, what were our goals for this master thesis and thanks to whom we could successfully finish it.

It is important to mention at the beginning, that this thesis is an output of a collaboration between our home university - Aalborg University in Copenhagen and new partner - ITMO University in Saint Petersburg in Russia. **CHAPTER 1.3** describes the motives behind this collaboration.

As with this thesis we finish our education in Aalborg University, proud to teach according to problem based learning system based on defined process model, in **CHAPTER 1.4** we present our process model tailored especially for this project.

## 1.1. Foreword

As we have chosen to develop our 2nd semester project - the Sensitive Organism concept into our master thesis project, we would like to make a comment about our motives for this decision. It is to some point following similar project structure and repeating some of the theories discovered before, during second semester. We are aware that master thesis should raise the bar higher and prove that each semester left us with useful knowledge and we are curious to discover, learn more.

For the master thesis semester we were given a chance to collaborate with ITMO university in Russia and under their supportive supervision create a lighting proposal for their real client. ITMO is involved in the relighting of green urban areas in Saint Petersburg, and we were given one of the parks to work with. This means that besides following the academic structure, required for master thesis, we had to consider the client and the realism of this project. The Sensitive Organism, our project-fundament which we redevelop here was an idealistic concept where vision was strong, but many of the technical question for its implementation in reality were unanswered. This time, the aspect of having a real client lead us to the general attempt of a fixture design, as a main technical tool that would help to implement the effect we want to achieve.

Change of country, influencing not only weather conditions but also culture - user preferences and customs, was another challenge we had to face and consider in our design. That is why we exposed ourselves to the local culture by moving for almost 2 months to live and work in Saint Petersburg, in the environment we designed for.

One of our main goals for this project was to prove ourselves that we understood what we have learned at AAU and that this knowledge matured with the practise over those 2 years. Here we talk about problem based learning, following the steps of a design process, making analysis with the use of urbanistic and anthropological tools, visualising light with various softwares and techniques, talking about light in phenomenological way, testing the concerning aspects of our concept before defining the final solution.

Delivering this project, we are satisfied to finish our education in an interesting collaboration with ITMO and exploring our interest - nature inspired lighting. This was an important step into our solo career after graduation, solid revision of our knowlesge and skills, training our trandisciplar approach.

#### Thanks

From this point we would like to to sincerely thank a group of people who supported us to realize this project and successfully get through our education at Aalborg University in Copenhagen. To our thesis supervisor from AAU - Mette Hvass and Georgios Triantafyllidis.

To team form ITMO university and russian students who gave us a helping hand during our stay. To all members of AAU board and fellow student with whom we had a privilege to go through this learning process which we end as much better lighting designers and people.

And last but not least to our beloved families and friends for love, interest and all encouragement.

## 1.2. Initial concept - the Sensitive Organism

Nature inspired lighting design for a green urban area in Sankt Petersburg, Russia, being the topic of this thesis, is a project in collaboration between two universities, Aalborg University Copenhagen and ITMO university in Sankt Petersburg. Project in Sankt Petersburg originates from a semester project called "The Sensitive Organism" done, among others, by us during spring semester in 2017 at Aalborg University in Copenhagen. Interest in the Sensitive Organism project from the representatives of ITMO University led to the further development of the design idea in the russian context and culture.

The Sensitive Organism was developed for a public residential area called "Urbanplanen Syd", located in Copenhagen, Denmark. Built in the 1960s for families from a densely populated area of Copenhagen to offer more space and nature in a healthier surrounding. In the past years, the initial vision of the area frayed, as it got a bad reputation in media; therefore, the Municipality of Copenhagen announced a competition to solve the problem by reshaping the area.

After analysis of solutions proposed by the architects and own investigation in Urbanplanen Syd three main issues stand out: the unused potential of nature, the deteriorating reputation and the lack of integration between different nationalities living in the area. These problems were assumed to be solved with the creation of a new common identity in architecture and the Sensitive Organism concept was developed to maintain this perception in the dark hours.

The refurbishment plan aims for a new, sustainable neighbourhood based on three core values - Games and learning, Community and City Nature. Nature, both ideologically and visually enhanced by the architects with the use of organic shapes in their plans (Fig.1) was chosen to be the fundament on which the concept would be based and from which the the Sensitive Organism vision emerged (Fig. 2).



Figure 1. Urbanplanen Syd future architecture by Tredje Natur architects [1]

Figure 2. The Sensitive Organism vision visualisation

The Sensitive Organism is an abstract structure, a nature inspired concept arised from the organic shape of the area. It had hearts in the most lively squares, veins along the main flows of people and it organs in every place people locate their activities.

Guided by this nature inspired vision, after wide research in the characteristics of nature, the main visual feature of the lighting design was adopted from the natural phenomenon - movement occurring when raindrops encounter a water surface.



Figure 3. Rain ripple pattern [2]

Figure 4. The Sensitive Organism masterplan

## 1.3. New Context - ITMO University

CLD - Creative Lighting Department at ITMO University is a new progressive project aimed at developing the interdisciplinary, experimental and practical potential of light design in what has to do with science, engineering, art, and business established in 2015. It is a unique centre of applied research and postgraduate education in the field of Lighting Design in Russia. Being situated within the School of Photonics, CLD draws upon cutting edge research in Photonics and Optics offered by several International Research Centres of the School.

St. Petersburg state innovative research project is developed by ITMO University in the framework of "The Complex Development Program of the city St. Petersburg (Russia) as the center of lighting culture for the period 2018 – 2030 with the perspective to 2050". The target of the program is the development of lighting in Saint Petersburg, as the first state project in the world, which includes the big data solution, analysis and conceptual foresight of the development of lighting environment in the context of improving the quality of life and developing the energy efficiency on the example of the city. The project is being developed by department "The Higher School of Lighting Design" with participation of leading laboratories of schools of photonics and translational information technologies at ITMO University [3].

The Department of Creative Lighting Design together with "Lensvet", the leading operator of urban lighting in Saint-Petersburg appoint new priority park innovation projects, from which we got assigned to one. One of the main motives of elaborating the thesis is the possibility of realisation as a proposal for a new lighting solution for the chosen area. The other factor is the further investigation of a nature inspired lighting developed in a different context. The aim of the collaboration is also to share and exchange knowledge between the two parties involved in the work process.

## 1.4. Project Process

Project process in the form presented below (Fig. 5) is a combination of problem based theory (Idea generation, Problem analysis, Problem Solving, Design, Implementing, Solution) and Process Model of The Architectural Experiment [4]. Following these steps would support us in the transdisciplinary approach to the project, involving methods and theories from various fields translated into lighting design process. Zoom into each of the steps can be found in the appendix (1).



Figure 5. Process model

# 2 BACKGROUND Chapters 2.1 Saint Petersburg 2.2 Focus area - park Sad San Galli 2.3 Nature Inspired Lighting 2.4 Our Vision

After introducing the context in which the project was realized in chapter 1 (parties involved and the Sensitive Organism origins), second chapter focuses on the current project and places the project on the map of Saint Petersburg. Note about the history and the lighting culture of this city, **CHAPTER 2.1**, explains why nature inspired lighting, in particular water inspiration is relevant to be used.

Basic information about history, future and current situation of the chosen area - Sad San Galli are presented in CHAPTER 2.2.

To make sure that the term 'nature inspired lighting' is familiar to the reader from the beginning, **CHAPTER 2.3** describes its basis terms - biophilia, biomimicry and green urban space, and translate them into the lighting tools.

Chapters 2.1-2.3 factorize the topic of the project - **Nature inspired lighting design** (2.3) **for a green urban area** (2.3 & 2.2) **in Saint Petersburg, Russia** (2.1). In response to the description of the topic in chapters 2.1-2.3, closing CHAPTER 2.4 defines the vision for this project in Sad San Galli in a sentence that captures what we would ideally like to achieve with our lighting design for the users of the park.

#### Historical Note

Brief look at the beginnings of Saint Petersburg will be presented in this paragraph to introduce the context in which project "The Sensitive Organism" will be redeveloped. By this, we aim to notice, that this city has its origins strongly connected with nature and this identity feature is worth to be cultivated today, over 300 years after the first foundation stone of new capital of Russian Empire was laid.

City was founded in 1703 by Emperor Peter the Great as his "window on the West". Located just 7° south of the Arctic Circle, the city was built under adverse weather and geographical conditions. City was spread across 42 islands, on wooden piles and built up land on the inhospitable swamp of the delta of the Neva river and at severe human cost. Plenty of canals of the Neva River, dominant feature of the city is the effect of Emperor's inspiration brought from voyages around the Europe. Thank to this Saint Petersburg was dubbed the Venice of the North. Many of the city's most spectacular architectural sites stretch along the Neva's embankments.



Figure 6. The Neva enbankments during white nights [5]

Orlando Figes in his book "Natasha's Dance" [6] describes the beginnings of this city and few times points out that water and sky was the canvas on which Saint Petersburg was built. This particular observation made by Figes, supports the idea of redeveloping the Sensitive Organism concept, inspired by water features (raindrop phenomenon in previous case) in Saint Petersburg and thus directly refer to its identity.

#### "

Petersburg was conceived as a composition of natural elements - water, stone and sky.

#### Lighting Culture

City's geographical location, only 7 degrees below the Arctic Circle, results in relatively extreme variety of daylight during the day throughout the year - from nearly 6 hours in December, to almost 19 in June. In Saint Petersburg, the summers are comfortable and partly cloudy and the winters are long, freezing, dry, and overcast and the temperature typically varies from -10°C to 23°C [7].



Figure 7. Natural light yearly calendar [8]

Saint Petersburg, due to its high latitude, from beginning of June has 3-4 weeks period when sun does not descend below the horizon enough for the sky to grow dark. This curious phenomenon called White Nights, is what city inhabitants wait for, to emerge from long months of cold and darkness and celebrates the brief return of nearly round-the-clock daylight.



Figure 8. White nights in Saint Petrsburg, Russia [9]

## 2.2. Focus area - park Sad San Galli

Sad San Galli (rus. Сад Сан-Галли) is an approximately 13.000 square meter green island in the Central district of Saint Petersburg in Russia. By local people this place is often called Sengalievskij Sad. Main entrance to the park is from the Ligovsky Prospekt, one of the main avenues of this former industrial part of the city. The park owes its name to respected men of St. Petersburg in the 19th century - Franz San Galli. He was the inventor of a new technology of heating system - the radiator. His company produced equipment for heating buildings, water supply and sewerage - a real god of housing and communal services [10].



Figure 9. Sad San Galli among all green areas of the central districst [11]

Figure 10. Sad San Galli map [11]

Mansion visible on the picture below (Fig. 11), located in the northwest corner of the park, was built in 1870 by architect Karl Rachau for San Galli and his family, next to his factory [12]. On the territory of park, from 1870s there used to be a fountain "Birth of Aphrodite" (Fig. 12). At the beginning of this century, sculpture of Aphrodite was removed to be restored, but still, to the dissatisfaction of people, Aphrodite is not back in San Galli park.



Figure 11. San Galli mansion and entrance to the park [12]

Figure 12. Birth of Aphrodite [13]

Today Sad San Galli is a public park open to everyone also during nighttime. It is balancing between being a place for residents from neighbourhood, as there are not much greenery besides Sad San Galli in the area, and between being a public place for all other passers-by. For many, park is the most pleasant way to get from Chernyakhovsy street on one end of the park, to parallel Ligovsky Prospekt on the other side.





Figure 13. Plan of San Galli Park complex [14]

Figure 14. Sad San Galli [10]

In the near future, the use of the park may change significantly, as behind the wall of the garden on the territory of the former plant are going to build a large-scale San Galli Park (Fig. 13). This topic is open for over 10 years now due to lack of construction permits and change of vision and since 2008 when former building on this area were demolished, new construction hasn't started. According to some Internet sources, plan is to build a 7-storey modern architecture complex which will be open and oriented towards the San Galli garden [14].

## 2.3. Nature Inspired Lighitng

Definition "nature inspired lighting" speaks for itself - nature with its characteristics provide the main source of inspiration for the lighting design. It is important to emphasize that this inspiration goes beyond aesthetical aspect, highlighting the existing nature in a favourable way. Often the aim is to support the relationship between humans and nature.

Over the course of the Sensitive Organism project, we had a chance to explore basic terms describing this particular relationship and later define them while writing an article "Creating identity with nature inspired lighting Design - The Sensitive Organism" [15].

In following paragraphs, three fundamental terms - biophilia, biomimicry and urban green space, which we described in mentioned article, will be cited.

#### Biophilia

Biophilia, introduced in 1973 by Erich Fromm, claims that humans possess an innate tendency to connect with nature and other forms of life. Originally, Fromm described it as "the passionate love of life and of all that is alive". In 1984, Edward O. Wilson developed and popularised the idea through his work "Biophilia" and concluded that this affiliation might partly have a genetic basis.

Nowadays, people spend more and more time indoors - in buildings, cars and man-made parts of the environment. The lack of biophilic activities and the time spent in the nature can strengthen the disconnectedness of humans from nature. Therefore, effort must be put into the reestablishment of the relationship between humans and nature on a day-to-day basis. Previous research has proved that biophilia has a positive impact on productivity, lowering the level of stress, enhancing learning comprehension and creativity, and accelerating recovery from illness.



Figure 15. Biophilia - mood picture [16]

For lighting design, this definition can be interpreted as encouragement to more in-depth study of the variety of colours, shapes, textures, and movements in nature as source of inspiration. This should regard both, quality of light provided and the design of for example - luminaire. Moreover, if people are connected to nature, they may place value in what is nature related and appreciate it more. Reflecting nature with light can be an effective solution for urban areas with limited access to nature, and an interim way to offer experience and comfort to people whose biophilic needs are not fulfilled within their neighbourhood.

#### **Biomimicry**

Biomimicry, also called biomimetics, is an approach that defines innovation as a search for sustainable solutions to human challenges in emulating nature time-tested patterns and strategies. This approach assumes that nature can provide working solutions to the sustainability problems humans caused and are now struggling with. Years of evolution and adaptation to change proved nature's strong ability to survive despite the challenges. The term "biomimicry" was coined in 1982, but was popularized by scientist and author Janine Benyus in the late 20th century, who suggested looking at nature as a "Model, Measure and Mentor", that is, the largest laboratory that has ever existed and ever will. The article titled "Biomimetics: Design by Nature" published in National Geographic referred to biomimicry as the future of engineering.



Figure 16. Biomimicry [17]

According to this definition, lighting design that takes from biomimicry can gain value of being sustainable. Sustainability is a rising concern over the last decades and lighting design should address this issue, not only by achieving a watt-per-square-metre target. Positive impact of biomimic lighting design can range from nano to macro scale, enhancing lifespan, maintenance, quality, aesthetics, energy consumption, and manufacturing costs.

#### Urban Green Space

Urban Green Space is a sub-part of urban open space, which contains all spaces accessible to the public within a city. A definition by Marilyn Myers from 1975 holds that as the counterpart of development, urban open space is a natural and cultural resource, synonymous with neither "unused land" nor "park and recreation areas" Urban green spaces represent a fundamental component of any urban ecosystem and include places, such as parks, woods, squares, gardens, and natural meadows as well as water elements ranging from ponds to coastal zones. Urban green areas play various roles in the urban environment. In particular, they increase the aesthetics of the city, provide space for recreation and preserve urban biodiversity. Contact with nature has a direct impact on physical, psychological, and social well-being and such beneficial exposure can be provided to city inhabitants through urban green spaces.



Figure 17. Urban nature - mood picture [18]

Urban green spaces for lighting designer should be the canvas to contribute to the challenge of reconnecting people living in cities to nature. Appropriate level of safety after the sunset, recreational atmosphere are the aspects of lighting that can encourage people to stay in urban green spaces longer. It is important to remember that nature has two equally crucial parts - flora and fauna and lighting should respect both as coexisting elements of the urban ecosystem.

## 2.4. Our Vision

We believe, that Saint-Petersburg with a population that is exceeding 5 million inhabitants, is one of the many big cities that are changing rapidly, and not only nature is disappearing from them, but within that fast development people also changed the way they live dramatically.

The problem with today's society is that city dwellers live their everyday life in fast forward, always thinking of the past and the future, but hardly ever being in the present. We would like to raise awareness of the problem and create a design, that takes them to the present. When people walk or pass through Sad San Galli park, they should have the opportunity to slow down for a moment, become present, and experience the small city nature they are surrounded with.



## "

Imagine if a small nature oasis in the heart of Saint Petersburg could reconnect people with nature and give them a mental rest from the daily stress...



This phase of the project was conducted to make sure that the fundamentals of our design concept will be based on solid understanding of the context in which Sad San Galli exists and functions.

**CHAPTER 3.1** describes the tools we took for analysis from respected names from the fields of urbanism and anthropology.

In **CHAPTER 3.2** attention will be paid to the function of San Galli nowadays, to its characteristic, strengths and weaknesses coming from its spatial arrangement, current condition.

As lighting design serving the people is our goal, understanding the needs and behaviors of the typical users of the space are showed in **CHAPTER 3.3** and current lighting condition in **CHAPTER 3.4**.

In **CHAPTER 3.5** collected observations are discussed to understand their meaning in the light of coming research question and its criteria that are crucial to proceed to the design phase. Evaluation aims to bring the essence of observation, focus on the key aspects of Sad San Galli that need improvement, to possibly enhance them with a new lighting design.

It is important to say, that analysis was carried out in March 2018, when Saint Petersburg was under the snow cover and with temperatures below 0 Celcius degrees both during the day and night. This fact had a significant influence on observations and truly reveals only part of Sad San Galli identity. Nevertheless, based on various data collected, we made an effort to create a picture of the park over the year.

Appendix (2-5) contains extra material from analysis phase of the project.

## 3.1. Methods and theories

In the following chapter, presented and evaluated data is based and reflected on methods and theories of well known authors. These methods are interpreted for the use of this project and discussed to understand their meaning in the light of research question and criteria development that are crucial to proceed to design phase. Analysis aims to bring the essence of observation and focus on key values of Sad San Galli to enhance them with lighting and possibly address also its main weaknesses.

#### ANALYSIS STRUCTURE

#### JAN GEHL & JMBC

## Public Life & Urban Justice in NYC's Plazas [19]

The core approach to investigating and reflecting on the present situation is primarily taken from a study by Jan Gehl, in collaboration with JMBC (J. Max Bond Center on Design for the Just City). Gehl has been a significant pioneer of people-focused approach, applying empirical analysis to create mutually beneficial relationships between people's quality of life and their built environment, while JMBC believes, that design can have a positive impact on urban reform, dedicated to advancement of design practice, education and research in the field. The methodology in their work [Public Life & Urban Justice in NYC's Plazas] is a combined research approach, using 3 main indicator groups (Public Space, Public Life, Urban Justice), to understand the needs of new public spaces.



Figure 18. Analysis structure scheme, inspiration and our interpretation

Public life and Public space in addition with Light are our 3 main indicators of the investigation and analysis, while selected, relevant urban justice (a collection of metrics designed to evaluate the ways the design of the built environment affects different well-being indicators) is the basic needs of an urban space, that are used to categorize and evaluate on the findings.

#### DATA COLLECTION METHODS

JAMES P. SPRADLEY

Participant Observation, 1980 [20]

Guidance for conducting the observations in Sad San Galli was taken from anthropological approach presented by James P. Spradley. Author present the idea of the Grand Tour - leading to overview of what is occurring, to identify the major features of the area of interest. Among 9 dimension he suggests to use as guidance for observations, this investigation focused on 3 main ones - actors (people), space and activities. Besides grand tour, Spradley also advise to use interviewing as a major qualitative method for the collection of data.

**KEVIN LYNCH** 

The Image of the City, 1960 [21]

Method to observe and distinguish the Public Space in, and around the park was taken from Kevin Lynch. He created an approach of how to analyse and improve the visual forms of cities based on five elements and their interrelationships. A well-designed environment image can improve people's sense of security and set up a balanced relationship between the outer world and themselves.

To capture the data we used following tools:

- ..... Desktop research
- ..... Interviews with client ITMO (notes in appendix 5)
- ......... Observational survey with descriptive observations (grand tour), space mappings (Lynch), with the help of photo and video registrations both daytime and nighttime.
- ..... Intercept surveys with the users of Sad San Galli



Figure 19. Data collection tools

## 3.2. Public Space

Data collected about the park are visualised in a form of 4 maps. First map presents only main features of the park, second map aims to introduce broader context, so to present the close neighbourhood of the park. On the third map information about materials and borders of the park is contained while fourth one shows the greenery of the Sad San Galli.









that during the winter time all tress leave their leaves or needles. Besides trees, the are few flower-beds around the park. Dominated by deciduous trees (ashes, horse chestnut, maple, linden, birch) with one conifer tree - larch. This fact means

#### Conclusions



More intimacy where the density of greenery is higher - feeling of intimacy seems to be higher in the area where there is more dense and diverse greenery. This may be supported by the fact that most of the benches are located in this area. Presence of greenery in close proximity and its diversity created more possible shelters, places slightly less exposed to the view.

More silence with distance from Ligovsky Avenue (entrance A) - Entrance A lead directly to busy and noisy Ligovsky Avenue, whereas entrance B is located at the end of calm, local Chernyakhovsky street, therefore park users can find more rest and silence if they are more closer to entrance B.

Better the condition of neighbourhood architecture, higher the feeling of safety in park area. Surrounding architecture is a part of the picture of Sad San Galli. On the distance of 200m along longer enge of the park, condition of building around changes dramatically, simultaneously changing the overall picture of the park. From San Galli mansion and other classical building near to entrance A, through regular residential building and school to abandoned and partly destroyed building and construction site. Unwelcoming neighbourhood of entrance B can reduce the reeling of safety at night time, as it is not visible what is hidden in this unused area, from which entrance to park is not difficult.

Type of materials influences the appearance of the park - different dominant materials used in the Sad San Galli change its overall appearance from less pleasant and welcoming close to entrance B (concrete, metal), to more pleasant in the direction of entrance A (attractive facades, wood or colour painted metal).

## 3.3. Public Life

The investigation about the life in the park was a qualitative approach including observational surveys and intercept surveys carried out both daytime and nighttime. To examine people in their natural behavior, we made observations without disturbing or raising awareness of people's actions. These observations were later noted down and captured in the form of photographs and videos, to further analyze. The second method of understanding people's relationship to the park was based on their voice in the form of intercept surveys.

#### ACTORS

#### .....

The actors were separated into four main categories and three subcategories, with a daytime versus nighttime comparison. Even though the lighting design concept is focused on the nighttime experience, it is important, to have a sense of daytime life in Sad San Galli, especially since northern countries have long dark hours during the winter season.

What we can see from the graph (Fig. 20) (detailed data in apprendix), is that in general it is a place for all. At daytime the actors using the space are equally distributed but at night time it is young adults, who are dominating the park. Another outstanding difference is the amount of adolescent women staying in the park at night time, which we believe can be the sign of lack of safety.





Figure 21-23. Sad San Galli users



Figure 20. Users comparison



#### ACTIVITIES

According to studies of Spradley observations distinguish different activities, sequences of activities and major features of these sequences. It is not only important to see what people are doing in the space but also, how are they doing it. This way, there is a depth to learning about the activities examining rhythms, routes and routines happening in the area of interest.

William H. Whyte - american urbanist and journalist in his book "The Social life of Small Urban Places" analyzes the success and failures of urban spaces in big cities [22]. Whyte shared simple but meaningful observations on how to observe existing and design and reshape social spaces, so that its basic features (sitting places, paths, water elements, greenery ect) are designed in users favour.

But what we would like to highlight and reference here are some of the nuances in people's behaviours in public space, that Whyte noticed and interpreted, which are also relevant in Sad San Galli.

DAYTIME					<b>60</b>
Biking	Ski-running (winter)		Gorodki (traditinal russian game)		0 0 0 0
	Walking	Running	Sitting	Relaxing	
	Passing-by	Playig on play	ground	Meeting	0 0 0
	Walking the c	dog Talking	Smoki	ng	• • •
	Drinking				
	• • • • • • • • • • • • • • • • • •				NIGHTTIME

Figure 24. Daytime - nighttime activities comparison

Our most significant CONCLUSIONS were based on actor types:

- ..... Adolescents without kids or dogs just pass through the park fast
- ..... Old people seem to come for long walks around the park paths
- ...... Men by-passers tend to choose the shortest, straight paths, while women by-passers tend to choose the shortest organic paths
- ...... Some senior people going from B entrance to A entrance (main street) take a small detour in the round paths.
- ······ People with dogs tend to stay longer ( around 30 mins minimum )
- ...... It is a social meeting place at nighttime, people stand or sit together have conversations



Figure 25 & 26. Daytime and nighttime flow of people. Black dots represent the stationary preferences and the saturation of the red lines indicate the usability of path.

Looking at the flow maps it is visible, that the nodes compared to paths have different dynamics, as William Whyte was writing, they have "a social life of its own". Junctions and corners are often used as meeting places (stationary) while paths serve as a place to walk & talk (active). Whyte points out that flows are characterized with high probability to meet somebody, exchange goodbyes & greetings. This was true on the main flows of Sad San Galli, especially among walking owners of dogs. Similarly, activities in the park differ from each other in terms of dynamic. From sitting or slow walking to playing or running, physical features of the park are favouring everyone's preferences.

This diverse dynamic of people activities and flow in the park seems to be a fundamental characteristic of park users and new lighting design should support that dynamics. The neighbourhood, which is a diverse group of people both in age and gender category are the primary users who stay in the park, but adolescents who just pass by are important to mention as they can create small non-verbal interactions with the primary users. Whyte describe them as "secondary users" and advises not to neglect them. Investigation showed (Fig. 27) that during the daytime passers-by pose 40% and during night time 60% of total number of people in park, and during walk through they spend in Sad San Galli approximately 3-4 minutes. Good walk through is definitely an advantage of the park, but in the same time high number of by-passers raise a question of how can a lighting design address them and encourage to stay in a bit longer.



Figure 27. Passers-by percentage comparison

One more interesting finding, formulated with the help of Whyte, is that all people who are coming to park not alone, but in group of two, three or more, usually are there because they have chosen to. This makes Sad San Galli a destination, a conscious choice in most cases, because people with company were a common sight in this park. Sad San Galli definitely has some values that attracts people, and future lighting ought to maintain this tendency also in the night time and strengthen parks desirability.

CONCLUSIONS form flow of people observations:

- ..... During nighttime the dynamics from the diversity of users is lower
- ..... Nodes are a natural meeting points and places of social interaction
- ..... By-passers are an important target group to be enticed to stay in the park longer
- ..... Sad San Galli is often a conscious destination for people, so it has values worth enhancing
- ..... Inner paths are less used

#### Users opinion

First attempt to review the opinions about the Sad San Galli was done based on the comments of Internet users about the area, found on two websites - Google maps (Fig.28) [23] and russian Foursquare [24]. In total, in this desktop research 85 comment were taken into consideration (49 Google maps and 36 Foursquare). Vast majority of the comment were left by Russians, but there were also representatives from other nationalities.



Figure 28. Google maps [23] users opinion about Sad San Galli

Second attempt to the collection of users opinion about park Sad San Galli had a form of an intercept survey. Language barrier was managed with the help of two russian students from ITMO who approached the users of Sad San Galli both daytime and at evening to ask two questions.

#### 1. How often do you come here and for what reasons?

Aim: To understand the reasons behind their visits to Sad San Galli (activities, goals, attractive park features) and their connection to the place (neighbourhood park, shortcut on the way, no connection)

.....

2. What associations goes through your mind when you think about Sad San Galli?

Aim: To understand conceptions and values people associate the park with.

Assisting ITMO students were given a freedom to moderate the conversation based on those two prepared questions. Collected data is the result of their translation of answers hightings after each survey. We, due to limited participation and control over data collection decided to consider it as a source of qualitative information showing the tendencies and key aspects of perception of Sad San Galli.

#### "

An oasis of nature in the stone jungle. There's a playground, cozy benches. It's nice to relax from the Ligovsky.

## "

Do not like a large number of people drinking. But the park is good.

### "

I turned here from Ligovsky which was very noisy and found silence and rest here from the city noise.

#### //

I like the fact that this park has 2 exits on opposite sides, it's a nice, good walk through.

#### "

A nice little garden with a playground. You can get out through the garden to the Ligovsky on Chernyakhovsky.

## "

Friendly atmosphere. There is a 'gorodki' field! Unfortunately, at evening a lot of young people drinking.

## //

This place used to have some problems and not good reputation but now it is better.

## "

I remember the times when there was fountain here, now it is gone and that is sad.

#### Conclusions

. . . . . . . . . . . .

Data collected during intercept survey and desktop research is used as qualitative indicator of main aspect which Sad San Galli's users appreciate and complain about. Below, three main findings of each category (positive - green and negative - red) are presented. Size of human icon refers to the strength of specific voice.



## 3.4. Light

San Galli Park has existing lighting, consisting of 47 identical outdoor poles distributed all over the park, along the paths. Each pole is of approximately 3.7 meter height, where 0.4m is the lamp-shade. During the time of analysis (March 2018) only one out of the total number of light poles was not working, while 4 of them were damaged to some extent (Fig. 30). Such distribution of poles with light sources result in very uniform lighting, without dark spots with average illuminance level up tp 10 lux on the ground level.



Figure 29 & 30. Sad San Galli - current lighting

Light sources used in San Galii are HPS - high pressure sodium lamps, common solution for outdoor lighting for public places (Fig. 29). After initiation, they relatively slowly reach their full brightness and typical warm color temperature around 2000K.



Figure 31. Current lighting in Sad San Galli, fixture location and light levels

#### Conclusions

Generally speaking, current lighting in Sad San Galli on sufficient level plays its role as a functional lighting. Light poles are distributed all over the park, in partly regular pattern, mostly along the paths which are lit so that all obstacles can be tracked for user with average sight possibilities. Luminaires distribution guides the pedestrian all the way from entrance A to B and support the overall orientation in the area. Although the average illuminance level is relatively low, around 5 lx, uniformity of lighting adds to the visibility and overall clear picture of the space.

For sure, maintenance and technology pose a problem that would have to be addressed in near future. Use of HPS may be a efficient solution for a design that was made possibly at the beginning of LED revolution, but its poor color rendering asks for a change. Nowadays use of fixtures using LEDs are common in outdoor lighting and Sad San Galli would benefit from implementing this technology.

In our opinion, current lighting situation is not critical, but doesn't add extra value to the Sad San Galli park and is not strengthening or presenting its values and what is most important in this project - its nature. As lighting designers who aim for more than just functionality of the design, we see a big potential for refurbishment of lighting in Sad San Galli park.



Figure 32. Sad San Galli - current lighting



Figure 33. Sad San Galli - current lighting

## 3.5. Sum up and evaluation

Evaluation of findings, leading to the definition of criteria, will be done based on method presented in chapter 3.1. Nine aspects from so called "urban justice" introduced by JMBC, representing key urban needs of each public space will be now discussed. Aim of this procedure is to define overall condition of the Sad San Galli as public space and find potential for improvement among those nine important categories which as lighting designer we can address with this project.

Urban justice	Meaning	Situation in Sad San Galli
EQUITY	Contribution to the in- crease of accessible open space for the people	Urban green area for pedestrians only, the trans- port vehicles have no access to the space
CHOICE	Choice to be at the space on purpose	The neighborhood comes often in 2 or 3 - sign of decision/choice. Bypassers could be more enticed to choose to stay.
BEAUTY	Elevates the physical aesthetics of the area	The park is considered to be a beautiful although this should be coherent looking at it from every angle at any time.
HEALTH & WELLBEING	Outdoor activities im- prove human health and mental state	Park considered as a place to rest & play, but it can be enhanced in the night when visits are for practical reasons, not for the presence of nature.
CONNECTIVITY	Feeling connected to nature & each other	Park appreciated by users due to limited green spaces in district, but this doesn't make its nature unique. In winter, at night it loses its restorative qualities coming from nature.
CREATIVE INNOVATION	New, unique and creative solutions	The area lacks innovations, looking at the light- ing situation the technology used is stanted, the lighting is not addressing new needs of people.
DIVERSITY	Range of activities & diversity of users	Diverse users during the day but not sharing common activities. Park offers only basic activi- ties coming from the physical surrounding (walk, playground, gorodki).
INCLUSION & BELONGING	Sense of being accepted, included to ownership	Lack of inclusion and belonging observed in case of users cultivating disrespectful activities (trash, alcohol, noise, drugs). Among rest strong feeling of community, protecting the spirit of area.
PARTICIPATION	Engaged in the park's look and upkeep	Users not within the close community especially at night time have less feeling of responsibility for the area. Diversity of users lost after dusk.

Due to the fact that Sad San Galli is dedicated only for pedestrians, there is no need for improvement in the "Equity" area. Remaining eight will be logically paired so that addressing only 4 would hopefully bring improvement in all 8.

1. Improve "choice" by addressing "connectivity"

High percentage of park users are people just passing by (around 60% day, 40% night). If the nature in Sad San Galli would be more enticing, biophilic need of contact with nature more fulfilled, possibly this target group would CHOOSE to stop in the park, stay for a while and maybe even come back with someone.

CHOICE CONNECTIVITY

2. Improve "beauty" by addressing "creative innovation"

Sad San Galli definitely lacks innovative approach in terms of lighting. Light is a powerful tool which, when designed consciously, can highlight the advantages and mask or redefine the disadvantages of the space. Park is often called beautiful by users for its nature, but at night nature is not enhanced. Using lighting and its innovative technologies and designs to add value to the aesthetics of this green area during night time, can create coherent picture of beautiful park 24/7 and improve the "beauty" aspect.

BEAUTY ····· CREATIVE INNOVATION

3. Improve "participation" by addressing "inclusion and belonging"

Plenty of social studies point to the feeling of belonging as one of the key methods to increase people's engagement. Humans are social creatures with an inherent need to belong. Strong identity of the place and community around that would be attractive to belong to, can have a positive influence on how users of the park would participate in its upkeep.

PARTICIPATION ····· INCLUSION & BELONGING

4. Improve "diversity" by addressing "health and wellbeing"

Nighttime in Sad San Galli is characterized with much lower users diversity and activities diversity comparing to daytime. Light enhancing the restorative qualities of nature in the park can attract diverse people to find a rest there.

DIVERSITY	••••••	HEALTH & WELLBEING
• • • • • • • • • • • • • • • • • • • •		



Chapter Transformation is a turning point in the design process, as from here on creative part begins. By this point data were collected and evaluated, where transformation and what follows aim to introduce to our (lighting designers) response to the findings from previous chapters.

**CHAPTER 4.1** is the definition of the research question, a question to which the answer in form of the lighting proposal addresses the issues we found as worth solving during analysis. Research question is a combination of very carefully selected words, from which some would be explained to show direct relation to analysis findings (4 urban needs) and lead to the definition of our own design criteria described in **CHAPTER 4.2**.

**CHAPTER 4.3** has an important role to prove the relevance of the criteria. Here we show, supported by existing research, theories and practices, that lighting has tools that can fulfill the criteria.
How can an **innovative** nature inspired lighting design attract city dwellers to stay in Sad San Galli at night time in order to find **mental rest** and create **positive identity** for the park **promoting the value** of city nature ?

RESEARCH QUESTION	& ANALYSIS FINDINGS (Urban Justice)
•••••••••••••••••••••••••••••••••••••••	• • • • • • • • • • • • • • • • • • • •
INNOVATIVE	CREATIVE INNOVATION
Meeting new needs of users, based on new technology and trends, transdisciplinary approach.	New, unique and attractive solutions, simultaneously elevating aesthetics (BEAUTY) of the park after sunset.
MENTAL REST	HEALTH & WELLBEING
Atmosphere helping to relax, slow down, enjoy time with nature and others, reassuring visual comfort.	Environment for nighttime activities containing mental resting in nature surrounding, a need relevant for diverse (DIVERSITY) group of users.
POSITIVE IDENTITY	INCLUSION & BELONGING
Identity that users would be proud of and have sense of ownership of its protection and passers-by would feel invited to stay.	Invitation to mental ownership for all people, improving their engagement <i>(PARTICIPATION)</i> in parks' upkeep.
PROMOTE THE VALUE	CONNECTIVITY
More conscious appreciation of natural environ- ments and benefits from contact with nature.	Improved connection to nature in Sad San Galli (CHOICE), oneself and others.

For our design concept, presented in following chapters, we defined four criteria, in accordance with analysis main findings and in following way relating to the research question:

# INNOVATIVE

Nature inspired, attraction, new technologies, solutions

RQ: How can an **innovative nature inspired lighting** design attract city dwellers to stay in Sad San Galli at night time in order to find mental rest and create positive identity for the park promoting the value of city nature ?

# REASSURING

Increased feeling of safety, visual comfort, mental rest

RQ: How can an innovative nature inspired lighting design attract city dwellers to stay in Sad San Galli at night time in order **to find mental rest** and create positive identity for the park promoting the value of city nature ?

#### ative nature inspired lighting llers to stay in Sad San Galli Environment for nighttime activities

**HEALTH & WELLBEING** 

containing mental resting in nature surrounding, a need relevant for diverse (*DIVERSITY*) group of users.

# CREATING IDENTITY

Inviting, attracting, enhancing spirit of the space

RQ: How can an innovative nature inspired lighting design attract city dwellers to stay in Sad San Galli at night time in order to find mental rest and **create positive identity** for the park promoting the value of city nature ?

# PROMOTING VALUE

Addressing biophilic needs of contact with nature

RQ: How can an innovative nature inspired lighting design attract city dwellers to stay in Sad San Galli at night time in order to find mental rest and create positive identity for the park **promoting the value of city nature** ? INCLUSION & BELONGING

Invitation to mental ownership for all people, improving their engagement *(PARTICIPATION)* in parks' upkeep.

connection to nature in

CONNECTIVITY

Improved connection to nature in Sad San Galli (CHOICE), oneself and others.

**CREATIVE INNOVATION** 

New, unique and attractive solutions,

simultaneously elevating aesthetics (BEAUTY) of the park after sunset.

# 4.3. Concept guidelines

Aspects captured in our design criterias (innovative, reassuring, creating identity, promoting value) are essential to fulfil the requirements from project research question and address the key areas of improvement found during analysis phase (creative innovation, health and wellbeing, inclusion and belonging, and connectivity).

Each criteria will now be supported with relevant knowledge from three areas:

- scientific knowledge from papers, articles, knowledge shared by leading manufacturers
- theories from respected authors within lighting design field (lighting literature)
- practical example of existing project/installation based on this criteria.

This proceedings lead to the definition of guidelines for our design, that would help to incorporate the criterias into our project. This chapter also leads to the selection of an issue to test in the next phase of the project, a question fundamental for our concept, but requiring further investigation.

### **INNOVATIVE**

**CREATIVE INNOVATION** 

simultaneously elevating aesthetics (BEAUTY) of the park after sunset.

. . . . . . . . . . . . . . .

### New, unique and attractive solutions, The aesthetics of an innovative nature inspired lighting can attract people to public areas, address their needs without increasing energy consumption.

Keywords: innovation, attractiveness, future lighting, new needs, nature inspired lighting

## **RESEARCH:**

Roger Narboni, independent lighting designer, who launched a new discipline - Light Urbanism, uses 30 years of experience to describe his vision of the city of tomorrow in terms of lighting [25].

"We need to invent another type of urban light, different forms of lighting with diverse functions, in order to respond to this morphology in the future development of public space. These new types of lighting systems will mean that the city can be lit differently, not just so that we can see and move around, but also so that it invites, even urges people to stop for a while, creating new boundaries, and puts a certain end to the regularity and rigidity of the public lighting of yesterday."

#### THEORY:

Descottes [26] among other topic, touches also the topic of innovation, giving suggestion on how to approach innovation as a lighting designer. Innovation doesn't have to deny the conventional thinking but innovations asks for experimentation and risk. Conservation of energy is a subject that according to Descottes will only become more pressing in the coming years, and in the designers interest would be to maximize the effects of light while minimizing the consumption of energy.

"Oftentimes it is best to ask not how much light is necessary to render a space functional, but how little light can be put to use for maximum effect." 

The key to implement innovative solutions can be found in the transdisciplinary approach to the project, where lighting design continues to practice in concert with many other fields.

"Lighting designer's work is not limited to the realm of aesthetics, but also responds to functional, technical, spatial, and experiential necessities of a project. Lighting design necessitates a deep, meditative exchange of knowledge, and therefore it must be understood not as an interdisciplinary field but as a transdisciplinary one that traverses the boundaries of conventional thought."

#### PROJECT EXAMPLE

Smart Street lighting in Copenhagen is an example of transdisciplinar approach to innovation [27].

- Protection of environment: step towards becoming the world's first carbon neutral capital city by 2025 and reduction of energy consumption due to switch to LED's

- Addressing new needs - safety of increasing number of cyclists: LED's with smart technology due to a 'communications module' that ensure that lights can dim according to a schedule, as well as being able to brighten when cyclists approach road junctions.

- Respect for tradition and waste management: to save on waste impact and costs, existing traditional lamps, Københavnerlamper (Fig. 34) – that have been since the 1970s were sold on auction and due to citizens' fondness for the original lamps, the new models will remain similar in appear-



Figure 34. Københavnerlamper [28]

#### CONCLUSIONS FOR OUR PROJECT:

Transdisciplinary approach, project for humans but with up to date technology and respect for the environment

Little light but with maximum effect and lighting with diverse functions

Question the regularity and rigidity of conventional lighting solutions

Non-uniform nature inspired lighting, illuminating more than just paths, can have a positive influence on people's feeling of reassurance.

Environment for nighttime activities containing mental resting in nature surrounding, a need relevant for diverse (*DIVERSITY*) group of users.

Keywords: reassuring, safety, visual comfort, mental rest, well-being

#### RESEARCH:

Biophilia is strongly linked to natural lighting as nurturing and sustaining element of nature. BioResearch conducted by Naikunen and Korpela [29] proved that public spaces featuring nature are perceived as having higher restorative quality. This can be achieved by emphasizing natural elements by light at night-time instead of man-made objects. This change of focus can not only have positive impact on perceived restorativeness, but also reduce the fear in the night time. In addition to this, illumination of artificial surfaces (e.g. asphalt pathways) with natural light patterns can enhance the presence of nature and, thus, increase the feeling of well-being.

Research by Andersen, Wienold and Chamilothori [30] exploring daylight patterns as a mean to influence the spatial ambiance asked the question whether there is a more positive evaluation for the irregularity of a façade and daylight pattern in a social context. Results shows that pattern characteristics have an impact on the perceived spatial ambience with a preference for irregularity.

In terms of feeling of safety, a study conducted in 1977 and again in 1997 by the National Institute of Justice [26] proved that the correlation between lighting and crime is inconclusive, as many crimes are committed during daylight or in empty lit buildings by night. Dark areas are likely to be used for crime purpose, but spaces with too much light and glare, resulting in pockets of great contrast and deep shadows, are tempting for criminals as well.

#### THEORY:

Stephen Kaplan [31] notices "The decline in opportunities for rest leaves us less able to deal with the growing fatigue. The fatigue that results from these multiple assaults on our attention is not physical, but mental."

Restorative experience, ideally in a natural environment is the most prominent mean of mental fatigue reduction. Restorative experience to be helpful for the recovery from mental fatigue should contain following 4 components, which we considered in terms lighting design of natural environments which facilitate the restorative experience.

BEING AWAY - change of a setting. Characteristic lighting design can be a trigger attracting people outdoor, to spent time in this specific, illuminated area.

EXTENT - understand as mix of connectedness and scope; Scope - environment is experienced as large enough that one can move around in it without having to be careful about going beyond the limits. For lighting design this can mean that illumination should make nocturnal picture of the

space easily comprehensive, providing visual comfort and guidance in the area. To have connectedness, the various parts of the environment must be perceived as belonging to a larger whole. Integral lighting design that creates understandable picture people can relate to.

FASCINATION - a fascinating stimulus is one that calls forth involuntary attention. (Involuntary meaning effortless ref. William James 1892) Lighting design providing attractive feature, effect light layer that is unique yet effortless in terms of attention. This may mean presenting phenomenologies of light in a fascinating way, making use of light nature or mimicking with light other phenomenons.

COMPATIBILITY - what one wants to do and is inclined to do are what is needed in and supported by the environment. Lighting supporting the activities that place was meant for.

Idea which Kaplan described as restorative experience in 1989 can be also found in very inspiring vision for the cities formed over a century earlier by Frederick Law Olmsted, who is considered to be the father of American landscape architecture [32]. This fact only proves that daily escapist experience within the city nature is a relevant topic for all people.

"We want a ground to which people may easily go when the day's work is done, and where they may stroll for an hour, seeing, hearing, and feeling nothing of the bustle and jar of the streets where they shall, in effect, find the city put far away from them"

#### PROJECT EXAMPLE

Broken Light in Rotterdam, Netherlands designed by lighting designer and visual artist Rudolf Teunissen is a perfect example how nature inspired lighting can transform the neighbourhood. Rethinking of the traditional streetscape in this case, had an impact way beyond the aesthetic; the issues of crime and prostitution in the district is now replaced by a strengthened sense of community [33]. The project design includes the illumination of both horizontal (the pavement) and vertical (the facades) surfaces of the street and removal of the negative qualities of street light - to avoid glare and reduce light pollution.



Figure 35. Broken Light project in Rotterdam, Netherlands [33]

#### CONCLUSIONS FOR OUR PROJECT:

Lighting with decreased uniformity on pathways instead of ambient-light levels, can create dynamics in the space without increasing probability of nighttime crime.

Horizontal surface with spread light spot patterns not centralised, but covering the path and the nature on the sides, create a feeling of irregularity, that people prefer for spatial ambience. Vertical surface should be illuminated as well to some extent, to increase the feeling of safety in the area.

Light used for guidance in the area is an important aspect of lighting design.

Effect layer providing an attraction, invites people and help them to have restorative experience.

# CREATING IDENTITY

## Nature inspired lighting design using colored light as a way to elevate park's identity has a positive influence on social engagement and it

••••••

**INCLUSION & BELONGING** 

Invitation to mental ownership for all people, improving their engagement *(PARTICIPATION)* in parks' upkeep.

positive influence on social engagement and interaction.

Keywords: identity, inviting, attractive, community belonging, participation

**RESEARCH:** 

Philips Lighting [34] on the topic of developing city's identity points to the potential of the seasonal change to together with lighting be creator of dynamic identity over the course of the year. Illuminated greenery may be beautiful during spring and summer time, but winter also has it uniqueness thanks to the beauty of the light reflection outside which is emphasized by the presence of the white snow.

"These luminous diversions certainly help to refine the city's identify and uplift spirits. By doing so, it provides citizens and tourists another good reason to prolong their visit downtown. (...) Without a doubt, the lighting industry is changing and changing fast. Also, spaces or buildings will add this new layer of nightly and seasonal identity. Architects, landscape architects and designers are working more and more as interdisciplinary teams to achieve this new discipline which combines still objects and interactive lighting."

#### THEORY:

Hervee Descottes [26] introduces colored light as a tool to give illuminated spaces special identity. Author refers to our human memory and perception which are sensitive to colors and on this basis argues that colored light can leave us with lasting impressions of a place. The controlled use of light colors can not only intensify the experience of an environment but also induce extreme emotion. Color blue is mentioned as example - deep ultramarine blue could convey a sort of calm stillness. "Color in lighting design has the distinct ability to contribute identity and orientation to a place. On a large urban scale, color can be utilized in master plans as a sort of visual compass that orients the visitor within the greater site while simultaneously highlighting places of importance."

#### PROJECT EXAMPLE:

The Morton Arboretum in USA [35] is a public garden and an outdoor museum with a program in tree research including the Center for Tree Science. From 2014 Arboretum organize seasonal, winter time tree illumination to attract people and demonstrate the beauty of winter nature and to **"celebrate the power of coming together to lift our spirits during the crisp, long nights of winter!"** 

Jen Taylor [36], who explored Arboretums' research wrote: "According to a study conducted by Morton Arboretum, neighbourhoods that invested in landscaping and green spaces saw increased self-esteem and fewer instances of vandalism. In addition to reporting lower crime rates, cities with green spaces experience improved mood, increased social interaction, and reduced road rage. Having a view that features natural green spaces therefore has the potential to keep us calm and safer, improve our mood, and build confidence."



Figure 36. Illumination at the Morton Arboretum poster [35]

#### CONCLUSIONS FOR OUR CONCEPT:

Illuminating not exclusively the paths, but the nature around, results in increased social interaction, dynamic identity over the course of year.

Special light phenomenon/unconventional colored light, can resonate with people's memory and intrigue their perception to notice and experience the space.

In order to create positive identity, safety aspect must be considered. Nature has a power to increase social interaction therefore nature inspired lighting and lighting enhancing nature is a way to create a safer environment with positive identity.

CONNECTIVITY

Capturing with lighting design phenomenons known from nature can promote the value of natural environments as spaces where human biophilic needs can be met. Improved connection to nature in Sad San Galli *(CHOICE)*, oneself and others.

Keywords: reconnection, connection to nature, biophilia, nature appreciation

#### **RESEARCH**:

Biophilia is strongly linked to natural lighting as nurturing and sustaining element of nature. Biophilic design is a unique branch of design relating to humans genetically hardwired to nature which they consciously or subconsciously value.

"While biophilia is the theory, biophilic design as advocated by Kellert et al. (2008) and Beatley (2010) internationally involves a process that offers a sustainable design strategy that incorporates reconnecting people with the natural environment." [37]

Ph.D. Maja Petrić, artist working at the interface of science, technology, design and art on the platform created together with Philips Lighting shares her experience and research about the value of biophilic design in lighting [38].

"Neuroscientists have determined that appreciating nature-inspired art, for example, elevates our wellbeing. (...) If used properly, we can use light, art and biophilia to heal and restore, a theory backed by scientific research."

THEORY:

James Corner in his essay titles "Light and Landscape" names light as the essential element for bringing the world to life, encouraging to practise "poetry of lighting" along designing for meeting the functional requirements [26]. Lighting of a landscape, as an platform enabling connectedness with nature, creates an atmosphere and effect people in lasting way.

"With the right source, angle, intensity, and quality of light, the reception of even the most ordinary object or environment can be heightened to an almost transcendental level of presence and effect. (...) Landscape after all is not an object to be highlighted, but a field, a texture of duration, passage, and elemental connectedness with nature. Light brings landscape to life, but landscape may also reveal new potentialities of both lightness and darkness as phenomenal expressions of space, place, and time."

#### PROJECT EXAMPLE

James Carpenter commenting this work in Toronto called "The Lake Light Threshold" [39]:

"All the work we do is trying to understand the phenomenologies of light that exist in nature, how you synthesize those qualities of light and then capture them by some means that sort of people see it and they have a connection to it. (...) Whatever image you have, is a quality of light and shadow that is driven from things you might have seen in nature. "

James Carpenter interview answer about use of glass to explore light qualities [40]:

"My interest in using glass to manipulate light essentially originated in the observation of nature. My interest in light was at the source of my desire to pursue architecture and to explore light in a systematic way that I had maybe only intuited before. Glass is very malleable and can be endlessly manipulated to simultaneously embody and reveal a multitude of qualities of light that connect us to nature at both a local and universal scale."



Figure 37. The Lake Light Threshold by James Carpenter [39]

#### CONCLUSIONS FOR OUR CONCEPT:

Artificial light interpretation of natural phenomenon can reconnect people with the environment

Light and shadow is a symbiotic relationship in nature so to synthesize natural light qualities in artificial design is to consider shadow as complementary aspect.

Materials and textures can help to manipulate light and create desired lighting effects

"Poetry of lighting" as an additional effect layer to functional layer of light brings life to the environment and positively influences people's perception of a space.

# 5 LIGHTING CONCEPT Chapters S.1 Inspiration S.2 Phenomenon selection S.3 Initial concept Readers guide

In this chapter, we use all relevant information from the previous findings, in order to develop a lighting concept, that fulfills the new needs of people and the space.

The process on the concept development breaks down to two key parts.

Development of a nature inspired light effect realised by a custom luminaire for Sad San Galli, and thus creating identity for the park.

Development of a masterplan experience using the effect luminaire as a main tool answering all our criterias. Lighting concept phase is also leading up to the test subject, necessary before the definition of the final design.

**CHAPTER 5.1** gives an insight to our inspiration process, shows briefly the way how from the nature associations we found water reflection as the feature on which our design concept is based.

**CHAPTER 5.2** goes deeper and explores the specific type of reflection - sun sparkle on water surface. Here present our ideas on how to translate chosen feature into light effect for masterplan in order to achieve our research question goals.

**CHAPTER 5.3** presents our initial concept, lists the principles for masterplan and introduces our idea for a custom made fixture that we imagine can fulfill the masterplan requirements.

Appendix (7-9) contains extra material from lighting concept phase of the project.

# 5.1. Inspiration

The inspiration had an intuitive process, looking from a broad range of phenomenons and projects coming from our vision of creating a nature oasis in the city. We started with a mindmaps exploring all associations, narrowing down to visual inspirations of most relevant and inspiring themes, among which we found most fitting to create a nature inspired identity for the area.

Mindmap below (Fig. 38) is a selected representation of terms from bigger mindmaps attached in appendix (7). We created this specific mindmap branching from the context area Saint Petersburg as a bigger picture and the Sad San Galli as the focus area to create a map of nature identities investigating possibilities for inspiration source to give our design a strong nature based identity.



The strongest direction we were derivating our nature inspiration from is water, as it is a major identity of Saint Petersburg that everyone can identify with. It is also a missing water identity from Sad San Galli as we found out from the analysis. People often recall Sad San Galli as a 'green oasis' which is a phenomenon typically involving water in the middle of the landscape and the park used to have a fountain which disappeared throughout the years.

Clearly, water references repeatedly appeared in our mindmap, that is why we took a closer look into different water phenomenons and categorized them, to make the final decision about water feature which would be used for creating our design identity.

We categorized water phenomenon inspirations from the Mindmap into three categories:

- ······ Dynamics
- ······ Patterns
- ..... Water&Sky Interactions

Most relevant findings from categories:



Figure 39 - 44. Water phenomenon mood pictures [40-45]

At the same time, we collected inspiration from existing projects and products which use any interpretation of water and we also put them into categories:

..... Projects with artificial light in connection with water (Fig. 45)

..... Project imitating water with light or material (Fig. 46 & 47)



Figure 45 - 47. Project inspirations [46-48]

A project by ÅF-Hansen & Henneberg design team in Copenhagen created a station's lighting to give it a strong identity (Fig. 47). Lighting patterns depict an artistic interpretation of water that would reflect the area's maritime environment. Yet again, the same company in Sweden designed a light that is in natural sympathy with the beach, sea and sky, mimicking the effect of nature without intruding on the natural surroundings (Fig. 45). Architecture project highlighted from Moscow by Scofidio + Renfro is using reflective material creating a natural scene for seating areas (Fig. 46).

In terms of other projects using artificial materials to create natural phenomenons, the last three images show projects using different materials with with specific surface and reflection percentage to create desired natural light patterns (Fig. 4-6). All the inspirations above helped us in the process of brainstorming to develop our concept scheme.



Figure 48 - 50. Project inspirations [49-51]

# 5.2. Phenomenon selection

At this point of the process we were undoubtedly inspired by the aesthetics of the specular and diffuse water reflection in terms of special effect and feature on which lighting design identity would be based. Further brainstorm were necessary to select the specific type of reflection supporting our research question goal. We looked at Saint Petersburg as a compass. Pictures below show the diversity of reflection types that can be seen in this city, depending on the weather, season, time of the day, sharpness of picture they reflect, body of water (Neva river, canal, puddle, wet ground).



Figure 51- 61. Reflection on the water surface in Saint Petersburg, Russia [52-62]

# **EFFECT PHENOMENON - IDENTITY**

Combining the identity of Saint Petersburg being "built on natural elements - stone, water and sky" [6] and own experience of residing and observing the city, the phenomenon of reflection on the surface of water appeared as a strong part of the city's identity.

Going deeper in the topic of reflection, we chose to work with a specific phenomenon, the interaction of sunlight and the surface of moving water in the form of sparkles.



#### POSITIVE IDENTITY

SUN SPARKLE ON THE WATER SURFACE

The reason for using a phenomenon strongly associated with the sun is partly because of the context, as water was not always considered as a positive element for the Saint Petersburg (spring floods problem). By taking an easily identifiable phenomenon that focuses on the relaxing, attractive side of water, we can focus of the positive identity experience as inhabitants of Saint Petersburg cherish all the limited sunny days in a year. The other reason is the feasibility of the idea, is that we found reflection itself too broad and complex to represent as a light effect.

The effect of sun sparkles on the water surface will be implemented to the design through a custom made luminaire which besides the functional layer, would have the effect layer.

Effect layer introduces innovation to the park, created identity through the color, attract with its uniqueness. This design decision of having such a feature would address our research question and help to fulfill the criteria.

Sketch on the right (Fig. 62) presents the initial idea of having those layers overlapping. Such solution would require further tests to define technical parameters and to make sure that the users perception of the final result would be as desired.



Figure 62. Sketch

# EXPERIENCE STORYBOARD

Coming back to the experience to achieve with light defined in the research question:

How can an **innovative** nature inspired lighting design **attract** city dwellers to stay in Sad San Galli at night time in order to find **mental rest** and create **positive identity** for the park promoting the **restorative value** of city nature ?

The following storyboard shows, how our lighting can take a person through the process described in our research question - from being attracted to understanding the value of nature.





Let's take a person, who is walking through Ligovsky prospekt (major, busy pedestrian road) after sunset as she just finished work. She walks past the entrance of Sad San Galli park and notices, that the lighting is different, unique, there is light on the trees, it looks brighter and more alive as it has a different color at some parts (innovative). She usually chooses a different route home, but it looks reassuring and inviting. This attracts her to go in and take a closer look. She walks in and finds a blue light with sparkles dominating on the organic (middle) paths playfully painting her blue while she is walking along the way. She decides to stay for a little, sit down on a bench, rest a bit, in the silence she found her, away from the rush hour urban bustle (reassuring). This experience takes her to the present, looking around, she discovered the nature surrounding her in this unique nightscape. This gives her a mental rest, resonates with her unconscious biophilic needs, and gives her a valuable, restorative experience in the small nature oasis in the middle of the city (promoting value). Later that night, when she is back home, she remembers the magical park with the nice, relaxing experience she had and she decides to enjoy Sad San Galli more often (positive identity).

We created and described this storyboard to point to very important thing - that it takes time, a process to bring people from simply being intrigued by something new to the conscious appreciation of the value this attraction represents. This storyboard combines all of our four criterias and shows why they are all essential to reconnect people back to city nature. This idea is not new, as Stephen Kaplan described this process in his work dedicated to the human-nature experience [31]:

"It is amusing to think of the factory worker who races off during the lunch period, fighting traffic and distractions, to find a spot in the shade of a tree for a peaceful break. If the peaceful effect would have been totally worn off by the time the return trip is made at the end of the hour, would this ritual be repeated again tomorrow?"

# 5.3. Initial concept

# MASTERPLAN STRATEGY

We wanted our design to be based on nature inspiration deeper than just on the effect layer. In chapter 2.3 we introduced term biomimicry - an innovative approach searching for sustainable solutions in emulating nature time-tested patterns and strategies. During the broad water inspiration we went through, our attention was caught by a close image of a spiderweb, with water drops sticked on its surface. This nodes-focused pattern found in nature can be implemented in our masterplan strategy - a plan for spatial light distribution over the park having several connecting nodes.



Figure 64. Spiderweb [63]

Figure 65. Light spots pattern [64]



Using nodes as point of experience change was the main strategy direction taken from spiderweb example. We saw it in the size of water drops where paths cross, different regularity and density of drops in the main web path in comparison with minor paths. Therefore we suggest to use light to differentiate minor paths form major, highlight and attract to squares and nodes, as americal urbanist William H. Whyte noticed "junctions and corners have a social life of its own".

What we aim for is to focus on inviting people to walk around and stay in the middle paths, as that is the heart of the park, meant for slow movement. To enhance the feeling of intimacy and visual comfort close to stationary and seating areas, ambient bollards are used to support these areas. To create a flow and connection to the scene, we extended the light effect to strengthen the attraction and guide people to the organic paths all the way from both entrances.



Figure 67. Light strategy masterplan sketch

### MAJOR PATHS

#### . . . . . . . . . . . . . . . . . . .

Using plain functional spot lighting with neutral color on the walkway overlapping the greenery altering on the sides of the paths.



### ORGANIC PATHS

#### 

Using plain spot lighting (dimmed) and blue effect spots half overlapping.

### SQUARES

#### •

Besides the public spots, ambient bollards are used close to the seating areas.





# LIGHT PRINCIPLES

To implement our lighting strategy differentiating the experiences within the park, we present a proposal of a custom fixture, pole as modular system with three light layers, providing the functional downlight, effect light on the horizontal plane, and vertical uplight for greenery. Vertical uplight here plays dual role - reassuring (vertical object illumination, chapter 4.3) and aesthetical by revealing the beauty of nature during dark hours.

Additional bollard aims to break main downlight pattern, which can be blurry and unattractive in the distant pedestrian perspective (for example from the entrances). Bollards brings gentle light to the sitting areas, there close light glow proximity support the intimate atmosphere.

The new propoposal is:

- ..... Less uniform than now slightly spotty (support paper)
- ..... Layer of lights (support paper)
  - ······· Functional (horizontal)
  - ..... Uplight (vertical)
  - ······ Effect



FUNCTIONAL SPOTLIGHT



WITH EFFECT SPOTLIGHT



WITH UPLIGHT SUPPORT



WITH BOLLARD

### FUNCTIONAL LAYER - LIGHT DISTRIBUTION

#### •••••••••••••••

Here the focus is on the functional layer of light we provide with our design. Light distribution is one of the main parameters of each outdoor fixture therefore an approximation of it was the subject of simulations we made using existing LDT files (LDT - data file with specification of photometric data).

Our desire with the light spots is to create a wave of bringer and darker areas promoting in park the natural contrasted regularity. The quality of a light spot was considered (avoiding extremes in uniformity) but also the distance between light spots, because too big dark gaps are undesired. Due to the economical reason, the increase in the number of poles was not beneficial, so we experimented with different light distributions to achieve the compromise.



Figure 68 - 70. Ateljé Lyktan [65], Castaldi [66] and Gewiss [67] products light distributions



Simulations were made with the Relux software, for fixture with light source at 4 meters height (similar to current fixture height and assumed as very convenient height to keep in Sad San Galli).

First source with the narrowest beam gave the the smallest light spot, bright in the middle, gradually fading to the edge of the beam. The second is similar to the first in terms of fading from the middle point, but it covers bigger area. Although the third option is the best solution to minimize the light gaps, it is too uniform. Uniform spot doesn't provide the gradual light fade into the darker area, resulting in eye fatigue. The balance between the size of the beam and its uniformity pointed to the middle light distributions is the closest to the desired for this design.





Scientific, theoretical and practical knowledge defending criteria hypotheses in the chapter 4.3 delivered a set of guidelines for design that we relied on while creating the concept.

Strong voice of use of a coloured lighting as a way to create identity, to resonate with people's perception and memory, to create an inviting effect layer having a lead to the presence of coloured light in our concept. During the design development, an essential factor of our concept was the combination of the functional and effect downlights overlapping each other and this created some concerns we decided to test.

In CHAPTER 6.1 we explain in more detailed way the test issue - human perception of coloured light in nocturnal environment. Here we also bring the scientific context of the perception issue, which helps to understand why this topic is relevant in our project.

Results and comments are shown in **CHAPTER 6.2** and in closing **CHAPTER 6.3** we collect the findings and show their importance for the final design development.

# 6.1. Test issue

What hasn't been answered by chapter 4.3 (concept guidelines) was the definition of the the effect layer parameters. Till now we agreed on having a circle of blue light (water inspiration) overlapping on the functional layer spot, as can be seen on the pictures below (Fig. 71 & 72). More precise definition of the effect layer guidelines required a test - maybe not robust but touching the tricky aspect of use of colour light especially at night - human perception. Above all we want to achieve an effect that would be pleasurable for the human eye and cause desired associations and we have doubts that only computer simulation can help us to successfully design such effect.

TEST TOPIC: Human perception of blue light in a nocturnal environment.



Figure 71 & 72. Functional and effect layer in our design

To start with, from biological point of view our perception at night is different during the day. Based on the construction of an eye, science distinguish mainly photopic (daytime, good color discrimination) and scotopic (nighttime, monochromatic) vision and combination of both taking place in low lighting conditions - mesopic vision. Mesopic vision is characteristic low level lighting conditions (for example for road lighting) which puts mesopic type of vision in the center of our interest.



Figure 73. Human vision types [68]

Graphs below (Fig. 74 & 75) present the human spectral sensitivity curve, showing how sensitive is the human eye to specific wavelengths (colors) within the visible light spectrum. For mesopic vision the peak of highest sensitivity is for the wavelength of green color. Our design concept uses blue light, as the main inspiration comes from water, and this blue light is meant to overlap with white light from functional layer (colour mixing aspect). Perception of an effect layer as different than blue, for example greenish, is undesired.



Figure 74 & 75. Scotopic, photopic and mesopic vision curves [69]

As lighting design softwares are not focusing on human perception of colored lighting, there is a need for these softwares to be able to visualise dynamic lighting, including dimming and color-changing effects. On computer tests, one might falsely perceive the effect, a light source can achieve.



Figure 76. Effect 3D illuminance image in RE-LUX software is not showing true light colors due to using semi transmitting colored material in front of the effect luminaire.

Figure 77. Raytraced 3D illuminance of the effect layer, although it shows the color, it is not ideal software for determining the effect color and overlapping ratio.

At the level of creating a lighting proposal, and in the topic of the aspect that is fully aesthetical, emotional in our design (effect layer), without major functional dimension, we treat this test as a source of qualitative information for our final design decision.

What we want to answer with this small test are two color related questions that would help us design our effect layer visible and working in the way we intended but not disturbing the functional layer in the same time.

- ..... A. Method of achieving blue color (blue LED or use of a filter)?
- ..... B. Overlapping depth of effect layer over functional layer (aesthetical value)?

# 6.2. Test

# EQUIPMENT

Starville LED PAR 36 COB RGBW 12W 2 PIECES

. . . . . . . . . . .

Light source: 12 W COB RGBW LED Colour mixing system: RGBW Beam angle: 60° Control: DMX-512



. . . . . . . . . . .

Figure 76. Starville LED PAR [70]

Filters

We tried 3 filters in the pre-test, to choose the ideal one for testing. Datasheets of used filters with information such as the light transmission for wavelength can be found in the appendix 10.



This decision means, that if test points to the filter as better way to achieve blue color (over blue LED), the further development of the fixture optics for the effect light would be using a medium blue filter as optimal choice. Manufacturer describes this filter as "a clean blue with hints of green. Good for moonlight and sidelight" [71]

### A. Method of achieving blue color



FILTER BLUE: more reassuring and calming. Aesthetical. Water associated presence. More flexible, dimming changes more visible. BLUE LED: harsh, purple looking, visually perceived less natural compared to the filter, artificial. Provokes more unsecure feelings than filter.

### B. Overlapping depth of layers

To answer the second question of our test we used the effect layer made with the use of filter only, as this method gave us more satisfying results in part A. In this simulation we searched for a solution where both layers would be visible and distinguishable, but together they would still look like

coming from one fixture. The area they cover was also a criteria (the more the better).



# 6.3. Findings and evaluation

The test was conducted to answer two color related questions that would help us design our effect layer. To finish our proposal we needed a test to give us directions, answers that would satisfy our imagination of an effect we want to achieve. Therefore, again we would like to say that findings are source of qualitative information for our final design decision and are defined according to our (designers) preferences. Finding presented below, our design decisions, would help in further simulations, sketches and fixture development.

A. Method of achieving blue color (blue LED or use of a filter)?



Our choice: Filter blue Optimal dimming: Effect 100% - Functional around 70%

B. Overlapping depth of effect layer over functional layer (aesthetical value)?



Our choice: 1/2 overlapping depth

The question of color temperature of a white light of a functional layer was raised during the test conduction, as effect layer overlaps and surely it's perception would be influenced by the color of the white light. We did not consider the use of cold white for functional layer due to its bluish appearance, too close to the effect layer characteristics.

Picture X shows the result of a quick, additional simulations showing the tendency we want to avoid. With warmer white, blue light is distorted towards greenish and overall aesthetics of layers collaboration is much lower. We assume that 4500K would be optimal to have white light with warm touch (also due to the support of the sun sparkle inspiration) but without distorting the blue color of effect layer.



Figure 77. White light color temperatures [72]



Pervious 6 chapters, presented the development of this project step by step. Chapter 7, final design, is the output of all the work presented before, a proposal we offer for Sad San Galli as support and as a solution to some of its struggles which light can address.

In **CHAPTER 7.1** we show the experience we designed for a Sad San Galli user in relation to research question. Our lighting design in not monotonous and uniform, it is differentiated according to park's structure and there is a logic behind our design decisions, which hopefully would lead a user through a process from being attracted to appreciating nature restorative value.

This process is based on research question and criteria, we want to attract to visit, invite to organic parth where effect light is present, stop a user for a while to give nature a chance to influence the visitor with its restorative power, which user would appreciate while leaving.

How we refer to criterias can be also seen in **CHAPTER 7.2** where a recap on the tools we used is presented.

Final **CHAPTER 7.3** gives all the answer we could deliver about the fixture that would help to implement our design.

# **RESEARCH QUESTION:**

How can an **innovative** nature inspired lighting design attract city dwellers to stay in Sad San Galli at night time in order to find **mental rest** and create **positive identity** for the park **promoting the value** of city nature ?

Be attracted to visit San San Galii, a nature oasis with unique lighting design

# Innovative

Take the inner, organic path, don't just pass-by, stay a bit longer...

# Reassuring

Sit in one of the main squares, look around, give yourself a moment to rest in the natural surrounding

Leave with appreciation of the valuable experience you had here and a memory of the new identity of this park.

Creating Identity & Promoting value

# 7.2. Criteria fulfilment

### INNOVATIVE

#### . . . . . . . . . . . . . . . . . . .

••••• Rethought traditional nightscape

Responding to new needs by unconventional lighting plan, questioning the regularity and rigidity of conventional solutions.



CURRENT SITUATION



OUR PROPOSAL

••••• Main downlight and subtle uplight

Hidden light source, focusing attention on the nature and surrounding not on the source of light.



CURRENT SITUATION



OUR PROPOSAL

••••• Modular light source

Combinig diverse light functions in one fixture, creating layers of light.







## REASSURING

#### . . . . . . . . . . . . . . . . . . .

••••• Addressing biofilic needs

Nature inspired design, attracting people to the place where thay can naturally rest.







#### ••••• Unconventional light art/Fascination

Altering spots and special effect attract people for social interaction, creating safety through occupancy of the space. Bollards in the stationary and seating areas with warm ambient beam to enhance visual comfort and intimacy for relaxation purposes.



· · · · · Illumination of more than horizontal paths surface

Besides horizontal paths surface, light reaches elements outside the paths (greenery, benches, bins ect). Uplight for the trees gently highlight the natural elements above, brings light to vertical surface, which together creates spatial ambience people find reassuring.



### IDENTITY

#### . . . . . . . . . . . . . . . . . . .

#### ••••• Nature inspired effect, colored light

To elevate the identity and attract people for social interaction the sparkle phenomenon with the special optics invites from both entrances into the middle part of the park. Blue hue is introduces, as people remember experiences by the color in which they are rendered (Descottes) and to strengthen the recognition of the effect phenomenon (promoting city nature concept in the area).



#### ····· Unconventional light art for every season

To create night experience and dynamic identity with mixed light tools for different parts of the masterplan. Luminaires altering on both sides of paths overlapping the nature and uplight on trees that create subtle alteration to the experience in different seasons. By this we mean the effect color and strength changes when paths are covered in snow and the uplight on trees in different seasons create different experiences as well (also for vertical and horizontal illumination).

### **PROMOTE VALUE**

#### 

#### ••••• Nature inspired biophilic design

Artificial light mimicking a visual stimuli from nature that the context of Saint Petersburg can identify with, influencing people's connectivity with nature and appreciation of green spaces.



#### ••••• Biomimicry masterplan design

Water drops on spider web inspiration to enhance the natural flow of the landscape with the play of light and darkness by spots. Node-oriented and differentiating minor from major paths.





#### ••••• Visual focus on nature

Perception change from ambient lighting with focus on the source in the present situation to spot down and uplighting in the new plan emphasizing nature itself. Even in winter time this artificial lighting can still evoke people's connectivity with nature.





Figure 87. View form the A entrance (Ligovsky Avenue)



Figure 88. Node



Figure 89. Organic path and square

# 7.3. Fixture

One modular system - a fixture that combines all previously mentioned tools creating a nature inspired lighting proposal for Sad San Galli. Fixture proposal is based on LEDs, already optimized to target a known application - modular, pole-mounted system for urban and residential parks.

Technology	&	Design
From practical/economical point of view this solution aims to improve power consump-	,	To add value to the aesthetic of the park, to enhance its nature, to successfully implement
tion, efficiency to be an investment for next		the design concept for illumination of Sad San
decades.		Galli with all with assumptions.

Each of the fixture modules (functional spot, effect, uplight) require separate set of guidelines, technical parameters to be defined. Suggested shape of the fixture is visually pleasurable, with the touch of organic shapes (curves) and respecting the traditional style of many park luminaires.

Below we share technical assumptions for the functional layer. Those parameters were defined approximately based on our calculations, simulations, but also on research in existing luminaire datasheets form manufacturers. Functional layer is a mandatory layer in all fixtures in our design.

# Functional layer

CRI: 80

CCT: 4500 - 4800 K Light output: 3000 lm Beam angle: 75 deg Narrow flood light IP 65, dimmable



Figure 78. Light distribution [66]



Figure 79. Fixture dimentioning

# Uplight

Uplight is an optional module in our design, vertical light layer found where the greenery height and density would be suitable for being highlighted. Mounting system of uplight module on the luminaire is a serious technical question, nevertheless some overall approximations based on the research among existing solutions will be presented here.

CRI: 80 CCT: 4000 - 4500 K Light output: 1000 lm Beam angle: 40-60 deg Spot light Dimmable Rotatable IP 65



Figure 80. Fagerhult PoleLITE product [73]



Figure 81. Uplight solution in the park in Saint Petersburg.

# Bollard

Bollar is a complimentary element of the design, yet not a part of modular fixture. Ideally bollard and a module-pole would create a luminaire family, sharing similar design style. Bollard in our design indicates the sitting areas and breaks the pattern therefore source of light must be visible (like torch) but covered with diffusing layer to do not cause much glare.

CCT: 3500 K CRI: 80 Light output: 1000 lm Omnidirectional





Figure 82. Light distribution [74]

Figure 83. iGuzzini iPoint bollard [74]

# Effect layer

In the topic of the effect layer (imitation of sun sparkle on water surface) this proposal puts emphasis on the atmosphere it creates, not on the technical aspect of its execution. Conducted test gave basic information about the overlapping depth over functional layer and the method of achieving blue color. Further testing and more time must be dedicated to this part to define its technical parameters and method of achieving sun imitation sparkles.


Figure 84 - 91. Dirrefent optics inspirations for sun sparkle effect

# FURTHER WORKS - FIXTURE

Development of the effect layer mechanism and optics in not the only aspect that would require further work in case this proposal would be approved for implementation. On this page we would like to point to two more issues we imagine as worth attention and attractive.

### DAYLIGHT SURPRISE

Daylight surprise with the reflective distorted steel material is an identity itself during daytime occuring only in moments when the sun is out, raising curiosity for the night sheme (connecting to night experience effect that is also strongly connected with sun). This suggestion elevates also the aesthetics, uses fixture as more than just object, but a playful element of the park, reflecting the surrounding. Moreover, this enhances the dynamic of daily and seasonal weather changes.



Figure 92. Daylight surprise sketch

### FIXTURE ADJUSTABILITY MECHANISM

Modular system was created to deliver a unique proposal. Step further would be to make this fixture universal, flexible solution for other green areas. Parks often have irregular shape and this adjustability of the bended part of the pole, on which two main modules of this system (functional layer and effect) are located would make this fixture easy to implementation in different areas.



Figure 93. Fixture adjustability sketch

### **OPTICS DEVELOPMENT**

Development of proper optics is the key to achieving the desired effect, being in the center of design. Our test suggested filter as suitable way to achieve aesthetic spot of bluish light, but more complex solution would be required to see light imitation of sun sparkle in this blue spot. Effect layer should also be adjustabe within the fixture to some extent, to create an effect in desired spot around the functional layer.



Figure 94. Optics development sketch



In addition to the topic of future works, mentioned also on previous page - we see big potential in the 3D print technology to be the answer for the fixture optics development challenges. Variety of materials and shapes 3D print can provide makes it a flexible solution for our needs and future tests. Another wish from our side for the development of the concept would be the interaction implementation. Light interacting with people can strengthen the effect we want to achieve, can invite even more diverse users to the park after sunset. For example playground for kids was not highlighted by us in a special way, but here interaction can support the needs of the youngest generation to have playful experience in a safe environment.

For now, even without the interaction we believe we managed to address the research question we defined. We created a lighting design taking a user into a journey, through a process from attraction, to prolonged visit when nature can use its power to improve human mental condition, to the creation of positive associations which point to the value of places like Sad San Galli.

This way we addressed the main areas of improvement we discovered during the analysis. Beauty is elevated through the innovative, biophilic lighting, using nature inspiration and focused of the beauty of green urban areas. Diverse users are invited to visit the park after sunset because now-adays everyone needs a reassuring moment and Sad San Galli after sunset is a safe place to have it. Because of this, the aspect of safety and proper light levels and uniformity is on the priority list for future work and simulations. We also did not get deep in the topic of dimming in order to save energy and respect the nocturnal environment. In the future, bioadaptive lighting can be a topic to explore and implement.

With new lighting design in Sad San Galli, big number of passers-by have now a reason to stay for a bit longer, appreciate the nature oriented, reassuring experience park offers and chose to visit it more often. Through a connectedness to nature in Sad San Galli, this place can become more valuable than just a different path on the way. Connection is a good departure point to change of attitude towards belonging and mental ownership of the place. Feeling of belonging as one of the key methods to increase people's engagement and thus the condition of the park and its maintenance can be improved.

Our design gave a green light towards a positive change at nighttime experience in Sad San Galli, a green oasis in the heart of Saint Petersburg.



Looking back to the project at the end, we had initial motives of developing this project, that we reflected on in the foreword. As we chose to take the roots of a previous project, we made a decision prior to the project start, that might have had an influence on our final outcome.We have taken some of process from "the Sensitive Organism" and a background lead from previous findings. The aspect of city nature, that is a relevant topic connected to our vision and RQ in this project. People's biophilic connection to nature that we were looking for in our effect, and the biomimicry connection with nature to implement in the design solution, that we used in our Masterplan design.

We had two universities, of which for one (Aalborg University), we were focusing on deepening, and developing a research-based lighting design project. The knowledge from other projects and authors helped us form guidelines and direction for our criteria to translate ideas and derivate general tests in order to evaluate on design decisions.

ITMO, from the other hand has a different approach and interest to projects, as it has strong roots in engineering and informatics. We often had to overcome struggles of understanding our role and the extent of the project based on having two parties in the project with different expectations.

The luminaire development besides the light masterplan was initially considered to be a goal as a bespoke lighting solution for the master thesis. We were hoping to get further with the luminaire specifications, but within this three month of timeframe, we got to the general idea about the design, the light output and usage of coloured optics, to create the desired effect, but we did not have the chance to text on actual optics to create the effect, and to develop the whole luminaire. We still want and are curious about the whole process of making a luminaire and hope in the future we can get closer to completion, but that is a long process and communication within different professionals working together. As this project is open to be implemented by client, there may be a future to this part of development.

What we learned is, that there is a fine line between roles as a lighting designer, that is not specified, and the roles have to be clear when starting a project. As a lighting designer, we need to be able to have skills from other fields required to work together with experts we will work with in the future (eg. Anthropologists, Electrician, Engineer) to the point to be able to communicate our needs, know our limitations and make realistic design decisions. The transdisciplinary approach is a great tool in our hand, to have a holistic understanding of the field we are going to work in and teaching new ways to successfully work in group formations.

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# Appendix 1 - Detailed process model

Phase	Process Step	Output
0.Start	FUNDAMENTS Analyse requirements Literature reading Understanding	Process plan Literature notes Project goals and requirements
1. Background (WHO )	RESEARCH OF CONTEXT (St.P) RESEARCH OF CONTEXT (park) STATE OF ART VISION	Historical/cultural note, mapping,mindmap (St. Petersburg) Historical/cultural note mapping,mindmap (park) Nature inspired lighting (relevant studies,inspiration projects)
02. Analysis (WHAT)	DATA GATHERING Public Space Public Life Light DATA ANALYSIS	Mapping, videos,photos,materials Anthropological approached observations interviews, recordings Observations, measurements,
	Public Space Public Life Light	Indicating maps Indicating maps, evaluation tables (Gehl)
0.4 Transformation (WIIIV)		neteeting maps, evaluation table
04. Iransformation(WHI)	(DESIGN) CRITERIA CONCEPT GUIDELINES	Criteria transformed to light quality to fulfill ( based on papers, guidelines )
o 04. Concept (HOW)	INSPIRATION	Inspiration images and projects groupped
	BRAINSTORMING A, MASTERPLAN CONCEPT	Idea sketching, Initial concept Light strategy Light principles
0	B, PRODUCT CONCEPT	Light strategy Light principles Accent on technology
	FINAL DESIGN	o
05. Test	LIGHT CALCULATIONS DESIGN TESTING	~ ~
06. Final Concept	Modifications based on test	0
o 07. Evaluation, Overview		•••••••

Appendix 2 - Comparison pictures (night/day and winter/summer)





### Appendix 3 - Analysis notes

PUBLIC LIFE – Spradley Space ( the physical place or places) Closed Bad maintenance Very well used Abandoned, neglected architecture around Signs of vandalism on wall ( graffiti )

Object (the physical things that are present) Paths, Benches Playground Small sport field ( with fence )

Act (single actions that people do) Move, Sit, Smoke, Run, Wait Activity ( a set of related acts people do) Walking Dog walking Playing with kids Sitting/relaxing Winter: snow form building Goal Relaxation Getting from A side to B side Socializing Fun Meeting point Feeling

# Appendix 4 - Survey detailed results



### Appendix 5 - Notes form the interview with ITMO

FACE(S) OF THE CITY - Skt Petersburg is divided into 18 districts. Each district has its specific atmosphere, characteristics, problems. Each of them has a kind of "face" that looks different in summer and in winter. Petersburg as one entity has a face as well, that should be considered when designing for any area within this city. ITMO want to bring out in the design the faces of each district, and encourages us to define how we see this faces, as foreigners( different perspective/insider-outsider). Focus on identity of the space, visually described as "face" is what ITMO and client will be happy to see in our design.

LANSVET - our client. "Lensvet" is a St. Petersburg state unitary enterprise, an organization on Petersburg's outdoor electric lighting. They expect results, specific solutions to the problems more than insight into analysis process. Starting from visuals of our design, through description of our solution to technical info - HOW?

### ITMO values/criterias in designs

visual comfort and safety (for moving around the area, for communication, for relaxation) Informative - reflects the spirit of the place. It is important to understand the city but also to focus on local aspect of the specific place. think what information you show with your lighting design, how you transform and change the image of the place innovative - progressive design solutions (sustainable)

CRITERIA	RELATED STATE OF THE ART TERM	RELATED URBAN JUSTICE NEED	OUR VISION	RESEARCH QUESTION
CREATING IDENTITY	'	INCLUSION & BELONGING invitation to belong for all users	"small nature oasis in the heart of Saint Petersburg"	"innovative nature inspired lighting design attract city dwellers to stay () and create positive identity for the park"
PROMOTING VALUE	BIOPHILIA URBAN GREEN SPACE	CONNECTIVITY improved connection to nature, onsellf and others	"could reconnect people with nature"	"promoting the restorative value of city nature"
INNOVATIVE	BIOPHILIA BIOMIMICRY	CREATIVE INNOVATION Unique solutions, new technologies	ı	"innovative nature inspired lighting design"
REASSURING	BIOPHILIA URBAN GREEN SPACE	HEALTH & WELLBEING restotarive experience after sunset, safety	"give them a mental rest from the daily stress"	"at night time in order to find mental rest () the restorative value of city nature"

# Appendix 6 - Criteria relation to prevous guidelines



# Appendix 8 - Inspiration collages





## Appendix 9 - Design sketches











# 144 No Colour Blue (Fluorescent Sleeve)

View on leefilters.com / Find a Dea	Source C 6774K	Tungsten 3200K	
A clean blue with hints of green. Good for moonlight and	Transmission Y	32.4%	28.3%
sidelight.	x	0.183	0.237
	у	0.228	0.348
	Absorption	0.49	0.55



Both pre-assembled and self-assembly sleeves are available in the lengths shown.

**Pre-Assembled Sleeves** 

- T5 Colour insert
- T5 Colour insert + UV
- T8 Colour insert
- T8 Colour insert + UV
- T12 Colour insert
- T12 Colour insert + UV

### **Self-Assembly Sleeves**

- Lengths
- T5 Filter, End Caps & Polycarbonate Sleeves
  0.30m (1')
  T8 Filter, End Caps & Polycarbonate Sleeves
  0.61m (2')
  T12 Filter, End Caps & Polycarbonate Sleeves
  0.91m (3')
  Quick Roll Length 7.62m (25') x any width between 2.5cm - 1.17m (1" x 46")
  UV Quick Roll also available to combine with colours
  1.82m (6')
  - 2.44m (8')

**LEE** Filters

LEE Filters Worldwide: +44 (0)1264 366245 • LEE Filters USA & Latin America: +1 (800) 576 5055