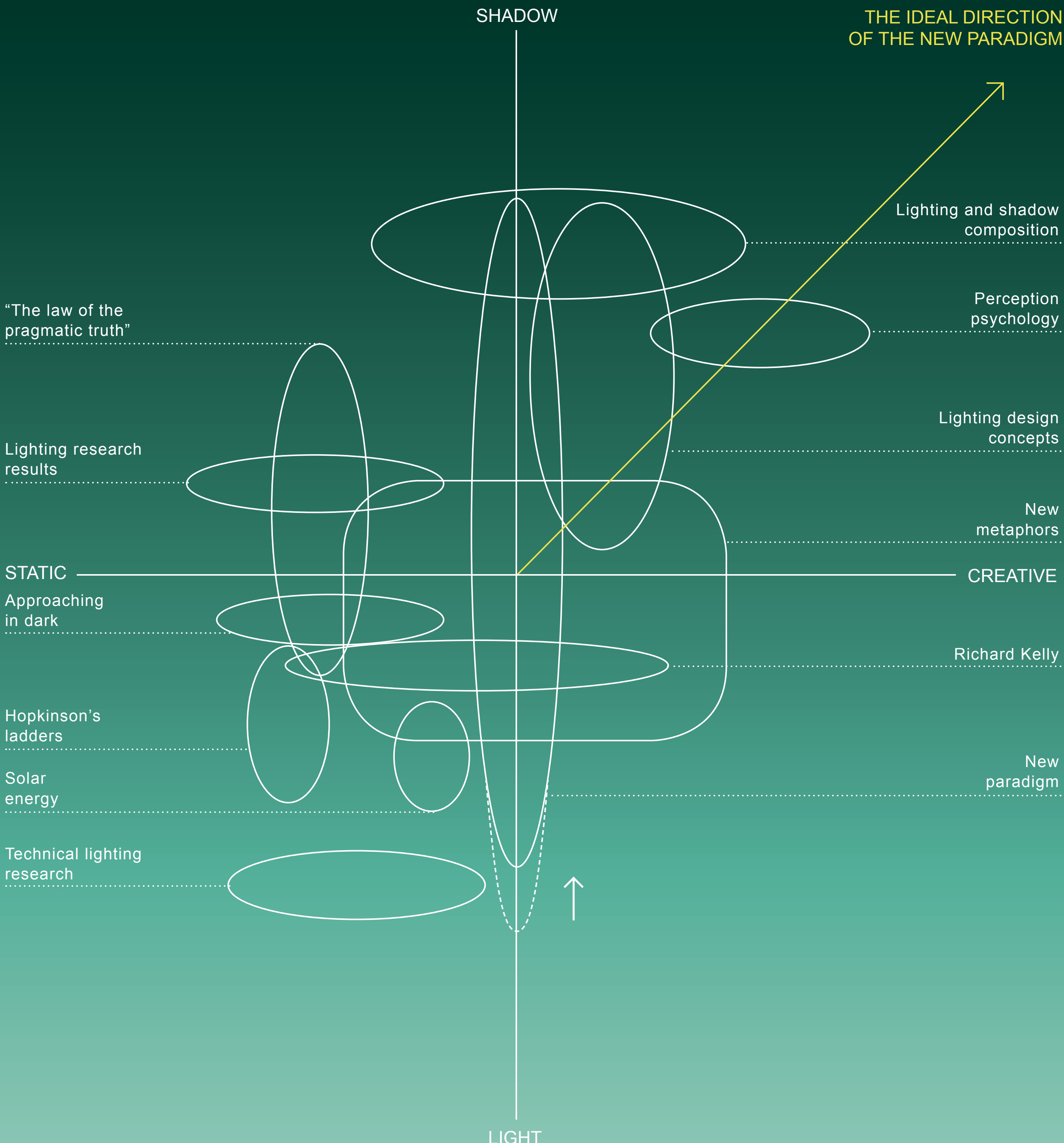
DESIGN CONCEPTS IN ARCHITECTURAL OUTDOOR LIGHTING DESIGN
Based on Metaphors as a Heuristic Tool



Aalto University

Julle Oksanen

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Based on Metaphors as a Heuristic Tool

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To Philip Gabriel

The late architect and lighting designer Philip Gabriel was my lifelong lighting design mentor and soulmate. It was my frequent privilege to visit him in Ottawa, spending unforgettable moments at his home and office. Phil also visited Finland many times. After a decade of mentoring we also started to give lectures together at universities and light fairs in Helsinki, Paris, New York, Las Vegas and Tennessee, to mention just a few. We continuously created architectural lighting design philosophies and concepts. We were 10- year members of CIE, Div. 3, TC 3.22 doing research on “Museum Lighting and Protection against Radiation Damage” in early 2000. We sometimes were like little boys while studying light. Once we drove overnight in Finland and measured moon luminance values with a luminance meter in order to study darkness. I drove the car and Phil measured from an open window and shouted the results to me. Phil’s great philosophical and professional contribution and impact can be seen throughout this dissertation.
I miss him

To Hannu Tikka

Professor and Architect Hannu Tikka is more than just a good friend to me. He is my heartfelt soulmate, friend, and professional partner. It has been my privilege to know and work with him for many decades. In 2003 we founded our common “Light & Space Academy, The Finnish Mobile University” in New York. Since then we have traveled in all over the world together giving pro bono lectures and workshops in over 20 universities. As an outcome of that we also have common professorships in the USA and our “Mobile University” has been associated with Aalto University Architect Department Group-X. Hannu guided and introduced me to the University world. Without him my master’s degree in landscape architecture and this doctoral dissertation would have been mere dreams.
I love him

Acknowledgements

Firstly, I would like to express my sincere gratitude to my supervising Professors, Vice President and Prof. Antti Ahlava and Docent and Prof. Anssi Joutsiniemi for their continuous support for my D.Sc.(Arch.) study and related research, for their patience, motivation, and immense knowledge. Their guidance helped me throughout the research and writing of this thesis. I could not have imagined having better advisors and mentors for my D.Sc. (Arch.) study.

Besides my advisors, I would like to thank my Thesis Instructors Prof. Antti Ahlava and Prof. Virginia Cartwright for their insightful comments and encouragement, but also for their tough requirements which incentivized me to widen my research from various perspectives.

Last but not least, I would like to thank my family: my mother Linda, my wife Leila, my children Olli Pekka, Pauliina Päivikki, Karoliina Kaunokki and Petteri Johannes, my brothers and Leila's sisters for supporting me spiritually throughout the writing of this thesis and my life in general.

Author

1. INTRODUCTION

1.1. Dissertation content

Architectural outdoor lighting design is currently based on strictly rule and system oriented technical lighting design. This method is totally impervious to external feedback and creative aesthetic development. The focus of my dissertation is on achieving change in the existing architectural outdoor lighting design paradigm by introducing the use of heuristic metaphors, modern- and also forgotten lighting design tools in practical architectural lighting design projects. These new elements are exemplified in the image on the front cover of the dissertation. Most of the concepts chosen are unknown among architects and other designers, who think, want, claim, imagine, wish or assume that light is part of their profession. The development of these concepts is presented in the following chapters.

Basic, but at the same time also partly unknown practical architectural lighting design tools are introduced in my Master's Thesis "Lost Shadows". (*Oksanen 2012*). This dissertation delves deeper into the principle structures of the design core and its elements. It opens the doors for creative aesthetic architectural outdoor lighting design world and can change its paradigm.

1.1.1. The status quo in architectural lighting

The status quo in architectural lighting design is distracting. In my own professional estimation, more than 95% of those designing lighting projects are self-taught lighting design individuals. Most universities throughout the world offer only a 2-hour course not even within the framework of any design, but rather of "building systems". (Giladi 1987). According to my subjective knowledge and over 30 years of continual international activities in the field of lighting education and design, the global situation is still the same as it was in 1987, with some decidedly rare exceptions. For years the International Association of Lighting Designers (IALD) has worked hard with universities to make lighting design a notable and integral part of their degree programs in architecture. (http://www.iald.org/trust/OutreachtoStudentsofArchitecture.asp). Unfortunately in the USA, for example lighting design is still integrated into the courses on environment Control Systems (ECS I + II) in the schools of architecture. Such ECS courses also include electricity and acoustics.

1.1.2. The status quo in technical lighting

Thousands of pages have been written. Much ink has been expended on technical argumentation on lighting. We could say that there is already a legacy of technical lighting and this is an outcome of hard efforts of technically oriented people. In 1900, the Commission Internationale de L'eclairage (CIE, i.e. International Commission on Illumination) was founded to research oil socks and their properties. Standardization took a major step forward in 1931 when the CIE introduced an international trichromatic colorimetry system known as the "CIE System". Engineers became active in illumination engineering societies. Sadly, the more visual skills of the lighting designer declined. The lighting design work shifted from the hands of visually oriented people to the hands of technically oriented people. Engineers have accomplished much as far as the quantity and distribution of light are concerned, but lighting design is at the same time unbalanced and skewed. Because of this, projects also look technical and often suffer from a lack of aesthetic merit. It is useful to look at and study lighting with open eyes, and to not judge earlier activities, solutions, norms or recommendations. The study of lighting requires an open mind unfettered by the judgments of earlier actions, solutions or recommendations.

It is also useful to carefully study existing solutions and their connection to technical lighting recommendations. This points the way to better architectural lighting design solutions. Past and present lighting design is largely implemented worldwide by electrical engineers, sometimes in collaboration with an architect or other design orientated professional. There is also a small group of professional lighting designers who have educated themselves without the approval of any official institutions such as ministries of education, academia or peers. These international pioneers of today's lighting design together with the rapid technical development of new lighting technology (for example RGB LED systems) often create a risk of unbalanced lighting solutions which often look odd. Lighting solutions with a "wow" factor but with no answer to questions such as "Why color" in the wrong environmental context these result in unfortunate night- time architecture solutions.

1.1.3. Time as a guiding factor

Time also has been a guiding factor. Architectural lighting design has been guided by major changes in the sector. Technical revolutions have been so pervasive as to invariably divert attention from the necessary basic lighting design development. At the moment LED, OLED and their rapid development are the focal point. Teaching has been minimal. This, in turn, has affected the entire field (engineers, architects and other light industry actors) resulting in a modest level of knowledge and understanding of light. The gap between architectural development and lighting design development is dire indeed and this situation must soon be remedied. This dissertation includes scientifically proven architectural lighting design material. Universities have only to find the space in their architectural programs to start to change the world of architectural lighting design. Light is still the fourth dimension of architecture.

1.1.4. The architectural lighting design context

Technical lighting research has been a well- organized part of electrical engineering science for over 100 years. It is implemented by technical universities, lighting research centers and illuminating engineering societies all over the world. Architectural lighting research is a relatively young and badly organized branch of lighting design research, implemented mainly by individual students in different schools of architecture and art. Individual students at theater academies focus on stage lighting, individual students at architecture schools focus on light in architecture and individual students in interior and industrial design departments of various schools focus on luminaire design and interior lighting design.

This dissertation is a work of interdisciplinary lighting design research, adding art and science in a harmonious and useful combination, focusing on the new paradigm for architectural outdoor lighting. However, it also provides tools and examples for future research on a change of approach to architectural indoor lighting. The dissertation is based on international lighting research results, human physiological and psychological research results applications of lighting design elements and internationally approved personal skills. The dissertation includes a myriad of images because of the nature of light as a research element.

1.2. Main sources of information

The argumentation for the new heuristic approach of the dissertation is based on a piece of research entitled "Kestävyys, poikkitieteellisyys ja tietämisen monimutkaisuus-heuristiikka avuksi" (Huutoniemi 2014) (rendered in English as sustainability, interdisciplinarity and the complexity of knowing-help from heurisics) and other research papers and books on heuristics and metaphor. Basic global lighting research, standardization, and publications have mainly been in the hands of the CIE since 1913. According to CIE research results, most nations have prepared their own technically orientated lighting recommendations which generally guide lighting design processes. International Engineer Society of North America (IESNA) in North America and the Suomen Valoteknillinen Seura r.y (Illuminating Engineering Society of Finland) in Finland to mention just a few. The dissertation is also based on the lighting research results of Rensselaer Polytechnic Institute's Lighting Research Center, located in Troy, New York, USA.

The literature has been based on the library collection of the International Association of Lighting Designers, lighting handbooks and recommendations. The Psychological research which decisively influences this new approach (contrast evaluation and lighting composition) is based on the work of the anthropologist E.T. Hall and the engineer Wout van Bolmmel on human beings' behavioral zones and approaching in darkness. The American lighting designer Richard Kelly's physiological research of "Ambient Light", "Focal Glow", and "Play of Brilliance" has been forgotten and neglected, but plays an important role the work for the present dissertation. The methodology of classical pragmatism is used as a pivotal "tool" to "transfer" technical lighting research results to serve architectural lighting design

1.2.1. Research methodology and methods used

The study uses qualitative methodology given the detailed study of lighting design structures and meanings, as well as enabling the use of C.S.Peirce's and William James's classical pragmatism as a tool for a new paradigm when detailed technical research results are applied to serve architectural lighting. Pragmatism is a philosophical tradition that began in the United States around 1870. It is a rejection of the idea that the function of thought is to describe, represent, or reflect/mirror reality. Instead, pragmatists develop their philosophy around the idea that the function of thought is an instrument or tool for prediction, action, and problem solving.

Pragmatists contend that most philosophical topics, such as the nature of knowledge, language, concepts, meaning, belief, and science are all best viewed in terms of their practical uses and successes rather than in terms of representative accuracy. Thus architectural lighting is an ideal field for the application of this tool. On the other hand, it is not a valuable tool for technical lighting solutions, because of possible risk factors (e.g. safety on highways and in warehouse areas). This method is the only way to do it, because it sets exact lighting research results free for use with reasonable tolerances.

The dissertation is based on heuristic methods and 19th-century pragmatism, which are introduced in detail. The dissertation makes reference to many of author's own projects as case studies in which these elements play a major role.

The object of research is urban outdoor lighting (roads, streets, pedestrian areas, parks, buildings, statues, and monuments). The embodiment examples of the pragmatic theory of truth are also used in interior lighting, as far as the examples serve the point. Otherwise, indoor lighting is excluded from the study.

1.2.2. Structure of the dissertation

This dissertation is divided into chapters as follows:

Chapter 2 entitled "Lighting design history" is divided into eras and presents background knowledge and an understanding of lighting.

Chapter 3 entitled “Modern architectural outdoor lighting elements and tools” presents the basic aesthetic and scientific tenets of the dissertation. It contains philosophies from the Age of Antiquity like those of Vitruvius and Aristotle up to contemporary scientists and scholars, the heuristic studies of Katri Huutoniemi and the studies on metaphor by Nezih Ayriran and citations from these. Heuristic metaphors guide the rest of the structure of the dissertation in the direction of modern architectural lighting design with its ”hardware” tools and many examples.

This chapter also recalls numerous of forgotten and useful lighting design tools, new and innovative tools and lighting design process studies. It comprises eight large sections (Heuristic approach - Metaphors, creativity and architectural lighting identity - Energy and architectural outdoor lighting - Solar energy & LED & Dimming methods in architectural outdoor lighting design - Richard Kelly’s design process - Shadow design and darkness design - City lighting master plan strategies). These sections contain 33 carefully studied and explained subsections. This chapter also shows that the existing technical lighting design process is rule oriented and systematic, thereby making the study immune/impervious to external feedback and creative aesthetic development. At the same time it demonstrates the inefficacy of the technical recommendations, leading to poor lighting solutions and incapable of serving old and modern architecture and - spaces. This chapter also presents five different kinds of practical heuristic metaphor examples: “Lighting composition”, Mariehamn West Harbor – “Building luminaire”, Telenor Building – “Whispering lights”, Fiskars Village – “Color lighting”, the Finnish National Opera – “Large surface lighting”, City 2030.

Chapter 4 entitled “Architectural outdoor lighting design concepts” deserves closer examination. It is the most important element in the whole lighting design process (both indoor- and outdoor lighting design) after the heuristic metaphor design phase. It describes five different levels of approaching conceptual design (“Thought free” - “Ideas from the past” - “The Analytic approach” - “The Gestalt approach” - “The Intuitive unconscious / super-conscious approach”) and six different conceptual examples of architectural lighting design.

Chapter 5 entitled “Architectural outdoor lighting design methods” presents two different kinds of professional architectural lighting design methods (Telenor head quarters in Oslo and Mariehamn West Harbor). They demonstrate the importance of carefully designed methods on projects based on heuristic metaphors (rarely used because of the lack of architectural lighting design education).

Chapter 6 “Conclusions” presents the answers to my research questions.

1.3. Research questions

Is it possible to create a new architectural outdoor lighting design approach by utilizing heuristics and metaphors as a problem-solving tool in lighting design?

“Although heuristics is not praised in scientific debate, it has been shown to be a pivotal part of both experts and laymen’s problem solving” *(Dreyfus & Dreyfus 2005;. Kahneman et al. 1982).* It is considered a useful help to generate and transmit ideas, and to cope with problematic situations. In the rule oriented “technical lighting” design process, where lighting design decisions are based on rules, norms, and technical lighting recommendations, the heuristic method is a rarely used design element. In the architectural lighting design process the heuristic approach is a very important tool after conceptual design approach selection and accomplishing a new metaphor.

Aristotle was the first philosopher known in history to point out the effective role of metaphors in creative processes. He defines a metaphor as, "...consists in giving the name that belongs to something else" *(Picot, J-C. 2006).* He explains the importance of metaphors: "...ordinary words convey only what we know already: it is from metaphor that we best get hold of something fresh."

Both heuristic and metaphorical thinking are valuable elements to cover this research question.

Can we find executable design tools to turn the direction of 100 years lasting technical lighting design practice towards more artistically orientated architectural lighting design processes?

There is at least one scientific "tool" to put most of the valuable light technical research results with all its scientific nomenclatures and practical uncertainties to use when defining practical solutions in real life architectural lighting design projects. That tool is "The Law of the Pragmatic Truth" or in other words: "The Pragmatic Theory of Truth".

Can we use those tens of thousands of pages of technical lighting research results in this transition process to arrive at aesthetic lighting solutions?

This dissertation presents practical project examples of using technical lighting research in a creative way by using heuristics, metaphors and "*The Law of the Pragmatic Truth*" as innovative tools.

What are the benefits of using the first-generation pragmatism of C. S. Peirce and William James in order to utilize pragmatic light technical research results to serve architectural lighting design?

Technical lighting research is important because of the continuous development of the industry, but the innovative use of pragmatism gives immediate meaning to technical lighting research results. It will "release" research findings to serve practical life and projects in aesthetically pleasing ways.

2. ARCHITECTURAL LIGHTING HISTORY

2.1. General

Lighting design features 1810-2014 have been in a state of fermentation these two centuries. Lighting design in particular has been under different kinds of pressure in different decades. In the following brief introduction I focus on architectural lighting history in a design oriented way. I present only a brief collection of notable activities during different selected lighting eras, not an exhaustive study of lighting history. This gives a starting point for understanding the big picture, which must surely be the main purpose studying history in general and the basic elements of the subject when making decisions for the future.

All these selected eras in lighting represent periods of transition in the lighting field. They reveal a clear picture of a relatively short lighting period generally and relatively fast changes in this field. The selection is also a revelation of the relation between a large technical lighting and a small architectural lighting community and how just one person, like Sir Humphry Davy in the field of technical lighting and lighting designer Richard Kelly in the field of architectural lighting can have a huge influence on the lighting field as a whole. The selection of luminaires in different eras gives a general view of the design style of the given time period.

2.2. Light before electricity

Until the 18th century people only had two sources of light at their disposal: Natural daylight and the flame – the latter being the only artificial light source since the Stone Age. These two types dictated the patterns of life and architecture down through the ages, but a new epoch was ushered in with the invention of gas lighting and then electric lighting.

Figure 1. Lamplighter lighting a gas streetlight in Sweden, 1953. By this time the remaining gas lamps were rare curiosities. Photo: (Wikipedia 2)

2.3. Electric light (1810)

The first experiments with electric light took place in 1809 or 1810, but the date of these is often given as 1813. The light source is on the table and electricity for the experiment was supplied from the batteries which were located in the cellar. However, there are some indications that experiments on the production of the electric spark between carbons had been performed before the above named date.

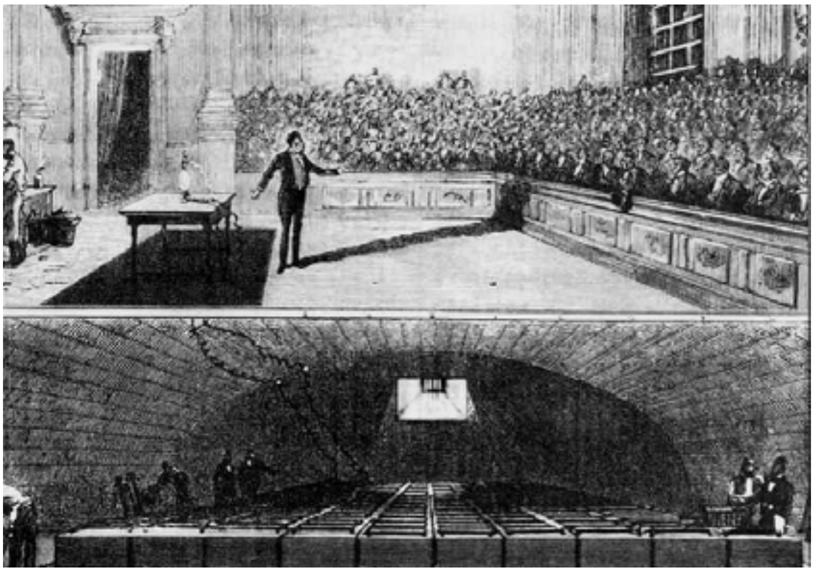


Figure 2. Humphry Davy demonstrates his new electric light to the members of the Royal Institution of London 1809. Photo: (Wikipedia 3)

2.4. Quantitative lighting design (1885)

With the advent of electrical lighting, obtaining illuminance levels similar to those of daylight became a question of how much technical effort one was prepared to invest. At the end of the 19th century, one attempt at providing street lighting was to mount floodlights on light towers. Glare and harsh shadow caused more problems than advantages and so this form of outdoor lighting was soon abandoned.

Figures 3 and 4. The American Electric Light Tower (San Jose 1885): Photo 12: (Wikipedia 4) Carbon Arc Lamp William Jandus 1895. Photo 13: “1000 Lights 1879-1959”, Tachen 2005, Cologne. p.18.

2.5. Experimental era (1900–1913)

The first steps towards the formation of an international body concerned with light measurement were taken at the International Gas Congress, held during the Paris Exhibition of 1900. Four hundred gas engineers gathered together in the Palais des Congres at the exhibition, under the chairmanship of Prof. T.Valt, the president of the Socie'te' Technique de l'Industrie du Gas de France. The result of this meeting was “The Photometry of Incandescent Gas Mantles”. The CIP of 1903, the precursor to the CIE founded in 1903.

The CIE was founded in 1913 in Berlin to study the photometric properties first of gas lighting, later expanding to other light sources (coils and incandescent lamps.).

Figures 5 and 6. Expo Universelle Paris 1900. (Photo: Wikipedia 5) Josef Hofmann Table Light 1904. Photo: Metropolitan Museum of Art.

2.6. The early days of lighting design (1913–1930)

The invention of the electric light bulb opened up a new frontier in modern architectural design. These could show how buildings looked after nightfall. The potential of electric light as a new “Building material” was recognized in the 1920’s and became a useful design tool. Skillful lighting allowed for theatricality and narrative, a dramatic interplay between light and dark, and a new emphasis on structure and space.

“As an early example of Mies’s use of light to bring focus and clarity to his architectural compositions, he incorporated an illuminated double screen of translucent glass that served as an only source of light for the structure after dark. This glowing volume provided a gravitational center for the pavilion and a counterpoint to the colored light and illuminated fountains featured across the fairgrounds after dark.” *(Neumann 2010a)*

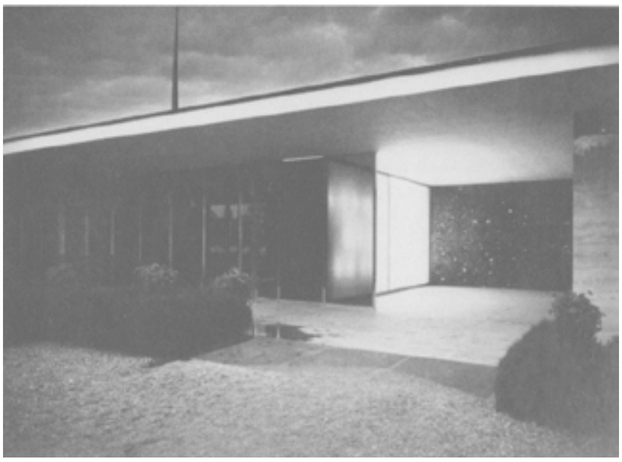
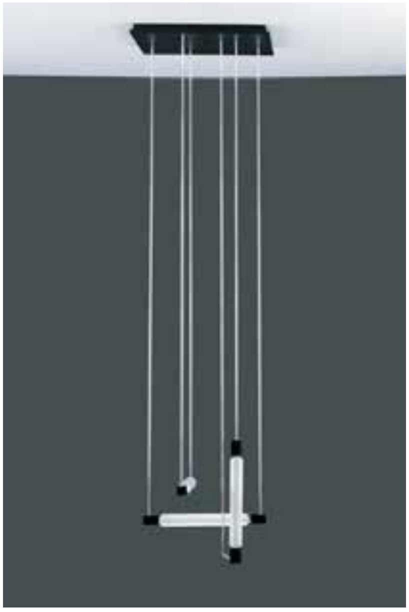
 

Figure 7. Barcelona pavilion by the architect Ludwig van der Rohe. 1929. Photo: (Wikipedia 7)

Figures 8 9 10. Gerrit Rietveld Hanging Light 1922 (left). Poul Henningsen Table Liight PH1. 1925 (middle) Marianne Brandt & Hans Przyrembel, Hanging Light. 1926.(right) Photos: "1000 Lights 1879-1959", Tachen 2005, Cologne.pp. 228-229 (Photo 17) , 240-242 (Photo 18), 236-237 (Photo 19)

2.7. The era of lost shadows (1931–1940)

After the experimental era of 1900–1913, where the first steps towards the formation of an international body concerned with light were taken (CIE), lighting research increased rapidly. One of the first elements in the "lighting research field" was "spectral sensibilities" which soon got a more modern name "spectral sensitivity". One of the earliest written accounts was found already in 1916 in Matthew Luckiesh's book "Light and Shade and Their Applications" …. compensate correctly the spectral sensitivity of the plate…." (*Luckiesh 1916, 95*)

The spectral sensitivity curve of the eye led to our system of photometry. Photometry is the science of the measurement of light in terms of its perceived brightness to the human eye. In fact the measurement of the effects of electromagnetic radiation became a field of study as early as the end of the 18th century. Agreement on the spectral sensitivity curve in the CIE also led to the development of the CIE chromaticity diagram to provide a system of colorimetry (Photo 11).

In 1931, the CIE (Commission Internationale de L ‘eclairage / International Commission on Illumination), introduced the international trichromatic colorimetry system, known as the “CIE System.” This introduction created a standardized lighting design method, and engineers became active in illumination engineering societies and as practitioners of lighting design. Gradually, theories changed from the visual skills of the lighting designer to the standardized lighting offered by the new engineering-based standards. A good thing from the lighting design point of view was that it gave basic tools for lighting design in general. The sad thing is that lighting design work shifted from visually oriented people to technically oriented people. This reflects the inability of engineers and architects to cooperate and the general lack of architectural lighting design education. Engineers focus upon and provide quantity of light, norms and lighting recommendations and distribution of light. Engineered projects result in a technical look and often suffer from lack of visual beauty.

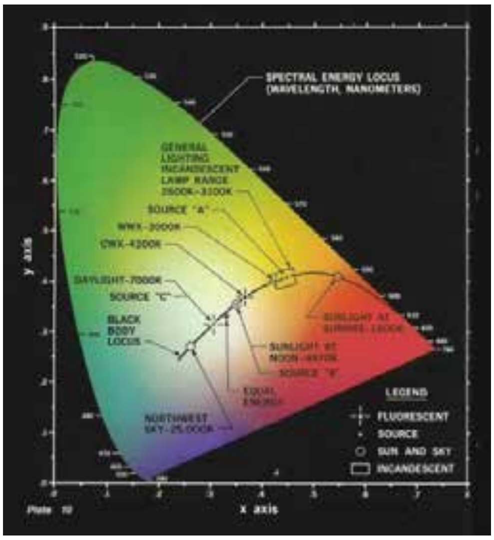


Figure 11. “CIE system”. Photo: http://www.physics.uc.edu

Figure 12: Alvar Aalto Golden Bell Pendant. 1937. Photo: *www.bukowskis.com/sv/antiques/ F16/291-Alvar* Aalto- taklampa

2.8. A “One man show” (1940–1969)

Richard Kelly (1910–1977) was an American lighting designer and the highest “ranked” pioneer of architectural lighting design. Kelly had already established his own New York-based lighting practice in 1935 before enrolling at the Yale School of Architecture, where in 1944 he graduated from the war-time “accelerated architecture program” as a BSc in Architecture. Kelly characterized the difficulty in selling lighting consultancy, then a new discipline, when he reflected "There weren't lighting consultants then. Nobody would pay for my ideas, but they would buy fixtures." His later career also saw him lecture at, among others, Yale, Princeton and Harvard.

After his death, the Illuminating Engineering Society of North America established the Richard Kelly Grant in his name to encourage creativity in lighting among young people.

Richard Kelly was a pioneer of qualitative lighting design who borrowed existing ideas from perception psychology and theatrical lighting and combined them into a uniform concept. His strongest contribution of all lighting designers in the lighting design world is undisputable. Richard

Kelly broke away from the rigid constraints of using uniform illuminance as the central criterion of the lighting design. He replaced the question of lighting quantity with the question of individual qualities of light. These were designed according to a series of lighting functions, which were in turn geared towards the perceived observer. In the 1950's Kelly made a distinction between the basic functions: ambient luminescence, focal glow, and play of brilliants*. (Neumann 2010b).*

He co-operated with world famous architects in famous projects like: Glass House, New Canaan, Connecticut, 1949, architect Philip Johnson / German Pavillion, Barcelone World's Fair, Barcelona, 1929, architect Ludwig Mies van der Rohe / Seagram Buildings, New York, 1954–1957, architects Ludwig Mies van der Rohe & Philip Johnson / Kimbell Art Museum, Fort Worth, Texas, 1972, architect Louis Kahn, to mention just a few*. (Neumann 2010)*

Richard Kelly was also a luminaire and daylight designer, working with famous architects and manufacturers.



Figure 13. Pioneer of quality lighting design: Richard Kelly (1910–1977). Photo: Book: "The Structure of Light" / Richard Kelly and the Illumination of Modern Architecture", Yale University Press, New Haven and London in association with the Yale School of Architecture, ISBN 978-0-300-16370-4, p.2.

Figure 14. Seagram Building, architect Ludwig Mies van der Rohe & lighting designer Richard Kelly, 1954–1957. Photo: "Seagram Building at night" by photographer Andreas Feininger/ Time&Life Pictures"/Getty Images.

Figure 15. American Floorlamp, Philip Johnson & Richard Kelly, 1953. Photo: Wikipedia, "Philip Johnson & Richard Kelly floor lamp", http://markmcdonald.biz/images/light1.jpg

2.9. The era of architectural reawakening and LED technology (1969–2014)

Professional lighting designers form a relatively small, but visible and active group of people dedicated to architectural lighting design. They have balanced technically orientated lighting design since 1969.

When I met Lighting Designer Howard Brandston in Troy New York in 2002 and interviewed him concerning lighting design history, he explained that there was a real pressure in the 1960's to create a common association for architectural lighting designers. Lighting legends like Howard Brandston himself, Stanley McCandless, Lewis Smith, Abe Feder, Richard Kelly had a meeting in New York City and decided to found The International Association of Lighting Designers. In the beginning there were just a few members, but at the time of writing in 2016 it has a remarkable number of architectural lighting designers around the world and its headquarters is now located in Chicago, Illinois, USA.

The IALD: “Founded in 1969 and based in Chicago, Illinois, USA, the International Association of Lighting Designers (IALD) is an internationally recognized organization dedicated solely to the concerns of independent, professional lighting designers. The IALD strives to set the global standards for lighting design excellence by promoting the advancement and recognition of professional lighting designers. Value lighting designers are a tremendous resource creating innovative, practical and economically viable lighting solutions. They understand the role of lighting design in architectural and interior design and utilize their extensive experience and knowledge of lighting equipment and systems to enhance and strengthen design”.

The unexpectedly rapid development of LED products has also confused the lighting world since 2000. Some kinds of visual overloaded color phenomena have come into effect with easily implemented RGB LED in unprofessional hands. The lack of university level architectural lighting design education is exacerbating this problem.

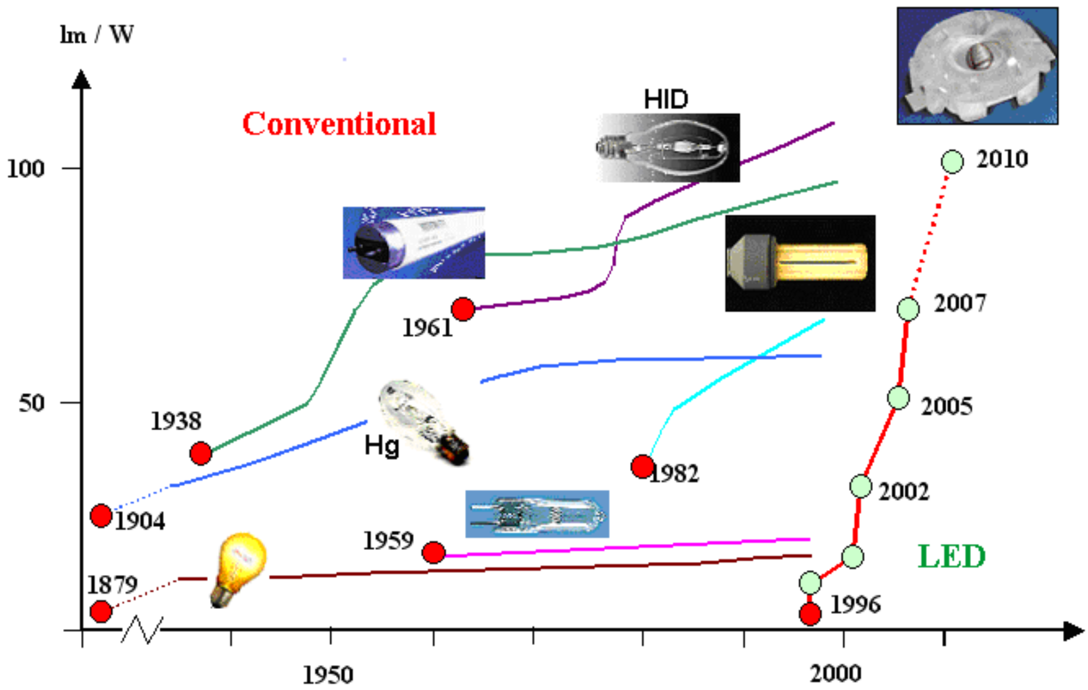


Figure 16. Light source development. Photo: Osram

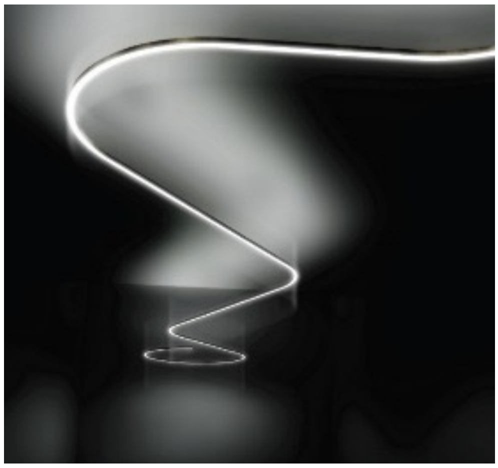


Figure 17. *IALD activity "Light Map"*, https://www.iald.org/

Figure 18: Freedom LED luminaire,Weikko Kotila & Julle Oksanen, 2012 manufacturer Fagerhult. Photo: W.Kotila & J. Oksanen. Freedom report.

2.10. Masters of architectural lighting

I selected master's level architects who have used light as the fourth dimension in their own architectural designs and whose buildings I have visited and seen with my own eyes (e.g. Louis Kahn's Kimbell Museum in Texas, Frank Lloyd Wright's Taliesin West and Howard Brandston's "Lady", the Statue of Liberty, NYC). This selection summarizes important views of world class architects on light and architecture. As such it reflects my personal motivation for conducting this research. The aim is far from a comprehensive outline of the topic, but rather to make the larger narrative of the dissertation more comprehensible.

2.10.1. Howard Brandston (Modified from http://concerninglight.com/projects/ and personal discussion at his home in Troy, New York

Howard Brandston founded his own lighting design consulting firm in 1965. It became the New York City-based Brandston Partnership Inc. During Mr. Brandston's tenure, the firm completed more than 2,500 projects in 60 countries, including the relighting of The Statue of Liberty and the lighting of The Petronas Towers in Malaysia

Howard Brandston received numerous international and national, notable awards and medals and he also received the Lifetime Achievement Award from the International Association of Lighting Designers and is the sole lighting designer in the Interior Design Hall of Fame. In 2014, he received the United States Institute of Theater Technology Distinguished Achievement in Lighting Award. In his sixty- year career, he has received more than one hundred design awards. For more than 50 years, he has been an Adjunct Professor, guest lecturer, and visiting professor at multiple universities around the world. In 1981, he founded the Workshop for Teachers of Lighting, an IES program that continues to educate teachers to this day. He also founded the Ad Hoc Committee of Lighting Funding Research Organizations, which led to the establishment of the Lighting Research Center at RPI. He is a former holder of the Feltman Chair in lighting at Cooper Union, and recently established The Howard M. Brandston Award in Lighting at Brooklyn College. He has designed more than 2500 projects in 60 countries.

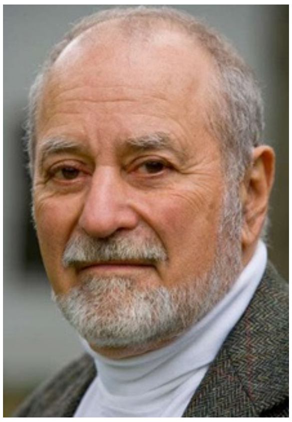
 

Figure 19. The Lady, Statue of Liberty. Lighting design Howard Brandston

"…A lighting designer is what the term says he is – a designer whose field of specialization is light, … The good lighting designer does not think in terms of equipment, wattage or illumination level. He thinks in terms of space" Quotation: Personal interview at Howard Brandston's home in Troy, New York, Fall 2002.

2.10.2. Le Corbusier (Modified from https://en.wikipedia.org/wiki/Le_Corbusier)

Le Corbusier was at his most influential in the sphere of urban planning, and was a founding member of the *"Congre's International d'Architecture Moderne*", (CIAM). One of the first to realize how the automobile would change human agglomerations, Le Corbusier described the city of the future as consisting of large apartment buildings isolated in a park-like setting on pilotis. Le Corbusier's theories were adopted by the builders of public housing in Europe and the United States. In Great Britain urban planners turned to Le Corbusier's "Cities in the Sky" as a cheaper method of providing public housing from the late 1950s. For the design of the buildings themselves, Le Corbusier criticized any effort at ornamentation. The large Spartan structures in cities, but not 'of' cities, have been widely criticized for being boring and unfriendly to pedestrians. Le Corbusier was a leader of the modernist movement to create better living conditions and a better society through housing concepts. Le Corbusier had a great influence on architects and urbanists all over the world. Corbusier also designed buildings. In 2016, seventeen of Le Corbusier's buildings, spanning over seven countries, were added to the UNESCO World Heritage Sites list, reflecting "outstanding contribution to the Modern Movement. One reason why I have selected Corbusier as one of the masters of architectural lighting was his metaphoric ideas at Notre Dame du Haut, Ronchamp, which is introduced in this dissertation.

Figures 20 and 21. Architect Le Corbusier Notre Dame du Haut, or Ronchamp, Designed by Le Corbusier. Photo www.Greatbuildings.com

“The history of architecture is the history of the struggle for light” . “Architecture is the masterly, correct and magnificent play of volumes brought together in light…I compose with light…Light is the key to well being.” Quotations: *http://www.azquotes.com/author/3274-Le_Corbusier*

2.10.3. Frank Lloyd Wright

Frank Lloyd Wright (modified material from Wikipedia, and personal notes in Frank Lloyd Writes Taliesin West introductory lecture in autumn 2014 at Taliesin West, Phoenix, USA)

Frank Lloyd Wright (June 8, 1867– April 9, 1959) was an American architect although he had no formal qualification in any field. Nor is there any evidence of high school qualification. He was admitted to the University of Wisconsin-Madison as a special student in 1886. There he joined the Phi Delta Theta fraternity, took classes part-time for two semesters, and worked with a professor of civil engineering, Allan D. Conover. In 1887, Wright left the school without taking a degree (although he was granted an honorary Doctorate in Fine Arts from the University in 1955). As a talented person, he was finally recognized in 1991 by the American Institute of Architects as “The greatest American architect of all time”. He was an architect, interior designer, writer, and educator, who designed more than 1,000 structures, 532 of which were completed. Wright believed in designing structures that were in harmony with humanity and its environment, a philosophy he called “organic architecture”. This philosophy was best exemplified by Fallingwater (1935), which has been called "the best all-time work of American architecture". His creative period spanned more than 70 years. His works includes offices, churches, schools, skyscrapers, hotels, and museums. Wright also designed many of the interior elements of his buildings. Frank Lloyd Wright wrote 20 books and many articles and was a popular lecturer in the United States and in Europe. His colorful personal life often made headlines, most notably for the 1914 fire and murders at his Taliesin studio in Phoenix, USA.

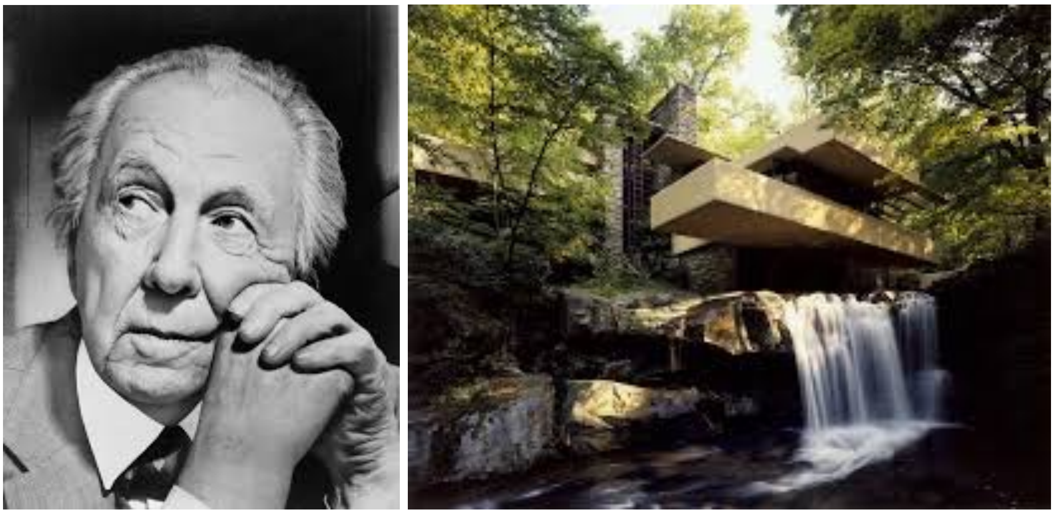


Figure 22. Fallingwater House designed by Frank Lloyd Wright. Photo www.wright-house.com

“More and more, it seems to me, light is the beautifier of the building…Lighting may be made part of the building itself.” Quotation: https://www.pegasuslighting.com/lc-lighting-info/quotations-and-thoughts-about-light.html

2.10.4. Louis Kahn

After visiting Louis Kahn's Salk Institute for Biological Studies in La Jolla, California and his Kimbell Art Museum in Texas, I totally agree that he was one of the single greatest influences on world architecture in the second half of the twentieth century, as is mentioned on the book "Louis Kahn", written by Professor Robert McCarter. Louis Kahn was an American architect born on the Baltic island of Saaremaa, Estonia in 1901. According to the book, Kahn described himself as a Finnish Jew by origin. In the book Professor McCarter provides a comprehensive overview of Kahn's architecture. Book also explores key themes and their evolution throughout his career. When I read the book, I recognized with amazement how Louis Kahn's projects, the like Salk Institute, included great analyses, design processes, construction methods and materials as in my dissertation. He treated and respected light fairly as a real part of his architecture. Mainly day lighting. Louis Kahn died in New York City in 1974.


Figures 23 and24. Architect Louis Kahn Kimbell Art Museum designed by Louis Kahn.Photo: Julle *Oksanen*

"You can say that the light, the giver of all presences, is the maker of a material, and the material is made to cast a shadow, and the shadow belongs to the light…" Quotation: http:// www.azquotes.com/author/7694-Louis_Kahn

3. MODERN ARCHITECTURAL OUTDOOR LIGHTING DESIGN ELEMENTS AND TOOLS

General

Architectural lighting design is facing new challenges. Fast developing tools in architecture and other associated professions exert huge external pressure on architectural lighting design. The rule oriented and systematic lighting design process era has slowly started to fade away. A heuristic approach, combined with pragmatism, gives a useful “Design Toolbar”, which looks different from before. This “toolbar” establishes completely new and creative tools for the lighting designers of tomorrow.

This chapter focuses on those new thinking oriented tools and concepts. All tools and elements have been compartmentalized in “independent” subsections, even though they are recognized in different chapters.

3.1. The heuristic approach

3.1.1. Strict methodical professionalism in the fields of lighting research and design

“The scientific method as an empirical and historical category, refers to activities which, if successful, produce to some extent consistent and predictable results. When the scientific field (also including smaller scientific scale fields like technical lighting), is aging and its foundation and paradigm mature, the scientific method evolves” (*Huutoniemi (2014)*

In the technical lighting field "normal science" explains and justifies itself as a rule oriented and systematic process, while in new or fragmented fields and sectoral borderlands (as in relatively young architectural lighting) ought to foster virtuosity, personal knowledge, and creative talents. These elements, which are very important in the creative architectural lighting design process, are not necessarily achievable with formal education alone. However, this does not eliminate the feasibility of teaching creative architectural lighting design, for example, to talented architecture students.

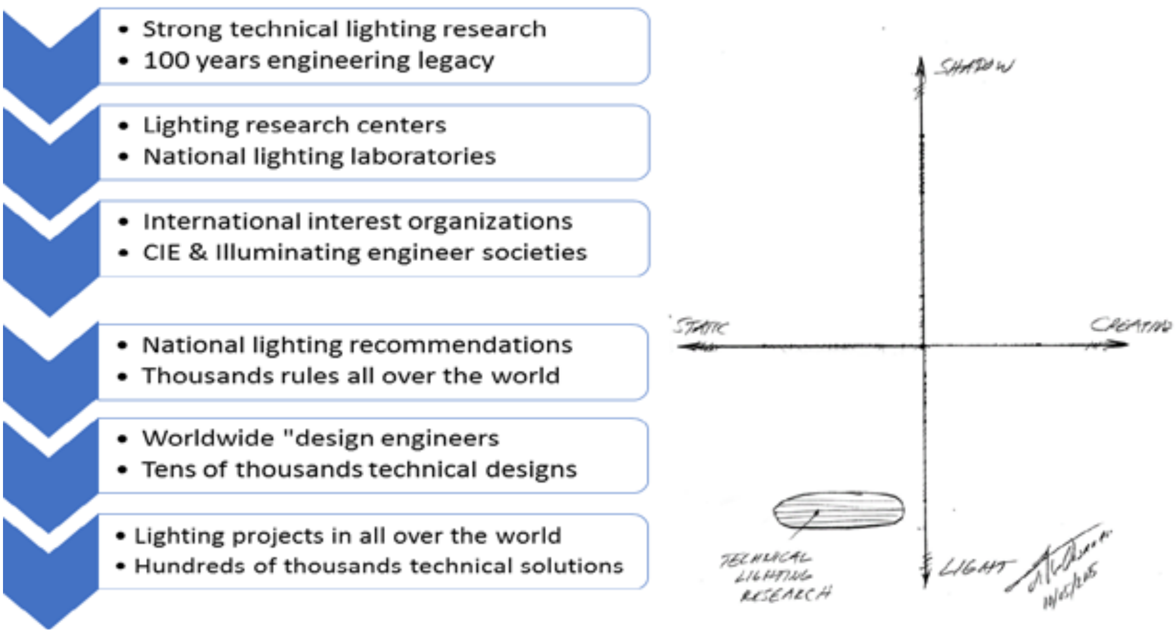


Figure 25. Left: A strictly rule orientated and systematic process scheme of the technically oriented lighting field makes the study immune to external feedback and creative aesthetic development.

Right: The structure of the interpretation frame for a creative architectural lighting design process. Figures: Julle Oksanen.

A strictly oriented and systematic technical lighting design (Figure 25 left) is located inside the quadrate “Static” and “Light” in Figure 25 right. The structure of the interpretation frame for the architectural lighting design process (Figure 25 right) includes horizontal and vertical lines; “Light/ shadow” – Spatial and quantitative features of lighting; “static/creative” – temporal and qualitative features of lighting. The quadrates formed specify the dispersed locations of all important and creative architectural lighting design elements. These elements are important design tools and are introduced in Figure 27, which also has specified centers of gravity for Richard Kelly’s philosophy and the Japanese lighting design tradition.

3.1.2. Heuristic approach

The genesis and the first and widespread manner of approach to teaching chemistry in the United Kingdom was heuristics. It defined a learning process in the late 1800s. Heuristics emphasized observations and learning measurement skills independently in different problem situations. The problem definer was usually a teacher and the approach was assumed to impart scientific methods and principles. The heuristics pioneer H. E. Armstrong explained his approach claiming that by means of experimental research information can be found which others have to achieve by forcibly learning by heart and following demonstrations. Armstrong stressed particularly the importance of doing things and understanding them.

After a process of maturation over time, a heuristic technique (from the Greek word: “to find” or “to discover”), later simply called a heuristic, is involved in any approach to problem solving, learning, or discovery that employs a practical methodology not guaranteed to be perfect, but adequate for the goals in question. Heuristics can be used in most areas of work and study. In cases where an optimal solution is impossible to achieve or is impractical, heuristic methods can find a satisfactory solution. Heuristics can be used as a mental shortcut reducing the cognitive burden of decision-making. Examples of this method include using “a rule of thumb” (see subsection 3.4.2. “Solar energy by project bases” – “Rule of thumb” calculation for solar energy). In that heuristic calculus the advantages of the system were soon confirmed. No very precise and scientific calculations were necessary, because the result was obvious, and on that basis the project could proceed without any doubt about its functioning. Other heuristics as mental short cuts: An educated guess, intuitive judgment, stereotyping, profiling or common sense.

George Polya’s Book *“How to solve it*”, published in 1945, introduced some other commonly used heuristics:

- If you are having difficulty understanding a problem, try drawing a picture. (A case in point is my clarifying drawing in Figure 27, *The complexity and dispersal of design elements (and tools) in the relatively young architectural lighting design field*).
- If you can’t find a solution, try assuming that you have a solution and seeing what you can derive from that (“working backwards”).
- If the problem is abstract, try examining a concrete example.
- Try to solve more general problems first.

A “Heuristic device” is used when an entity A exists to enable the understanding of some other entity B. A great and much used example of this in architecture and architectural lighting is a model that, as it is never identical with what represents, is a heuristic device to enable the understanding of what it models.

Figure 26. Practical example of using a “heuristic device” in the Museum of Contemporary Art in Finland, Kiasma. From left to right: Kiasma is ready and in use - Model on a scale of 1:2, located in the National Research Center’s testing area - Inside the exhibition room of the fifth floor model - Exhibition room completed. In the model we studied daylighting values over one year and the functioning of the light coves.

“Stereotyping” is a type of heuristic that all people use to form their own opinions or make their own judgements about things that they have never seen or experienced (Oversimplified conception). Stereotypes are the pictures that we have in our heads which are built around personal experiences as well as what we have been told about the world. In social psychology a stereotype is a thought that may or may not accurately reflect reality.

Stereotyping is, or at least can be, a disturbing factor in architectural lighting design projects where team members have no architectural lighting design education at all.

3.1.3. Heuristics in the architectural lighting design process

Dispersal of the creative architectural lighting design elements (important design tools) introduced in Chapters: 3.2 - 3.7 are illustrated in Figure 27 as follows:

"Metaphor, creativity and architectural lighting identity" (Chapter 3.2):

The use of heuristic design tools (lighting research results, approaching in the dark, Richard Kelly and Hopkinson ladders, the law of the pragmatic truth and solar energy) create a "New metaphors" segment, which can change the position of the new paradigm towards the creative and shadow quadrate.

"*Energy and architectural outdoor lighting*" (Chapter 3.3), "*Solar energy, LED and dimming*"- methods in outdoor lighting design" (Chapter 3.4):

These are very important and practical tools in daily work to reveal elements as the tools of Chapter 3.2 (lighting research results, approaching in the dark, Richard Kelly and Hopkinson ladders, the law of the pragmatic truth and solar energy) to implement darkness design efficiently and sustainably in real life design work.

"*Richard Kelly's design process*" Chapter 3.5):

Richard Kelly's segment is on the other hand a "technical separation" of light and at the same time a very important tool for creative lighting design. A very effective element in creating new metaphors.

"*Shadow and darkness design*" (Chapter 3.6):

A light and shadow composition segment is a result of using a shadow and darkness design as a equal partner for a lighting design. These partners can form a great composition together which can have a major influence on the lighting design concepts segment, which can change the positions of new metaphors - and new paradigm segments.

"*City lighting master plan strategies*" (Chapter 3.7):

This chapter (especially "Futuristic City 2030") covers all the elements and segments of Figure 27. Richard Kelly's principles (ambient light from large surfaces, focal glows from detailed light elements etc.), perception psychology, and approaching in the dark lighting values, necessary lighting design calculations, solar energy solutions, composing light and shadow, Hopkinson's ladder calculations(indirectly), new lighting design concept - metaphor and change of paradigm.

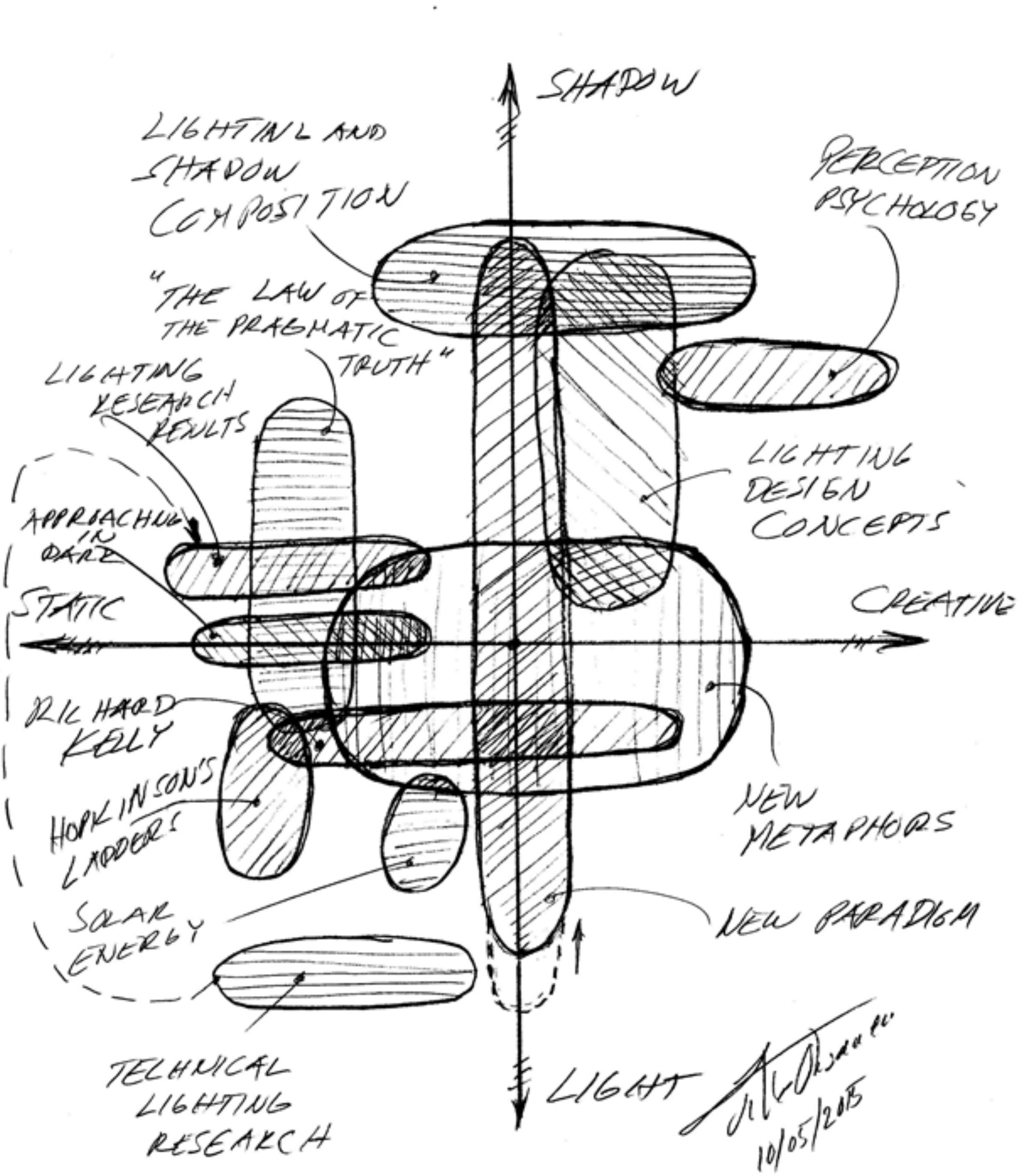


Figure 27. The complexity and dispersal of design elements (and tools) in the relatively young architectural lighting design field. This is a field open to innovative and creative designers. The diagram demonstrates the necessity of heuristically analyzed metaphors. A strictly rule oriented and systematic process scheme of the technically orientated lighting field, which is introduced in Figure 25, belongs to the oval box bottom left "Technical lighting research". Photo: Julle Oksanen

The strict methodical professionalism required by practice is not likely to contribute to the sustainability of a more general social aspiration. While consolidating of methods enables the accumulation of learning and knowledge in a specific field, it creates the boundary between experts and amateurs, and thus makes the study immune to external feedback and development pressures. Although the settlement of patterns of specialization is natural in many problem-oriented areas – like technical areas, health sciences, "design research", design, etc. (e.g. Cross 2007*)* – it is poorly suited to creative architectural lighting design and research which touch on a broad and diverse range of actors (architects, interior designers, industrial designers, physicists, anthropologists, engineers, etc.). This fact feeds a transformation process from methodology towards heuristics.

Turning attention from methodology to heuristics in architectural lighting design is not an invitation to abandon the systematic pursuit of knowledge, only the pursuit of invoking universal technical lighting arguments. In this sense, the heuristic approach is close to pragmatism (e.g. *Dewey 1929*). Pragmatism sees knowledge as a part of practice, and emphasizes the adaptation of the methods used as a result of trial and error. Truth and knowledge are compared with that which "works," but as the social theorist Stephan Fuchs points out, it is not about the functioning of a single part, but of the whole system. (*Fuchs 2001*) Later in the dissertation, pragmatism and also heuristics play important roles in the successful architectural lighting design process through examples and metaphors. These examples are combinations of different conceptual design approaches (most of them analytic and intuitive), heuristic treatments, and accomplished metaphors.

Examples can be found in:

3.2.3.1.1 Heuristic Metaphor: "Whispering Lights", Fiskars Village

3.2.3.1.2 Heuristic Metaphor: ”Lighting Composition", Mariehamn West Harbor

3.2.3.1.3 Heuristic Metaphor: "Building Luminaire", Telenor Building

3.2.3.1.4 Heuristic Metaphor: "Color Lighting", Finnish National Opera

3.2.3.1.5 Heuristic Metaphor: "Large Surface Lighting", Hypothetical City 2030

Although heuristics is not praised in scientific debate, it has been shown to be a pivotal part of both experts' and laymen's problem solving (*Dreyfus & Dreyfus 2005;.Kahneman et al.1982*). It is considered a useful help to generate and transmit ideas, and to cope in problematic situations. In the rule oriented "technical lighting" design process, where lighting design decisions are based on rules, norms, and technical lighting recommendations, the heuristic method is a rarely used design element. In the architectural lighting design process, the heuristic approach is a very important tool after conceptual design approach selection and accomplishing a new metaphor.

3.2. Metaphor, creativity, and architectural lighting identity

3.2.1. Baseline

The lighting design process is an easy task if it is merely a matter of complying with the national lighting recommendations. A professional architectural lighting design process is not an easy task and needs professional tools for processing. Metaphor is paramount in this and the basic element for heuristic treatment. The author's own practical examples are introduced in subsection 3.2.3. "Heuristic metaphors in architectural lighting design" and in more detail in chapter 4.3. ”Introduction of different conceptual examples"

Genesis: Aristotle was the first philosopher known in history to point out the effective role of metaphors in creative processes. He defines a metaphor as, "...consists in giving the name that belongs to something else" *(Picot 2006).* He explains the importance of metaphors: "...ordinary words convey only what we know already: it is from metaphor that we best get hold of something fresh..".

3.2.2. Metaphor in architecture

As far as architectural philosophies "serve" light, which is "The Fourth Dimension of Architecture", it is good to take a brief look at the long history of metaphor in architecture. The significant role of metaphors in the formation of architectural identity has been realized and applied by architects since Vitruvius. Sometimes it is a conscious process and sometimes it is an unconscious process. When architects implement this tool, they create works of architecture, which are indelible reflections of the human mind. There are many architectural achievements indicating a strong correlation between the design approach based on metaphor and effective architectural identity. "It is seen that many architects have generated new images by triggering their imagination by overlapping two or more discrete images in their minds through homospatial thinking, particularly related to properties of a project topic or site area. Prominent architects such as Wright, Taut, Le Corbusier, Tatlin, Fuller, Cansever, Correa, Calatrava, Holl, and Libeskind have been able to generate multilayered, sophisticated and significant meanings through this approach. The important point here is that these significant meanings are not entirely new; as a matter of fact these are the metamorphosed forms of one or more existing meaning through "homospatial thinking"" *(Ayiran 2012).*

3.2.2.1. Example based on metaphors prior to the modern movement

The ideas about the role of metaphors in architecture date back to the Age of Antiquity. Almost two millennia ago Vitruvius suggested the use of nature as a metaphor and the observation of things growing, like a tree. He also points out that when people adopted a sedentary lifestyle, some built shelters for themselves resembling bird's nests by taking inspiration from swallows. As nature designed the human body symmetrically, perfect buildings, particularly temples, were designed by the ancients to be symmetrical. The reason for the effective identity of Gothic architecture is associated with its use of the structures of natural entities and natural processes as metaphors. Perronet described the metaphorical basis of Gothic architecture as follows: "The magic of these buildings is explained largely by the fact that they were built in some degree, to imitate the structure of animals; the high, delicate columns, the tracery with transverse ribs, diagonal ribs and tiercerons, could be compared to the bones, and the small stones and voussoirs, only four or five inches thick, to the skins of these animals. These buildings could take on a life of their own like a skeleton or the ribs of a boat, which seem to be constructed using similar models" (*Perronet 1770)*. "The constructive success and distinct identity of Gothic architecture could be attributed to the synchronization of its structural system with the "natural flow of forces" and in this sense the application of natural processes as metaphors". *(Schuyler 1894).*

Figure 28. Symmetric interior of Notre Dame Cathedral in Paris, France. Vitruvian man metaphor.
Photo: Magnus Manske

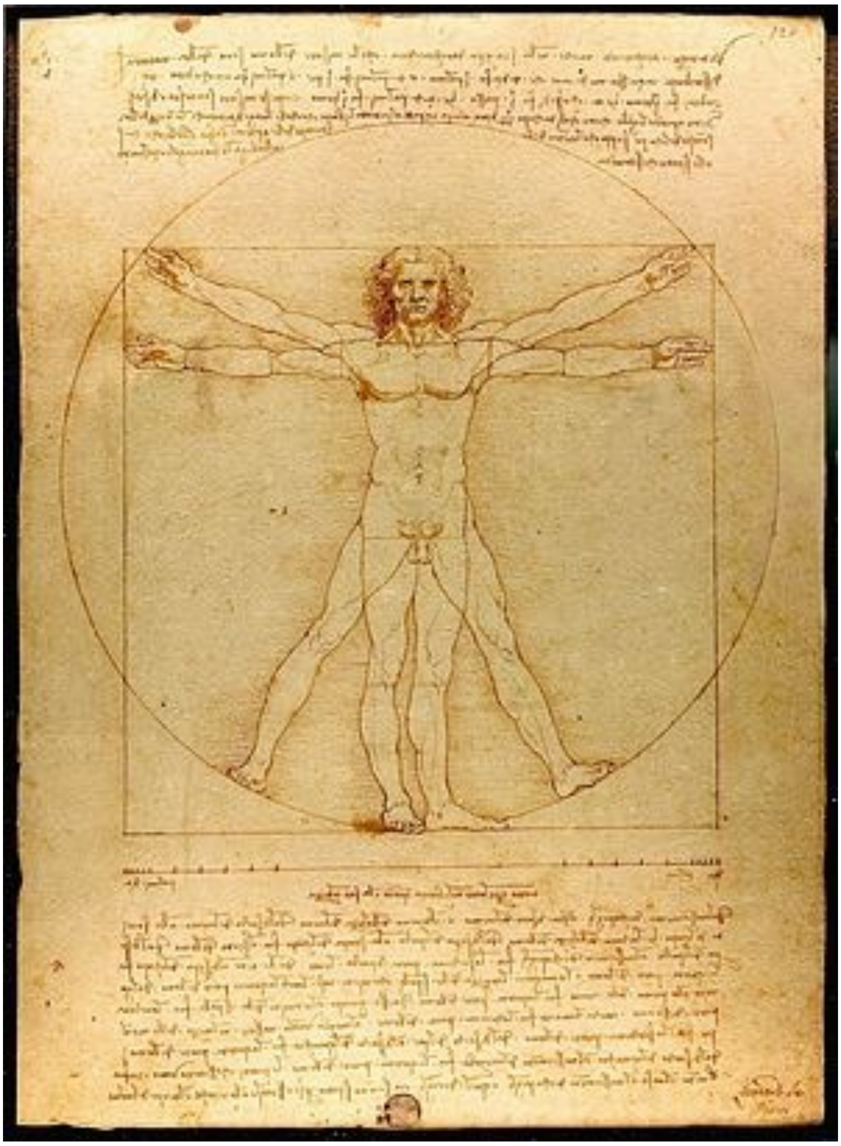


Figure 2916. The *Vitruvian Man*, Italian: *Le proporzioni del corpo umano secondo Vitruvio*, drawing by Leonardo da Vinci around 1490

According to "*Leonardodavinci.stanford.edu. Retrieved 2010-08-20*": "Leonardo Da Vinci's drawing of the Vitruvian Man is accompanied by notes based on the work of the architect Vitruvius. The drawing, which is in pen and ink on paper, depicts a man in two superimposed positions with his arms and legs apart and inscribed in a circle and square. The drawing and text are sometimes called the *Canon of Proportions* or, less often, the *Proportions of Man*. It is kept in the Gabinetto dei disegni e stampe of the Gallerie dell'Accademia, in Venice, Italy, under reference 228. Like most works on paper, it is displayed to the public only occasionally". The drawing is based on the correlations of ideal human proportions with geometry described by the ancient Roman architect Vitruvius in Book III of his treatise De Architectura. Vitruvius described the human figure as being the principal source of proportion among the classic orders of architecture. Vitruvius determined that the ideal body should be eight heads high. Leonardo's drawing is traditionally named in honor of the architect. The connection of this drawing to metaphors is symmetry, some kind of a Vitruvian Man metaphor.

Example from Le Corbusier, Ronchamp Chapel:

Ronchamp Chapel, built in 1955, has a strong identity which is based on theological metaphors. The many sketches clearly demonstrate that Le Corbusier is trying to establish a mystical relationship between Mary's body and the Church. In the chapel, there is another metaphorical layer. It is interaction with mortuary sculptures in the Brittany region of France *(Samuel, 1999).*

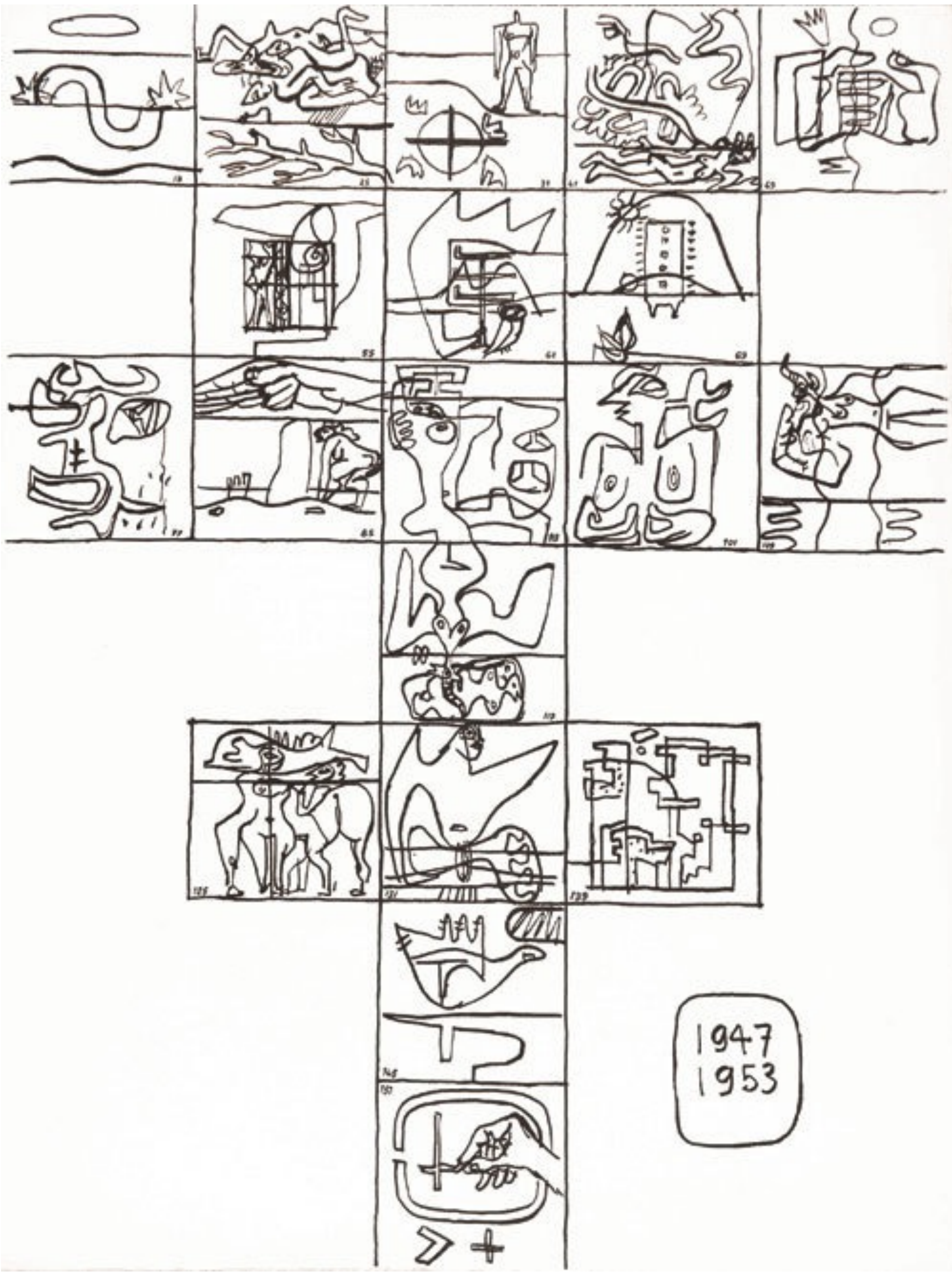


Figure 30. A lithographic print of the Iconostase structure of Le Corbusier's Poe'me de l'Angle Droite. Photo: LeCorbusierPrints.com.

Figure 31. Chapel of Notre Dame du Haut - Ronchamp Chapel, designed by Le Corbusier. Photo: Lucas Gray.

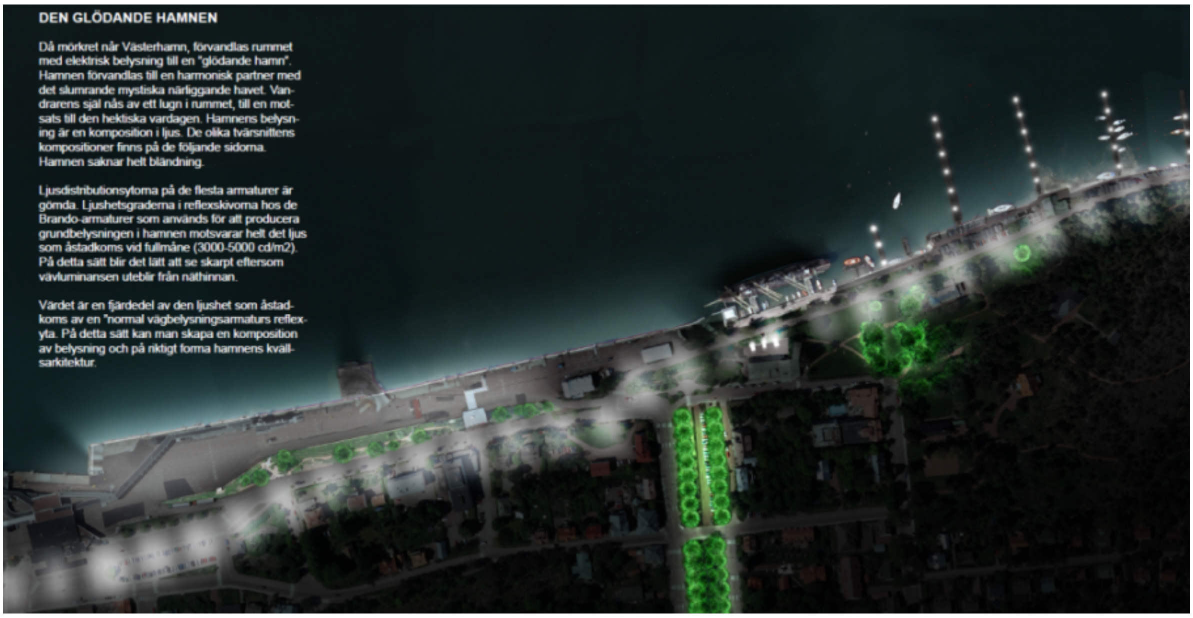
Figure 32. Inside the burial chamber at Mane Braz, Brittany, France. Photo. http://www.wikiwand.com/en/Megalith

3.2.3. Heuristic metaphor in architectural lighting design

As is the case in every other field of art, one of the most important purpose of architectural lighting is to reveal a unique night-time situation which has never been experienced before (at least at the site under the design work), and broaden the feelings, thoughts, and imagination of observing human beings. An enjoyable, innovative, and unique lighting design solution creates a good memory of the space in the observer's mind. It is not important what kind of hardware or software have been used (like design processes, luminaires, teams etc.). The result is all that matters. The best possible result would be if the observer could remember no light "technical" details at all, such as what kinds of luminaires had been used etc., but remembers the space as a pleasant place to visit.

Considering that the concepts of identity and uniqueness are close enough to be used for this, the main purpose of architectural lighting can be defined as designing a lighting solution which has a certain and unique identity. Heuristic metaphors seem to be beneficial instruments compared to several other methods and approaches applied by architectural lighting designers (whatever professional group they represent) in order to achieve this purpose. Heuristic metaphor is the first and most important step towards the successful architectural lighting design process and end result. It shapes the rest of the lighting design process. I illustrate this with an example:

Practical example: Mariehamn West Harbor area./ Glowing harbor.



First our client gave us a design area. We visited in the area and made notes, photos, and interesting findings. In this phase I already got a metaphoric idea or a collection of metaphoric ideas (During my personal design career I have collected a "metaphor library" in my mind and created an application for this project area). The dark sea looked scary from the quayside and I wanted to create a white and humble light- a veil to emulate it, a glowing harbor. The 100- meter vessel *Pommern* with its 50- meter high masts was quite naturally a focal glow of the space (element from Richard Kelly's metaphoric process), the beautiful long shape of the harbor path and the new museum building under construction combined to shout out a lighting composition. Soft classical music in the silent light. Strong contrasts and a modest white veil of light. The metaphor was created quite soon. Its heuristic treatment can be seen in subsection 3.2.3.1.2 and section 3.6.8. Lighting design "eureka" elements, the heuristic tools, are introduced in Figure 33. In this project a metaphor as a heuristic tool led the design to a successful conceptual philosophy and the use of the right tools later in the concept plan, master plan and detailed design plan. Conceptual-, Master plan and detail design reports are added as an appendix to this dissertation.

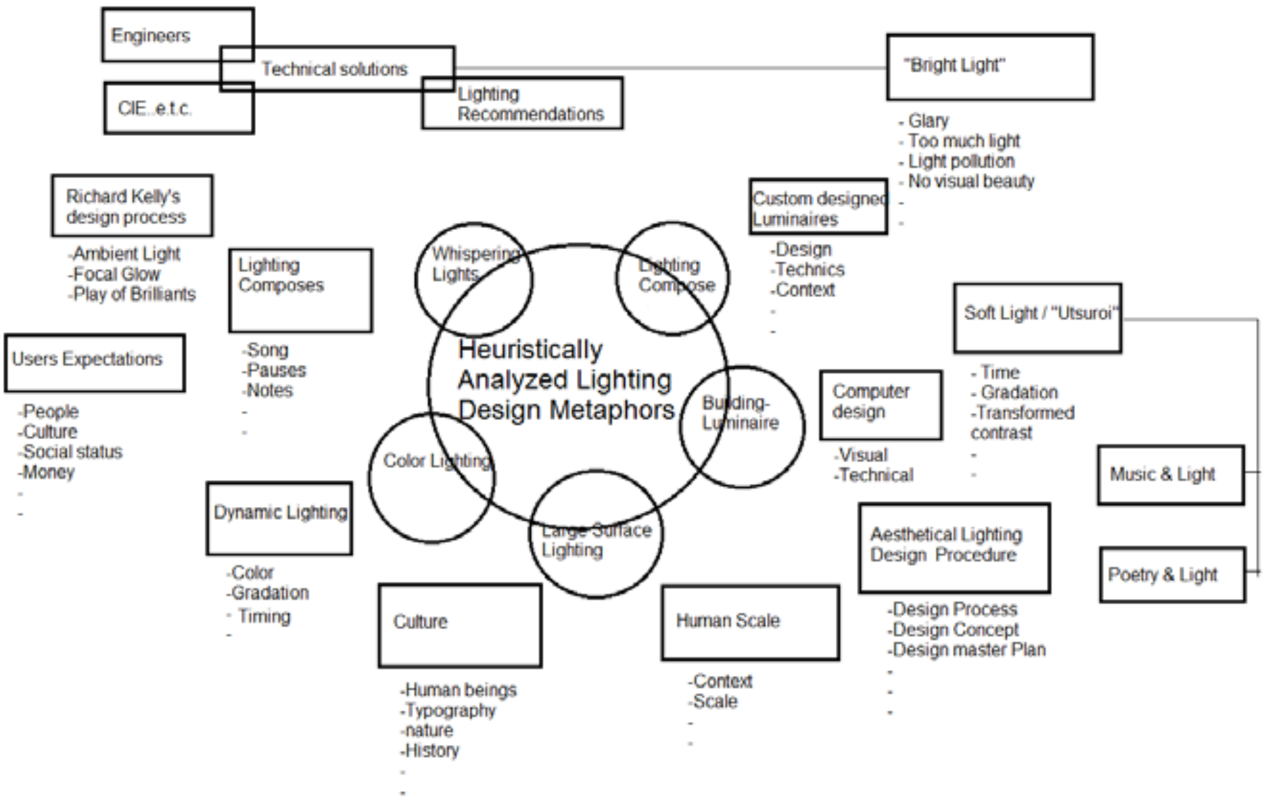


Figure 33. Lighting design "eureka" elements in heuristically analyzed metaphors. The heuristically analyzed metaphors are in the central position. The five smaller circles are project examples which are introduced in the dissertation. "Whispering Lights" refers to the Fiskars Village project, "Lighting Composition" refers to the Mariehamn West Harbor project, "Building Luminaire" refers to the Telenor Building ptoject, "Large Surface Lighting" refers to the hypothetical City 2030 project, "Color Lighting" refers to the Finnish National Opera project. Drawing: Julle Oksanen

A strictly rule-bound and systematic technical lighting design process, named later on in this dissertation the "Thought Free" method, is a process that many people use. They define the problem, apply the science and light the space. Usually this is a process of applying calculations and meeting specific quantitative needs. But quality, intuition, and feeling are required for success in most lighting applications. This may not really be a "thought free process" but it is usually free of feeling. Aesthetic architectural lighting design needs heuristic metaphors. Sometimes the metaphoric concept can be found either throughout trial and error, or comparing many deeply thought-out possibilities and selecting the best one. Depending on the case, there are many factors which influence this decision, such as personal skills, personal semiotic connections, personal general attitude towards design, space itself, limitations like the client's budget, etc. The idea selected may come into the designer's mind immediately (as in the case Mariehamn West Harbor case) or sometimes it may take even a year (as in the case of Fiskars Village). Whatever final heuristic metaphor has been selected, the elements of Figure 33 are present. Architectural lighting designers only have to find and recognize them and use them according to their design abilities.

3.2.3.1. Architectural lighting examples

The dissertation includes a comprehensive package of architectural lighting design material, focusing on giving answers to the research questions. In order to avoid overlapping information and breaking the logical structure of the dissertation, the heuristic metaphor material is introduced in this subsection briefly, creatively and focusing only on the main metaphorical structuring. Treatments of heuristic metaphors are introduced in greater detail in the relevant places in different subsections.

3.2.3.1.1. HEURISTIC METAPHOR: “WHISPERING LIGHTS”, FISKARS VILLAGE

“Heuristically analyzed lighting design metaphor element” – “findings” in words: Poetry & Light – “Utsuroi” – Gradation of shadow and light – Whispering lights – Glare free – Focusing light – Shadow is the best friend of light – Light & Sound in water fall.

Fiskars mill village is a very poetic place with more birdsong than manmade noise. Large oaks, a small river and a pond guided us to select a “poetic lighting solution”. It led us to avoid glare so much that we wanted to hide all light distribution surfaces with a glare-free solution. We told our client that we would accept project if we could start from complete darkness, because we felt that in this case we were more designers of shadows than designers of lighting. Shadow is the best friend of light. The flow of the river was music for the area and we wanted to illuminate that flow and sound. Light & Sound in a water-fall. At that time, in the late 90’s, it was difficult to follow our dream to prepare a great gradation for lighting elements, because we had to use gas discharge lamps and dimming was not an option. We had to operate with luminaire wattages and in some cases, like the black brick building (introduced later), we had to use gray filters to achieve low illuminance values. We called it whispering lights. We had to think in a more metaphorical way than thinking of numerical values of luminance, illuminance, etc. Heuristics had a strong role as we tried out different light sources, luminaires, and luminaire constructions. One night when we testing luminaires to illuminate trees, the people of Fiskars thought that we were butterfly researchers.

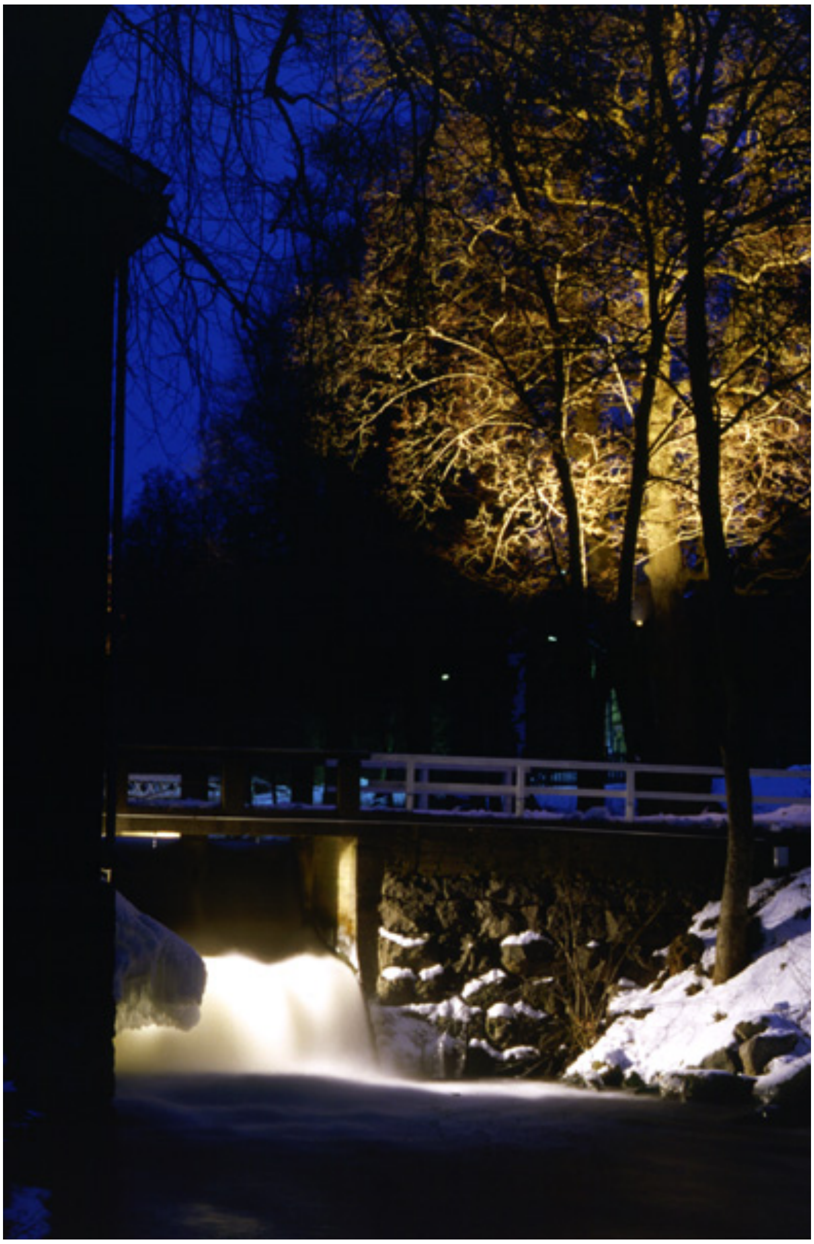


Figure 34. This metaphor design process is introducd in Chaper 3, subsection 3.6.7."*Darkness in Fiskars Village area*". Design Vesa Honkonen & Julle Oksanen. Photo: Vesa Honkonen.

This type of metaphor is useful in extensive rural areas and in illuminating picturesque landscape areas. The existing lighting practice for such areas normally consists of road lighting and illuminating building entrances. Uncontrolled light pollution from road lighting is the only light to be found in the environment. (Only approx. 30% of light flux from a road lighting luminaire reaches the road surface). The use of metaphor is an artistic and professional substitute for existing solutions. In many cases lighting the nature can compensate for the whole road lighting system. Absence of glare and the hidden light distribution surfaces of luminaires form an inviting environment and take rural landscape beautification to a new level.

3.2.3.1.2. HEURISTIC METAPHOR: "LIGHTING COMPOSITION", MARIEHAMN WEST HARBOR

"Heuristically analyzed lighting design metaphor element" – "findings" in words: Music and Light – Richard Kelly's design process – Shadow is the Best Friend of Light – Contrast: Black sea and white soft light veil – Poetic light.

When we visited the project site for the first time, the sea was really calm and sinister. We wanted to build up a recognizable “Jing & Jang” space by designing a white and humble light veil as a partner for a vast black surface of the sea. Some kind of Jing & Jang meeting point. Yet an evenly illuminated harbor would have been dull, so we also wanted to use Richard Kelly’s design process (explained later) to achieve some contrast in the harbor area. We had the metaphoric idea of adding music and light by preparing different kinds of lighting compositions on the area.

We were so excited about this metaphor that we started our first, conceptual report with a poetic story “Den glödande hamnen” (“The glowing harbor”).

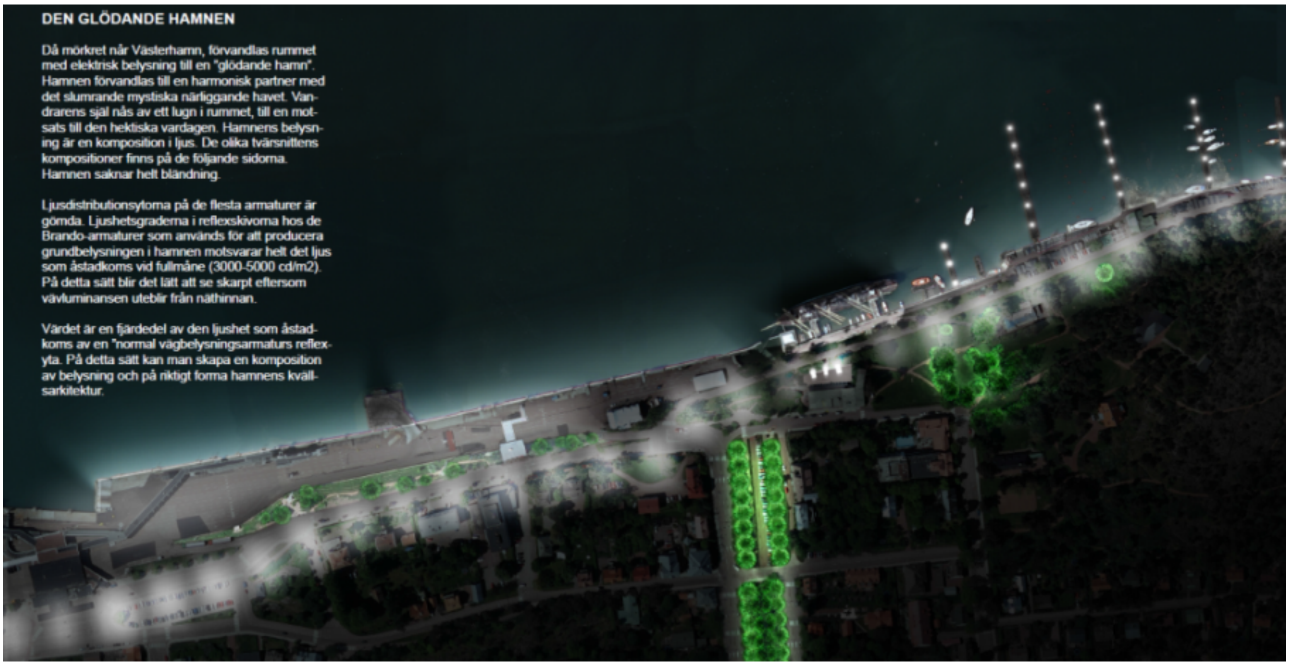


Figure 35. The Mariehamn West Harbour lighting design project is a good example of a fairly long suburban area. Lighting design Julle Oksanen Lighting Design LtD, Julle Oksanen & Oliver Walter. Photo: Oliver Walter

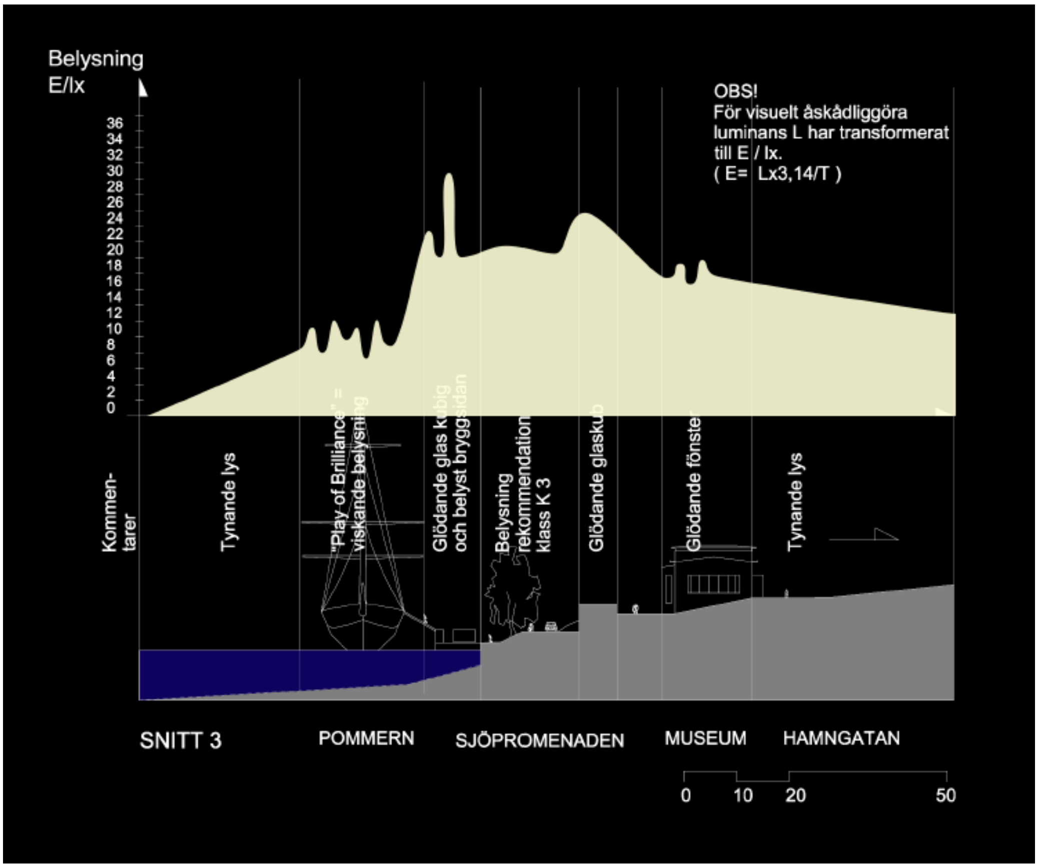


Figure 36. This metaphor design process is introduced in Chapter 3, section 3.6.8."Lighting Composition". This lighting composition was made for architectural section 3. The horizontal line includes the geometry of the section and different elements on it. The vertical line refers to horizontal illuminance in lx. Lighting design Julle Oksanen Lighting Design LtD, Julle Oksanen & Oliver Walter. Photo: Oliver Walter

Figure 37. Lighting composition in Mariehamn West Harbor on architectural section 3. Photo: Petteri Oksanen

It is good to use strong contrasts when composing lighting, because our eyes work logarithmically (which is why we can see in full sunlight and in dark forest). A luminance meter works linearly. Glare must be completely excluded by using either reflected light (light coves) and/or using luminaires with lower brightness of lighting distribution surfaces than moon brightness (as in the Brando luminaire, introduced later) and narrow beams in cases of straight lighting distribution (strong cut-off type luminaires).

“Play of Brilliances” are the high masts towards black night sky, “Focal Glow” is the glowing museum and “Ambient Light” is the white veil over the area, produced by “Brando”- luminaires.

When a designer introduces his/her lighting composition to the customer, it is important to sing or play (on an instrument or CD recorder) the light composition to impart a flavor of the feelings included. I personally always sing my lighting compositions to customers and listeners by moving a laser pointer at the top of the composition and increasing or decreasing my singing volume simultaneously with the horizontal movements of the laser pointers from left to right.

3.2.3.1.3. HEURISTIC METAPHOR: “BUILDING LUMINAIRE”, TELENOR BUILDING

“Heuristically analyzed lighting design metaphor element” – “findings” in words: Darkness and Norwegian nature – Northern stars – Building as a luminaire – Vertical lighting values on a plaza – Darkness flows from the fjord through the building – No extra luminaires needed – New luminaire design – Indoor lighting is outdoor lighting – Light & Darkness, pairs in life.

According to personal knowledge, visits to Norway and without any scientific facts as background information, we felt that Norway is a silent, foggy and shadowy country where honest people walk about silently in pullovers. We wanted to bring slowly flowing darkness from the fjord to the plaza and through the buildings. Light & Darkness, pairs of life combined together beautifully and seamlessly without any conflict. This meant that we did not want to use any “extra” luminaires on the plaza. Huge vertical glass walls were our luminaires. Building as a luminaire. Based on this metaphorical notion we used indoor lighting as outdoor lighting. We made some heuristic calculations taking into account both indoor and outdoor lighting demands and found that we had to design a new indoor luminaire (Notor). The whole project (Indoor lighting and plaza) was illuminated by eight kilometers of Notor luminaires. Indoor lighting on the atrium areas included large, glare-free lighting solutions and freedom to see the northern stars from the undisturbed lights.

Figure 38. Example of glass façades as huge and efficient luminaires with low surface brightness. This metaphorical design process is introduced in Chapter 5, subsection 5.2.”Pragmatic lighting design method example: Telenor”. Photo: Jan Drablos

In this kind of unique metaphor, it is important first to use “lumen method” calculations to ensure the functioning of the selected metaphor strategy. The calculation principle is introduced in subsection 3.6.11 “*Architectural lighting calculations / The lumen method*” and practical glass building calculus is introduced in subsection 5.2. The final calculations would be best done on a computer in order to achieve sufficiently accurate results.

One type of variation of this metaphor: Kaoru Mende's Tokyo Club building:

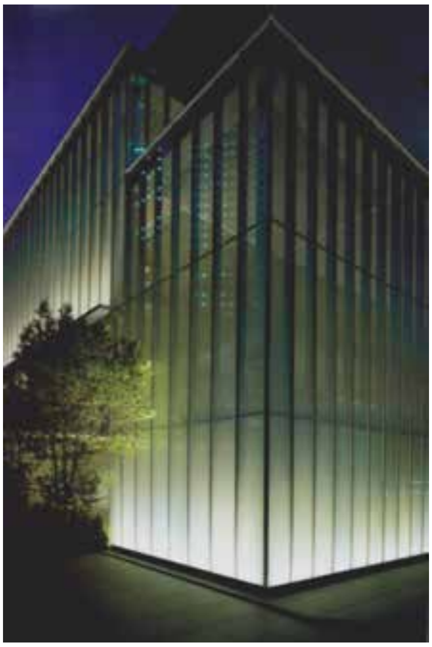


Figure 39. Example of metaphor variation where glass facades have a clear vertical contrast gradation and the building becomes an object d'art and luminaire for nearby areas The Tokyo Club/ 2005 Tokyo, Japan. Lighting designer Kaoru Mende. Photo and text: "DESIGNING with SHADOW"- Kaoru Mende + Lighting Planners Associates Inc. ISBN978-4-89737-683-7 . p. 26-27.

Other variations on this metaphor: NAMA, designed by Steven Holl:

Figure 40. Example of variations on a metaphor where the glass buildings are huge, glowing, and evenly illuminated luminaires of the city / town. Nelson Atkins Museum of Art (NAMA). Design Steven Holl. Photo: Julle Oksanen

3.2.3.1.4. HEURISTIC METAPHOR: ”COLOR LIGHTING“, FINNISH NATIONAL OPERA

“Heuristically analyzed lighting design metaphor element” – “findings” in words: Art and color lighting – Kinetic lights – Changing spirit of the building – Cube as a messenger – Performance day and specialty – Everyday life and light.

The existing façade lighting of the Finnish National Opera looks like any other typical facade lighting, because it is treated like a typical large public building. In our opinion the lighting needed an artistic touch and completely new spirit and “soul”. On weekdays the building could be illuminated like a “candle”; Light from indoors flowing out to freedom creating interesting contrasts and clear difference compared to any other building near-by. Everyday life but a different light. With the approach of a new performance, the spirit of the building would change completely. The huge cube above the stage would change to become a messenger with its kinetic color lights while the rest of the building is only lit from within, inviting people to come inside. Colors and images on the cube surface would follow the same elements as the performance itself. On the opening-night the cube would only glow the color of the performance and artists and/or other images would be as if they had fallen on the stage in the middle of a scene. After the performance, as the people leave the building, they could feel how the building has given everything, but is still breathing the same colours as in the performance, on both the building surfaces and the forecourt.

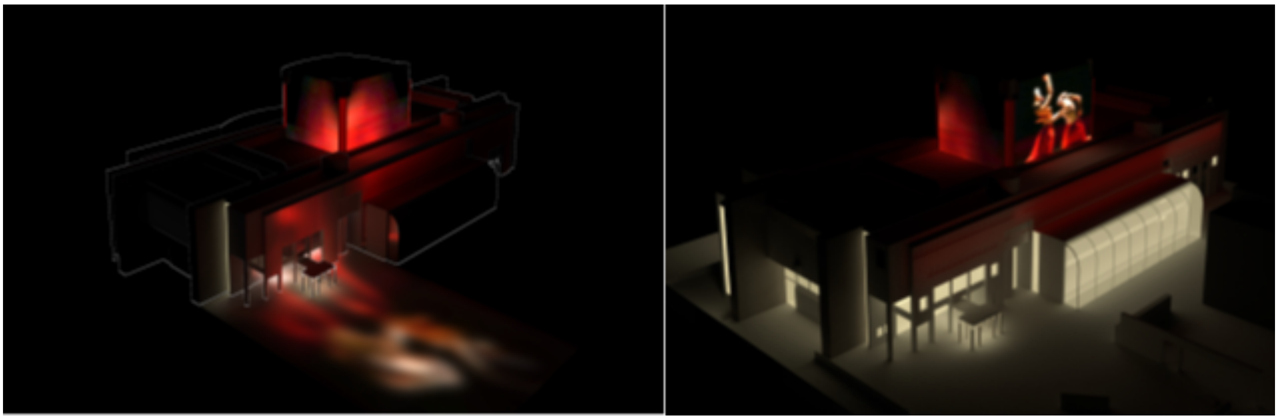


Figure 41. This metaphor design process is introduced in Chapter 4, section 4.3.3. The Finnish National Opera, Helsinki. Photo: Julle Oksanen Lighting design LtD, Julle Oksanen & Oliver Walter.

This metaphor should be used with caution. Colored light is a strong visual phenomenon and can be very disturbing in the wrong context or when overused. Another disturbing element is that it is very easy to implement with the new LED technology and anybody can be a lighting designer with low voltage LED systems. The other reason for being cautious with colored lighting is that we do not know much about its effect on human beings.

Three interesting research results from the Aalto University lecture material *“Valo, varjo ja väri - UIAH”, http://www.uiah.fi/akk/kuvasom/fotw.htm , “Psychological color”* and its effects on human behavior (Author not marked on the lecture material) also support the careful use of colored lighting:

- The area is difficult, since the related research findings are not easily measurable.
- Colour psychology research studies have produced contradictory results.
- Few controlled trials have been conducted.

My personal subjective view is that the important elements of this metaphor are the context and the ability to answer the question “Why use color”. If the only argument is that “Color light is fun”, which it generally seems to be, is not enough and reflects an immature view in design. Abundant use of color lighting at night-time architecture leads over time to a general mental saturation among residents.

This has happened, for example in Qatar, according to a comment made to the author by a Qatar prince via a potential main architect during the Qatar architectural outdoor lighting project negotiations. The project consisted of a 2km x 16km outdoor area from the beach to the prince's palace. His Highness asked the main architect to inform the lighting designer that "No color lighting will be accepted in this project".

Figure 42. Doha Qatar skyline at night in September 2012. Colors without contextual analyses create a restless view instead of mental harmony, causing mental confusion. According to the author's own experiences of Asians, the owner of a building wants to have more light and more colors than in a neighboring building. Photo: *(Wikipedia 8)*

Figure 43. A valid argument for using red color in the Allianz Arena façade lighting in Germany is the red color of FC Bayern Munchen. Red is not the only color and is used when needed for promotional purposes. Photos: *(Wikipedia 9)*

3.2.3.1.5. HEURISTIC METAPHOR: ”LARGE SURFACE LIGHTING“, HYPOTHETICAL CITY2030

“Heuristically analyzed lighting design metaphor element” – “findings” in words: City without poles and ugly luminaires – Sustainability – Solar energy – LED panels integrated into building structures – Richard Kelly’s “Ambient Light”, “Focal Glow” and “Play of “Brilliants” – Totally glare- free solution – Money, Pay-back time a few years.

Subjectively, and, I believe, also the general collective opinion is that lighting a large surface has a calming effect and creates mental harmony. When using large light distribution LED surfaces as a luminaire, the glare is absent, meaning that there is no veil luminance on the retina of the eye. The space is peaceful, the contrasts are clear and it is easy to see the details. Resolutions of different shadow gradations are excellent and easier to do than in a glary situation where numerous post tops and/or road lighting luminaires “shoot” light beams into observers’ eyes causing veiled luminance on the retina. A large surface lighting solution creates an elegant "*Ambient Light*" for the space. It is enjoyable to design "*Focal Glow*" and "*Play of Brilliants*" elements in this kind of environment. Well-designed large surface lighting totally eliminates the use of separate road and street lighting luminaires. Nocturnal city beautification is easier to achieve without big, ugly and glary light fixtures with their high and massive columns. Solar panels, which are integrated above the LED panels on the structure, will produce remarkable amounts of free and clean solar energy for our use. Pay-back time for the investment can be easily calculated.

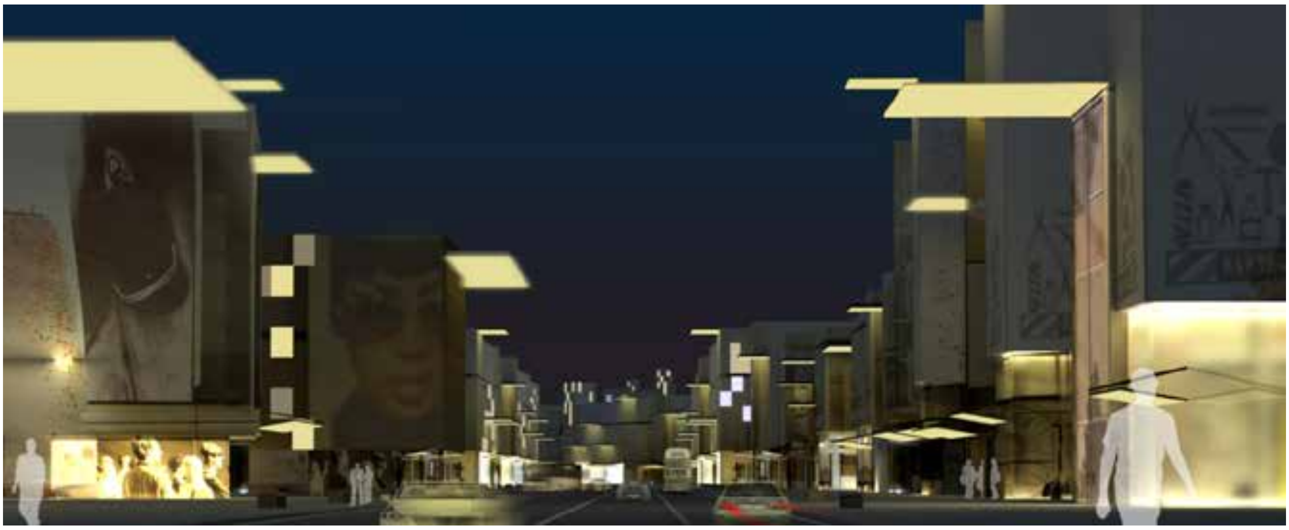


Figure 44. Large surface lighting. This metaphor design process is introduced in Chapter 3, section 3.7.4. “Lighting master strategy for a hypothetical future dream Large Surface Lighting City called City 2030”. Design Julle Oksanen photo:Oliver Walter and Dan Silberman

All the following sections and subsections in this chapter and the following full chapters and their sections and subsections are based on sections 3.1. (*The heuristic approach*) and 3.2. (*Metaphors, creativity and architectural lighting identity*) philosophies. They are the determining pragmatic elements of architectural lighting design processes and tools.

3.3. Energy and architectural outdoor lighting

3.3.1. Energy strategies from the perspective of lighting design

“Under pressure” from light pollution and global warming (carbon dioxide emission) problems, CELMA, the Federation of National Manufacturers, Associations for Luminaire and Electro Technical Components for Luminaires in the European Union, issued a guideline on obstructive light in 2007. Some countries in the EU area have added this obtrusive lighting element to their national lighting recommendations. The prevention of global warming has also led to international agreements in both the USA and EU. In Finland the process development on energy efficiency agreements was planned to be implement between 2008–2016 by the Ministry of Employment and the Economy. The first implemented actions in the lighting world included a ban on certain types of incandescent lamps in 2011. The next step will be to ban inefficient gas discharge lamps (light efficacy less than 50 lm/W) in 2016. This will cause problems for electricity utilities. For example, the Helsinki utility will be required to change some 60,000 outdoor lighting luminaires in 2016 (or once their stocks of inefficient mercury vapor lamps have run out.

All luminaire manufacturers have renewed their luminaire distributions to minimize obstructive light. At the same time the new international energy agreements have led to increased use of modern and more efficient (lm/W) LED light sources instead of gas discharge lamps.

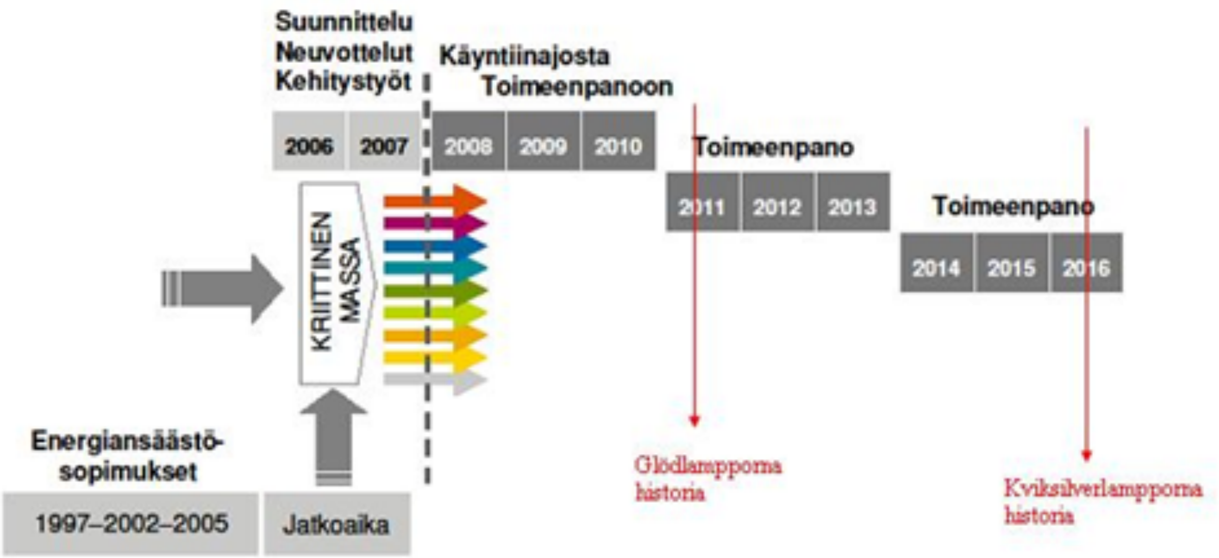


Figure 45. Energy efficiency agreements in Finland for 2008-2016. Photo: Ministry of Employment and the Economy.

LED Paradox

I have tried in vain to find a figure for the total lighting energy consumption during the LED “era” in public lighting. There is ample information on the energy efficiency and advantages of LED lighting, but total energy consumption during the LED era is unavailable. There are indeed advantages in

LED lighting, such as easy operating and small units, but also a sad combination amounting to a real curse: LEDs are easy to use / everybody can be a lighting designer / lighting design education is lacking / LED is not so efficient as people think it is / LED is a “long-life” product but operating electronic LED power supplies are “short-life” products set to cause enormous problems in the future. As long as we use world polluting energy production materials (oil, coal, nuclear energy, etc.), the increasing use of LEDs constitutes this “real curse”. However, if we were to use only clean and free solar energy for energy production in lighting, this would not be a curse or problem at all (except in some cases from a visual perspective).

The celebrated UK-based journalist Mark Harper, who contributes actively to *the New York Times, the Financial Times* and other prestigious publications, wrote an article on Smartplanet.com *“Another myth of LED energy savings”* (December 5, 2012). In his article he refers to the environmentalist Jonathon Porrit’s observations about “the rebound effect”, which is the result of the “LED paradox” mentioned earlier. He claims that LEDs make it easier than ever to illuminate bridges and facades in ever changing, dazzling, controllable multiple colors.

Figure 46. Tower Bridge London with LEDs from GE.

LEDs could become the bridge to an energy efficient lighting future. One potential paradox: Pervasive use could wipe out gains. Other projects introduced in the article were: The top of the Empire State Building, Tower Bridge London and Poland’s Poznan City soccer stadium.

One aspect of the LED paradox is that designers can build LEDs into the structure of everything from buildings to furniture to fashion. As lighting grows more varied and ubiquitous, the sum total of energy consumption could wipe out all the energy saved by switching to more efficient sources in the first place. Porritt stated in his keynote lecture in the LuxLive2012 Lighting Exhibition in London that however good the energy efficiency gain, there is a danger people will then take that gain and use it on additional services that they did not previously have available to them.

3.3.2. Paris lighting strategy (City lights off)

Paris faces darkness as City set for illumination ban. Paris’s legendary label as the “City of Light” may soon lose some of its luster when the French minister for energy and environment unveiled a proposal for lights in and outside shops, offices, and public buildings -- including the flagship Louis Vuitton store and the Lido cabaret house on Paris’s Avenue des Champs Elysees -- to be turned off between 1 a.m. and 7 a.m. starting in July 2012. The plan, to be applied across French cities, towns and villages, is aimed at saving energy and money and showing “sobriety” told Minister Delphine Batho in 2012. The law came into force in April 2013. In a study of changes made in cities and towns across the country, ANPCEN (Association Nationale Pour la Protection du Ciel et de l’Environnement Nocturnes) said that “Paris, Lille, Angers and Saumur had made good progress, while Lyon, Chambery and St Junien ‘could do more”.

Figure 47. Photos show the Eiffel Tower submerging into darkness at 8:30 pm (local time) as part of the Earth Hour switch-off on March 23, 2013 in Paris. Photo: AFP Relaxnews

Conclusions

LED product manufacturers know the “LED paradox” and have put a lot of money and research effort into LED dimming and automatic approaching control systems, which reduce total LED energy consumption globally and disposes of disposes of the “LED paradox”.

3.4. “Solar energy & LED & dimming” methods in outdoor lighting design

3.4.1. Solar energy by unit bases

Example: BRANDO luminaire equipped with ULOR 0% system, automatic approaching control system, LED panels and solar systems. Designed by Julle Oksanen & Oliver Walter, manufacturer Iguzzini, Italy.

The Brando luminaire was designed after numerous heuristic studies on several earlier projects to achieve the “Basic tone for the Lighting Composition” metaphor (See subsection 3.6.8. “*Lighting Composition*”). Large, white and light-diffusing reflectors produce a low level white and glare-free light veil over a design area and strong cut-off direct light imparts rhythm to the space.

In architectural outdoor lighting systems the smallest “solar energy unit” is a single luminaire. Parallel to solar energy studies as part of the process of curbing global warming, light pollution research has caused new requirements and recommendations for outdoor luminaires and installations. Modern lighting solutions also have approaching control- and astronomical dimming possibilities. Energy savings between 40% and 85% can be achieved using these advanced lighting production and control systems in combination. The development of the Brando luminaire in the period of 2008–2014 is a good practical example of how manufacturers and luminaire designers ought to take account of these new requirements and demands.

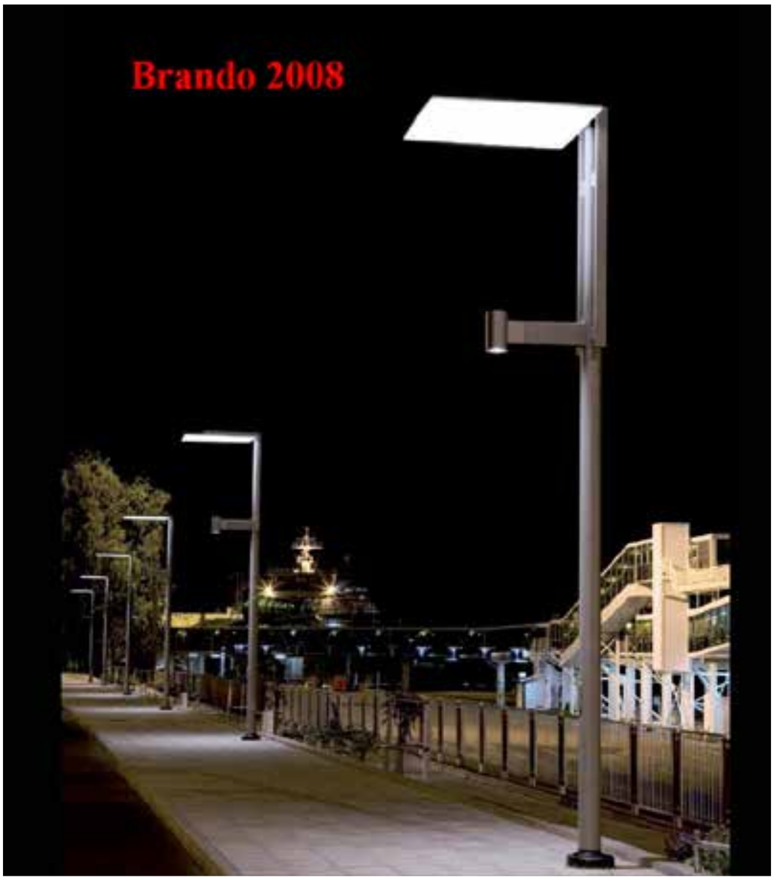


Figure 48. One sided “basic” Brando luminaire in 2008. Photo: Britt-Marie Trensmar

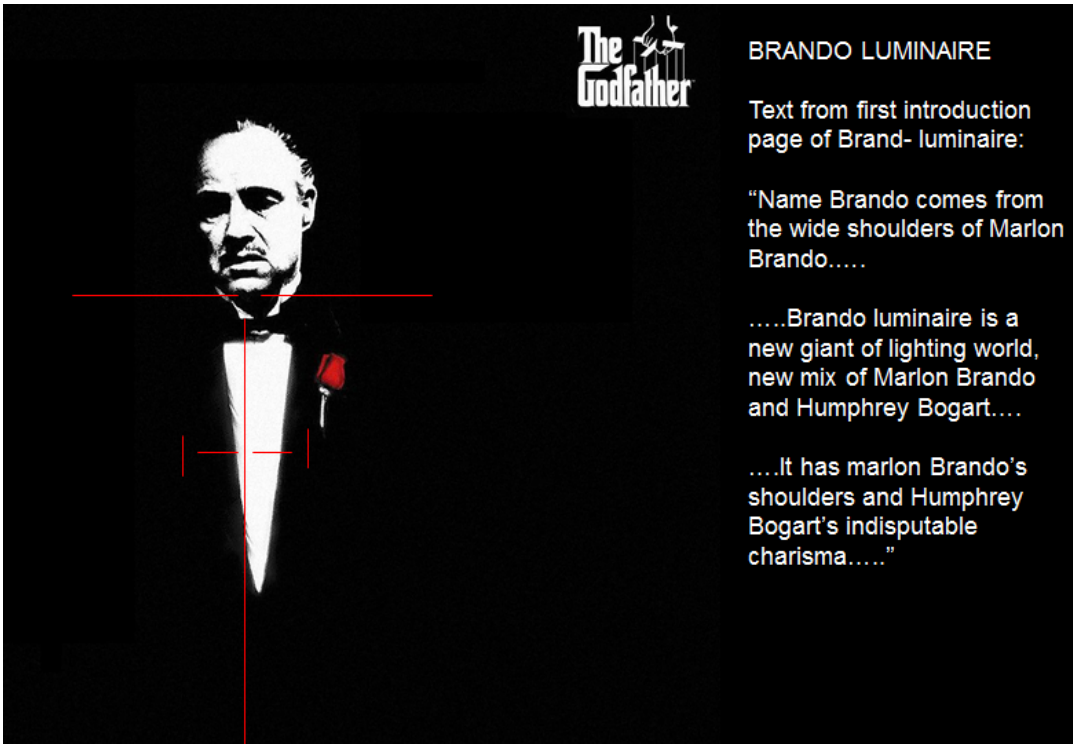


Figure 49. Brando innovation.

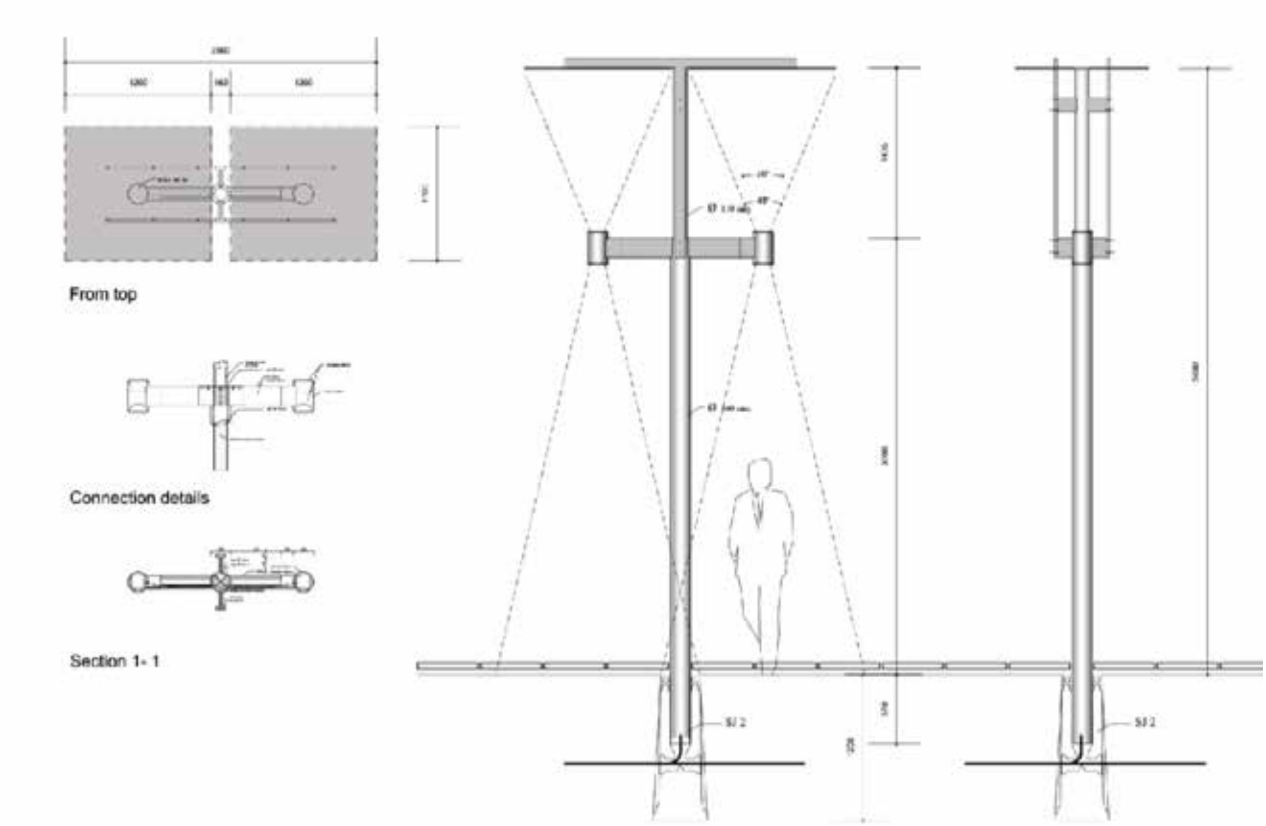


Figure 50. Brando dimensions

Light pollution

New energy efficient optical designs are mostly completed with a new light source, LED, so that ULOR = 0..

Obtrusive light is that part of the light from a lighting installation that does not serve the purpose for which it was designed.

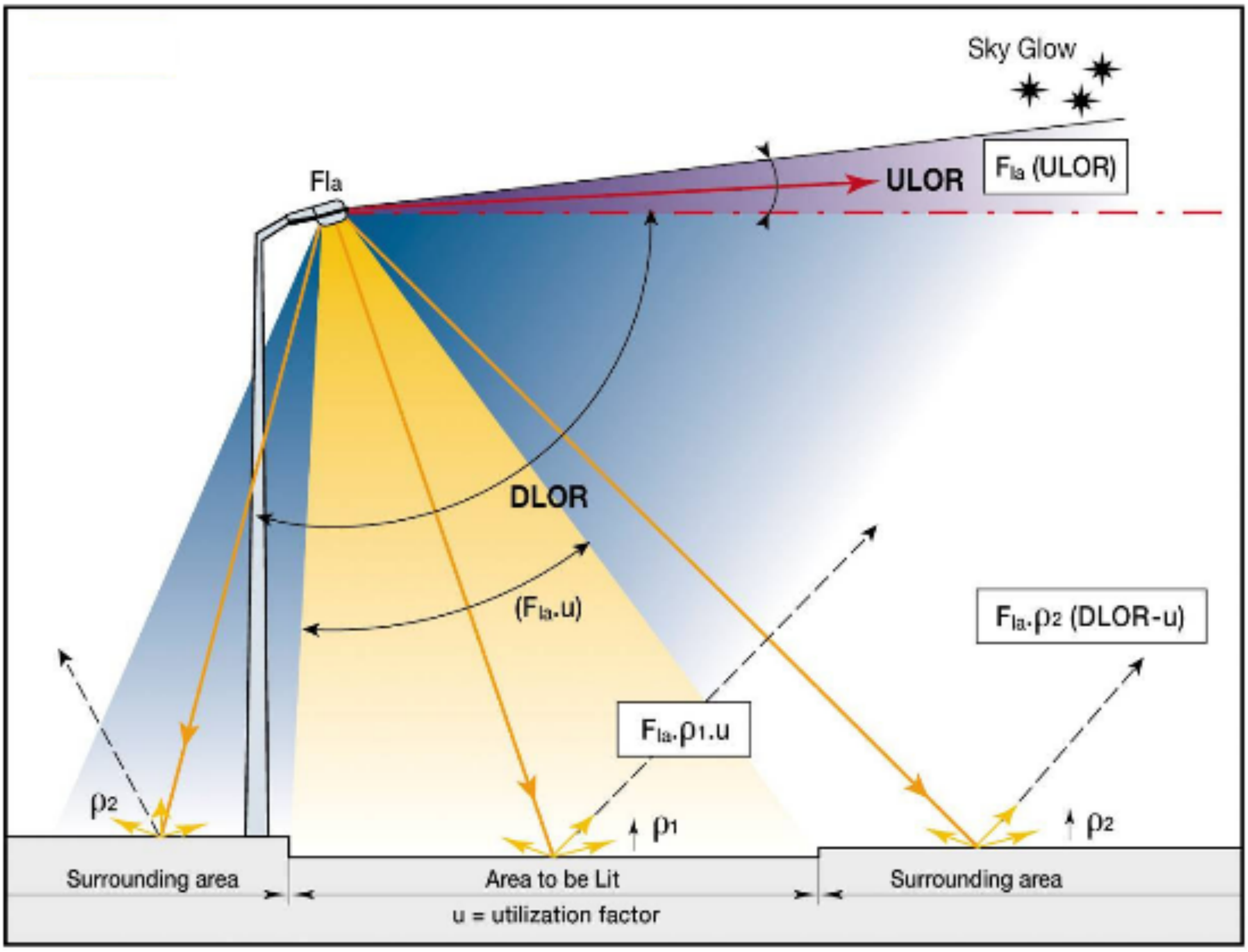


Figure 51. Methodology to design an outdoor lighting installation in order to minimize sky glow. Photo: CELMA

Contribution of an outdoor lighting installation to sky glow can be determined from data provided by:

- the luminaire manufacturer:
  - Lamp lumen output: F_{la}
  - Upward Light Output Ratio: ULOR [%]
  - Downward Light Output Ratio: DLOR [%]
  - Utilization factor of the lighting installation: u [%]
- contracting authorities and site conditions:
  - Average maintained level of illumination: E [lx]
  - Area of the surface to be lit: S [m^2]
  - Reflection factor of the area to be lit: ρ_1 [%]
  - Reflection factor of the surrounding area: ρ_2 [%]

The upward light of an outdoor lighting installation which feeds the sky glow is given by UPF which is made up of the following elements:

- Direct luminous flux emitted upward by the luminaire: $F_{la} * ULOR$
- Luminous flux reflected by the area to be lit: $F_{la} * \rho_1 . u$
- Light reflected by the surrounding area: $F_{la} * \rho_2 (DLOR - u)$

Table. CLASSIFICATION OF DISTURBING LIGHT / CIE 150:2003

Class	E1	E2	E3	E4
Environment	Nature like	Countryside	Suburb area	Town city
Lighting environment	dark	Little envir. lighting	Average environmental lighting	Strong environment lighting

Project environments are divided for 4 classes according to activity and ambient lighting conditions.

Table. LIMIT VALUES FOR THE DISTURBING LIGHT / CIE 150:2003

Environment class	Illumination of the sky	Light to the windows		Light intensity of a light source		Luminance of the building	
	ULR %	E_v lx		I kcd		L_{av} cd/m²	L_{max} cd/m²
		ilta	yö	ilta	yö	ilta - aika	
E1	0	2	1	2,5	0	0	0
E2	5	5	1	7,5	0,5	5	10
E3	15	10	2	10	1	10	60
E4	25	25	5	25	2,5	25	150

Limit values above should be respected when the disturbing light exterior of the target is measured.

ULR % = maximum light portion turned above of the horizontal level while lamps are in usage positions.
E_v lx = vertical light intensity turned to the windows of a building; is calculated while designed or measured afterwards if necessary.
I/kcd = light intensity, that turns to a target that is "disturbed", is the value received from the lighting plans and calculations.
L_{av}/ cd/m² = the luminance (ie. luminocity of the surface) from the lighting installation that is turned towards the walls of surrounded buildings.

Classification of disturbing light for different types of environments together with maximum illumination of the sky, ULR % = Upward Lighting Ratio, defines the use of the luminaire.

The Brando luminaire is a direct - indirect light producer. The light producing unit has a single 70W Metal Halide lamp. Fifty per cent of light lumens go up on to the white reflector, which reflects light softly around the environment and 50% of light lumens fall directly downwards at a beam angle of 34 degrees imparting rhythm to the space.

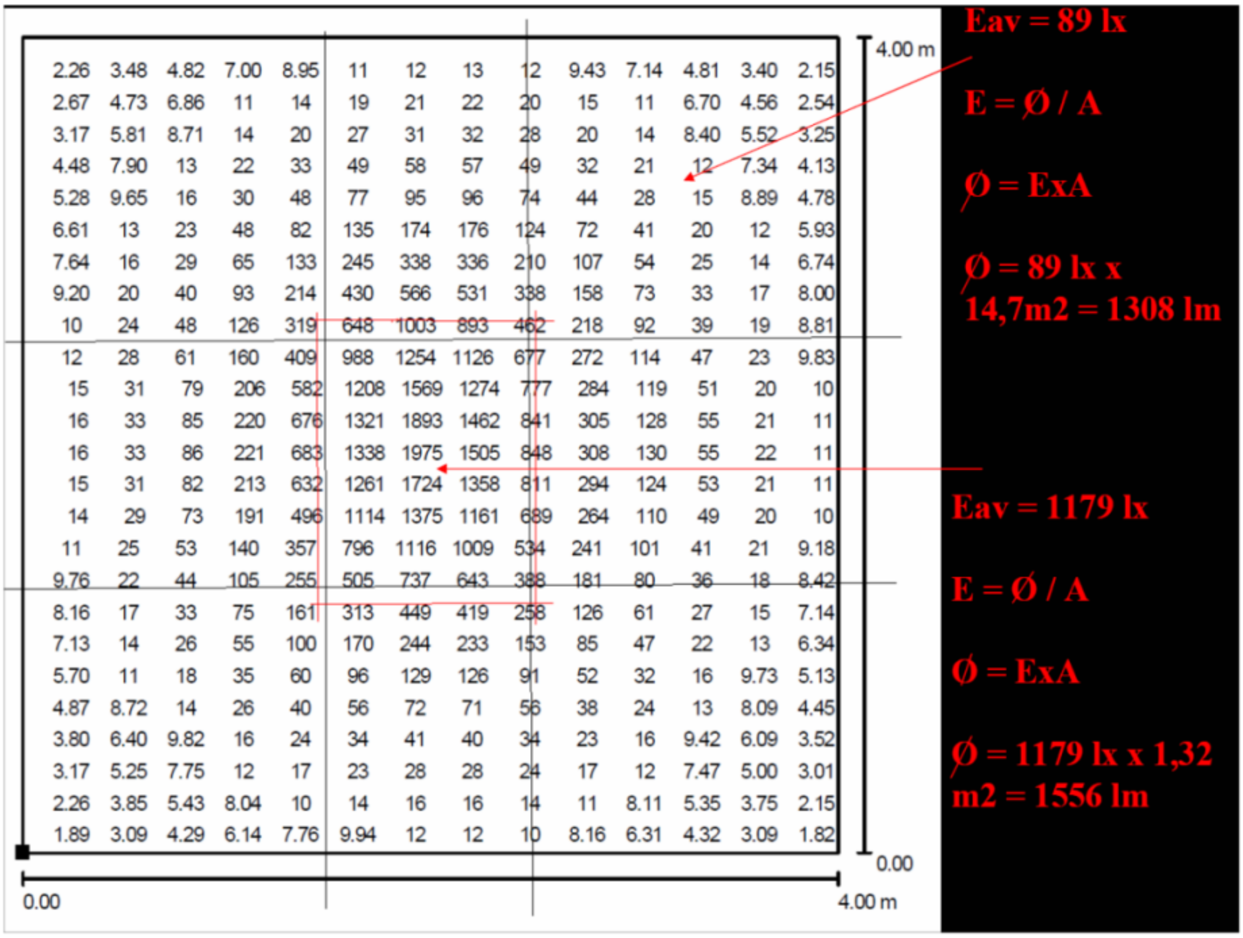


Figure 52. Trespass light measurements by Julle Oksanen. Photo: Julle Oksanen

In trespass light measurement, the reflector is marked in **red** in the middle of the image. E_{av} on the reflector surface is 1179 lx. When this value is multiplied by the reflection area A (1.3 m^2) the total lumen package flowing onto reflector surface is 1556 lm.

The same calculation for trespass lighting (ULOR) yields 1308 lm.

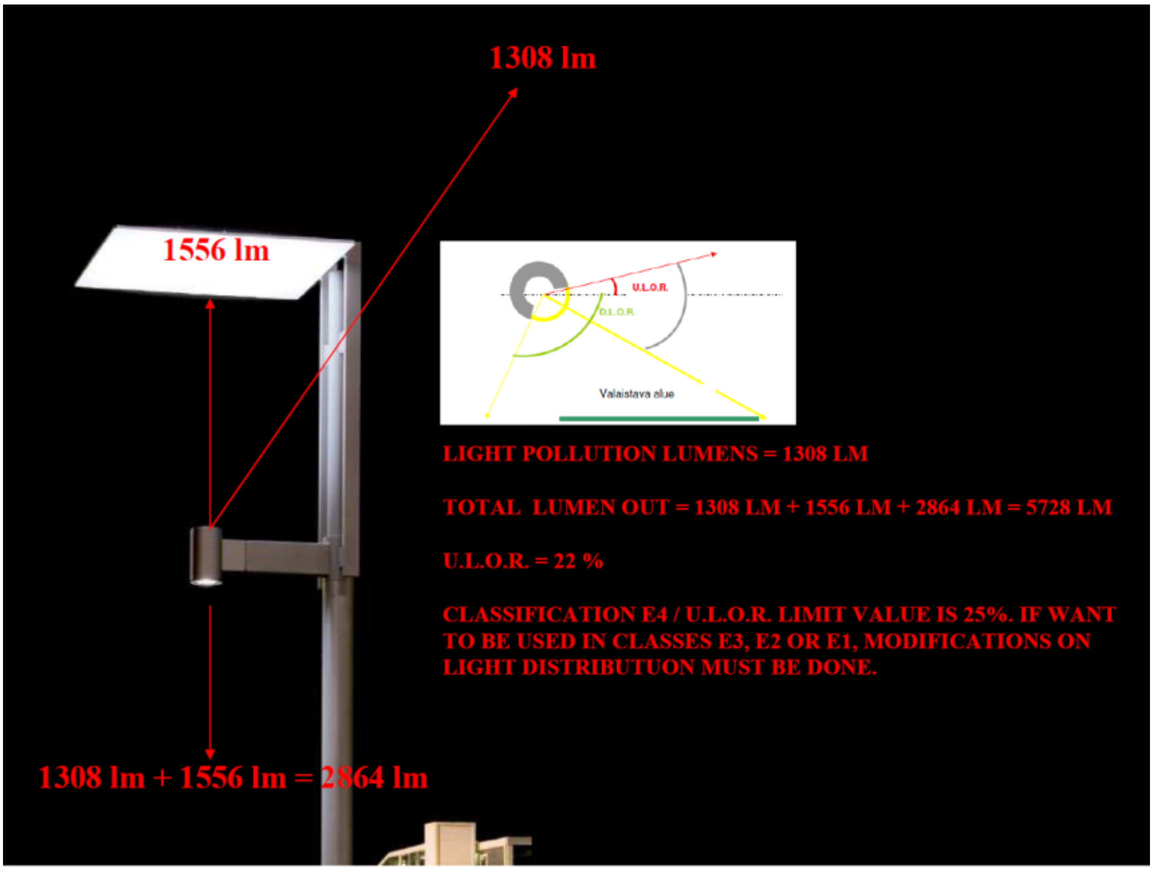


Figure 53. Trespass light calculation by Julle Oksanen. Photo: Julle Oksanen

Calculation shows that ULOR = 1308 lm. Total Lumen output is 5728 lm. This means that ULOR % = 22%. This means that the existing Brando can only be used in town and urban areas where ULOR % = 25%.

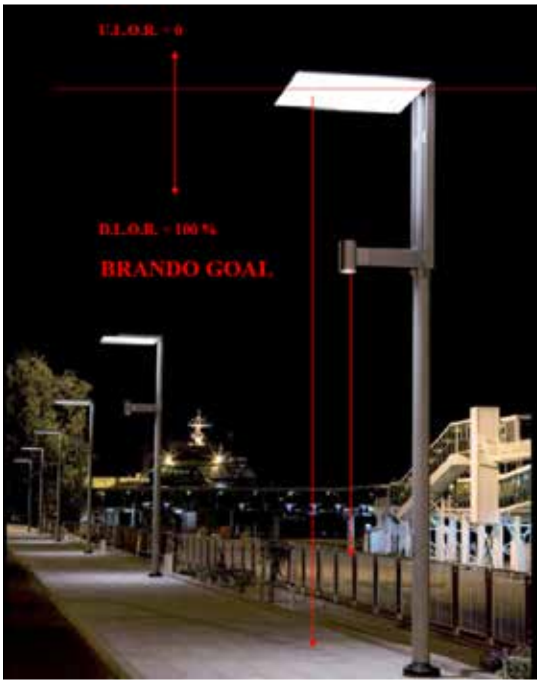


Figure 54. The goal is ULOR % = 0. Photo: Julle Oksanen

In order to be able to sell Brando in all E-classified areas, the optical systems have to be changed. Light which goes upwards onto the reflector panel from the light unit must be changed to a direct light panel.

LED + Solar - Brando studies:

LED and solar Brando have been used to operate with LED panel instead of the 2008 version metal halide 70W gas discharge lamp. The solar panel is located on the top of the aluminum reflector. In the energy calculation the batteries are designed to be located inside the pole. They also could be installed under the ground inside the hermetic sealed box.

LED

Light emitting diodes, LEDs, have extremely long life, good impact resistances and low energy consumption. When dimmed, the light color remains constant. When connected to the mains, they require control gear to ensure the correct operating current. The point light source provides for precise light control while the plastic encapsulation of the diode acts as a protection and lens. The output of the LED decreases with increasing temperature. Conseguently good heat dissipation is important for smooth operation. Direct solar radiation should be avoided, likewise installation near other sources of heat. With an average rated life of 50,000 hours, LEDs are suitable for long operating times. As they start instantly and react directly to control, they are ideal for quick, dynamic light scenes. The development of LEDs currently focuses on more compact shapes, a higher luminous flux, and better luminous efficacy as well as a more economical production process.

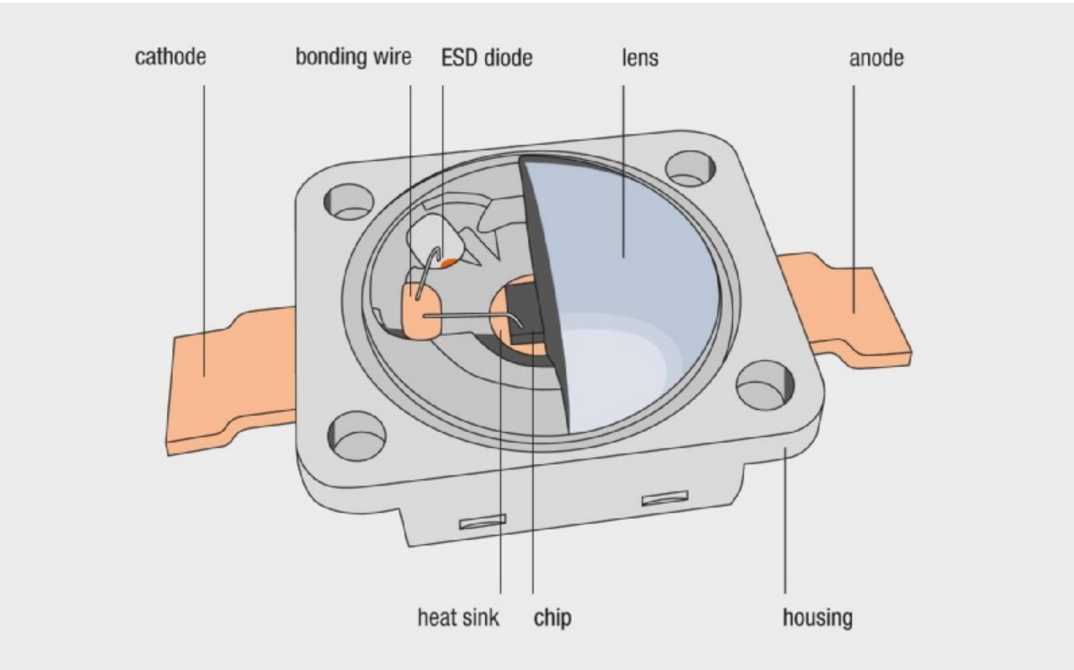


Figure 55. Simplified principle of LED. Photo: Osram

LED as light source is available in many forms. From single spot and LED stripes up to large LED panels.

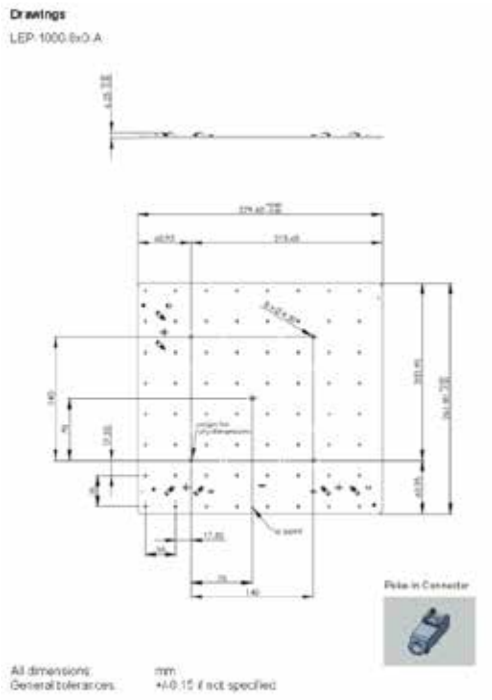


Figure 56. Example of large LED panel system: Osram Prevaled LED panel. Photo: Osram

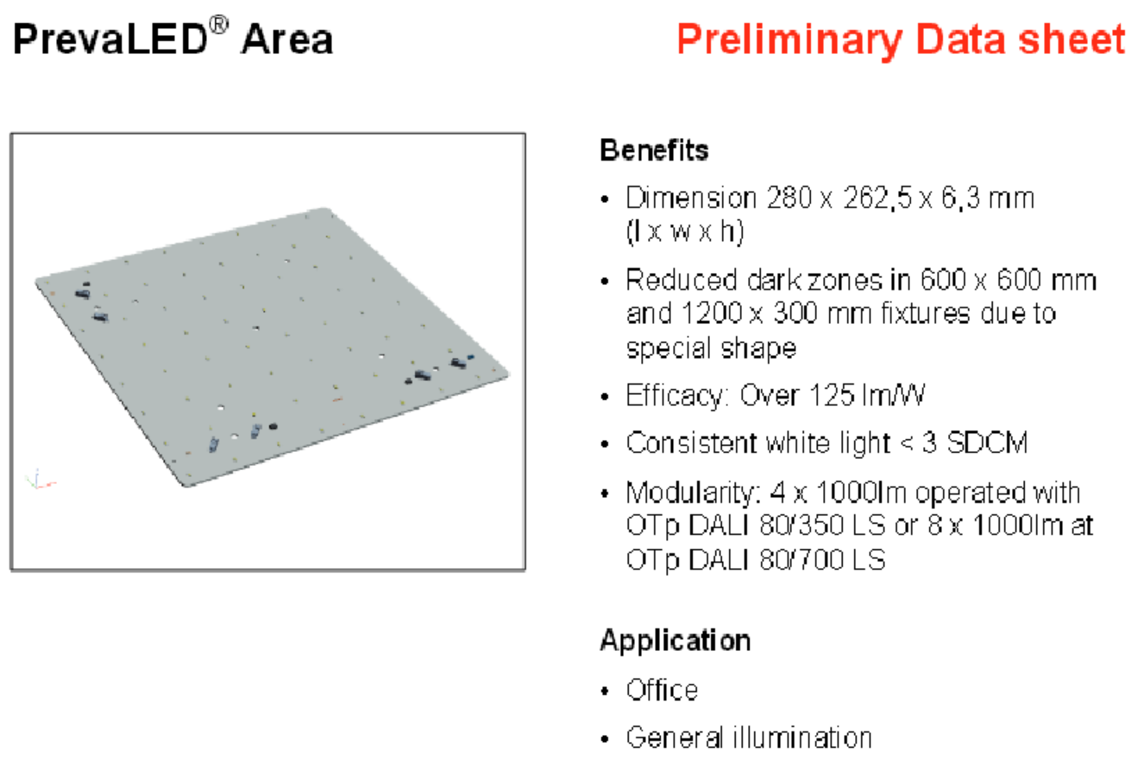
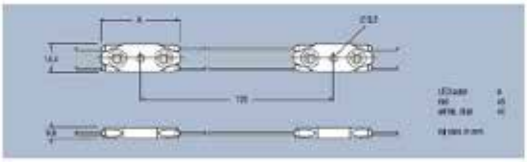


Figure 57. Example of a large LED panel system: Osram Prevaled LED panel.Photo: Osram

LED Brando

LED PANEL SOLUTION

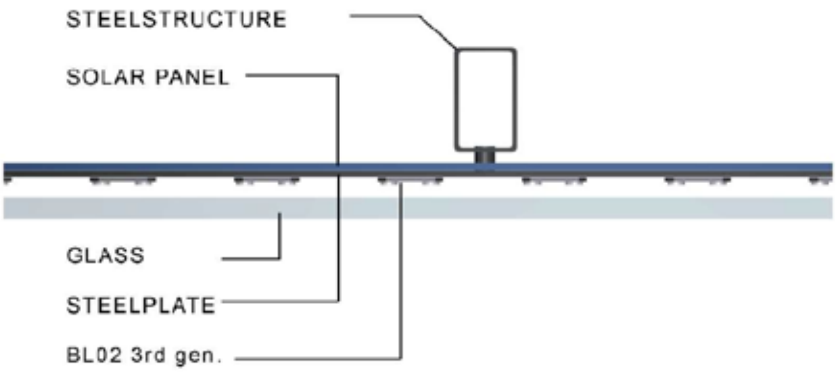


The image on the right is done with existing BL 04 units, which can be used in LED Brando version (Brando type without batteries) Osram Backlight BL 02 3rd generation are more suitable for solar Brando.

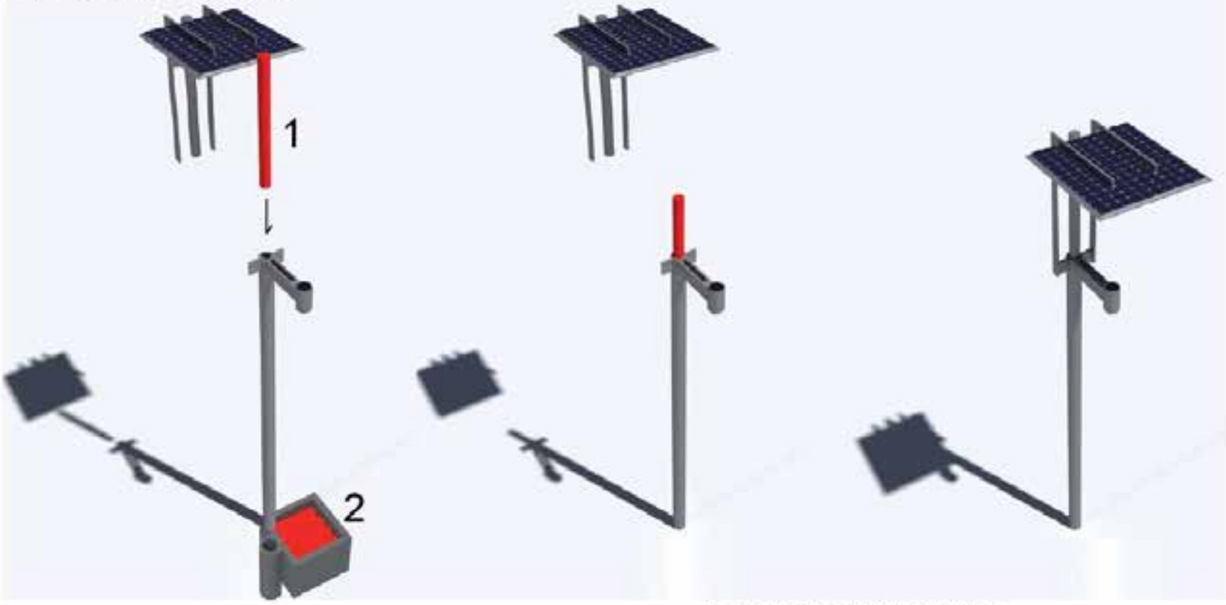
Osram Back Light BL 02 LP **3rd Generation (Available on 07/2010)**
Lumen Package of each LED element 15 lumens (LED module 30 lumens).
IP classification IP 66.
Hybrid Brando has 118 pcs of BL 02 LP 3rd Generation LED Modules (236 pcs of LED).

LED PANEL SOLUTION/ SECTION DETAILS

The coming BL02 3rd generation LED unit has 170 deg light beam and lumen package of 15 lumen. The existing BL02 and BL04 version has 120 deg light beam and 7.5 lumens.



SOLAR-LED-BRANDO



Option 1) Batteries located inside the pole
Option 2) Batteries located inside extra foundation box under the ground.

1- SIDED SOLAR BRANDO ELEMENTS:

LED module: 119 pcs of BL 02 3rd Generation LED Boards (2 LED units in each LED Board / 15 lumen each LED unit)
Power: 50W
Power supply: 1 pcs of OT 50/120-277/10E (50W)
Dimming unit not needed. Solar energy from batteries will be used during slow traffic times.
Batteries: see battery information page.
All power units are located inside the pole.

BATTERY INFORMATION

Batteries required:

Charging: 30,625 Ah

Capacity: 153,125 Ah

Battery example:

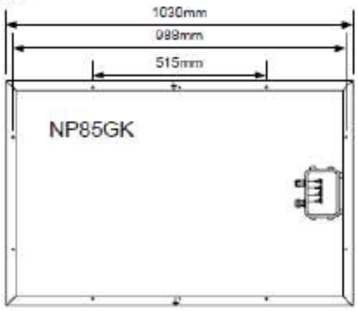
Type: Yuasy NP7 – 12

Capacity: 7 Ah

Amount: 20pcs

Batteries located inside the pole.

Solar energy calculations are bac-sed on these components: Yuasa NP7-12 battery and NAPS NP85GK Solar panel combination.



BATTERY, 12V, 7AH
Energy Storage Capacity:7Ah
Output Voltage:12V
Battery Technology:Lead Acid
External Height:97.5mm
External Width:151mm
Depth:65mm
SVHC:No SVHC
External Depth:65mm
External Length / Height:97.5mm
Max Height:97.5mm
Terminal Type:4.8mm x 0.8mm
Weight:2.8kg

Max Charge Current:1.75A
Max Cyclic Charge Voltage:15V
Min Cyclic Charge Voltage:14.4V
Standby Charge Voltage:13.8V

Brando with LED lights, full power 50W includ-ing control-lers etc.							
Exemplary load pattern:							
Lights switched on at sunset, using light detector							
Full power		3 hours					
75%		3 hours					
35%		6 hours					
Power usage calculation			power	current	time	Ah	
			50	4,167	3	12,5	
			37,5	3,125	3	9,375	
			17,5	1,458	6	8,75	
					Total	30,625	Ah/day

Figure 58: Brando solar energy results

Module used for sizing:							
Summary per site							
		Solar percent-age					
Site	Country	Lowest	Highest	Average			
Ancona	Italy	13%	90%	51%			
Zurich	Switzer-land	6,00%	81%	41%			
Helsinki	Finland	0%	89%	35,00%			
Miami	USA	43%	80%	64%			
San Fran-sisco	USA	25%	100%	66%			
Knoxville	USA	22%	83%	55%			
Nairobi	Kenya	57%	87%	73%			
Baghdad	Iraq	35,00%	92%	66%			

Figure 59. Brando solar energy results

OLED- Brando (source: collected promotion material from Osram)

An OLED panel instead of a LED panel could be the next step in solar Brando (possibly available 2016–2018).

The active, organic and largely transparent layers in the OLEDs are extremely thin, less than 500 nanometers. Consequently the whole OLED is extremely flat, lightweight and is potentially flexible. A complete OLED lighting system can therefore be ultra-flat, transparent, and flexible and in addition it can cover a large area. At present the rigid glass substrate and the molded encapsulation currently used impose restrictions with regard to flexibility and an extremely flat design. Thinner and more flexible substrates, a thin film encapsulation and transparent electrode material would further improve the OLED's special features – areas which OSRAM engineers are researching particularly intensively.

The luminescent layers of the OLED can be vapor deposited homogeneously on large areas. This results in a new kind of planar light source which differs significantly from all earlier sources. OLEDs can supplement most conventional light sources and also open up completely new application areas and growth markets. Today they are already inspiring designers and will enhance the market for high quality designer luminaires in the near future. In a few years, OLED technology will revolutionize lighting as we know it today.

OLED manufacturers are focusing on luminance of 3000 cd/m^2 on light distribution surface. That is the average luminance of the moon. That luminance causes no extra veil on the retina and contrasts can be seen beautifully and sharply without any kind of extra vision effort.

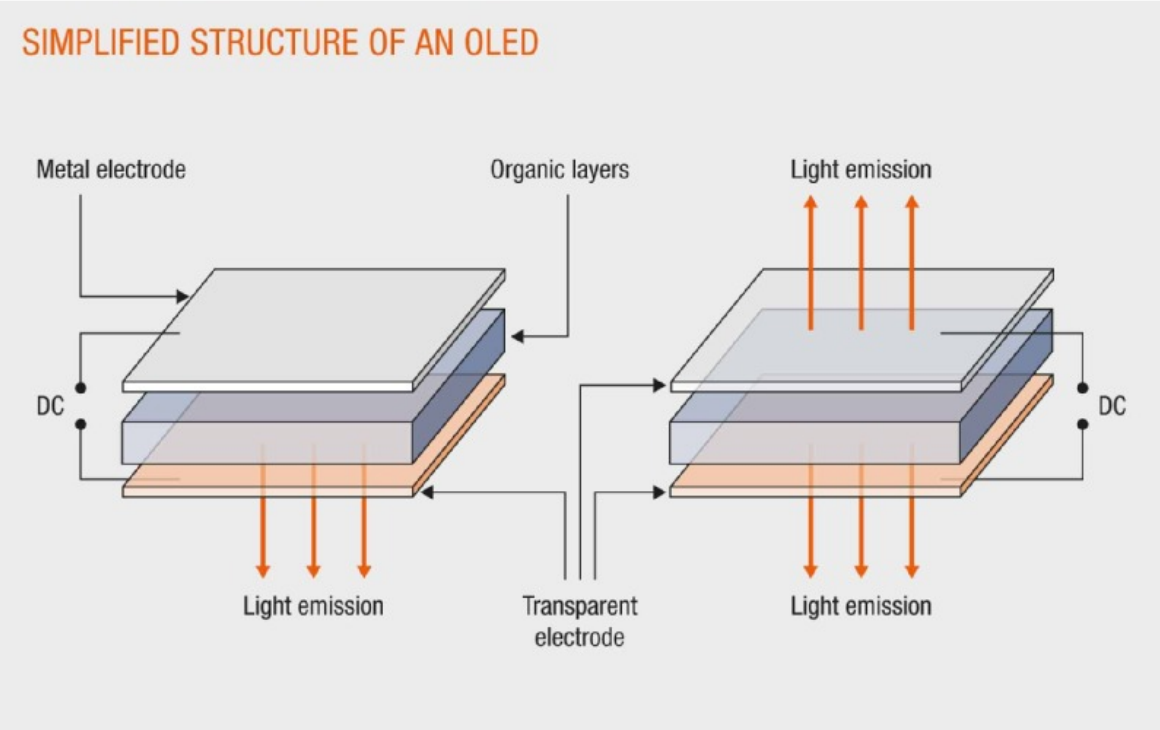


Figure. 60 Osram

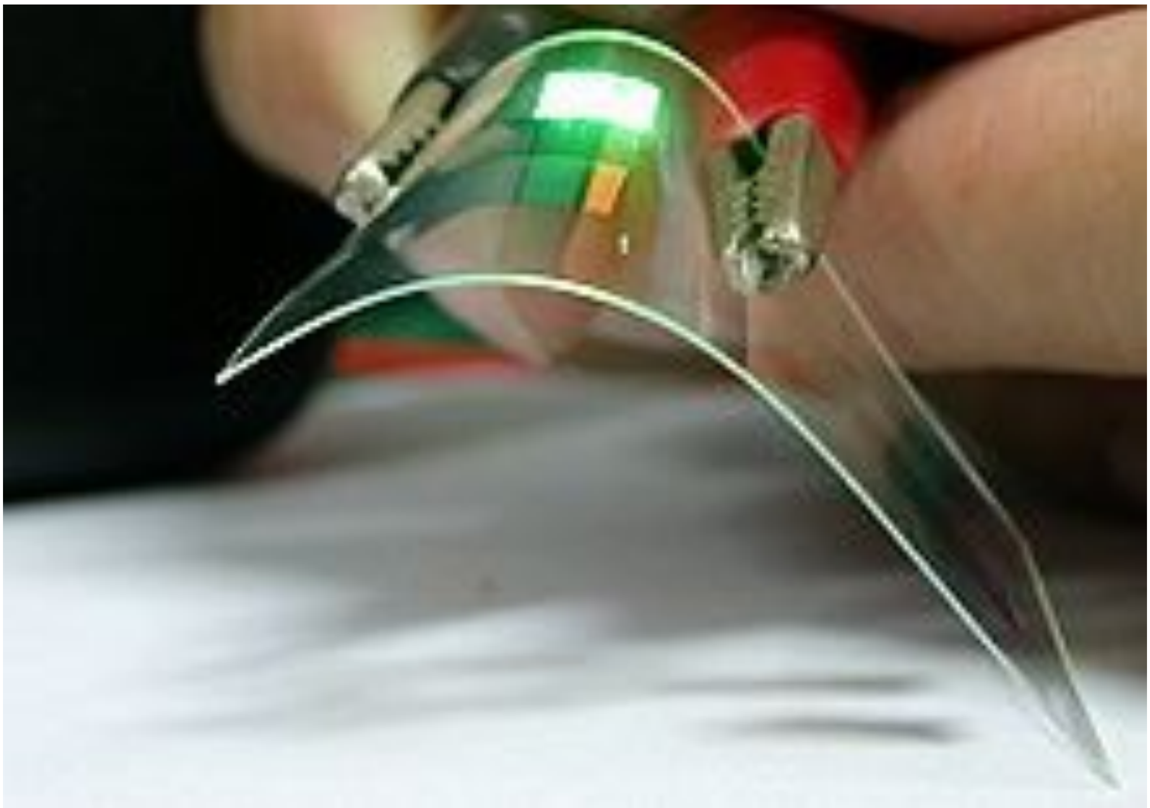


Figure 61. OLED in practical form. Photo: Osram

Automatic approaching control system for Brando

Lighting control management is the fastest developing lighting sector. The reasons for this are: huge energy savings, easy to implement, and quick payback times. Solar – LED - Brando is equipped with an approaching lighting dimming system. LED panels (e.g. 9 pcs of Osram Prevaled Area type plates / Brando) take their energy either from batteries inside the poles or the electricity net depending on the loading situation of the batteries. An automatic switch ensures the right energy source. The direct current (DC) flows from solar panels into the batteries. The batteries are connected to an inverter which convert DC to AC, which is suitable for the Brando luminaire system.

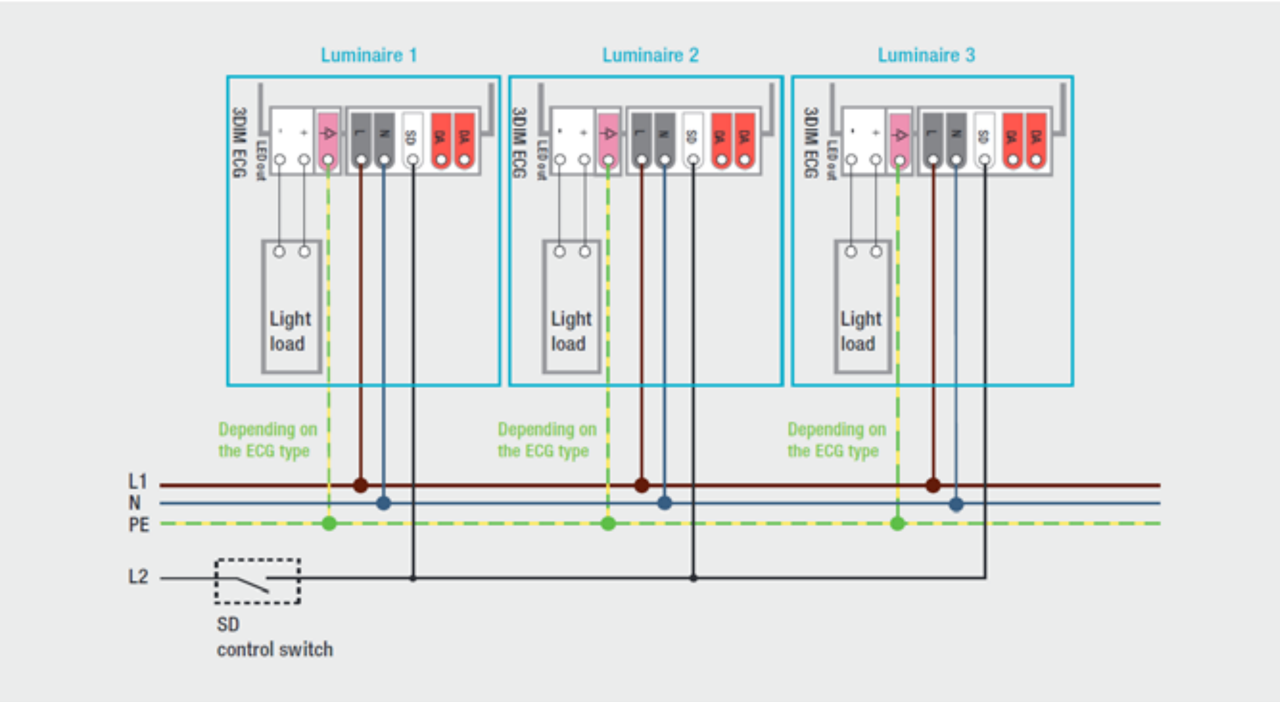
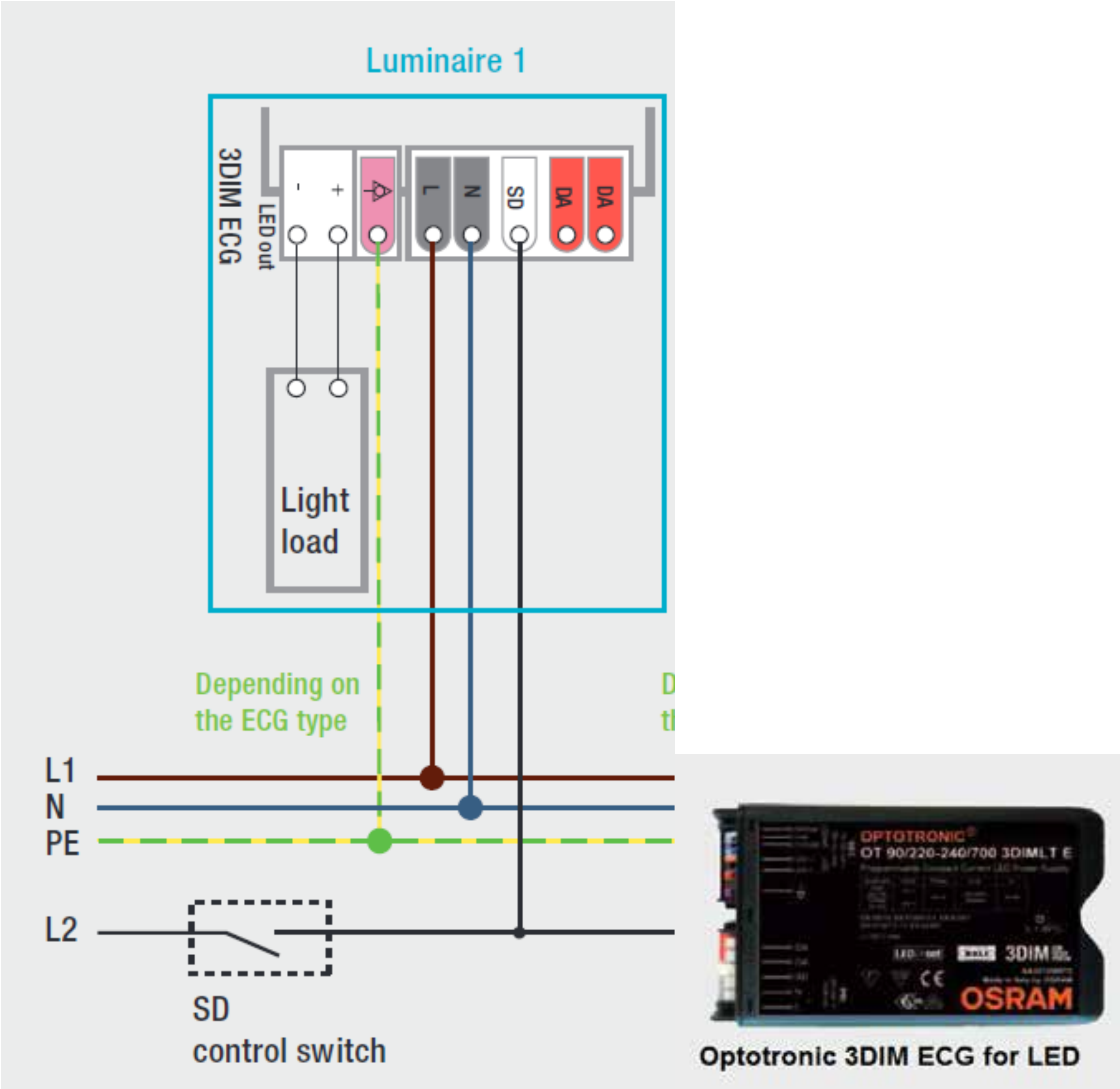


Figure 62. StepDIM activation for Brando. Photo: Osram



Electricity flows into the Optotronic control gear either from the street lighting net or from Brando's own solar system inverter. The electricity impulse from the approaching person, cyclist or car reaches the control switch SD. Optotronic 3DIM ECG for LED component has been pre-set in the type of function desired. For example, when path or road is empty and there is no movement, the light is dimmed to 10% of maximum. When a person approaches the space on the path or road, the light slowly rises to 100%. (It can be adjusted to the desired speed after testing). After some minutes of the movement (the duration can be set) light returns to 10% of maximum (adjustable). Photo: Osram

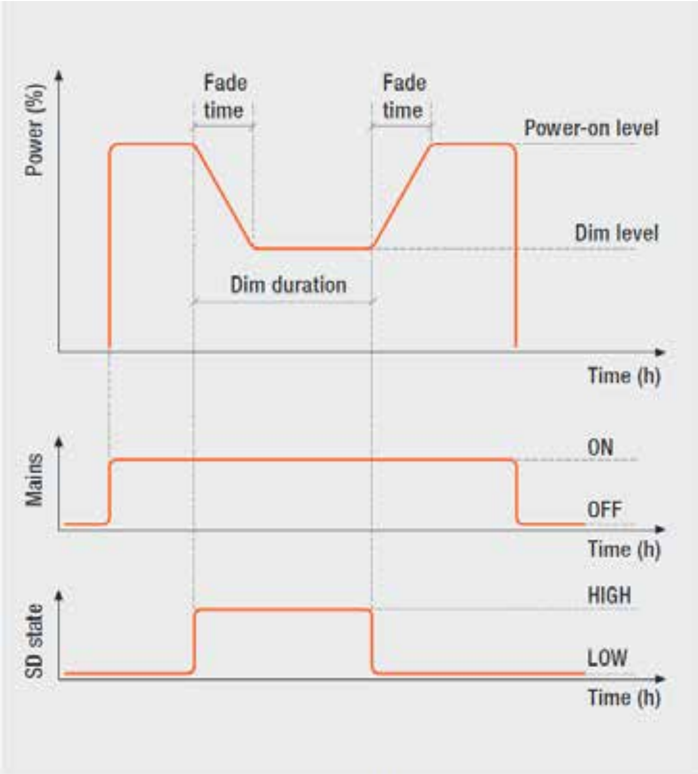


Figure 19: StepDIM behavior – "StepDIM/DALI" mode (factory settings).

Factory setting for Optotronic 3DIM ECG for LED control gear. Between L1 and N mains is 230V. SD keeps the power up (e.g. 100%) until the programmed fading model starts to fade the lighting via a preprogrammed fading time down to the programmed dimming level- (e.g. 50% of maximum). Fading times and power levels can be programmed at will. Photo: Osram

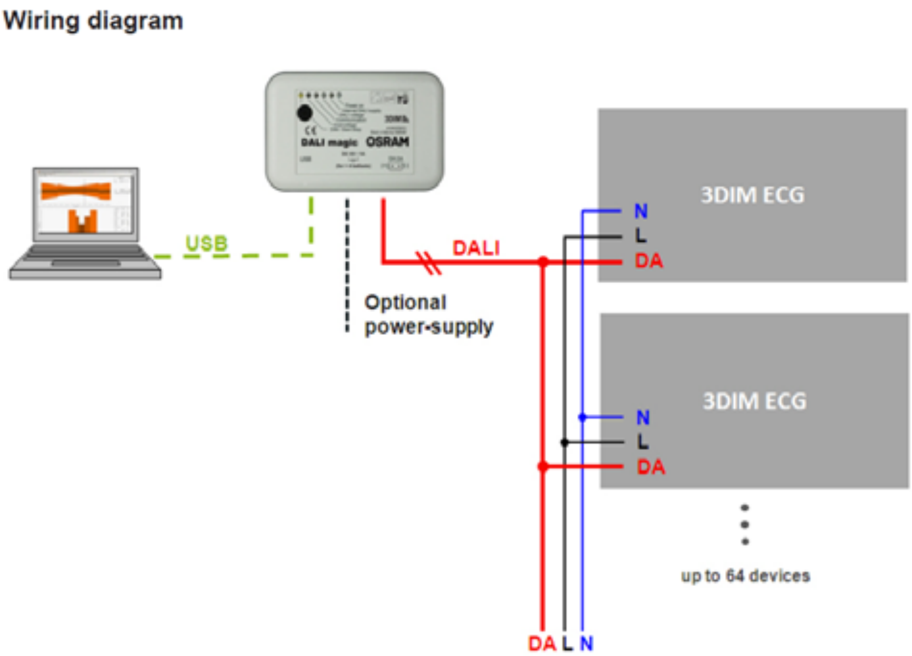


Figure 63. Optotronic can be programmed to work as desired using Osram Dali magic component and a PC. Photo: Osram

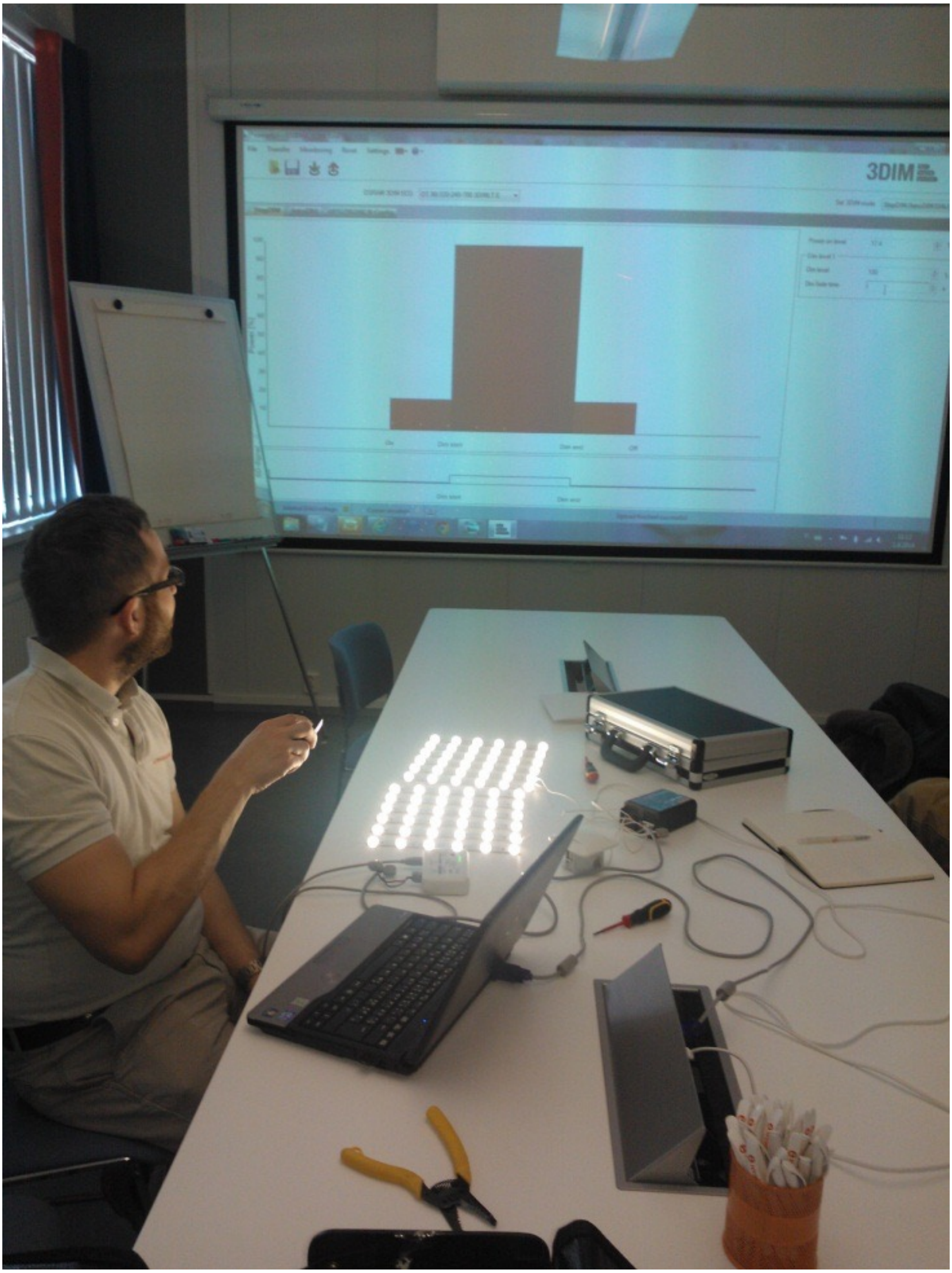


Figure 64. Osram engineer Olli Oksanen testing Brando luminaire pre-settings for LED driver with a computer. Computer + Osram Dali magic + 3DIM ECG + LED’s on the testing table. Photo: Julle Oksanen

Figure 65. Brando goal: ULOR 0% + LED / OLED panel + solar panel + batteries + approaching control dimmable system. Photo: Julle Oksanen

Conclusion of the individual solar Brando luminaire design process:

In conditions of tough commercial competition leading manufacturers produce new LED and OLED modules fast. In the gas discharge lamp era, new products came to market in cycles of years. The production cycle of the new luminaire types likewise took years. New LED products are launched on a monthly basis. This causes annoying problems not only for LED manufacturers themselves, but also for luminaire manufacturers and designers. A huge backlog in manufacturers' R&D departments and new optical design and production of existing luminaire types have caused a delay in the Brando process. Slow battery technology improvement and the expected type of commonly used solar energy (unit, project, or centralized solar systems) will also delay the development of Brando. Approach control is easy to implement immediately.

Conclusions on energy efficiency

Using the heuristic “rule of thumb” method energy savings of 80% can be achieved compared to the existing Brando (without solar panels and dimmable approach control system). More exact energy calculation is inappropriate because it is highly unlikely that the development will progress due to “battery problems”.

3.4.2. Solar energy on a project-basis

An example: Julle Oksanen’s studio work at the University of Tennessee, School of Architecture: Pedestrian bridge lighting project at Knoxville, Tennessee, USA

The metaphorical idea in this architectural lighting design studio work was to design a glare-free, peaceful and “whispering light” on a small plaza and pedestrian bridge over the Tennessee River. Brando luminaires were planned to produce a “basic tone” for a modest and white lighting veil over the plaza and part of the pedestrian area. The bridge is totally glare-free because all the light falls on the bridge surface from the concealed light coves. (See subsection 4.3.5. “Pedestrian bridge, Knoxville).

This subsection concentrates on solar energy and on minimizing carbon dioxide emissions.

Project-based solar systems (Photo Voltage systems) are tested/used in many sustainable city projects, factories and large public buildings. Solar panels and components are widely sold in all over the world. Leading lighting manufacturers (like Osram) have all the light controlling units and systems in place to implement both indoor lighting and outdoor lighting projects. These systems can easily be added to project-based solar systems. Energy savings of up to 40%-85% are achievable using these advanced lighting control systems together with solar systems. The advantage of project based PV systems over single solar luminaire systems is the easy maintenance of centralized components (like batteries and light control systems) and the inherent energy business opportunity.

Figure 66. Project image. Julle Oksanen's studio work at the University of Tennessee. Photo: Larwie and Associates, CRJA, Wilbur Smith Associates, S&ME, Sanders Pace Architecture, Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter

A pedestrian bridge over the Tennessee River obtains its energy from solar panels located on the roof of the Thompson Bowling Arena. Batteries and inverters are located inside the "solar room" inside the building. The bridge is illuminated by light coves, and the pedestrian pathway and plaza also have LED luminaires. The number of solar panels and batteries can be easily calculated using basic electricity formulas and solar statistic maps.

Figure 67. Rooftop solar installation. Image credit: Earth 2 Tech

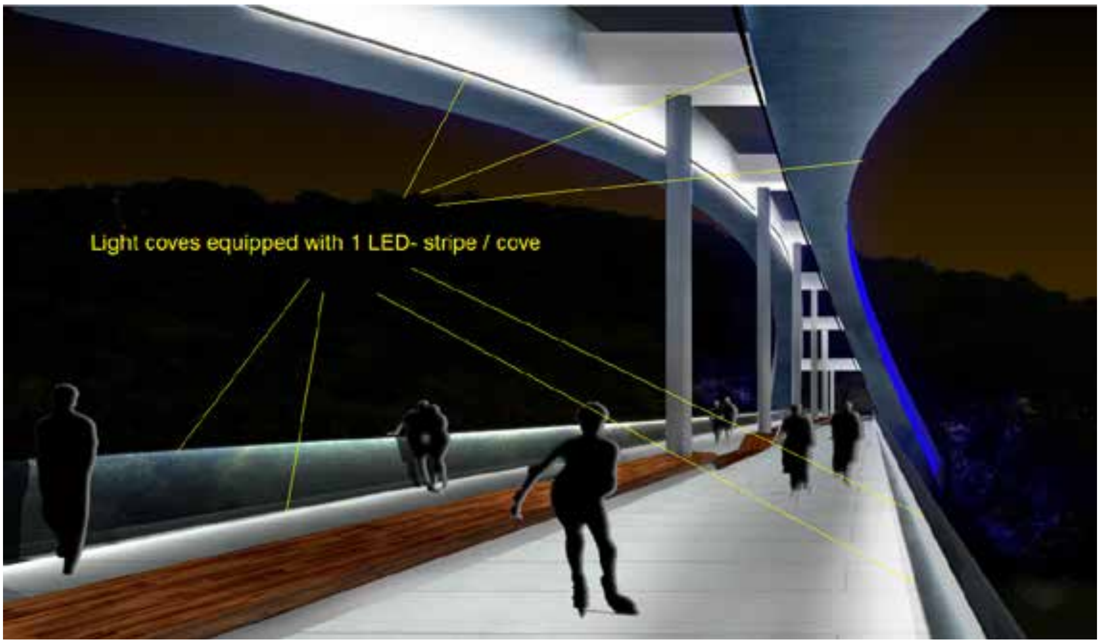


Figure 68. LED light coves. Julle Oksanen’s studio work at the University of Tennessee. Photo. Larwie and Associates, CRJA, Wilbur Smith Associates, S&ME, Sanders Pace Architecture, Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter

solar availability

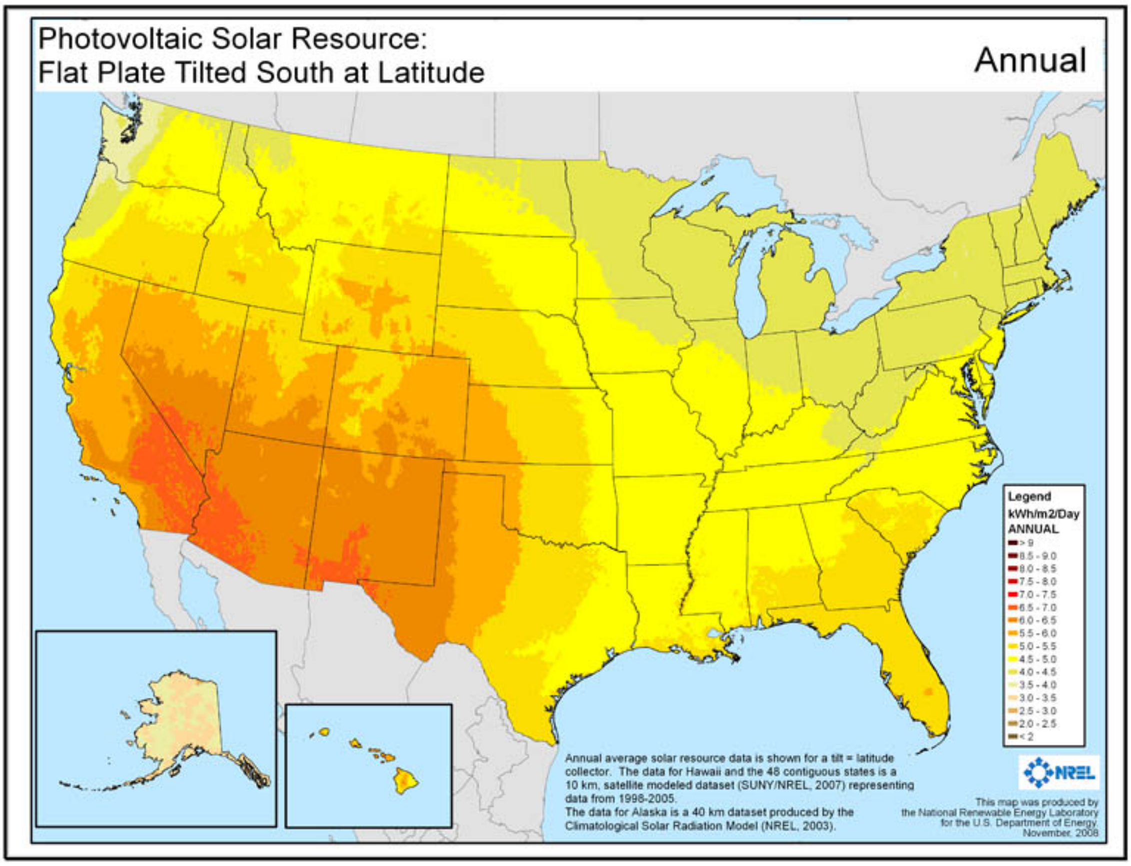


Figure 69. PV Solar Radiation (10 km) Static Maps (1998 to 2005 data). Photo: U.S.Department of Energy 2008.

This map presents the annual average daily total photovoltaic (PV) solar resource, averaged over surface cells of 0.1 degrees in both latitude and longitude, or about 10 km in size.

A heuristic "Rule of thumb" calculation regarding solar energy

On the roof of the Thompson Bowling Arena the average daily solar energy generated is 5 kWh/m^2/day. The roof area covered with solar panels is $13000m^2$ yielding a total annual average amount of solar energy of 65000 kWh/day. By the time this dissertation is completed, the estimated utilization factor of modern solar energy system will be approximately 25%. Thus some 16000 kWh/day could be in used for lighting this particular bridge. The energy used on the bridge is 600 kWh/day (the bridge lit for some 10 hours /day and the total energy consumption of the LED stripes is 60kW). The remainder of the energy, 16000kWh/day - 600kWh/day = 15400 kWh/day could be sold to TVA (Tennessee Valley Authority). Another option would use 15400kWh/day for expanding the illuminated area or use fewer solar panels on the roof of the Thompson Bowling Arena. This bridge lighting project could be a business opportunity for the Knoxville authorities. More exact calculations ought to be implemented to select the right option.

Electricity connections between solar panels and luminaires

DC electricity from solar panels must be converted to AC electricity by inverters, because solar harvesting is an unsure action and a smooth and continuous electricity supply cannot be guaranteed. Solar systems are added to the electricity nets of power plants ensure a continuous energy supply while lighting systems are in use.

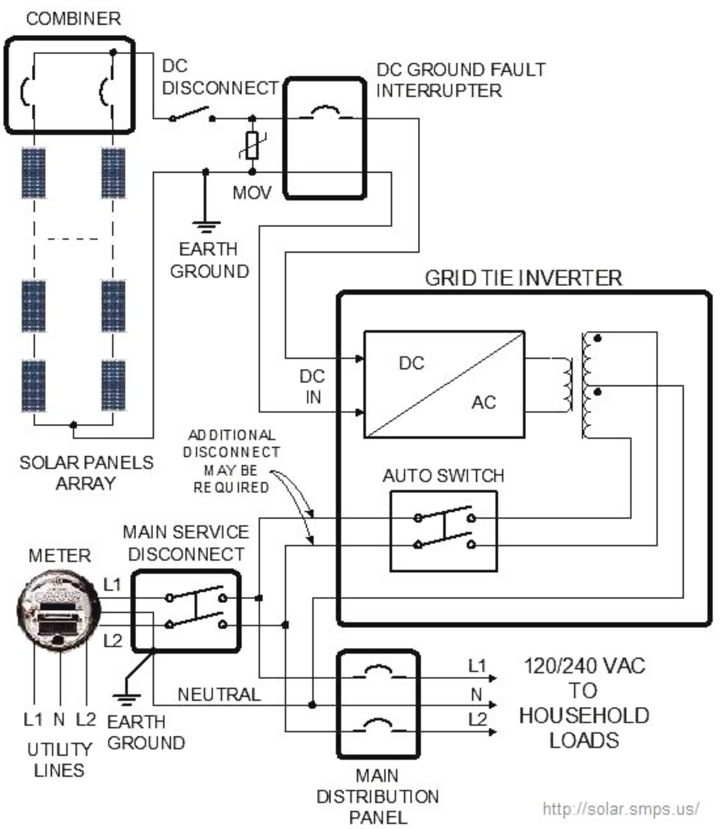


Figure 70. Simplified schematic diagram of a basic grid tie solar power system illustrating its operation. Automatic preset approach systems, as in the earlier Brando example, can easily be added to this type of large project.

Conclusion of solar energy by product and/or project bases:

Some years ago we thought that product and project based Photo Voltage (PV) systems were easy to maintain and could be also a profitable business with reasonable pay-back time. The big picture is that we are circulating all existing materials which are and have been on the globe. Put succinctly, nothing vanishes and nothing new arrives on earth and that is all we have. But that is not the truth. The one and only substance we have on earth is the constantly flowing, clean, powerful and free-of-charge energy from the sun. In future, when we seriously have to start to solve our environmental problems, product or project based solar systems may no longer be practical in lighting. Problems will occur in the maintenance of widespread small production units, compatibility with existing energy production systems and mechanisms, well-balanced energy production and electricity delivery and storage problems of widespread solar energy production units. Battery technology can serve smaller units, like cars, mobile phones, etc. For energy production on a large scale, the human race needs to build and develop huge solar energy centers / solar power plants all over the globe. These solar production centers will replace much of the existing, polluting energy production systems (nuclear energy, oil, water, wind energy, bioenergy etc.). The biggest problems are a lack of real will, politics, attitude, the ability to start to use new technology. Some day the pressure will increase and be so hard to handle that we will have to do it regardless of the consequences. In contradiction to this conclusion, I have used a project based solar energy system philosophy in Chapter 3.7 "*City lighting master plan strategies*" / subsection 3.7.7.5.2. "*Energy saving calculations using the Rule of Thumb*". The reason for this is that the hypothetical "City 2030" research project is a huge solar production city as regards lighting energy.

Solar energy is not the only way to save energy and minimize carbon dioxide emission in architectural lighting design projects. The dissertation will examine and provide explanations for design based energy saving architectural lighting design processes, tools and elements. New metaphors have been implemented using in-depth evaluation by means of the modified "contrast ladders", based on R.G.Hopkinson's work on Scales of Apparent Brightness, Richard Kelly's design principles, studies of approaching in the dark, technical lighting research results and pragmatic theory of truth. Subsection 3.6.4 "Poetic light & shadow in Western culture" introduces one interesting example of how a good architectural lighting design process can save 92% of energy compared to a rule oriented technical lighting solution.

3.5. Richard Kelly's design process

3.5.1. Perception psychology

Perception psychology is the psychology of a mental process. During this process sensory and emotional data are organized logically or meaningfully in the observer's head. The process serves as a basis for understanding, learning, and knowing or for motivating a particular action or reaction. Perception psychology in architectural outdoor lighting design is based on Richard Kelly's lighting ideas. Richard Kelly (1919–1977) was a pioneer of qualitative lighting design who borrowed existing ideas from perception psychology and theatrical lighting and combined them into a uniform concept for lighting design. Kelly broke away from the rigid constraints of using uniform illuminance as the central criterion of lighting design in the "All surfaces white" era of architecture. He replaced the question of lighting quantity with the question of individual qualities of light. These were designed according to a series of lighting functions, which were in turn geared towards the perceiving observer. Three of these functions are critical to perception psychology for landscape lighting design: "*Ambient Luminescence*", "*Focal Glow*" and "*Play of Brilliants*".

Figure 71. Richard Kelly. Photo: Richard Kelly’s archives.

3.5.2. Ambient Luminescence

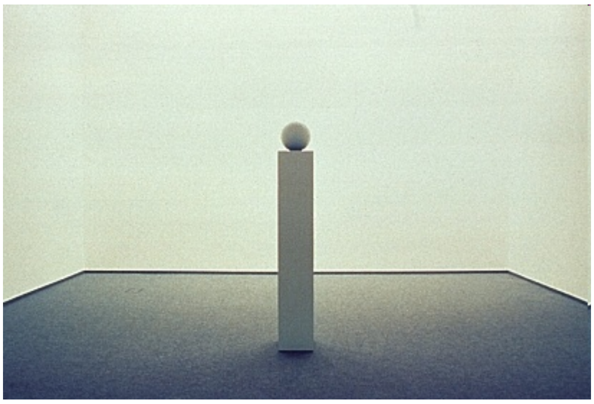


Figure 72. Ambient Luminescence, theoretical display. Photo: ERCO

Figure 73. Ambient Luminescence, case study. Photo: Julle Oksanen

Kelly called the first and fundamental form of light "*ambient luminescence*". This is the element of light that provides general illumination of the surroundings; it ensures that the surrounding space, its objects and the people there are visible. This form of lighting facilitates general orientation and activity. Its universal and uniform orientation means that it largely follows along the same lines as quantitative lighting design, except that ambient luminescence is not the final objective but just the foundation for a more comprehensive lighting design. The aim is not to produce blanket illumination, or "one size fits all" lighting at the supposed optimum illuminance level, but to have differentiated lighting that builds on the base layer of the ambient light.

3.5.3. Focal Glow

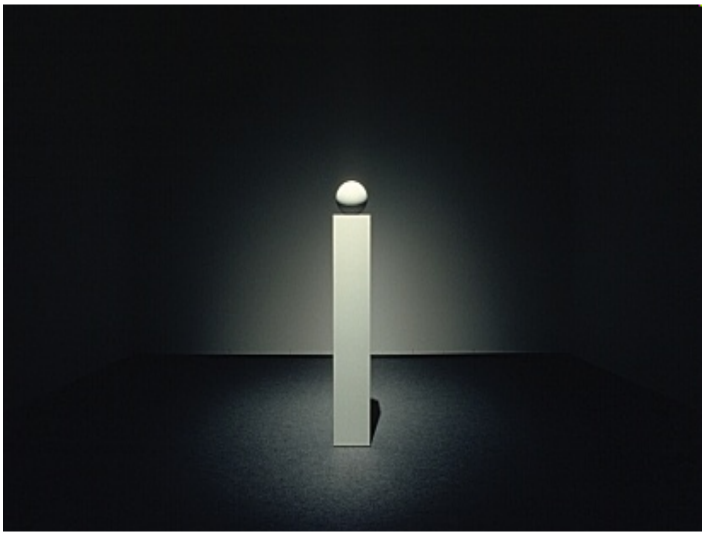


Figure 74. Focal Glow, theoretical display. Photo: ERCO

Figure 75. Focal Glow, case study. Photo: Howard M. Brandston Lighting Design.

To arrive at a differentiation, Kelly came up with a second form of light, which he referred to as "*focal glow*". This is where light is first given the express task of actively helping to convey information. The fact that brightly lit areas automatically draw our attention now comes into consideration. By using a suitable brightness distribution it is possible to order the wealth of information contained in an environment. Areas containing essential information can be emphasised by accented lighting, whereas secondary or distracting information can be toned down by applying a lower lighting level. This facilitates a fast and accurate flow of information, whereby the visual environment is easily recognized in terms of its structures and the significance of the objects it contains. This applies just as equally to orientation within the space (e.g. the ability to distinguish quickly between a main entrance and a side door) as for emphasizing certain objects, such as when presenting goods for sale or when highlighting the most valuable sculpture in a museum collection.

3.5.4. Play of Brilliants

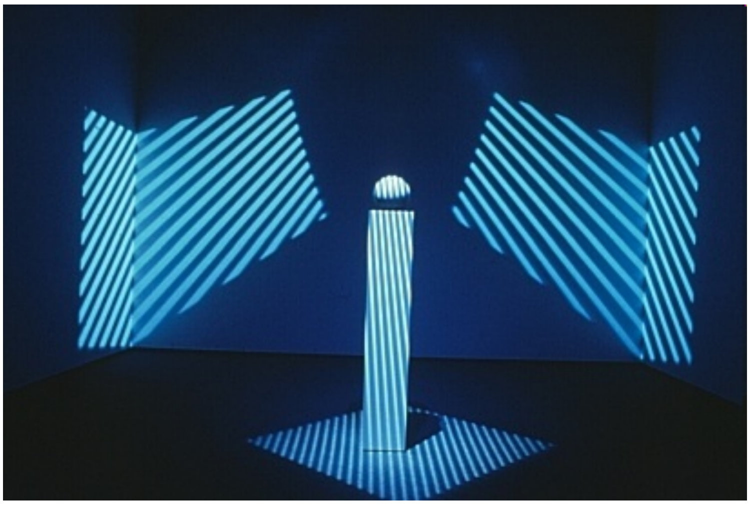


Figure 76. Play of Brilliants, theoretical display. Photo: ERCO

Figure 77. Play of Brilliants, case study: Gateshead Millennium Bridge. Lighting design Speirs + Major. Photo: Graham Peacock.

The third form of light, "*play of brilliants*", results from the insight that light not only draws our attention to information, but can also represent information in and of itself. This applies above all to the spectacular effects that point light sources can produce on reflective or refractive materials. Furthermore, the light source itself can be brilliant. This "*play of brilliants*" can add life and ambiance, especially to prestigious venues. What was traditionally produced by chandeliers and candlelight can now be achieved in a modern lighting design by the targeted use of light sculptures or by creating brilliant effects on illuminated materials.

3.5.5. A real life example

A good landscape lighting design project to demonstrate these three principles of Richard Kelly is ”Kilden,” the concert and theatre hall in Norway. It was designed by ALA architects and has a lighting concept by Julle Oksanen Lighting Design Ltd.

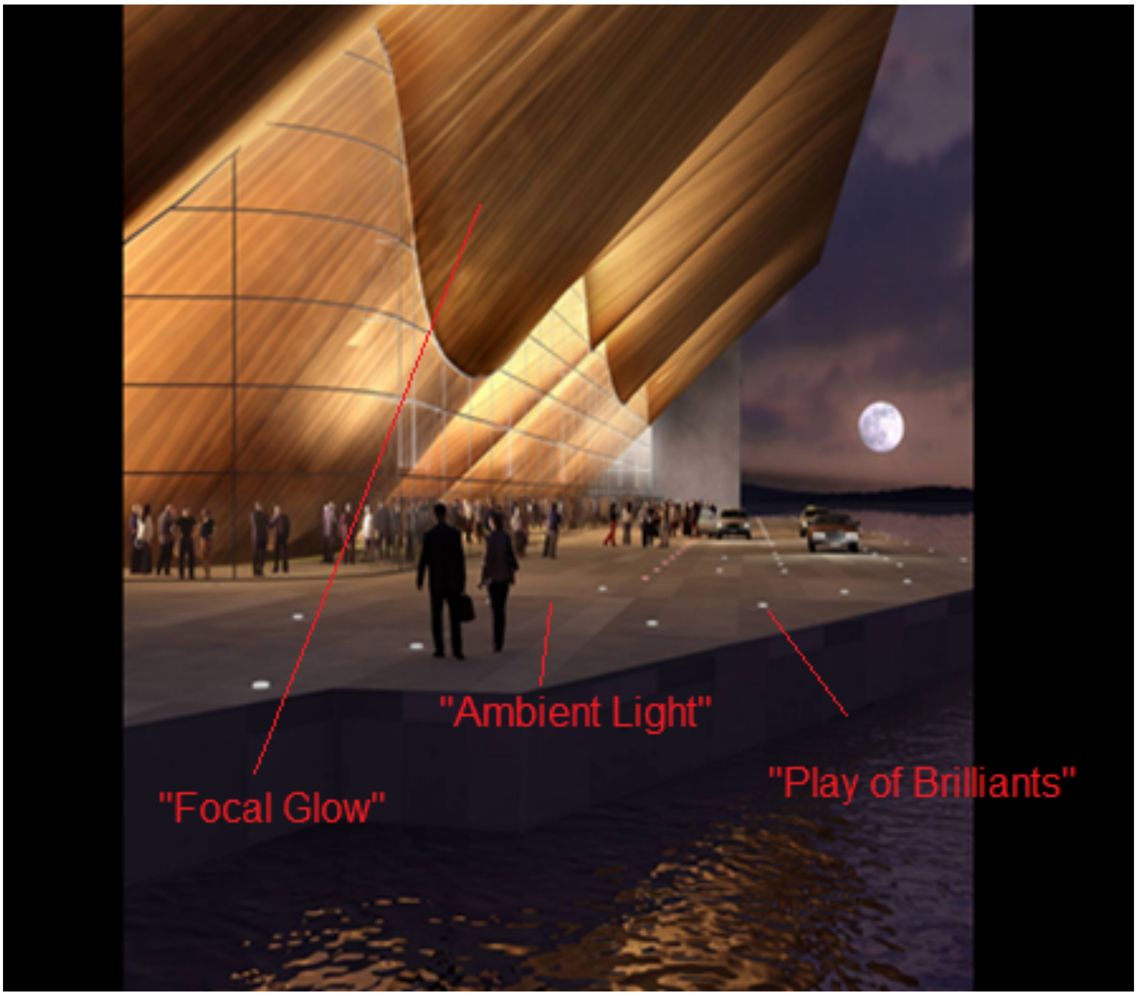


Figure 78. “KILDEN”. Architect and CAD manipulation. Photo: ALA Architects Ltd

”*Ambient Light*” = The glowing facade produces horizontal light on the ground. The horizontal light meets the minimum engineering and code standards for levels of light necessary for things like safe movement. Minimum values are acceptable due to other fixed lighting in the area, and ’live lights’ coming from cars for example, will provide more light to raise the lighting levels. In other words, if maximum lighting was provided, additional ’live lights’ would raise lighting levels far beyond the amount necessary, creating light pollution.

One of the most important things in all successful architectural lighting design solutions is to avoid glare. It is the worst enemy of light. In this case heuristics helps again by using one’s own experience of measuring different luminance values. As a rule of thumb: Contrasts are strong and there is no veil on the retina if the maximum brightness of the light distribution surface in all views is lunar brightness. According to my own practical measurements, the Moon luminance is approx. 3000 cd/m2.

”*Focal Glow*” = In-ground luminaires differentiate the facade of the building by creating a glowing wooden surface. Because of its statuesque and attractive nature, the wooden and curving facade was selected as a ”*Focal Glow*” element of the landscape lighting. It is a glowing landmark on the area and by switching on and off different underground luminaires it can be used as an information wall. As an example of information; more light is focused upon the entrance of the theater when there is a performance. In Figure 84 all in-ground luminaires are on and the façade has a full brightness.

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”*Play of Brilliance*” = In-ground luminaires (stars on the ground). This landscape lighting solution was based on underground luminaires as ”Stars on the ground”. This exciting solution removes ugly and disturbing technical lighting poles and glary floodlights.

Figure 79. Punkt Festival 2012: The Venue

3.6. Shadow and darkness design

3.6.1. General

Architectural outdoor lighting design, as a process, is at the same time also darkness and shadow design. Darkness fascinates us as human beings, but its design needs exceptional skills, open-mindedness, and courage. Let us imagine a hypothetical situation in which the lighting designer begins to design a lit environment with total darkness as the starting point (As is the case in paragraph 3.6.7. "*Darkness in Fiskars Village area*"'). The lighting designer begins to remove, or eliminate, dark layers from the total black background, removing darkness layers one at the time, until the desired lighting degree on the designed surface (e.g. on a facade) is achieved. The lighting designer proceeds subject by subject until the desired overall look has been achieved. This kind of “shadow design” is a professional way to do lighting design. The lighting designer is a shadow designer, who treats his/her task as an artist treats the canvas by painting gradations of darkness using light sparingly on illuminated surfaces, thereby using a whispering light palette as the design tool. Shadow design can be compared to oil painting techniques.

“Case” Mona Lisa: “The enigmatic smile remains a mystery, but French scientists say they have cracked a few secrets of the "Mona Lisa." French researchers studied seven of the Louvre's Leonardo da Vinci paintings, including the "Mona Lisa," to analyze the master's use of successive ultrathin layers of paint and glaze -- a technique that gave his works their dreamy quality. Specialists from the “Center for Research and Restauration of the Museum of France” found that da Vinci painted up to 30 layers of paint on his works to meet his standards of subtlety. Added up, all the layers are less than 40 micrometers, or about half the thickness of a human hair, researcher Philippe Walter said on Friday. The technique, called "sfumato," allowed da Vinci to give outlines and contours a hazy quality and create an illusion of depth and shadow. His use of the technique is well-known, but scientific study on it has been limited because tests often required samples from the paintings” *(Washington Post 2010).*

In some cases this kind of lighting/darkness design technique is possible, but almost 100 years of this intransigent technical lighting design era have made glary and high illumination level city structures a context for new lighting designs. The fascination of darkness is totally missing. The only way to succeed with such city structures is to dismantle the old lighting installations and start from darkness. Some cities e.g. in Finland, are considering such lighting renovations in certain parts of the city structure (e.g. Helsinki in Finland).

The historical chapter and over 30 years of hands-on, personal international activity in the USA and Europe are good evidence that in Western culture, visual night-time architecture has been built up basically with light and lighting design. After reading JunichiroTanizaki’s and Kaoru Mende’s books it is obvious that in Asian culture designing night-time architecture is based on shadow and darkness design *(Tanizaki 2001)* and *(Mende 2012*). In the West, lighting projects have been accomplished based on lighting recommendations and numerical values. Asian lighting design processes have been based on Gradation (The realm between light and shadow) / Contrast (The dynamic interplay of shadow and light) / Layering (The art of shadow upon shadow) / Using the blue moment efficiently / “Utsuroi” (Visualizing time) / Sequencing light and shadow / Creating urban skyline with shadows etc. Because of the lack of architectural lighting design education, these important shadow and darkness design elements and philosophies are not well known in the Western lighting design world.

Modified use of “Contrast Ladders”, based on R.G. Hopkinson’s work on Scales of Apparent Brightness (see subsection 3.6.5.) is a “Western style” of shadow treatment and a good tool for Western lighting designers. Adding numerical study to Asian *philosophical shadow design is an interesting combination. Also, lighting composition* depending partly on numerical values leads to the same shadow design results as in Asian design philosophies, but in “Western style”.

Studies of meeting in the darkness play an important role when we select minimum lighting design values for lighting compositions in architectural outdoor lighting solutions. Mandatory face recognition distance is needed for relaxed movement in space and that needs certain lighting design values. With this “tool” we can avoid too dark environments.

Music also has mystical connections with lighting. It bears similarities to lighting composition and mystic connection on colors.

3.6.2. Human beings and darkness

3.6.2.1. "Physiological darkness" (*Mansfield & Oksanen 2015*)

Figure 80. Chýnov's cave near Chýnov village, Czech Republic. Photo: Peter Broz (Chmee 2)

"Darkness is as real to us as light, which means that darkness is not just an absence of light but is tangible, as in the sensation when we go into a completely dark room – there is a presence there not a void. Stephen William Kuffler, who was a pre-eminent Hungarian-American neurophysiologist and often referred to as the "Father of Modern Neuroscience", demonstrated that even in utter darkness the retinal ganglion cells keep up a steady irregular firing of impulses *(Hubel, D.H.1995)*. Circadian rhythms are entrained by a cycle of light vs. absence of light. This is critical to human health and well-being. More details can be found e.g. at http://www.lrc.rpi.edu, written by Professors Mark Rea and Mariana Figueiro at the Lighting Research Center, Troy New York, USA. The promise of electrical lighting and things like night vision goggles is that we can gain control over the most fundamental cycle – our circadian rhythm".

3.6.2.2. "Physical darkness"

Figure 81. Matthew the Apostle. Photo: http://www.dailymail.co.uk/news/article-3219706/Riddle-lost-city-lake-one-Jesus-disciples-laid-rest-ancient-metropolis-Kyrgyzstan.html

Matthew 6:23 / The Lamp of the Body:
"The eye is the lamp of the body; so then if your eye is clear, your whole body will be full of light. But if your eye is bad, your whole body will be full of darkness. If then the light that is in you is darkness, how great is the darkness! No one can serve two masters; for either he will hate the one and love the other, or he will be devoted to one and despise the other. You cannot serve God and wealth".

"We sense darkness with our body. Darkness offers contrast to light, just as summer feels better after a long winter. It is one of the pairs of life in our senses like taste: sugar / salt, emotion: love / hate, life: birth / death, hearing: noise / silence, seeing: day / night, etc. Darkness is therefore physiologically fascinating". (*Leslie & Oksanen 2015*)

3.6.2.3. "Behavioral darkness"

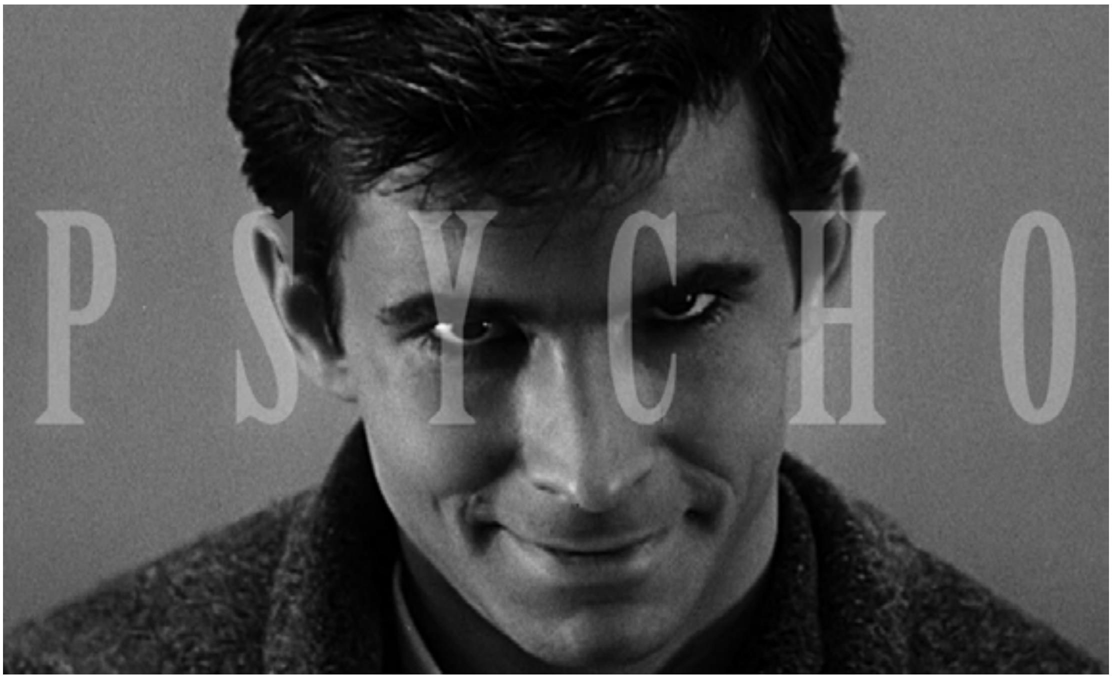


Figure 82. Psycho Wallpaper by CainaG in Movies & TV

"We all have a dark side. It is a basic typology of our human interiors. For most people, it is an unconscious part of the personality. Therefore, we seek external expression, such as violent films, horror movies, and so forth. The dark side of a person needs an outlet and expression. Male aggressiveness is challenged in sports, for example. Darkness and shadows hold our attention and fears. The human dark side kept suppressed leads to fear. Yet we are curious about it. We usually cannot tolerate or accept it in ourselves, so we seek to discover it outside ourselves. Darkness is therefore psychologically fascinating". (*Dekay & Oksanen 2015*)

3.6.2.4. “Biological darkness”

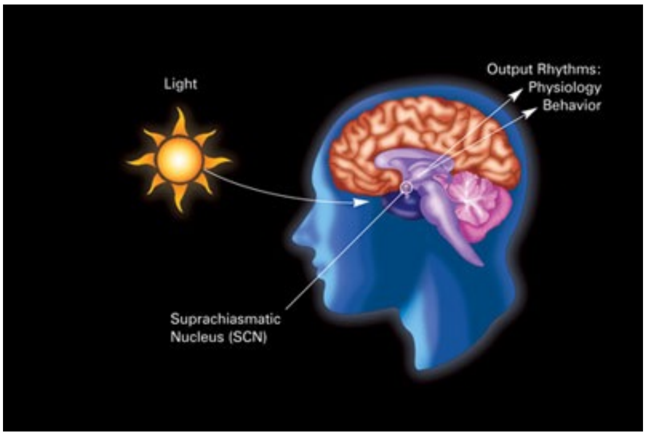


Figure 83. Diagram illustrating the influence of light and darkness on circadian rhythms and related physiology and behavior through the suprachiasmatic nucleus in humans. Photo: https://en.wikipedia.org/wiki/Circadian_rhythm

“We biologically need sleep to clear metabolites from our brain. *(Science, 2013)*. However, we could sleep at night or at any point during the day, and many animals only come out at night. We humans evolved over millennia to sleep at night, when we were most at risk of being eaten by nocturnal hunters. *(Russel, Foster, 2013).* Since we didn’t have control over the dark until we started using candles or electric lighting, we didn’t have control over a third of our day. Darkness is therefore also a practical challenge”. (*Rajkovich & Oksanen 2015*)

3.6.2.5. “Mental darkness”

Figure 84. Death of the Virgin by Caravaggio (1606)

“One of the biggest questions we ask ourselves as humans is what does it mean to die, and it is one we cannot answer. Thinking about darkness is a way to approach this issue and getting to know darkness and not being afraid of it is seen as a parallel for accepting death. Darkness is therefore mentally fascinating”. (*Sachs & Oksanen 2015*)

3.6.2.6. “Artistic darkness”

Figure 85. Jazz musician Jukka Perko plays in the dark. image:Paulina Ahokas

“Darkness reveals new dimensions in jazz music. Jazz musician and saxophonist Jukka Perko gave a concert in darkness in 2014. It was a very mystical and strong experience for him. The idea of the concert was an improvisation. The audience sat in complete darkness and was led into the space along a dim corridor with closed eyes. They therefore did not know what kind of concert hall they were in. The musicians did the same. In complete darkness communication is not under control. The player can see no facial expression and therefore unable to see if he is pleasing the listeners. Summa summarum: You are alone with your instrument. At the same time you feel safe among the audience. Jukka Perko felt that the experience was very warm and interesting. He did not want to say anything more about it. He stated that it was a mystery”. *(Enckell 2014)*

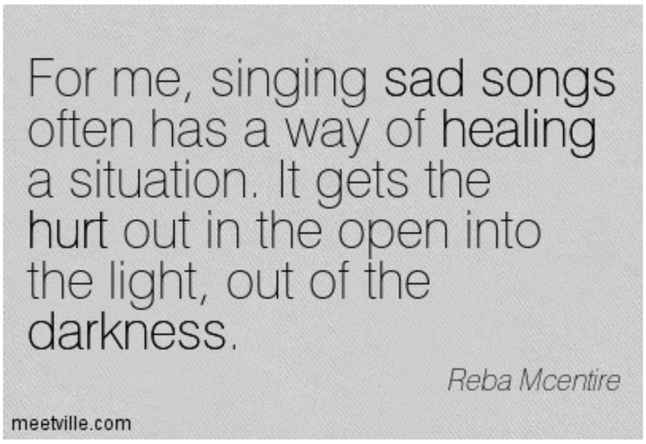


Figure 86. http://meetville.com/quotes/tag/darkness/page63

Darkness and black color have an interesting and mystic connection to death (explained in 3.6.2.5. “*Mental Darkness*”). We also can recognize sad music played e.g. at memorial services. “Dark music”.

Gothic architecture and light

(Source: Brett & Kate McKay, 2011: http://www.artofmanliness.com/tag/basics-of-art/)

Expansive interior light has been a feature of Gothic cathedrals since the first structure was opened. The metaphysics of light in the Middle Ages led to clerical belief in its divinity and the importance of its display in holy settings. Much of this belief was based on the writings of Pseudo-Dionysius, a Christian theologian and philosopher of late 5th to early 6th century. He held that all light, even light reflected from metals or streamed through windows, was divine. To promote such faith, the abbot of the Saint-Denis monastery on the north edge of Paris, Abbot Suger, encouraged the architects remodeling the building to make the interior as bright as possible.

Figure 87. Abbey Church of St. Denis in Saint Denis- France. Abbot Suger's remodeled building with bright light. Photo: Frantisek Zboray, 2003

Ever since the remodeled Basilica of Saint-Denis in 1144, Gothic architecture has featured expansive windows, such as those of Sainte Chapelle, York Minster, Gloucester Cathedral and Milan Cathedral. The increase in size between windows of the Romanesque and Gothic periods is related to the use of the ribbed vault, and in particular, the pointed ribbed vault which channeled the weight to a supporting shaft with less outward thrust than a semicircular vault. Walls did not need to be so weighty.

Figure 88. Expansive windows "Sainte Chapelle - Upper level". Photo: Didier B (Sam67fr)

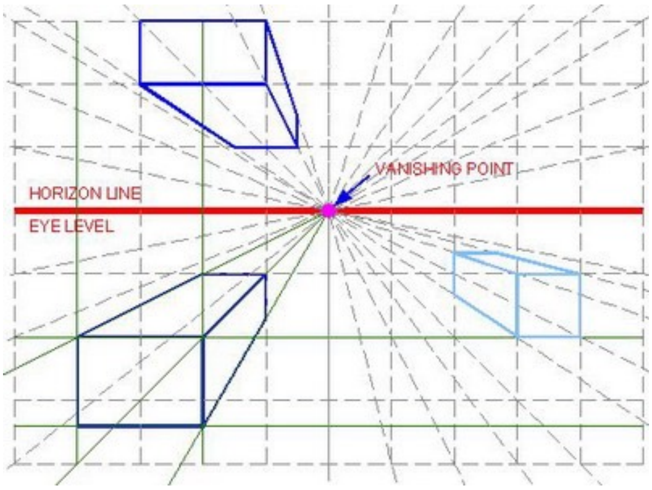
The internal columns of the arcade with their attached shafts, the ribs of the vault and the flying buttresses, with their associated vertical buttresses jutting at right-angles to the building, created a stone skeleton. Between these parts, the walls and the infill of the vaults could be of lighter construction. Between the narrow buttresses, the walls could be opened up into large windows.

Throughout the Gothic period, thanks to the versatility of the pointed arch, the structure of Gothic windows developed from simple openings to immensely rich and decorative sculptural designs. The windows were very often filled with stained glass, which added a dimension of color to the light within the building, as well as providing a medium for figurative and narrative art.

Renaissance Art & Light on Time Period: 1400s–1600s

(Source: Brett & Kate McKay, 2011: http://www.artofmanliness.com/tag/basics-of-art/)

Things to Look for in Renaissance Art:



Perspective. To add three-dimensional depth and space to their work, Renaissance artists rediscovered and greatly expanded on the ideas of linear perspective, horizon line, and vanishing point.

Linear perspective: Rendering a painting with linear perspective is like looking through a window and painting exactly what you see on the window pane. Instead of every object in the picture being the same size, objects that were further away would be smaller, while those closer to you would be larger.

Horizon line: Horizon line refers to the point in the distance where objects become so infinitely small, that they have shrunken to the size of a line.

Vanishing point: The vanishing point is the point at which parallel lines appear to converge far in the distance, often on the horizon line. This is the effect you can see when standing on railroad tracks and looking at the tracks recede into the distance.

Emotion. Renaissance artists wanted the viewer to feel something while looking at their work, to have an emotional experience from it. It was a form of visual rhetoric, where the viewer felt inspired in their faith or encouraged to be a better citizen.

Realism and naturalism. In addition to perspective, artists sought to make objects, especially people, look more realistic. They studied human anatomy, measuring proportions and seeking the ideal human form. People looked solid and displayed real emotions, allowing the viewer to connect with what the depicted persons were thinking and feeling.

Shadows and light. Artists were interested in playing with the way light hits objects and creates shadows. The shadows and light could be used to draw the viewer's eye to a particular point in the painting.

Figure 89. School of Athens, by Raphael, 1510. This painting, which depicts all the great philosophers of ancient Greece and Rome, serves as an example of the way in which Renaissance artists were inspired by and hearkened back to the days of antiquity. The perspective lines draw the viewer to the center of the painting and the vanishing point where history's two greatest philosophers, Plato and Aristotle, stand. In line with their philosophies, Plato points to the heavens and the realm of forms, while Aristotle points to the earth and the realm of things.

The Baroque Period & Light (1600s–1700s)

(Source: Brett & Kate McKay, 2011: http://www.artofmanliness.com/tag/basics-of-art/)

Things to Look for in Baroque Art:

Images are direct, obvious, and dramatic. - Tries to draw the viewer in to participate in the scene. - Depictions feel physically and psychologically real. - Emotionally intense. - Extravagant settings and ornamentation. - Dramatic use of color. - Dramatic contrasts between light and dark, light and shadow. - As opposed to Renaissance art with its clearly defined planes, with each figure placed in isolation from each other, Baroque art has continuous overlapping of figures and elements. - Common themes: grandiose visions, ecstasies and conversions, martyrdom and death, intense light, intense psychological moments.

Examples of Rembrandt's brilliant shadow & light symbiosis in his "Philosopher" series:

Figure 90. Philosopher in Meditation, Rembrandt

Figure 91. Philosopher with an Open Book, Rembrandt

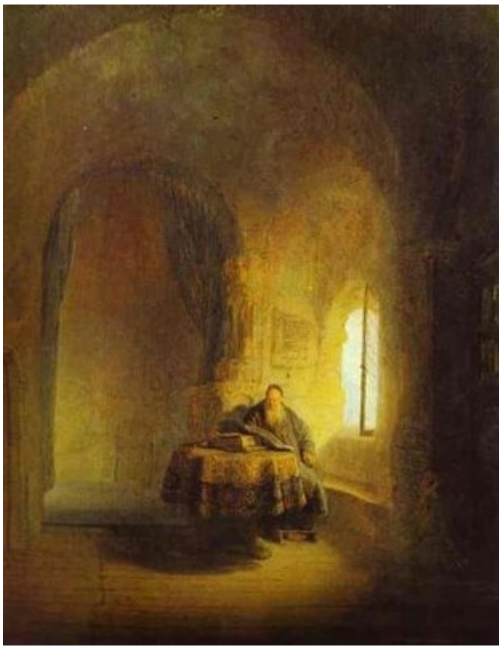


Figure 92. Philosopher Reading, Rembrandt

Baroque architecture

(Source: Brett & Kate McKay, 2011: http://www.artofmanliness.com/tag/basics-of-art/)

Baroque architecture is the building style of the Baroque era, begun in late 16th-century Italy, which took the Roman vocabulary of Renaissance architecture and used it in a new rhetorical and theatrical fashion, often to express the triumph of the Catholic Church and the absolutist state. It was characterized by new explorations of form, light and shadow, and dramatic intensity.

Example: Church of the Gesu

Figure 93. Façade of the Church of the Gesu, the first truly baroque façade. Photo "Il Gesu" by English-speaking Wikipedia user Chirho.

Figure 94. Interiors of Gesu. Photo: "Lazio Roma Gesu1 tango7174" by Tango7174.

The Basics of Art: The Romantic Period 1800–1860

(Source: Brett & Kate McKay, 2011: http://www.artofmanliness.com/tag/basics-of-art/)

Artists of the Romantic Period tried to capture these ideals in their work. They rejected the rationalism and rule-driven orderliness that characterized the Neoclassical style of the Enlightenment. Like Baroque artists, Romantic artists hoped to inspire an emotional response in those who viewed their art; but instead of seeking to inspire faith as their predecessors had, most sought to evoke a nostalgic yearning for rural, pastoral life, the stirrings of life's mysteries, and a sense of the power and grandeur of nature.

Figure 95. Looking Down Yosemite Valley, by Albert Bierstadt, 1865. German-American artist Albert Bierstadt left New York to capture the rugged beauty of the American West. As with other Hudson River Valley artists, he would sketch the areas he explored, as painting on site was impractical, and then turn the sketches into paintings upon returning home. The resulting landscapes were often a combination of different features seen in various locations, and the colors and especially the lighting were played with and intensified to heighten the awe-inducing effect of the scene.

Conclusions

Figure 96. http://www.flickr.com/photos/paulobar/230134559/ Photo: Paulo Barcellos Jr.

Night- time fascination even in the busiest cities in the world, like New York City, is based on shadows and darkness. We can find all the fascinating elements of darkness in Paulo Barcello Jr's photo. "Physiological darkness" (Light and shadow in the same photo) + "Physical darkness" (emotion: love/hate) + "Behavioral darkness" (darkness is holding attention and fear) + "Biological darkness" (control over the darkness, no fear of nocturnal animals)+ "Mental darkness" (interesting contradiction between darkness and death and living city that never even sleeps)+ "Artistic darkness" (what lighting composition, can you here the song "New York, New York" in your ears??).

Despite hard and time-consuming efforts I have not found any written scientific articles or any professional psychologically educated person to explain and/or determine the scientific basis of the essence of darkness and its impact on human behavior. This observation has revealed, I think, a clear link between design and the mystical essence of the "great unknown" as a factor between semiotic connections in architecture and interesting design.

Cultural differences in darkness behavior have a powerful influence on architectural lighting design metaphors through lighting concepts. These differences cannot be identified or explained by means of technical numerical light values. There is some divergence as regards lighting recommendations, but because all countries follow the CIE (Transnational Research Organization) research results, cultural influence cannot be identified. We have to look and search for these remarkable, educationally important and influential behavioral differences through anthropological studies.

3.6.3. Japanese shadow design

3.6.3.1. Ancient Asian shadow puppetry

Ancient shadow play culture is a naturally developed link to modern Japanese lighting design culture. Numerous similarities can be found between these two shadow design activities, among them reverence for shadows, telling stories with shadows, directions of light, creating shadows instead of creating light, etc.

Shadow puppetry originated during the Han Dynasty (206 BC–220 AD), when one of the concubines of Emperor Wu of Han died from an illness. The emperor was devastated, and summoned his courtiers to bring his beloved back to life. The officers made a shape of the concubine using donkey hide. Her joints were animated using 11 separate pieces of leather, and adorned with painted clothes. Using an oil lamp they made her shadow move, bringing her back to life.

Since then, shadow play (shadow puppetry) has been an ancient form of storytelling and entertainment in Asian countries. Shadow play uses flat articulated figures (shadow puppets) to create cut-out figures which are held between a light source and a translucent screen. Before electric lighting, oil lamps were used as light sources. The thin cut-out shapes of the puppets form sharp shadows and sometimes also include translucent color or other types of detailing. Various effects can be achieved by moving both the puppets and/or the light source. A talented puppeteer can make the figures appear to walk, dance, fight, nod, and laugh.

Light & Shadow & Movement

In shadow puppetry, opera, ballet and theater people do not move, they sit still and the movement happens on the stage through a combination of shadow and light and actors'/dancers' movements. In real life, outdoors, lights and shadows are still (facades, streets, trees, windows, etc.) and it is the observers, like pedestrians, cyclists, drivers etc. who move. In both cases, the interest is created through a balanced use of shadow and light.

Figure 97. Left to right: Left: A Javanese *wayang kulit* (shadow puppet) performance by a famous Indonesian *dalang* (puppet master) Ki Manteb Sudharsono, is usually a whole night long. Photo Gunawan Kartapranata.Middle: New Year ballet. Photo: Paris Opera. Right: New Year's Eve, Champs Elysees. Photo: Irwin H. Segal. Similarities in all three images are: light & shadow & movement.

3.6.3.2. Origins of Japanese lighting design

"In making for ourselves a place to live, we first spread a parasol to throw a shadow on the earth, and in the pale light of the shadow we put together a house" *(Tanizaki 2001b)*

Figure 98. Japanese style house. Photo: Homes Aura

“And so it has come to be that the beauty of a Japanese room depends on a variation of shadows, heavy shadows against light shadows – it has nothing else. Westerners are amazed at the simplicity of Japanese rooms, perceiving in them no more than ashen walls bereft of ornament. Their reaction is understandable, but it betrays a failure to comprehend the mystery of shadows.” *(Tanizaki 2001c)*

“I have written all this because I have thought that there might be still somewhere, possibly in literature or the arts, where something could be saved. I would call back at least for literature this world of shadows we are losing. In the mansion called literature I would have the eaves deep and the walls dark, I would push back into the shadows the things that come forward too clearly, I would strip away the useless decoration.” *(Tanizaki 2001d)*

Figure 99. Old Japanese-style room. Photo: Aminus3

There is no doubt about the influence of shadow puppetry on Japanese lighting design, but it is only one element inside this complex field. According to a Japanese lighting designer Kaoru Mende: “After all, Japanese architectural lighting design started by absorbing Western lighting techniques and following the finest examples of its applications. But the perennial and passionate debate over the differences between Japanese and Western culture inevitably comes down to differences in climate and topography, architectural techniques and form, belief and religion differences that in their totality have also produced contrasting culture attitudes towards light and illumination*” (Mende 2005)*. Some typical Japanese lighting (or should we say shadow) design elements:

> Darkness gradation (the realm between light and shadow). Instead of uniform use of light, using shifting shadows from top to bottom and from left to right. An infinite range of shadow gradation within light and dark is a unique Japanese design philosophy and technique.

> Contrast (the dynamic interplay of shadow and light). Our senses are extraordinarily adaptable. We perfectly can handle 100,000 lx sun light, but also 2 lx of moonlight might seem very bright as well. We cannot analyze contrast effects with our human senses as we can do by measuring lighting values, like illumination and luminance. In lighting design we have three fundamental and studied ratios: 1:3 (for example in interior lighting/offices not to tire the eyes), 1:5 (for example building entrances to smooth the relation between peripheral areas and closed elements, like entrance carpet) and 1:10 (for example, a large environment lighting vitrine with eye- catching products, like department stores). These are

constantly used illuminance values in daily lighting design. But the actual contrast is based on visual perception, which must be taken into account in good lighting design. Colors, materials and space structuring are important elements.

Layering (the art of shadow upon shadow) Western metropolises and towns are so overloaded with light that lighting designers have to mainly use the “layered lighting” philosophy, while Asian lighting designers have more opportunities to use the “layered shadow” philosophy in lighting design.

Figure 100. The Tokyo Club/2005 Tokyo, Japan. (Lighting designer Kaoru Mende. Photo: Kaoru Mende + Lighting Planners Associates)

“The newly built members-only social club sits in a quiet, tree lined neighborhood. Given the character of the neighborhood, the building needed an inviting exterior that harmonizes with rather than isolating it from its surroundings. The exterior is illuminated by uplighting just inside the front glass façade that serves as the face of the building. The gradation of light comes from the uplighting facades naturally in the upper reaches of the façade, adding elegance to the exterior and casting gentle light onto the street. Besides seamlessly merging the exterior with its surroundings , the tree lined street bathed in gentle light has a palpable yet shooting presence inside. Here, interior lighting meets all its typical practical functions with a design scheme that creates a relaxing ambience free of excess ornamentation” *(Mende 2005a)*

Figure 101. World City Towers / 2006 Tokyo, Japan. (Lighting designer: Kaoru Mende. Photo: Kaoru Mende +Lighting Planners Associates Inc.)

"This super high-rise luxury housing complex built in Tokyo's Tennozu Isle District is like a resort in the city. The lighting in the luxury hotel-style main entrance of the complex both minimizes the presence of lighting fixtures and emphasizes the texture of the entrance's striking juxtaposition of architectural materials. The lobby is cast in comfortably restrained base lighting designed to highlight its various design elements. Illuminating the materials in this way adds brightness to their texture to create an elegant everyday space. Likewise, landscape lighting provides enough light for safe passage while creating light and shadow contrasts that bring out the spatial depth of the grounds. The rhythm of carefully arranged sequences of light and shadow serves to emphasize the space's uninterrupted breadth and depth." *(Mende 2005b)*

3.6.4. Poetic light & shadow in Western culture

3.6.4.1. Asian and Western similarities

There are differences between Asian and Western countries such as:

culture

climate

topography

architecture

design technics

attitude

religion

etc.

These differences have an influence on the contrasting culture, attitudes towards light and illumination, shadow and darkness on both continents. Ethnography is a crucial tool for better design, helping designers to connect profoundly with their clients and create more compelling solutions. It asks the designer to share the environment, problems, language, rituals and social relations of a particular group or community of people. It is good to not only understand but also to feel/experience the world as they do.

However, in spite of these ethnographical differences there are also general similarities and equal possibilities in lighting design, both in Asia and the West. Light creates the night-time architecture and is a common language throughout the world. Skillful use of shadow design is the key to interesting, city beautification with light on all continents.

Figure 102. Similarities between an Asian city and Western city. Left: Tokyo. Photo: Puku/ SIME-4CornesImages. Right: New York City. Photo: benjamineenglishcorner

The general fact is that we have globally much too much light all over in our illuminated landscape areas and also indoors. We have to remember that “The Shadow is The Best Friend of Light” (author) and that shadow is born from light (Howard Brandston). Life &Death / Salt & Sugar / Love & Hate / War & Peace/ Light & Shadow. They all are pairs of life and we desperately need them. Look at old films made in the West like “Citizen Cane” or “Casablanca” or Charlie Chaplin’s “The Great Dictator” or “Harry Lime the Third Man”. Masterly use of shadow and light with dramatic music.

Figure 103. A still from the film Casablanca: "Moe's bar". Photo: (*Wikipedia 10)*

Beautifully applied light & shadow in lighting project is to be seen in Grand Central Station in New York City, where the average horizontal illuminance value is E_{horav} = 15 lx. International lighting recommendations require E_{av} = 200 lx. Energy saving is 92% and the solution is beautiful. People all over the world come to enjoy the wonderful Genius Loci of the station.

Figure 104. Grand Central Station. Photo: Julle Oksanen

At Grand Central Station the ambient light was achieved with silently whispering lights on the forecourt area. The focal glow was achieved with lights glowing at the entrances to the platforms. The play of brilliance was achieved with a row of incandescent lamps on the upper edges and chandeliers. The lighting level is E_{hav} = 15lx, which is 8% of the recommended E_h = 200 lx. The space is like an enormous shadow which has some lights flickering here and there, yet an approaching person can still be discerned from a distance of 10 meters. The lighting composition is perfect. It was designed by lighting designer Charles Stone (FMS Ltd, New York New York). You can almost hear the basic silent sounds of a violin and the sharp footsteps of a traveler. All the senses are tuned to sensitive levels. This is a masterpiece of the lighting renovation project from the late 1990's.

Lighting designers have to think of space three-dimensionally with the right relation of shadow and light. Two masters of shadow and light, the architect Professor Juhani Pallasmaa from Finland and the lighting designer Professor Howard Brandston from New York say that the world needs more skillful thinkers and - architectural shadow designers. I am not sure if these things can be taught, but we need to accomplish something quite radical to achieve more beautiful night- time architecture. We have to find the "Lost Shadow" again in the West. The best way to find this lost shadow is to add lighting/shadow design as an integral part of programs in design education in schools of architecture. Now would be a perfect time when a sustainable and efficient light source, LED, has been "selected" as a light source for tomorrow. At the moment only a few universities worldwide offer degree programs in lighting design. We have to thank the IALD (International Lighting Designers' Association) for their persevering and pioneering in the interests of lighting education. See: *www.iald.org*

3.6.4.2. Materiality and tactility of light

Juhani Pallasmaa articulated in masterly fashion his personal and poetic relation to light and shadow in his lecture *"The touch of light – materiality and tactility of light" (Pallasmaa 2011)*

In his lecture Professor Pallasmaa explained how light and its accompanying shadow give volumes, spaces and surfaces their character and expressive power, and they reveal the shapes, weight, hardness, texture, moistness, smoothness, and temperature of materials. He explains how the interplay of light and shadow also connects architectural spaces with the dynamics of the physical and natural worlds, seasons, and the hours of the day.

I think that these elements are seldom recognized, or anyway thought through carefully enough during the design process, even if they are valuable and needed in the process of creating a professional lighting design metaphor. They also belong to a heuristic "toolbar" after metaphor selection, because of their emphasis options. If they were recognized easily, we would have more beautiful lighting solutions in our city structures.

Pallasmaa also refers to Paul Valery's question "What is there more mysterious than clarity? What more capricious than the way in which light and shade are distributed over hours and over men?". *(Pallasmaa 2011)* Pallasmaa also explains how natural light brings life to architecture and connects the material world with cosmic dimensions. Light is the cosmic breathing of space and the universe. Pallasmaa shares his thoughts with Le Corbusier, Frank Lloyd Wright and Louis Kahn, whose thoughts on light and space are integrated into this dissertation in the introduction to "Masters of architecture and architectural lighting", with the exception that Pallasmaa, as a philosopher, goes a little "deeper" when talking about "Cosmic dimensions".

Pallasmaa continued his lecture by explaining how light has its own atmospheres, ambiances, and expressions; it is surely the most subtle and emotive of means of architectural expression. No other medium of architecture - spatial configuration, form, geometry, proportion, color or detail - can express equally deep and subtle extremes of emotion, ranging from melancholy to joy, grief to ecstasy, sorrow to bliss.

I think that there is a paradox: We all “accept”, agree and admire his, Le Corbusier’s, Louis Kahn’s and Frank Lloyd Wright’s great words and thoughts, but why then is lighting design education still lacking and why are projects implemented by self-taught people? The question arises; don’t we believe these masters’ message or don’t we believe in education?

Pallasmaa also lectured about daylighting by saying that the occasional and happy mixing of the cool light of the northern half of the sky and the warm light of the southern sky in a single space can give rise to an experience of ecstatic happiness. As a young architect, I understood light merely as a quantitative phenomenon, but I have learned to understand that, in fact, it expresses the most subtle, metaphysical, and emotive qualities. Nowadays, I try to bring natural light into the darkest areas of my buildings, where it is experienced as a special gift and sign of the architect’s generosity.

I think that daylight is close to every architect’s heart and his lecture would have been incomplete without it, especially when the lecture is given in New York City and Pallasmaa comes from Finland, the country of “mystic daylight”.

Pallasmaa continues by talking about light and shadow and how as a pair they articulate space into sub-spaces and places, and their interplay gives space its rhythm, sense of scale, and intimacy. He also refers to Brancusi; “Art must give suddenly. All at once, the shock of life, the sensation of breathing” *(Pallasmaa 2011)* in architecture this sensation of breathing is mediated by light. Light directs movement and attention creating hierarchies and points of importance and foci. The paintings of Rembrandt and Caravaggio demonstrate the power of light for defining hierarchy and a point of dominance.

I think that this strengthens my faith in lighting education. I have also studied the art of Rembrandt and Caravaggio during my over 10-year attendance at CIE division 3, Technical Committee 3.22; “*Museum Lighting and Protection Against Radiation Damage*”.

Figure 105. Rembrandt: “Meditation”.

Figure 106. Caravaggio: "O chamado”.

Pallasmaa pointed out that in these paintings, human figures and objects are wrapped in a soothing embrace of soft light and merciful shadow. In the paintings of Georges de la Tour (1593–1652) and Louis Le Nain (c. 1603–1648) the light of a single candle suffices to create an intimate enclosing space and a forceful sense of focus. Due to its flickering character, candlelight is especially tactile; it seems to finger objects and surfaces like a gentle massage. Candle light creates an entire universe of intimacy. No wonder Gaston Bachelard wrote an entire book “On the light of the candle” *(Pallasmaa 2011).*

Figure 107. Georges de la Tour “Payment of Taxes”.

Figure 108. Louis le Nain “La tour”.

At the end of his lecture, Professor Pallasmaa evaluated Johannes Vermeer's painting. "Ten days ago I experienced one of the most beautiful works of art I have ever seen. This was Johannes Vermeer's "*Woman Holding a Balance"* (c. 1664) in the Alte Pinakothek in Munich. I had seen the painting perhaps twenty years earlier at the Natural Gallery of Art in Washington, D.C., but it did not hit my soul quite as forcefully and nobly as it did now. The light enters behind the curtain from the upper corner, embraces the room very gently, lights the white parts of the woman's dress into a sacred glow, and picks up the objects and pearls on the table like one would pick berries on a meadow. This is not only light for the eyes; this soothing light penetrates directly into one's heart. ". *(Pallasmaa 2011).*

Figure 109. Johannes Vermeer "Woman Holding a Balance".

3.6.4.3. Shades of Light

"During the academic year 2012–2013 I was employed in Troy, New York by Rensselaer Polytechnic Institute's Lighting Research Center as a Visiting Adjunct Professor. I met my predecessor Howard Brandston at his home in New York, where I introduced my teaching material to him. I recognized his profound and philosophical style immediately. I enjoyed philosophical discussions with him. In 1966, Howard Brandston founded the New York-based lighting design consultancy now known as the Brandston Partnership Inc. (BPI). During the next 44 years, he and his staff were responsible for more than 3,500 projects around the world. The firm currently employs a total of 30 people with offices in New York, Shanghai, and Beijing". *(Brandston 2008).*

According to Howard Brandston's personal philosophical touch and style, his book "LEARNING TO SEE: A Matter of Light", includes a lot of metaphorical and heuristic material from a lighting designer's point of view. The same elements and arguments are clearly identifiable as in Juhani Pallasmaa's lecture, only the approaching perspective is a little different. While Pallasmaa's lecture has a strong and profoundly personal approach from an architectural point of view, Brandston has more didactic style and includes a wider angle of approach. Of course it is difficult to compare a lecture and a book, but both strongly support the heuristics and metaphors of my dissertation.

Brandston writes how light is time's swiftest traveler and how light allows us to see not only through our senses, but also through our soul. It is a word that evokes a wide range of feelings within different people. To a philosopher, light is a metaphor for knowledge; to the scientist, it is a fundamental component of his or her work; and to the scenic artist, it is a tool with which to manipulate emotions. It has been defined by Maxwell and painted by Caravaggio. To the rest of us, who are sighted, it is the primary medium through which acquire information. Light is energy – it is matter by which all life is measured.

Brandston writes how light is a link through all humanity, encompassing the entire spectrum of needs and emotions and how it defines cultures and reveals architecture. He also recounts how light creates shadows and is born of shadow. This philosophical sentence is some kind of mix of two shadow philosophies; “Shadow is the best friend of light” (Julle Oksanen) and ”The material is made to cast a shadow, and the shadow belongs to the light” (Louis Kahn). He also explains how light has the power to uplift, soothe, enhance visibility and discrimination, and generate a sense of comfort or even discomfort at times. Light can be harnessed to inspire, befriend, create a sense of community.

Interestingly his metaphorical comment; “Light, like music, fills, reveals and creates space” support my music and lighting composition metaphor in the Mariehamn West Harbor project.

The Statue of Liberty and poetical light

Some matured thinking of light unveils Brandston’s years of professorships in the Lighting Research Center. There is also a clear scientific way to look at light as in his sentence: “Light is a pure form of energy that is neutral to all matter it touches no matter what the context. It is an essential natural energy that is produced in many ways” *(Brandston 2008).* He uses these scientific doctrines and applies them to poetry by explaining: “Lighting is the application of light to composition space. It is a malleable medium that manipulates the senses to reinforce the context and mood of spaces. Lighting is an art unto itself, supported and enhanced by science.” *(Brandston 2008).*

A great example of Howard Brandston’s skills in applying his poetical theories and - touching on a pragmatic lighting design project, is one of his greatest and most challenging projects, the lighting design of the Statue of Liberty in New York City.

“The Lighting of the Lady”

The clear and exemplary poetic use of heuristics in solving the metaphor of “The Lighting of the Lady”:

“I pondered the challenge of how to illuminate this icon, so I took a boat out into the harbor and observed her from various distances and at every angle. I observed her at dawn, noon, dusk and in the darkness of night. At some point of the process, I walked to the end of the Battery Park Promenade, sat on a stone wall, and it came to me: She looked best in the light of dawn. I took out my little notepad and wrote: “Needed: one light source with spectral power distribution to mimic the morning sun, one to mimic the morning sky and a new light fixture to project light from a great distance – this makes a lady with green skin look good.” *(Brandston 2008).*

Figure 110. Statue of Liberty. The Lady has a soft and “whispering light” on her, beautifully integrated into the context. Photo: Howard M. Brandston

Figure 111. Statue of Liberty. The photo reveals the success of Howard Brandston’s idea to emulate the morning sun when the green skin looks good. The new light source was produced by GE for this specific and iconic project. Photo: Howard M. Brandston.

3.6.5. Modified use of “Contrast Ladders”

This subsection is based on R.G. Hopkinson’s work on Scales of Apparent Brightness, the Law of Pragmatic Truth and whispering lights and answers Research Question 2) “*Can we find executable design tools to change the direction of the last 100 years of technical lighting design practice into more artistically orientated architectural lighting design processes?”.* The answer to this question can be found in the use of “*The Law of Pragmatic Truth*”. It has been used as a modification tool to define pragmatic and collectively accepted “tolerances” between scientific research results on the use of “Contrast Ladders”, based on R.G. Hopkinson’s work on the Scale of Apparent Brightness and practical values in architectural outdoor lighting projects. Wise use of this tool also saves huge amounts of energy in public lighting. Modified use of “Contrast Ladders” can be applied to serve practical lighting design, especially when we are concerned with low lighting levels where this modification process works perfectly without any kind of saturation of sight.

This subsection also gives an answer to Research Question 3) *Can we use those tens of thousands of pages of technical lighting research results for this transition process to achieve aesthetic lighting solutions?* If the abstruse Hopkinson’s work on Scales of Apparent Brightness can be modified to serve aesthetic architectural outdoor lighting projects by using “The Law of Pragmatic Truth”, then why would this law not work for hundreds of more basic technical research results? It is also very important to remember that we cannot quantify values for human sensations (smell, noise, vision). Technical research results are mostly based on numerical values.

This subsection also gives an answer to Research Question 4) *What are the benefits of using the first-generation pragmatism of C.S. Peirce and William James in order to utilize pragmatic light technical research results to serve architectural lighting design?* The benefit is that technical lighting research results can be applied to serve real- life projects.

3.6.5.1. R.G. Hopkinson’s observation

As a young engineer R.G. Hopkinson was assigned his first task, a street lighting project. When measuring road sign luminance values, he wondered why the meter did not show what he saw. Night-time measured luminance was 34 cd/m^2, although the sign seemed as bright as during day-time, when the "brightness" of the sky was more than 100 times greater. (The luminance of the street sign during bright daytime is easily 3500 cd/m^2).

Figure 112. The traffic sign on the right is 100 times brighter than the one on the left. Photo: Julle Oksanen

This observation was led Western style shadow treatment in the right direction. R.G.Hopkinson created valuable Scales of Apparent Brightness based on this observation. J.M. Waldram used his

“Designed Appearance” technique in his lighting of many English cathedrals; this was a practical implementation of Hopkinson’s Apparent Brightness work. Unfortunately engineers working on large scale did not know how to proceed after R.G.Hopkinson had finalized his research and the results were ready for use. This dissertation rehabilitates Hopkinson’s research results to the honorable level where they belong.

3.6.5.2. Hopkinson’s Scale of Apparent Brightness and Contrast Ladders

“Lighting is a technology in which the relation between physical energy and the visual sensory reaction is of prime importance. Photometry would be impossible without the basic Relative Luminous Efficiency function for the standard observer. This basic stimulus-sensation relation enables us to build a scale of photometric units in terms of the energy of stimulus”. *(Hopkinson 1957)*

“A very precise scale is hardly feasible because:

Our visual mechanism at any one moment can register only a limited range of energy stimulus. A small amount of energy reaching the eye may cause no sensation of light (It is below the threshold of sensation).

Too much energy saturates the vision mechanism.

The increment of energy, which causes a given apparent change in brightness, varies systematically in a non-linear manner (Equal changes in luminance do not produce equal changes in subjective brightness).

There is uncertainty and hysteresis in stimulus-sensation relation.

Human beings cannot assign an exact numerical value for visual sensations.

There are different methods for deriving an Apparent Brightness Scale:

Contrast Scaling

Luminosity Photometer

Method of Direct Estimation”

(Hopkinson 1957b)

In the conclusion of that scientific article Hopkinson states that it is not a purpose of his paper to detail the uses of an apparent brightness scale. That must await another occasion. His paper is clearly the beginning, not the end, of the story. It shows, I think, that a useful engineering scale of apparent brightness can be derived by various methods, including direct estimation. The effects of adaptation can be allowed for.

Hopkinson writes that much more work is necessary before a final scale can be proposed, but in my personal experience of using his Scale of Apparent Brightness in my own projects, the existing basic research is enough. I have two reasons for this opinion. 1) Ambient lighting levels are always low in lighting design projects where contrast ladders work more exactly than in high ambient lighting levels and 2) According to S.S. Stevens’ research human beings cannot assign an exact numerical figure for observed lighting levels. *(Hopkinson 1957c).*

Hopkinson nevertheless hoped that CIE could turn its attention to solving the problem. Unfortunately lighting research activities in CIE have have spread on a large scale to address all new challenges in the lighting world and Hopkinson's Scale of Apparent Brightness has been left behind as a valuable tool for possible future use.

This dissertation studies and explains the use of modified contrast ladders based on Hopkinson's Scales of Apparent Brightness in practical applications with the help of "The Pragmatic Theory of Truth". R.G.Hopkinson was a scientist and used scientific procedures. His study of the "*Scale of Apparent Brightness*" is based on scientific observations and scientific nomenclature (such as "Luminance stimulus" and "Apparent brightness on an arbitrary scale"). See Figure 113.

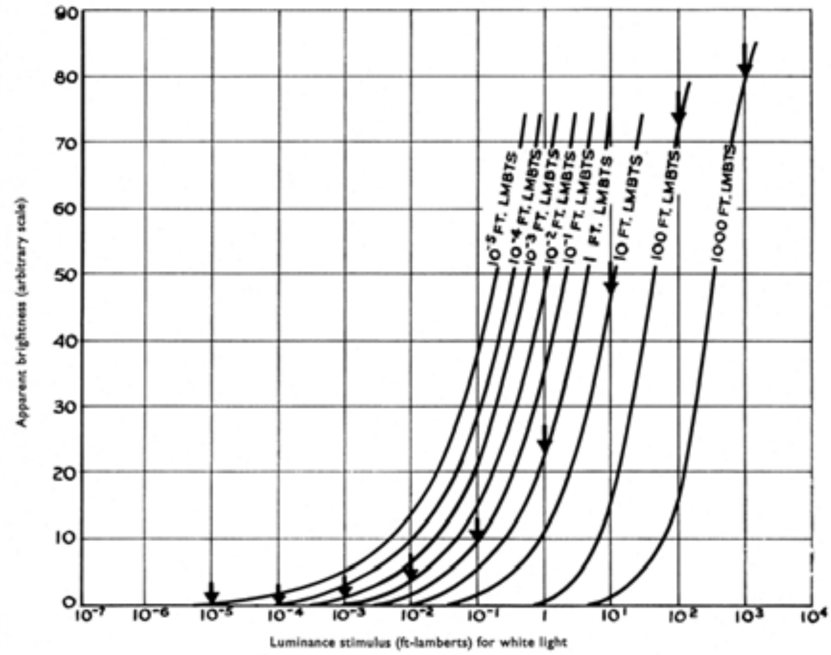


Fig. VII.3. Scale of Apparent Brightness determined from Contrast Scaling Technique (Hopkinson, 1939, Hopkinson, Waldram and Stevens, 1941). Each curve relates the physical brightness stimulus (luminance) with the corresponding subjective brightness magnitude for a given adaptation level.

Figure 113. Scale of Apparent Brightness. The diagram is scientific and too complicated to be used for practical lighting design projects, for example for façade lighting. Photo: (Hopkinson 1939)

In order to be able to use these scientific results in real life practical projects, we have to find the key. That key is "*The Law of Pragmatic Truth*", an instrument between scientific theory and practice.

3.6.5.3. Pragmatism as an instrument

One problem is "shadowing" and even preventing the use of Hopkinson's Scale of Apparent Brightness diagram in practical architectural lighting design. Research tests were implemented in "Black and white" *(Hopkinson 1957c)* and in real life we have colors (like building facades, trees, monuments, etc.). Another problem was the difficult and scientific nomenclature, which was complicated for practical lighting designers (e.g. engineers, architects etc.) to use and understand. There is a scientific "tool" to put to use this valuable diagram with all its scientific nomenclatures and practical uncertainties when defining perceived brightness values of brightness and linearly measured luminance values in architectural outdoor lighting design. That tool is "*The Law of Pragmatic Truth*".

Pragmatism is a philosophical tradition that began in the United States around 1870. Pragmatism is a rejection of the idea that the function of thought is to describe, represent, or mirror reality. Instead, pragmatists develop their philosophy around the idea that the function of thought is that of an instrument or tool for prediction, action, and problem solving. Pragmatists contend that most philosophical topics-such as the nature of knowledge, language, concepts, meaning, belief, and science are all best viewed in terms of their practical uses and successes rather than in terms of representative accuracy.

A prime example of real life and “The Law of Pragmatic Truth” is Isaac Newton and his laws of physics. *”Philosophiae Naturalis Principia Mathematica”* of 1687. We design buildings today according to these laws, although we now know that they are not theoretically perfect, they are however, precise enough for practical calculations and work in real life.

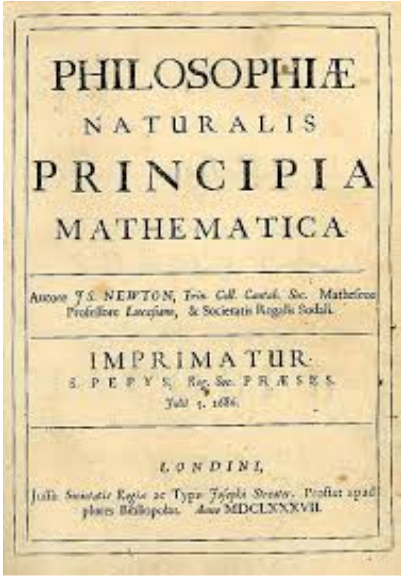

PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA
IMPRIMATUR
S. PEPYS, Reg. Soc. PRÆSES.
LONDINI,
Anno MDCLXXXVII.

Figure 114. Photo: http://www.library.usyd.edu.au/libraries/rare/modernity/newton3.html

“*The Law of Pragmatic Truth*” can be used as a tool to define pragmatic and collectively accepted “tolerances” between scientific research results and practical values in architectural outdoor lighting projects. Wise use of this tool also saves huge amounts of energy in public lighting. Hopkinson’s Scales of Apparent Brightness can be modified and transferred to serve the purpose of practical lighting design, especially in the case of low lighting levels where contrast ladders work perfectly without saturation of sight.

3.6.5.4. Hopkinson’s Scales of Apparent Brightness and practicality

First we have to “change” or replace scientific terminology with practical terminology using The Law of Pragmatic Truth as an instrument:

> When we “multiply” Hopkinson’s scientific “apparent brightness (arbitrary scale)” by “The Law of Pragmatic Truth” factor we get “relative brightness”, which practically means “visible units”. The change in each vertical unit (1-2-3-4-5-6-7-….90) means a barely perceptible change.
>
> When we “multiply” Hopkinson’s scientific “luminance stimulus” (tested with a square field patch subtending 3 degrees side at the subject’s eyes) by “*The Law of Pragmatic Truth*” factor we get the “luminance of the object”. (Façade, tree, monument etc.)

For practical reasons we have to change the old-fashioned Footlamberts to cd/m^2. 1FL = 3,43 cd/m^2

A green, 25 cd/m^2 line is also marked and classified as a limiting average maximum façade luminance value (luminance of object) in the environment classification E4 (cities and towns, with strong environment lighting).

Defining adaptation level = ambient luminance in a real-life architectural lighting design project can in some cases cause problems, especially if the ambient light in the observer's view is not solid. For example, in a dark forest ambient light is practically solid and easy to measure with a luminance meter, but in urban areas, for example, there are different areas of brightness. In cases where the ambient light is not solid and easy to define and measure, the designer can take many measurements and use an average value of these. In extremely busy city centers the average ambient brightness may rise so high that it is no longer practical to use this method at all.

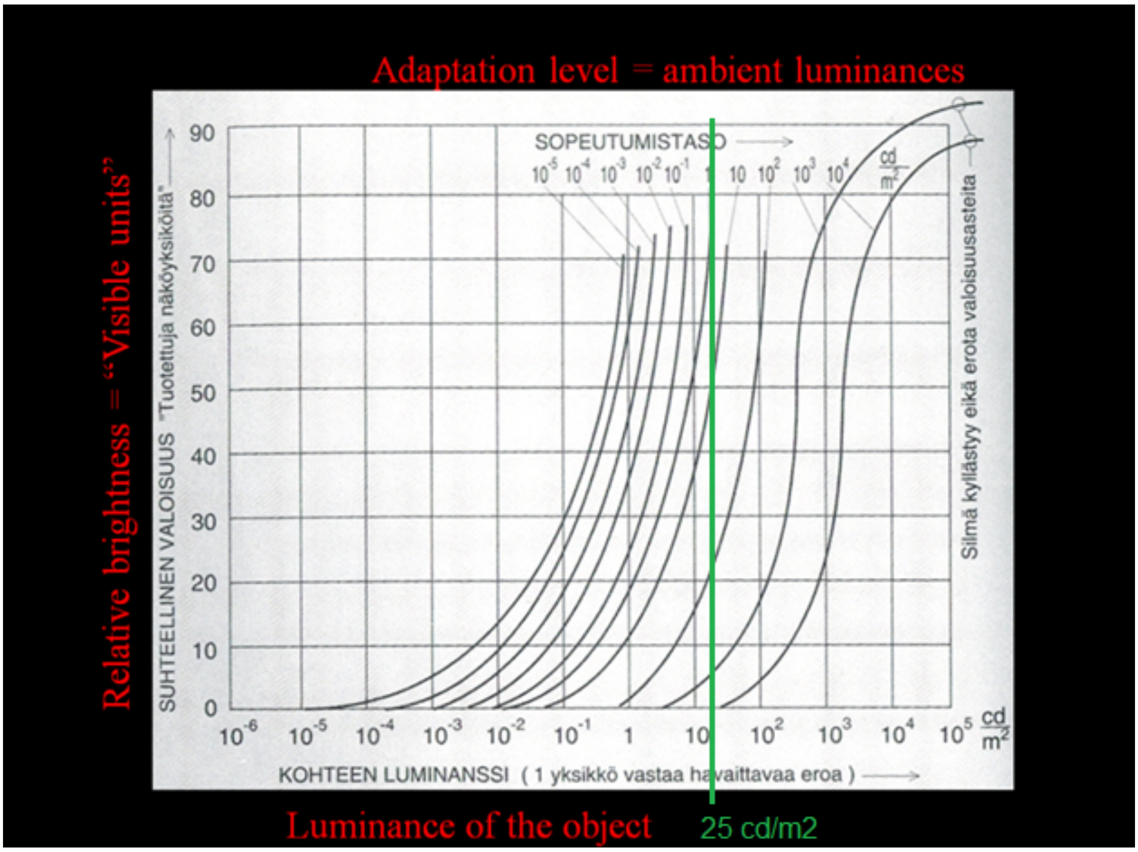


Figure 115. Scale of Apparent Brightness in cd/m^2. Scientific terms are replaced with practical terms. Photo: Julle Oksanen & Antti Purhonen

Table. CLASSIFICATION OF DISTURBING LIGHT / CIE 150:2003

Class	E1	E2	E3	E4
Environment	Nature like	Countryside	Suburb area	Town city
Lighting environment	dark	Little envir. lighting	Average environmental lighting	Strong environment lighting

Project environments are divided for 4 classes according to activity and ambient lighting conditions.

Table. LIMIT VALUES FOR THE DISTURBING LIGHT / CIE 150:2003

Environment class	Illumination of the sky	Light to the windows		Light intensity of a light source		Luminance of the building	
	ULR %	E_v lx		I kcd		L_{av} cd/m²	L_{max} cd/m²
		ilta	yö	ilta	yö	ilta - aika	
E1	0	2	1	2,5	0	0	0
E2	5	5	1	7,5	0,5	5	10
E3	15	10	2	10	1	10	60
E4	25	25	5	25	2,5	25	150

Limit values above should be respected when the disturbing light exterior of the target is measured.

ULR % = maximum light portion turned above of the horizontal level while lamps are in usage positions.
E_v lx = vertical light intensity turned to the windows of a building; is calculated while designed or measured afterwards if necessary.
I/kcd = light intensity, that turns to a target that is "disturbed", is the value received from the lighting plans and calculations.
L_{av}/ cd/m² = the luminance (ie. luminocity of the surface) from the lighting installation that is turned towards the walls of surrounded buildings.

3.6.5.5. A subjective and practical example and a closer study of modified Hopkinson's Scales of Apparent Brightness: The forest – flashlight – white paper test:

The forest-flashlight-white paper test serves to clarify the use of modified contrast values and also opens the "gate" to Hopkinson's scientific world. The test is very simple and educational. Two people go to the forest. One has a flashlight and the other has a sheet of white A4 size paper.

"Assume a white sheet of paper lit by a flashlight against the background of the forest at night and during the day.

Night

Assume reflectance (ρ) of background forest = 0.2; that of the paper to be 1.0 (although a better estimate would be 0.8).

Assume illuminance due to the moon = 2lx

Assume flashlight of intensity = 50cd at a distance of 3m from the paper.

E = I/d2 and therefore the vertical illuminance, Ev on paper due to flashlight = 50/9 ~ 5.6lx

From L = ρE/π, luminance of paper, L_p = 1 x 5.6/π = 1.8cd/m² and luminance of background, L_b = 0.2 x 2/π = 0.1cd/m²

Day

Assume illuminance due to daylight = 10 000lx (strictly speaking on the horizontal

plane but a reasonable estimate for the vertical plane).
From $L = \rho E/\pi$, luminance of paper (*without* flashlight), $L_p = 1 \times 10000 / \pi = 3183 cd/m^2$, luminance of paper (*with* flashlight), $L_{pf} = 1 \times 10006 / \pi = 3185 cd/m2$ and luminance of background, $L_b = 0.2 \times 10000/\pi = 637 cd/m^2$

Adaptation luminance
There is continual debate about what value should be taken for the adaptation luminance. Waldram, for example, suggested taking the average luminance in the field-of-view within 10^o of the area of vision. In this example (ignoring the luminance of the paper) a reasonable approximation can be an adaptation luminance of 0.1cd/m^2 at night and 637cd/m^2 during the day.

The object, background, and adaptation luminances can now be plotted on the metric version of Hopkinson's Apparent Brightness scales prepared by the author (approximate **blue** circles).

Thus at night the Apparent Brightness of the paper against the forest background is 33-8, a brightness ratio of about **4:1**.

During the day the Apparent Brightness of the paper with and without flashlight against the forest background is 85/84-72, a brightness ratio of **1.2:1** and **1.2:1** respectively.

This explains why the effect of the flashlight is so marked compared to the situation during the day.**”** *(Mansfield 2016)*

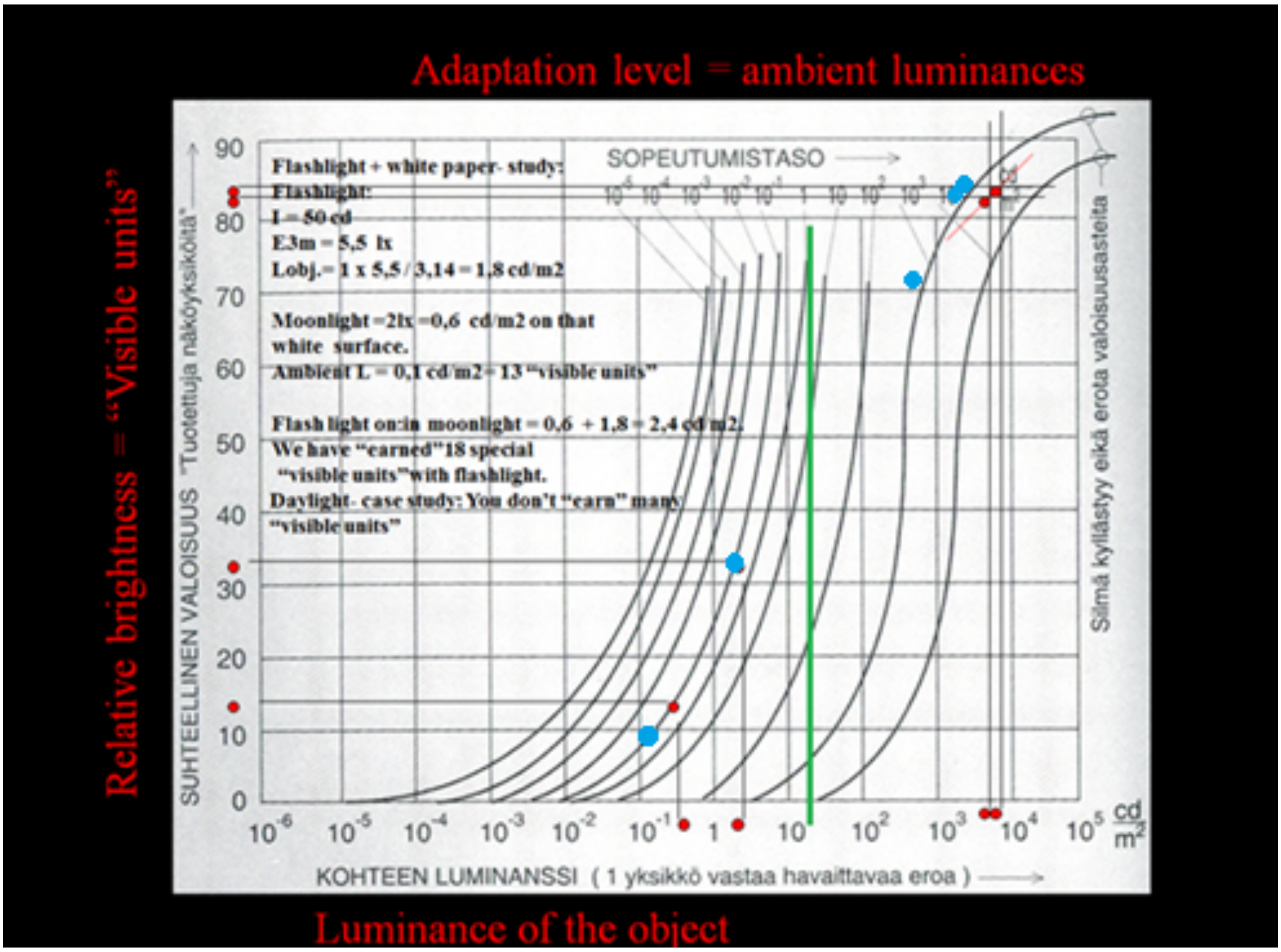


Figure 116. Pragmatic flashlight test with modified contrast ladders according to Hopkinson's Scales of Apparent Brightness. The red dots are a quickly done heuristic calculation by Julle Oksanen on a real-life project and the blue circles are the results of Dr. Kevin Mansfield's scientific calculations. Photo: Julle Oksanen

The pragmatic flashlight test with contrast ladders works perfectly at lower ambient lighting levels and is a great tool to use e.g. with CIE new recommendations concerning the maximum façade surface luminance (green vertical line) in cities and towns.

3.6.5.6. Students' Sibley Hall façade lighting study at Cornell, New York, USA:

I have personally taught and explained the use of contrast ladders in many universities for over 20 years after discovering it myself. Given that human beings are not capable of assigning numerical values to visual sensations like light, demonstrations have always followed the theoretical part of the courses.

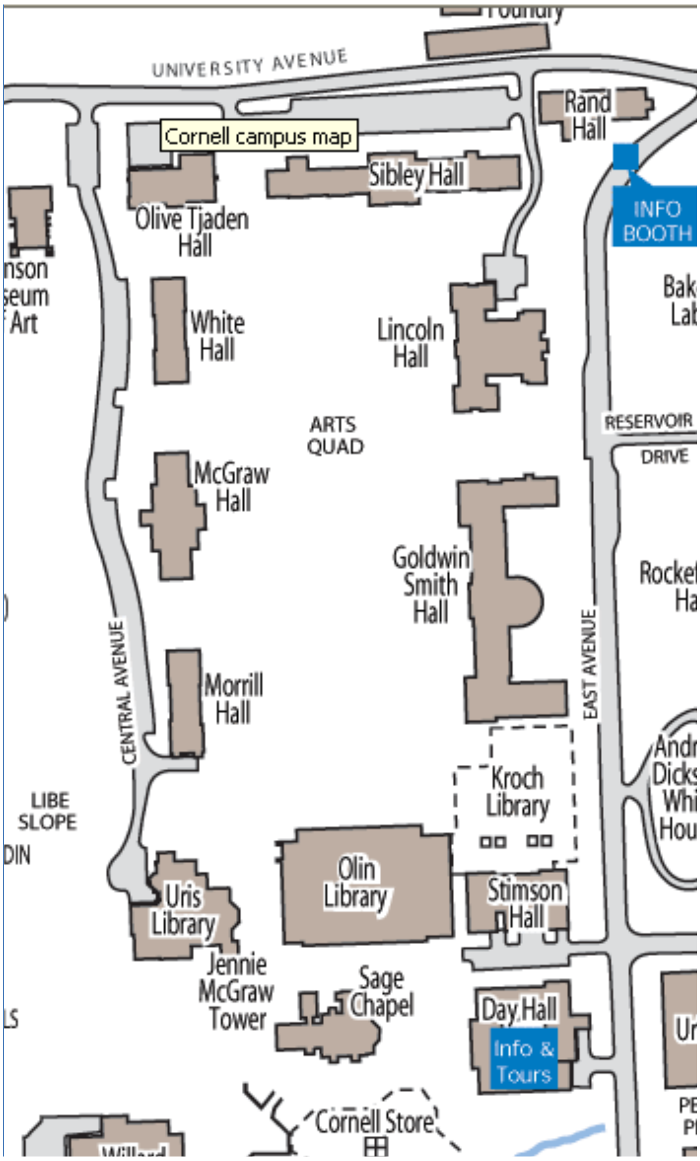


Figure 117. Students' workshop area, Sibley hall at Cornell. Photo: Julle Oksanen

Figure 118. Calculation and measurement object, the walls of Sibley Hall. Photo: Julle Oksanen

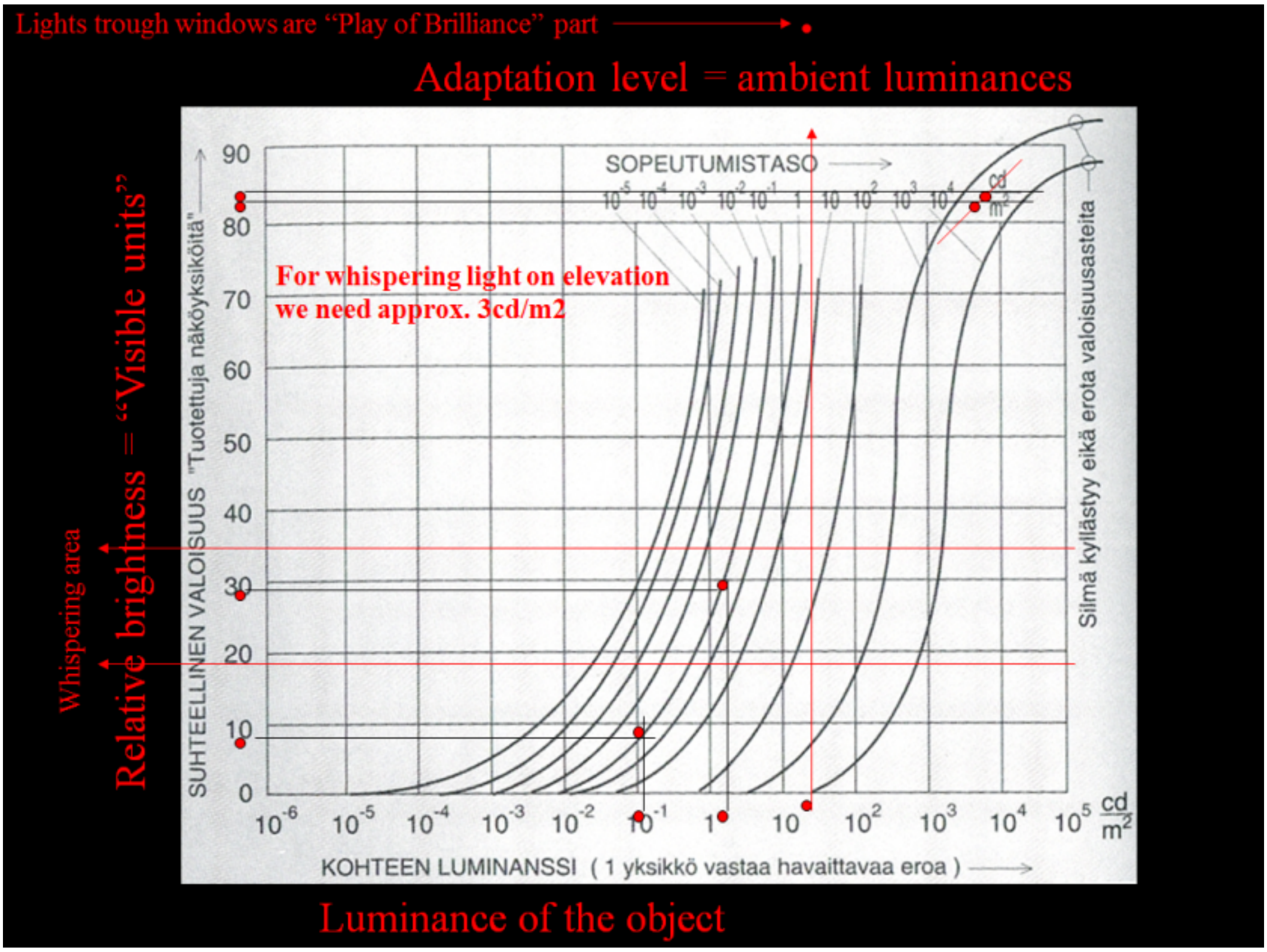


Figure 119: Students' contrast ladders application study. Photo: Students at Cornell

Figure 120. A common practical lighting demonstration. Photo: Nicholas Rajkovich

3.6.5.7. Facade luminance studies on “own projects”:

Figure 121: New lighting for Fiskars Village Mansion. Photo: Vesa Honkonen

In the façade lighting of a mansion at Fiskars old 1500W halogen lamp luminaires were changed to 70W Metal Halide lamp luminaires. The results of the new lighting solution: Ambient luminance (adaptation level) $L_{adapt.}$ = 0.1 cd/m^2, the reflection factor of a light façade is 60%, designed and measured as E_{facade} = 21 lx. Lighting recommendations offer E_{facade} = 35 lx. The energy saving is 40% and the facade could be much darker. Lighting designers Vesa Honkonen & Julle Oksanen had problems finding façade lighting luminaires with 35W metal halide lamps, which could have been a perfect solution for the “Whispering Lights” type of lighting design, which was the goal.

Figure 122. Fiskars Village brick building. Photo: Julle Oksanen

A dark brick building in the same Fiskars area. The ambient luminance is 0.1 cd/m^2. $E_{recommendation}$ = 100-200 lx. E_{facade} = 31 lx. According to the contrast ladders 20 Visible Units could be “earned” already with 24 lx. The energy saving is 69% - 75% and again even too much light on the façade surface. Lighting designers Vesa Honkonen and Julle Oksanen had to install a gray film in front of the light distribution surface of the floodlights used. The same problem as in the mansion façade; no suitable 35W metal halide lamp luminaires could be found.

3.6.5.8. Practical use of Contrast Ladders; Arras Cathedral, France:

In 2000 the architect Vesa Honkonen was invited to participate in a lighting design competition “Exterior lighting design for the medieval town of Arras” in 2000. The lighting design was completed together with the present author. Contrast ladders were used to define the luminance value, e.g. for the main cathedral of Arras (Marked number 12 on Figure 123).

The main lighting design philosophy was on the one hand to give darkness in the central parts of each plaza (marked in gray) and illuminate the peripheral regions (yellow). The philosophy on the other hand was to dim the lighting for a short distance at the approach to the plaza. In this way the observer arrives at the plaza from a tiny, dimmed street and enjoys seeing the illuminated facades of the plaza. This would have been easy to do because of the modest classifications of the tiny streets of Arras.

Figure 123. Arras town structure. The cathedral, numbered 12 on the image, was introduced in the competition entry. Photo: Vesa Honkonen Architects, architect Mari Koskinen.

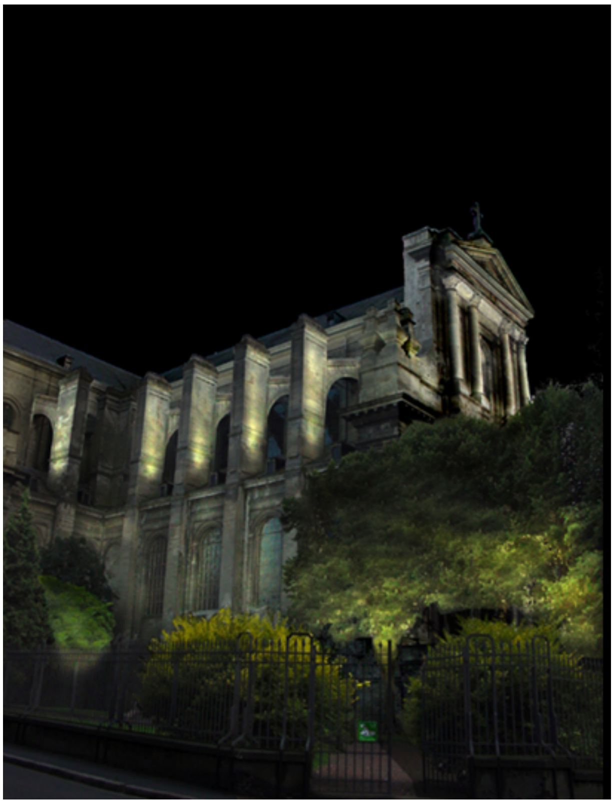


Figure 124. Computer simulation of the cathedral façade lighting according to lighting designers Vesa Honkonen & Julle Oksanen. Photo: Architect Oliver Walter

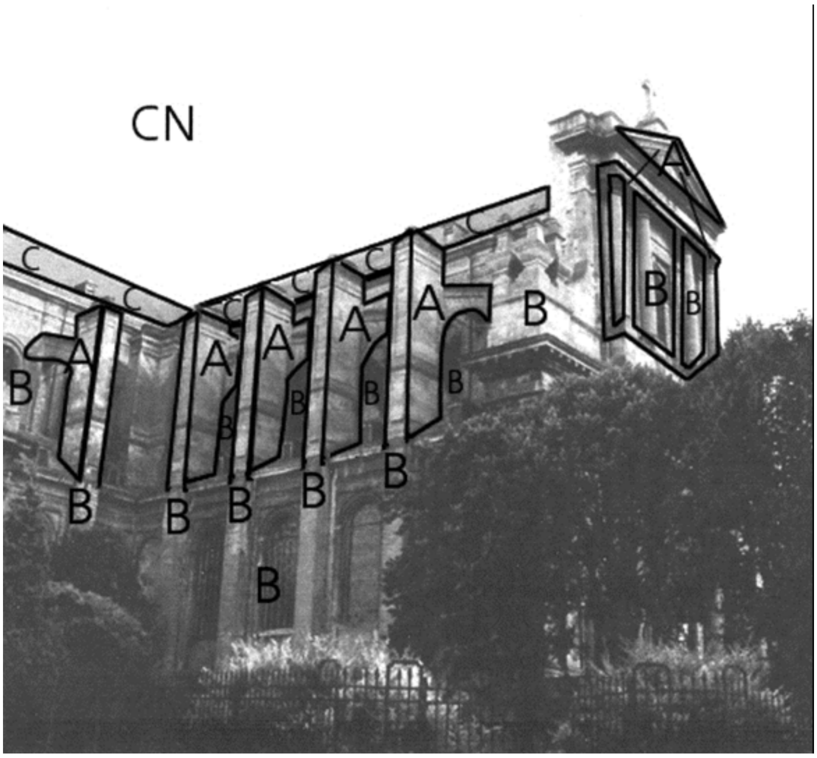


Figure 125. Lighting design elements with different luminance values were marked on a black- and - white photo as A, B, C, and CN. Photo: Oliver Walter

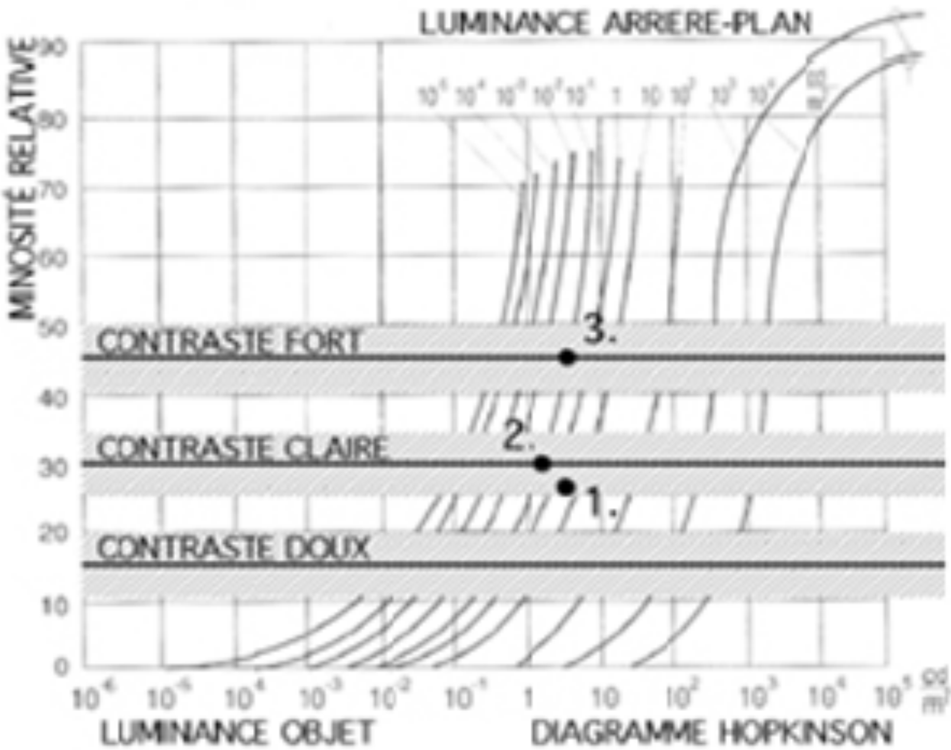
12. CATHEDRALE

	LUMINANCE DE LA SURFACE	FACTEUR DE LA REFLEXION DE LA SURFACE	NIVEAU D'ILLUMINATION	TEMPERATURE DE COULEUR
A	6 cd/m2	0,3	60 lx	3000 K
B	4 cd/m2	0,3	40 lx	3000 K
C	2 cd/m2	0,3	20 lx	3000 K
CN	0,1cd/m2	-	-	-

	OBJET / ARRIERE-PLAN	LUMINOSITÉ RELATIVE
1	A / B	27
2	C / CN	30
3	A / CN	45

LUMINOSITÉ RELATIVE 15=contraste doux 30=contraste claire 45=contraste forte 60=contraste tres fort 75=contraste gênant (± 5 unités)
CN=ciel de nuit

Different luminance values were determined by “the method of estimating” from computer simulation. Illumination values for different elements were defined by the reflection factor of the surface of the cathedral (the reflection value estimated as 30%). Because of the “Whispering Lights” type of luminance values, a warm color temperature was selected.



Contrast ladders were used to determine contrast values, which, of course, also influenced the luminance values of different lighting elements. The highest “Visible Units” values were between the dark sky, marked CN (Ambient luminosity, $L_{ambient}$ = 0.1 cd/m^2) and illuminated pylons, marked A (L_{pylon} = 6 cd/m^2). Between these elements “Earned Visible Units” amounted to 45.

The successful use of this method can be justified e.g. in subsection 3.6.7. “*Darkness in Fiskars area*”. We used contrast ladders as a part of the lighting composition. The “whispering façade lighting” is peaceful and does justice to the night-time architecture. Unfortunately contrast ladders are not in common use because of the lack of lighting education.

To cover the spatial comprehensiveness of the object of darkness research and darkness design in different kinds of outdoor spaces, the following part scrutinizes two extreme cases; New York City and Fiskars Village. New York City is the biggest metropolitan area in the United States of America with a population density 10,725.4 inhabitants/km^2 in 2013. (NYC land area 1,214.4 km^2, water area 414.08 km2 and population of 8,405,837 inhabitants). *(http://fi.wikipedia.org/wiki/New_York*) Fiskars Village has 600 inhabitants and just a few km^2. (*http://www.fiskarsvillage.fi/*). These two areas cover all the outdoor spaces included in the dissertation analysis and represent peripheral examples of urban sprawl, which describes the expansion of human populations away from central urban areas into low-density areas.

An example of urban sprawl: Night time satellite image of Greater Buenos Aires. Urban sprawl has created a huge conurbation where population growth and physical expansion have merged in the form of a continuous urban and industrially developed area.

Figure 126. "NASA ISS006-E-24987" by Image Science & Analysis Laboratory, NASA Johnson Space Center NASA

Another reason for selecting NYC and Fiskars Village is that I have a personal connection to both spaces. I have lived in New York and conducted lighting research for skyscrapers in NYC, but I also accomplished the lighting design for Fiskars Village together with the architect Vesa Honkonen. Both these spaces include semiotic and inexplicable connections between darkness and design. The scientific treatment of darkness, such as using contrast ladders, the pragmatic theory of truth, lighting composition and minimum semi-cylindrical illuminance values, leads to answers to the research questions of this dissertation (the importance of new metaphors, the shift from technical solutions to aesthetic solutions, orientating design processes etc.). It is also very important to have personal experience of these spaces to be able to evaluate darkness in them.

3.6.6. Darkness in New York City

As mentioned in subsection 3.6.2. *"Human beings and darkness*", fascination with night-time and the visual beauty of night-time even in the busiest cities in the world, like New York City, are based on shadows and darkness and their controlled gradations.

Figure 127. Shadow is "the best friend" of light, also in New York City and creates a lively and dynamic atmosphere. The continuous noise of traffic and the hectic lifestyle intensify such feelings. Photo: Paulo Barcellos Jr. http://www.flickr.com/photos/paulobar/230134559/

New York City structure creates peculiar feelings.

Figure 128. Night and day photos from a hotel room window on Time Square. The contrast differentiation set human motions afloat. This cross section at Time Square is brighter at night-time than in daytime. Photos: Julle Oksanen

Figure 129. Huge buildings are out of human scale and create strong contrasts. The bright sky forms dark areas for pedestrians and people at zero level, which is not “a normal case”. Photo: Julle Oksanen

The designer of Kiasma, Helsinki Museum of Contemporary Art, the architect Steven Holl, has stated: “You cannot get the spirit of Kiasma from any photos. You have to go into the building and sense it there with your body and soul”. When I personally walk the streets of New York City whether by day or by night, I have a similarly strong feeling that it simply is not right to do lighting design based solely on technical lighting recommendations. It high time to change lighting design paradigms worldwide. We have to start to think of light as a way to beauty the city architecture by night, not just as a safety matter. That is also the main assumption of this dissertation.

3.6.7. Darkness in Fiskars Village area

Figure 130. The old mill area, Fiskars, Finland. Photo: http://www.lily.fi/blogit/what-else-there/5-x-suomi-design

Fiskars old mill area is a 350-year old environment, founded to manufacture plows, axes, knives and other iron tools mainly for agricultural purposes. It was also the birth-place of Fiskars, a large international enterprise. Onoma, a cooperative of over a hundred artisans, designers, and artists in Fiskars is a unique community. All the members of the cooperative, founded in 1996, live or work in Fiskars Village. All year round the cooperative arranges high-quality exhibitions in the village, presenting crafts, design, and art.

Figure 131. An example of the artisan groups located in Fiskars: an internationally successful designer and cabinetmaker Kari Virtanen and his team NIKARI. Photo: shttp://nikari.fi/image/data/brochures/Nikari_Kari%20Virtanen%20designs.pdf

Fiskars wanted to have Christmas lighting and fireworks for its 350th anniversary celebrations. The lighting designers Vesa Honkonen & Julle Oksanen proposed that instead of a fireworks display costing a million € and lasting three minutes, Fiskars could get better lighting for the whole area with for the same amount of money.

The existing lighting was so poor that the designers announced that they would accept the project on one condition: The old lighting had to be totally removed and the designers would start from scratch. Vesa Honkonen and Julle Oksanen were the “darkness designers” rather than the lighting designers.

On the Fiskars project we were searching for a concept and a heuristic metaphor using minimized technical lighting recommendations and the pragmatic theory of truth as aids. We had a strong intuition that were dealing with something special: A relatively small area and an integral entity, complete darkness as starting point for the design, clients and inhabitants with high expectations, nature, one road through the space, the river as a reflector, old buildings, and the continuous sound of the tiny waterfall. We wanted to make a lighting composition for the architectural section and minimize the disruptive light. We wanted to focus all the road lighting exactly on the road surface, not on the environment. We wanted to illuminate building façades with what we called “Whispering Lights”. We wanted to put emphasis on nature and hide all the light distribution surfaces. We found a new metaphor that led to the conceptual design process: “Shadow, the best friend of light”.

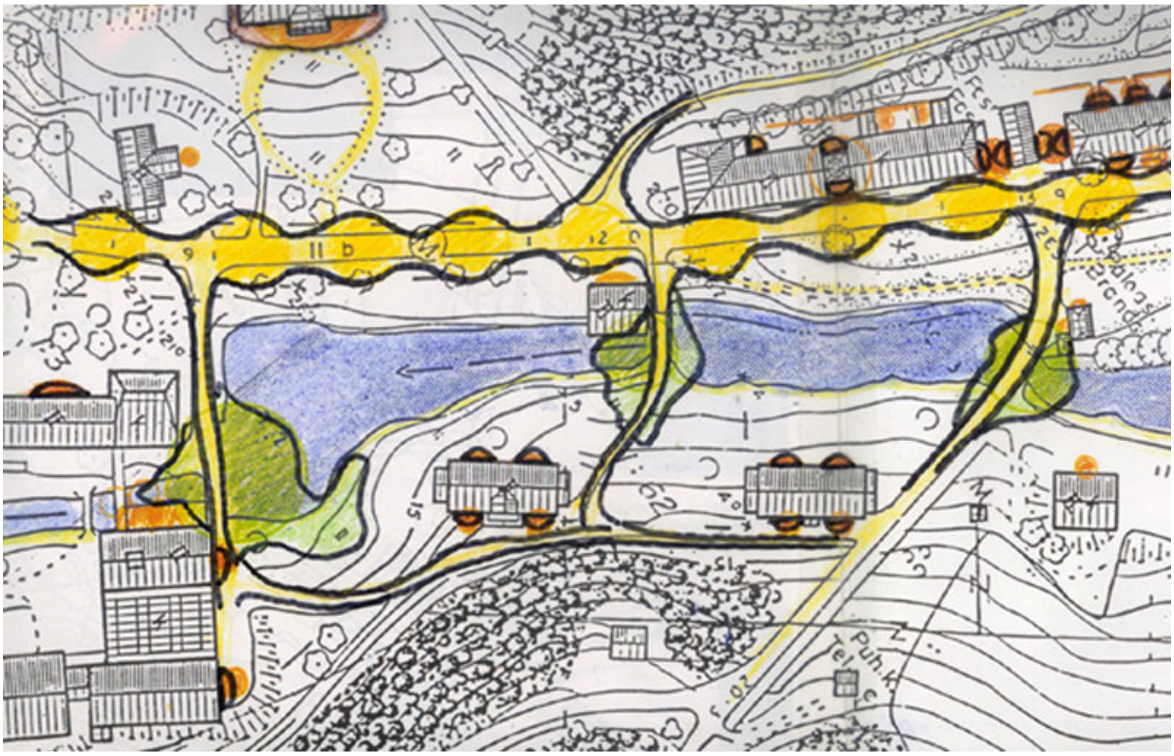


Figure 132. Lighting functions by Vesa Honkonen & Julle Oksanen. Photo: Vesa Honkonen

There were three clear elements which rose to prominence as regards functionalism and the arguments for a lighting design concept. They were:

Movement (the road through the mill area)

Nature (trees and river)

Buildings (old buildings for the directors and also the workers)

Movement:

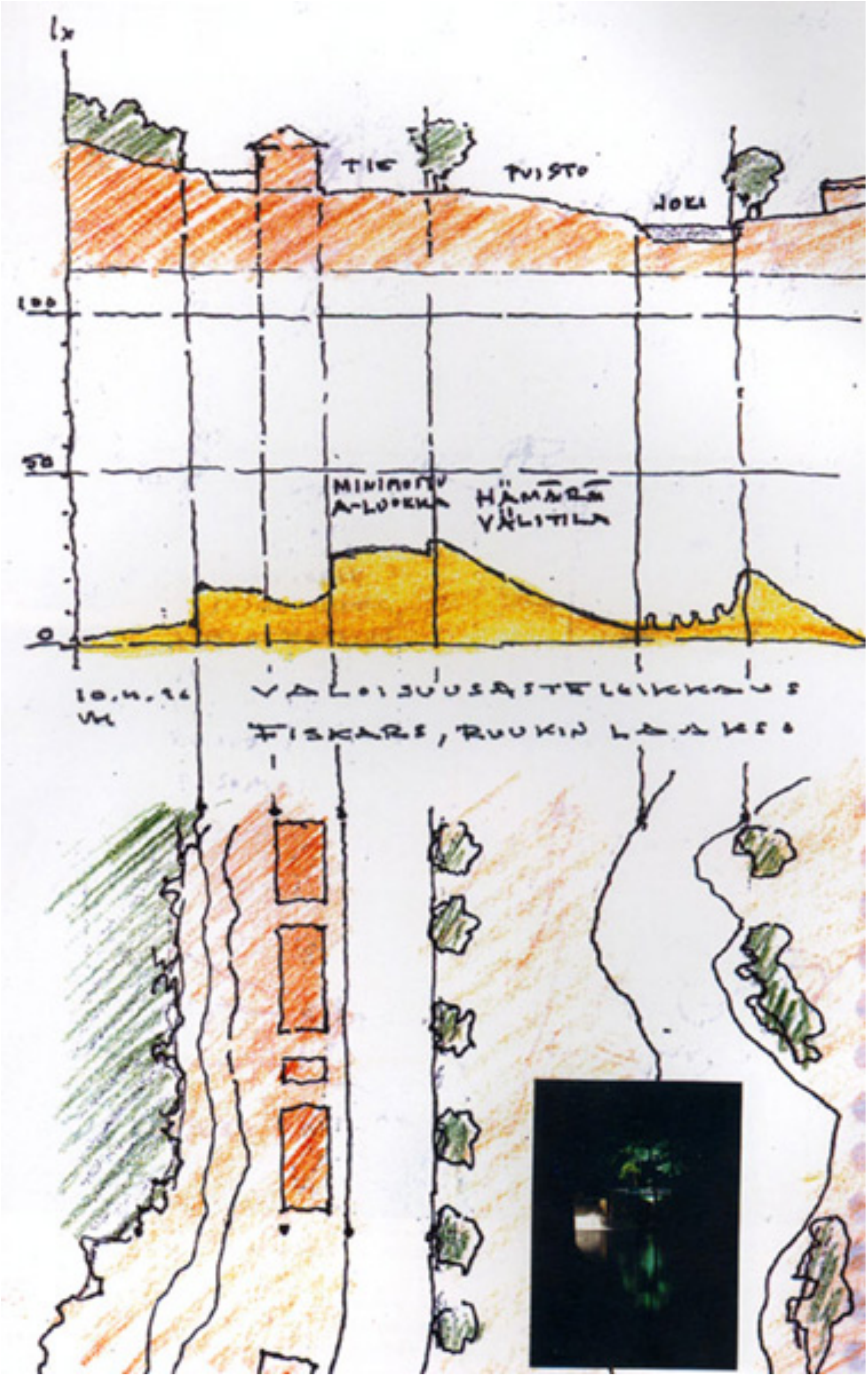


Figure 133. Lighting composition by Vesa Honkonen & Julle Oksanen. Photo: Vesa Honkonen

An architectural section was cut through the area and an illuminance section was created. A composition for light. This is like a musical composition, but instead of notes there are illuminance values.

The existing lighting solution was just 10m high poles with 250W High Pressure Sodium lamp luminaires on 2m long arms. Yellow light was everywhere. The composition for that was just one line through the whole area. This was a very dull composition and comparable to one long note. I was not very excited.

In music the pause is at least as important as the note. During the pause the listener anticipates what is coming next and enjoys the composition after hearing sounds after pauses and at different volumes and strengths. It is the same in an illuminance section. There are different illuminance values which are equivalent to notes and dark places which are equal to pauses.

Contrast, the power of light and life. Equal to; Love & Hate, Life & Death, Rich & Poor, Jing & Jang, Light & Dark…Pairs of a rich life.

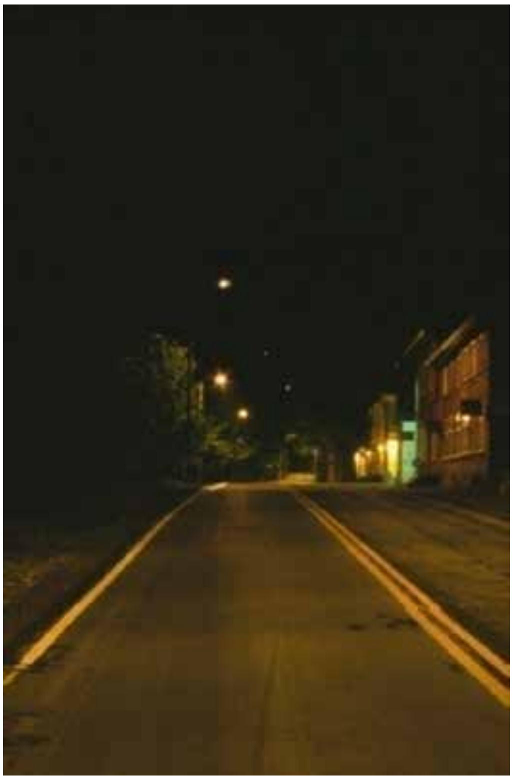


Figure 134. Fiskars old street lighting. Photo: Vesa Honkonen

Old and yellow light pervaded the whole place. This photo from the old case happens to give an impression of quite a nice area, but this is a trick of the camera. In reality the place was really awful with lighting right out of control. In normal street lighting luminaire accounts for only approx. 30% of the lumen package of the used lamp falls on the road surface. The rest of the light, 70% of the lumen package of the lamp, disappears in LOR -> heat, into the bushes, on the wall surfaces of the buildings near the road and all over the surroundings. The uniformity of light was really boring and the lighting levels were high, in the region of L = 1.5 - 2.0 cd/m^2. Of course it was quite safe to drive, but for such an historical area that simply is not enough.

Figure 135. Fiskars new street lighting. Photo: Jussi Tiainen

New lighting: From the illuminance section it can be seen exactly how the light was designed to run on the road surface in the road area. That meant that a custom-made optical system had to be used. This “wet” image shows how sharp light falls down on road surface from custom-made optics. The light does not stream all over to spoil the lighting composition of the whole area. Special POT optics were used and the lamp was pushed deep into the lamp chamber. White light was used (Ceramic Metal Halide Lamps) instead of yellow High Pressure Sodium. Color rendering also increased from 20 up to 80. The color temperature was still a warm and inviting 3000 Kelvins. Uniformity suffered, but that was part of the design. It became possible to reduce the speed limit from 70 km/h down to 40 km/h. The glare value was of course fantastically low. No glare at all. The old G-value was over 8 and under 9.

Nature:

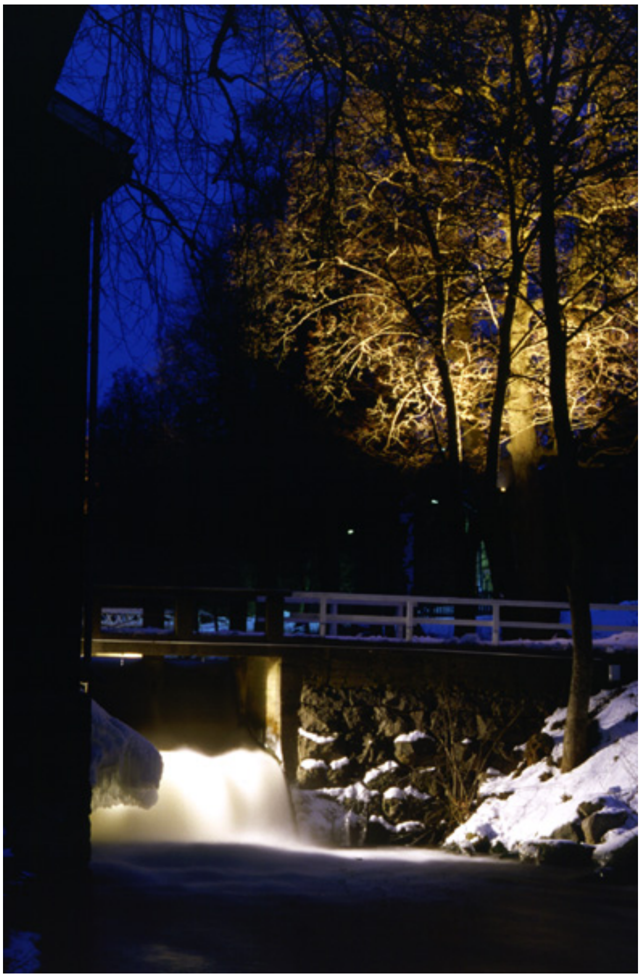


Figure 136. Fiskars river area lighting composition. Photo: Vesa Honkonen

Julle Oksanen: “Shadow is the Best Friend of Light” and “Glare is the Worst Enemy of Light”

Figure 137. Fiskars pond and tree lighting. Photo: Vesa Honkonen

People walk near this pond and especially in autumn it looks fantastic because of the changing colors. Reflections from the water surface of the pond reflect the mystery of life and darkness. The excitement of life and optical illusion is clear. After some warm red wines served in the restaurant on the right side of the image, walking on the bridge on the pond, the goblins and trolls carousing in the darkness can almost be felt, heard, and seen between the illuminated trees…The pond tempts the visitor to a nocturnal dip.

Buildings:

Figure 138. New lighting of main mansion. Photo: Vesa Honkonen

Façade lighting of a mansion at Fiskars. Old 1500W halogen lamp luminaires were changed to 70W Metal Halide lamp luminaires. Results of the new lighting solution: Ambient luminance (adaptation level) $L_{adapt.}$ = 0.1 cd/m^2, the reflection factor of a light façade is 60%, designed and measured E_{facade} = 21 lx. The lighting recommendations offer E_{facade} = 35 lx. Energy saving is 40% and the facade could be much darker. We had problems finding façade lighting luminaires with 35W metal halide lamps. These would have been a perfect solution for “Whispering Lights” lighting design, which was the goal.

Figure 139. Glowing Fiskars brick building. Photo: Julle Oksanen

A dark brick building in the same Fiskars area. The ambient luminance is 0.1 cd/m^2. $E_{recommendation}$ = 100 - 200 lx. E_{facade} = 31 lx. According to contrast ladders 20 visible units could be "earned" already with 24 lx. The energy saving is 69% - 75% and again too much light on the façade surface. We had to install a gray film in front of the light distribution surface of the floodlights. The same problem as with the mansion façade; no 35W metal halide lamp luminaires could be found.

Conclusion of NYC and Fiskars Village:

No matter whether it is the busiest city in the world or the tiniest village, darkness design is more important than lighting design. Fiskars Village was the first project where we/I started to think seriously about darkness design instead of lighting design. Thus the starting point for searching for conceptual lighting design processes and new metaphors in my personal design career started in 1999. For seventeen years I have passionately sought answers to the dissertation research questions.

3.6.8. Lighting composition

General:

A rational and comprehensive tool for creating beautiful architectural outdoor lighting has been lacking. Part of the reason is the transition process from architectural lighting design in the 1930's to the engineering sciences. Because of detailed lighting research in CIE, technical lighting designers started automatically to focus mainly on details like the facade lighting of a certain building, a certain road, path, etc. The skills to beautify the city at night and the holistic perception of space declined. This professional differentiation between technical lighting and architectural lighting has led to a lack of cooperation between different interest groups like town planning offices, construction departments, electricity companies, independent architects and -engineers, etc. A common lighting “language” is hard to find. The real reason for all this is the lack of architectural lighting design education at university level. Until this is remedied architects cannot communicate or ask astute questions of engineers, who have a great deal helpful light technical information to offer. This information should be "translated" to serve the purposes of architectural lighting. A good example of how technical research results in lighting can help to create beautiful architectural lighting is a “lighting composition” for a certain “lighting section”.

Lighting composition following the heuristic metaphor

Lighting composition is a result of finding an interesting and tested heuristic metaphor. In the innovation phase I/we were looking for a “Heuristically analyzed lighting design metaphor element”. Most important “findings” in words: Music and Light – Richard Kelly’s design process – Shadow is the Best Friend of Light – Contrast: Black sea and a soft white light veil – Poetic light.

The lighting composition designed in the lighting section drawing is not an accurate scientific method, but it has proven to be a great tool for architectural lighting design. It is advisable to divide the lighting design into well thought-out parts. Each part has its own architectural lighting section and composition. Each lighting section is an artistic composition of light that corresponds to music. In music the pause is as important as the note. In a lighting section the composition of shadow is as important as light (Shadow is the best friend of light). A lighting section can also take account of light technical values, such as road classifications, trespass lighting values, etc. A lighting section composition can be sung or played to the customer on a musical instrument.

Concept

Before composing lighting sections it is important to create a clear lighting design concept for the project. This activates creativity.

When darkness falls on the Mariehamn area, electric light pervades the whole space forming a “glowing harbor”. The white veil over the harbor forms a strong contrast to the mystical, murky sea, a pair of life. Pommern, the biggest 4-mast bark on earth lies dormant in the glowing white mist. The captain is walking alone in his captain’s cap and uniform, a brown leather briefcase in one hand and a pipe in his mouth. He is walking slowly in the white light glow towards his home leaving behind only the slowly dissipating smoke from his pipe. The harbor falls into a dark sleep. Electric light is composed to serve this nocturnal episode, which is more or less a dream, a personal vivid memory of Orson Welles’ “*The Third Man*”.

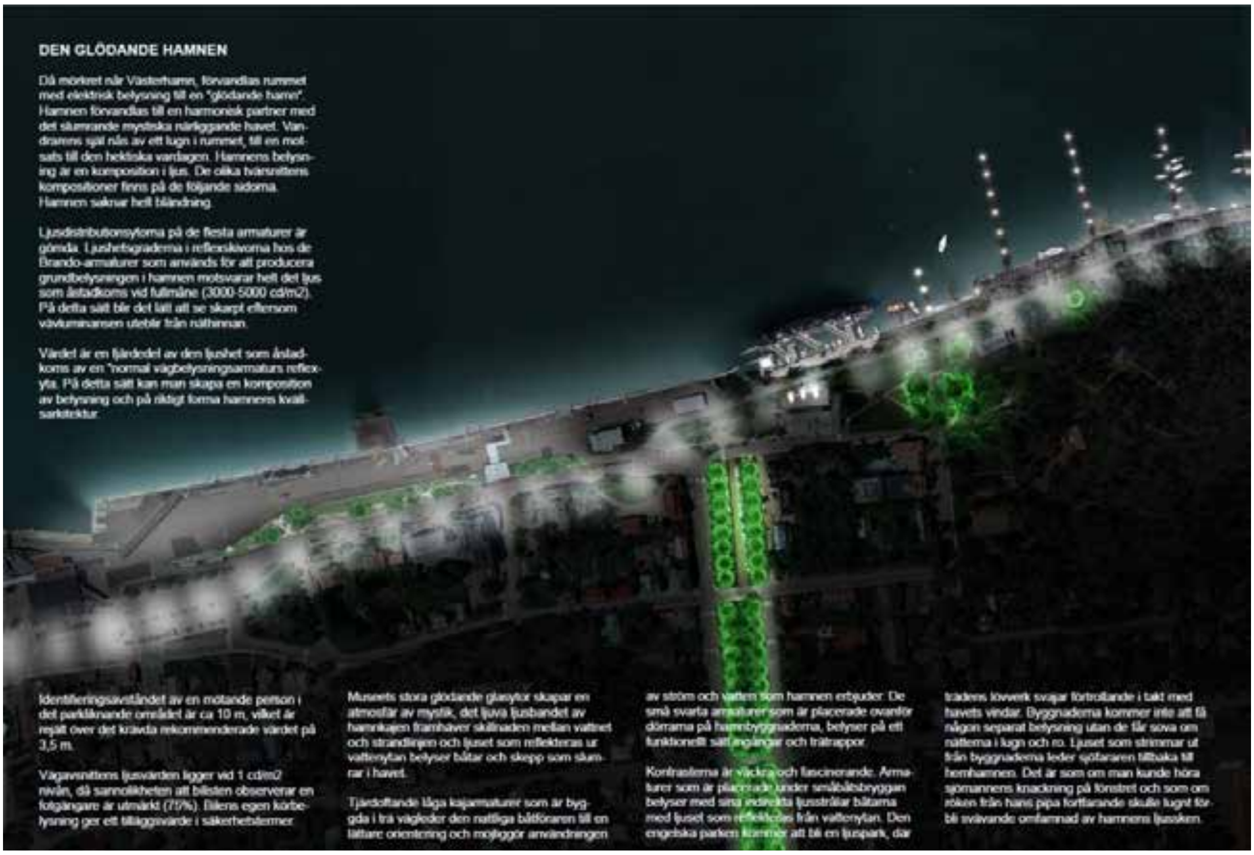


Figure 140. Mariehamn Harbour lighting concept. Photo: from Julle Oksanen's & Oliver Walter's concept report.

Typical technical lighting solution:

Engineer type of lighting design focuses on the light technical values of the area and light only for seeing.

Figure 141. "Typical" road lighting solution. Photo: Shawn Nielsen

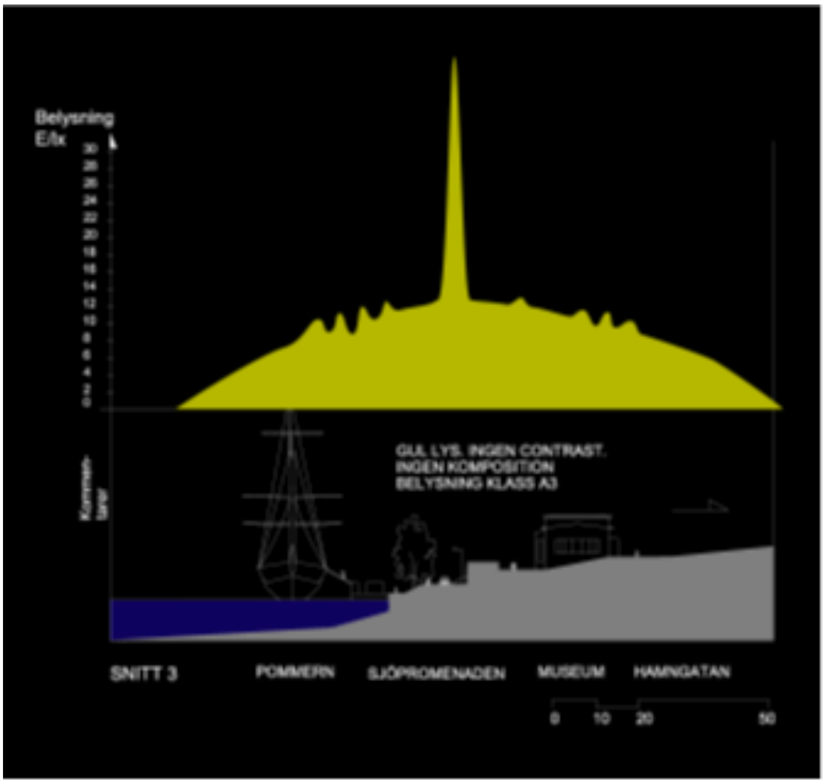


Figure 142. Lighting composition for typical technical road lighting. Photo: Julle Oksanen & Oliver Walter (Mariehamn concept report).

A typical road lighting solution (8m high High Pressure Sodium road lighting luminaires). Quite dull, yellow environment with a glary luminaire light distribution surface form a boring and unpleasant lighting composition. If this lighting composition is compared to music, it would be a boring basic tone with a woman's scream in the middle of the tone.

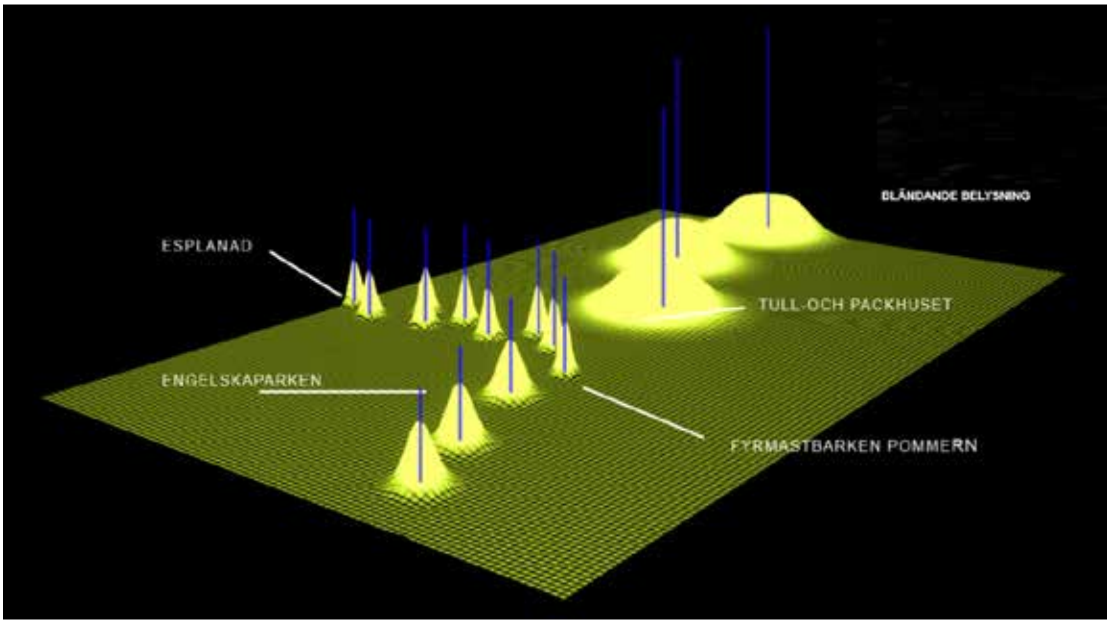


Figure 143. Technical lighting solution for the harbour area. Photo: Julle Oksanen & Oliver Walter (Mariehamn concept report).

The “technical lighting design” solution for the whole harbor area would cast a yellow and dull veil over the whole area. Blue stripes represent the glare of each luminaire. They cause a light veil (veil luminance) on the retina and contrasts cannot be clearly seen.

Architectural lighting design composition in Mariehamn harbor

The philosophy was to follow the concept and form a modest white veil over the harbor area, the basic tone of light that supports the strategy of nocturnal episode (the captain’s pipe and the smoke etc.). On this basic white whispering tone, it is marvelous to build up a lighting composition that includes lights and shadows.

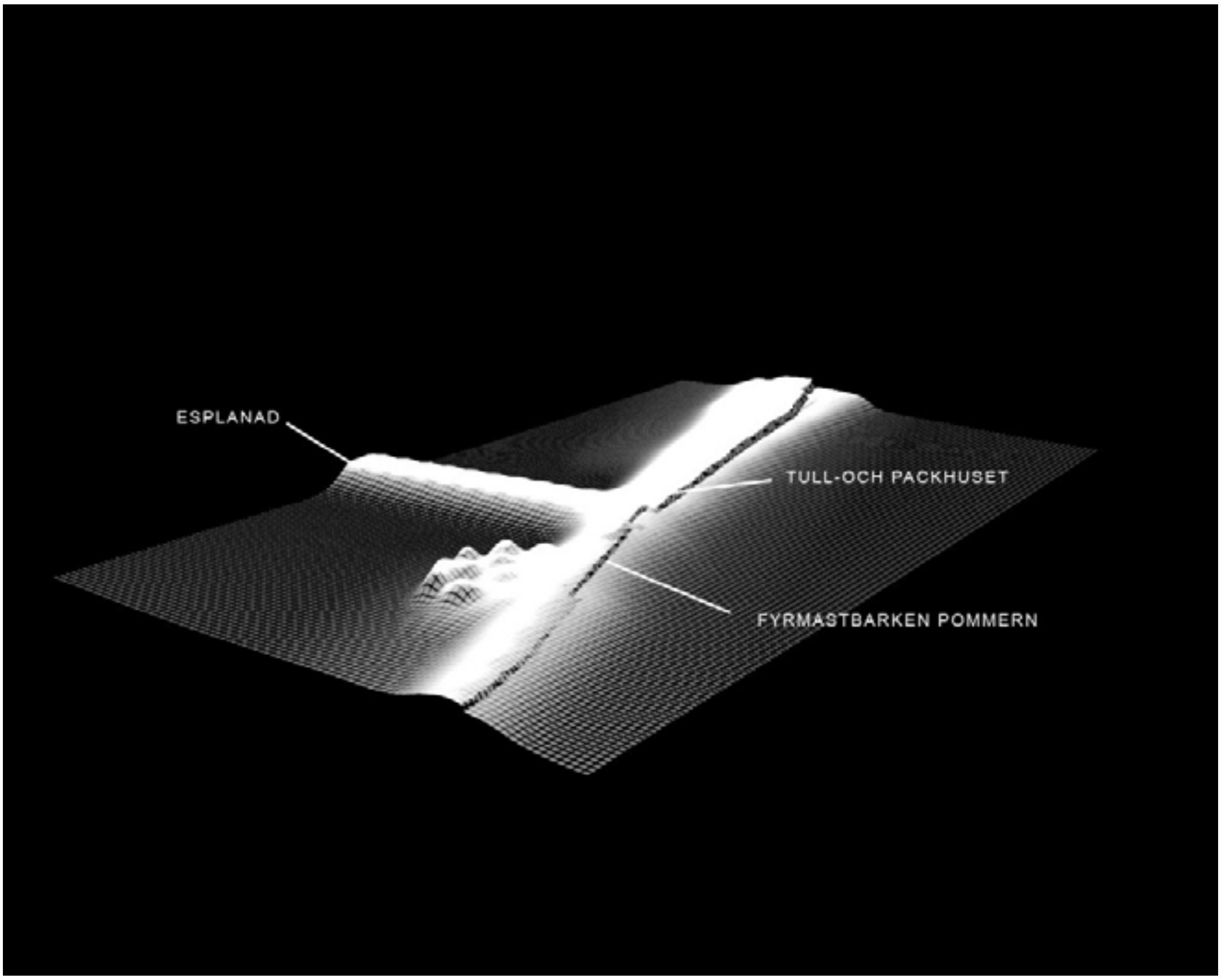


Figure 144. Architectural lighting solution for the harbour area. Photo: Julle Oksanen & Oliver Walter (Mariehamn concept report).

An important part of the architectural lighting design solution was to create a beautiful and peaceful white veil, the basic tone of light throughout the design area. A glare-free solution was designed using Brando luminaires. The luminance of the light distribution surface was approximately 400 cd/ m^2, which is much below the “Threshold glare value” = Moon luminance (2000cd/m^2- 3000 cd/m^2). This beautiful white glow is a great basic element for a successful architectural lighting design process. It is an accompaniment to the lighting composition.

Figure 145. Instrument for the basic tone: Brando luminaire. Photo: Britt-Marie Transmer

Lighting sections area:

The lighting section under research is an architectural section between the Pommern and the Museum, marked “Snitt 3” (Section 3).

Figure 146. Lighting sections 1,2,3, and 4. Photo: Julle Oksanen & Oliver Walter (Mariehamn concept report)

Figure 147. Mariehamn West Harbor area. Lighting section 3 was made for the section from the left side of the Pommern straight to the right side of the Museum building. Photo: Västerman and Sjöpromenaden report

Lighting section 3:

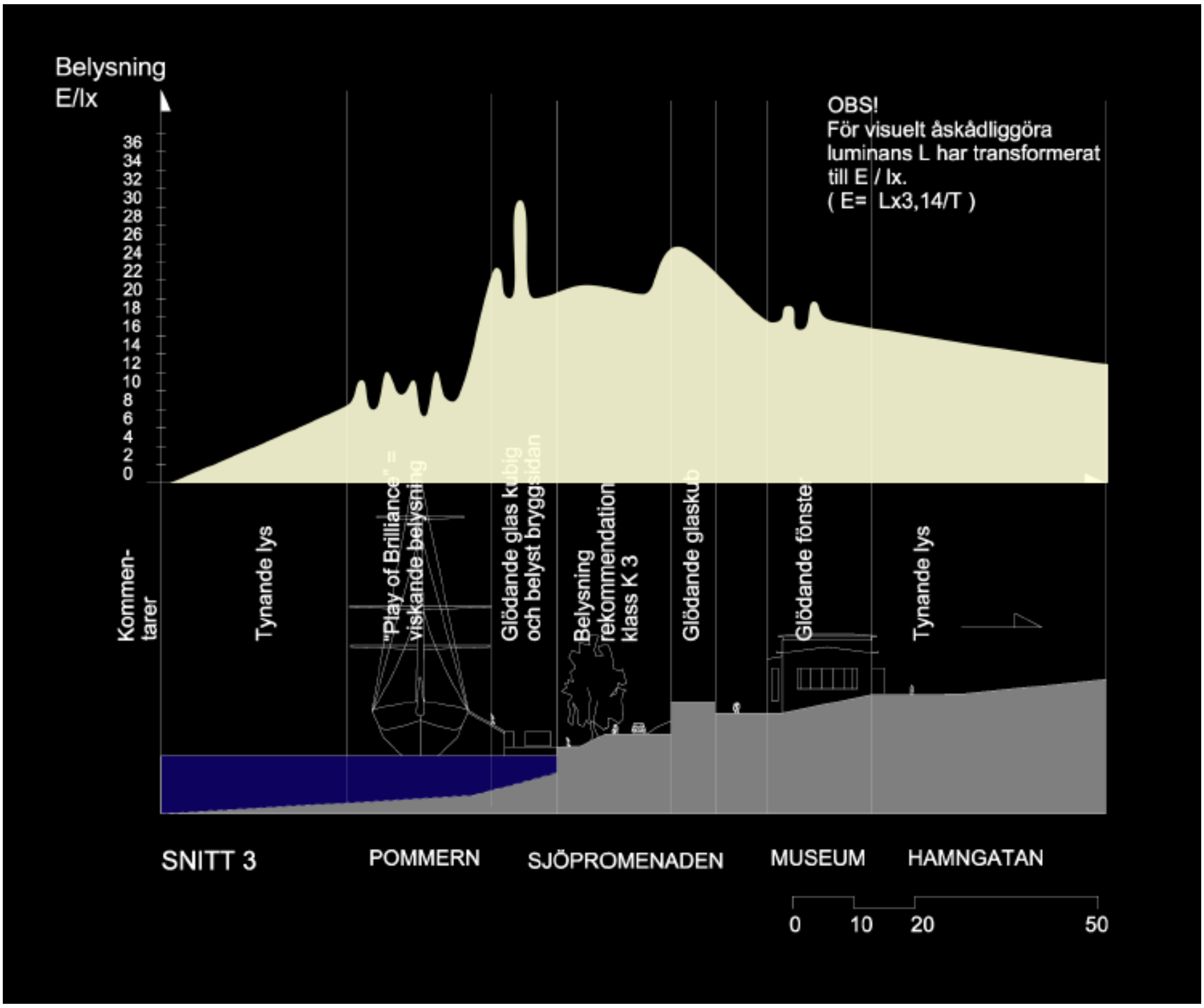


Figure 148. Lighting section 3. Photo: Julle Oksanen & Oliver Walter (Mariehamn concept report).

Lighting composition for section 3. The vertical element in the diagram is the E illumination value in lx. The yellow areas represent carefully designed lighting compositions. The basic lighting “tone” is a few lux (3-4 lx) over the whole lighting section. That represents the basic “white light veil”. The yellow area above is approximately 3-4 lx basic tone and the various bulges represent “*Focal Glow*” lighting (like light cubes of the new Museum building) and “*Play of Brilliance*” lighting (like the illuminated masts of the Pommern). A Brando luminaire is located on the left side of the “Sjöpromenaden”. It is not exactly on this section, but causes approx. E_{hor} = 18lx on the street surface (Brando pole distances selected according to light traffic classification K3). On the left edge of the lighting section the light is fading to the sea and on the right edge of the lighting section into the park area.

Figure 149. The lighting composition also worked perfectly in real life. Photo: Petteri Oksanen

Figure 150. Simulation for lighting section 3. Photo: Julle Oksanen & Oliver Walter (Mariehamn Master Plan report)

Figure 151. The Pommern and lighting drawing principle in the lighting section. Photo: Julle Oksanen

As can be seen from comparison of the image of the Pommern and the lighting composition in section 3, the illuminance values are not scientifically exact. The 50-meter masts look bright, but E_{hor} cannot even be measured. Thus these illuminated masts must be proportioned to the lighting composition wisely and understandably. The main idea is that the lighting composition gives the right kind of mental impression of the composition and lighting design goals, not exact lighting values. Of course the main idea is to try to follow the values as correctly as possible. For example the marina is designed to follow the lighting recommendation values (light traffic classification K3).

Conclusions: Since lighting compositions are impossible to assemble with precise scientific values (according to recommendations, norms etc.) as a whole, creativity is called for as well as the pragmatic theory of truth, both of which impart “freedom” to the lighting design.

The Mariehamn West harbor project proves the functionality of a new “lighting composition” metaphor, which leads to a new type of lighting design and conceptual process and answers all the research questions (1–4).

3.6.9. Meeting in the dark / recognition distance and light / Minimum darkness in outdoor lighting composition / contrast

Instead of an intrinsic value, darkness gradation is a “philosophical gate” to achieve an aesthetical, successful and interesting lighting solution. New architectural lighting design metaphors and different kinds of conceptual processes must be designed so that safety aspects are also under control. A numerical value for pedestrian safety has been researched scientifically. Mandatory facial recognition distance and minimum semi-cylindrical illuminance values for outdoor spaces have investigated and introduced by the anthropologist E.T.Hall, the architect Jan Caminada and the engineer Wout van Bommel. Their research shows that measured semi-cylindrical illuminance values were so low, that tolerances and evaluating fluctuation between different test observers enable great and safe darkness design instead of technical lighting design (existing practice). Successful lighting composition and darkness design values are between E_{sc} = 3-5 lx and the research results were between E_{sc} = 0.8-1lx.

“With our senses we are able to detect certain stimuli in our surroundings. But most go unnoticed, for example large parts of the electromagnetic spectrum. So, the “picture” our brains make of our surroundings remains limited – and the world we experience with our senses is not identical with the physical world. If we had different or additional senses the world would look very different. Visual perception is a process driven by sensation with its outcome dependent on judgements based on the perceiver's situational experiences. Seeing is an intellectual exercise strongly influenced by perceptions and cultural experiences. It may be expressed in several ways, among them, verbally and pictorially.” *(Science Center Spectrum 2008)*

Research

The study of the physiology of perception is important because it enables us to understand how colour and levels of light lead us to perceive our environments as discernible and safe. In the 1980s, the anthropologist E.T.Hall, the architects Jan Caminada and the engineer Wout van Bommel conducted a study on how people behave in the dark and found two important elements of relevance to lighting designers:

The mandatory recognition distance between people approaching each other in the dark is 3.5 meters (approx. 12 feet). There should be enough light in public space to enable people to see each other’s *faces* at this recommended distance.

Personal zones

Figure 152. Personal zoning according to research. (Philips ILR 1980 /3)

Recognition distance

To meet this recommendation, the semi-cylindrical Illuminance value E_{sc} should be higher than 0.8 lx or approximately 0.08 foot candles. (More information on lighting recommendations and handbooks).

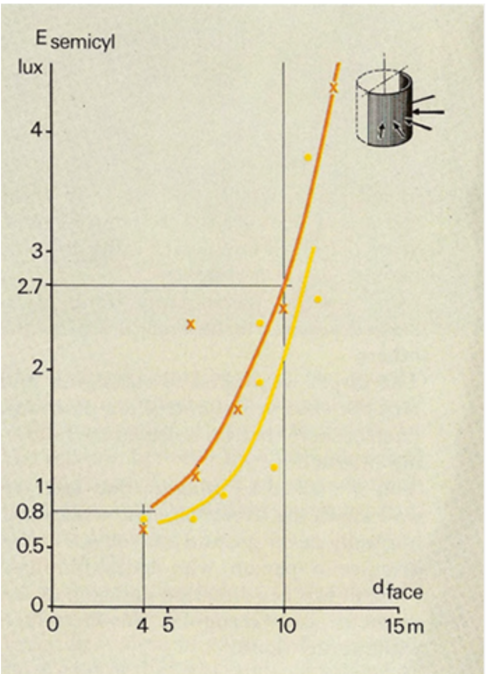


Figure 153. Esc value as a face- recognition argument when approaching in the dark. (Philips ILR 1980 /3)

Semi-cylindrical illumination values yielded coinciding and coherent results. Other values had some contradictions. The semi-cylindrical illumination is understandably value, because almost all face types more or less follow this basic shape. Head and face variations did not influence the result. Lighting design software programs automatically calculate this value using an average face height of 1.5m E_{scmin} = 0.8 lx (at selected places E_{sc} = 3 lx).

A computer calculation example

Figure 154. Calculation example: City 2030. Design: Julle Oksanen. photo: Oliver Walter and Daniel Silberman.

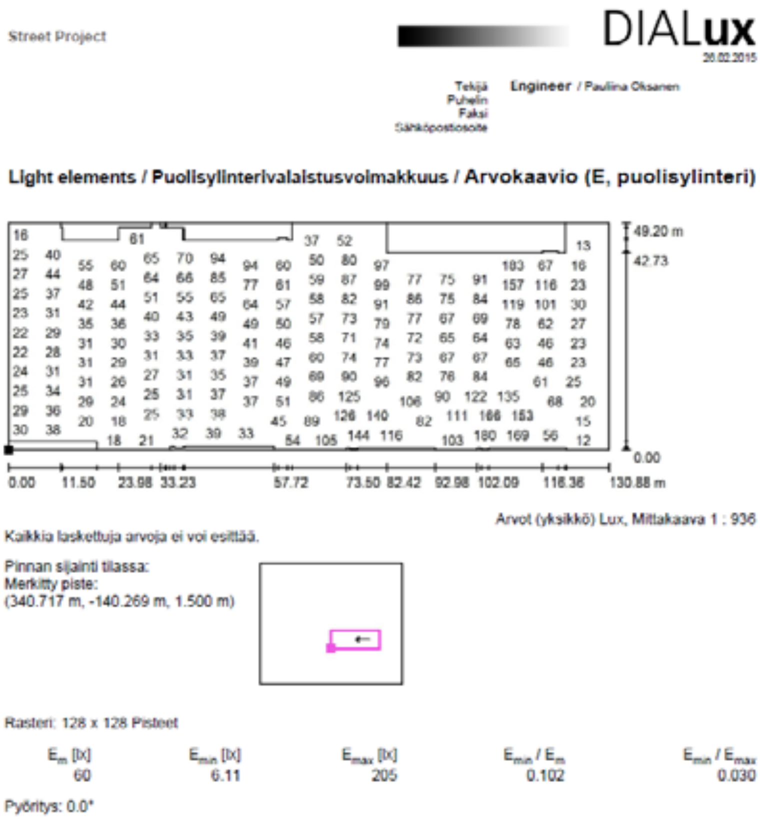


Figure 155. The average E_{sc} value is very high. E_{sc} = 60lx allows LED dimming down to 90%. Then E_{sc} = 6lx and facial recognition distance approx. 15m (see Figure 153). The darkness gradation possibility is great and the result is interesting and inviting.

Approaching test

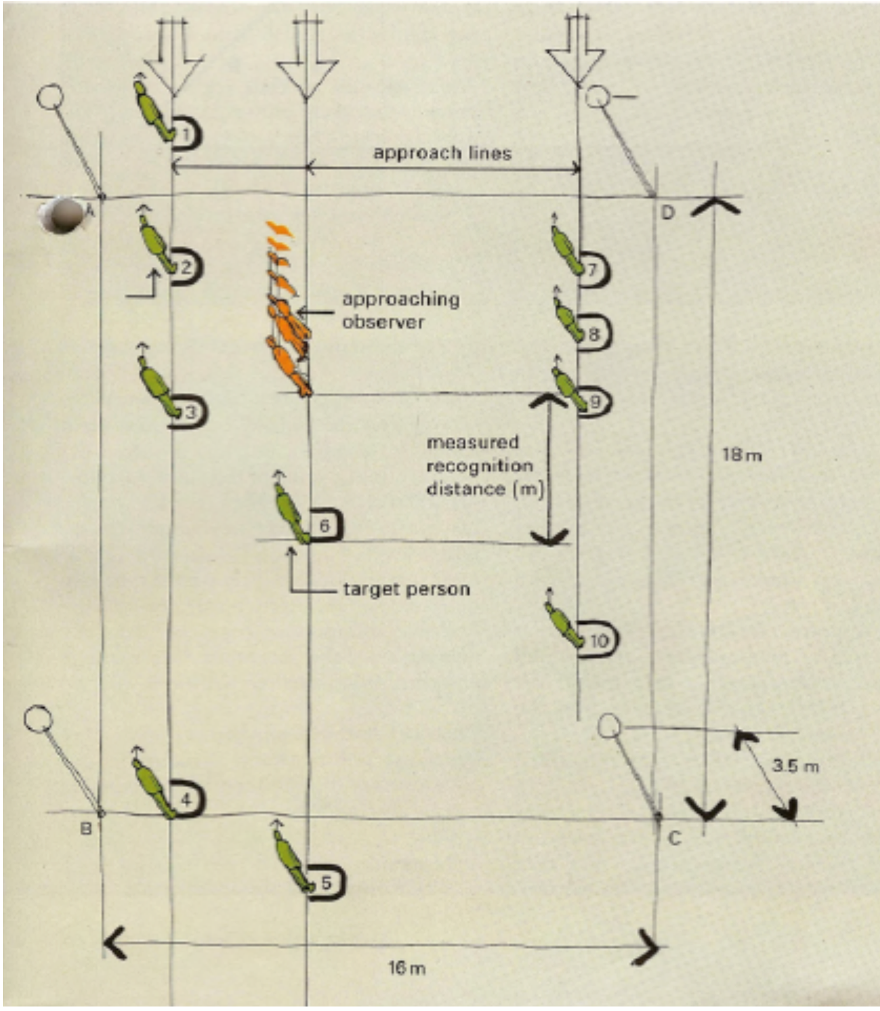


Figure 156. Approaching test implemented in Eindhoven. (Philips ILR 1980 /3)

The study was implemented in Eindhoven, Holland, where Philips is headquartered. Both Wout van Bommel and Jan Caminada worked for Philips lighting division in the 1980's.

Personnel from one of the Philips lighting department were taken to an outdoor demonstration laboratory. The lighted area of the post top luminaire distribution surfaces and the volume of light (influenced by candle power and brightness of the luminaire surface) could be changed in order to create different lighting conditions. Each person was tested as other persons approached. The lighting values were adjusted each time and the test person was required to shout "stop" when he or she recognized the face and attitude of the person approaching. The distances were measured against the lighting values and also $E_{horisontal}$, $E_{vertical}$, $E_{semicylindrical}$, and $E_{cylindrical}$. Based on the results of this study, recommendations were made to produce uniform lighting values for public areas.

Luminaires used and glare rating

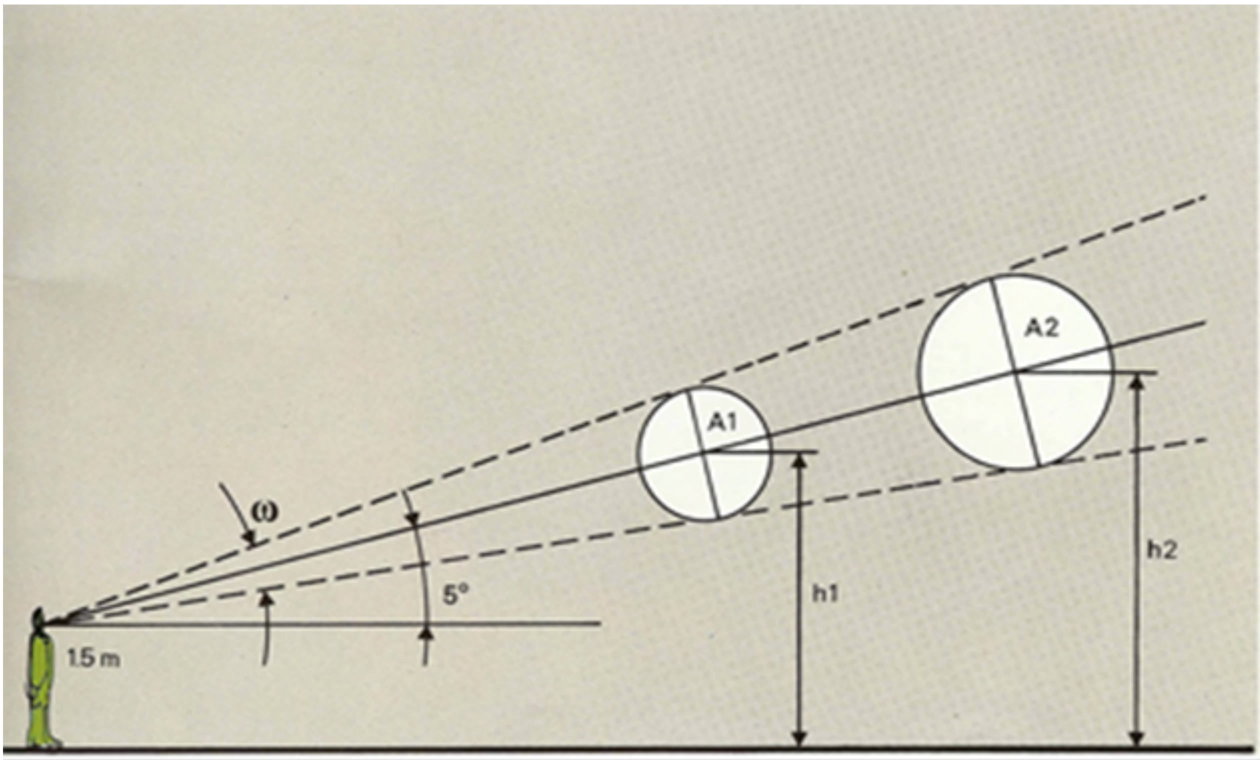


Figure 157. Principle drawing for LA ^{0,25}- value. (Philips ILR 1980 /3)

If the luminaire surface is brighter than the recommendation allows, it affects the recognition distance because glare veils the retina and the test subject loses the ability to distinguish contrasts. This shortens the recognition distance and if the distance is shorter than 10 feet, at least one person will change their walking direction. This situation causes tension and the space may be perceived as unsafe. These recognition zones are valuable for relaxed and enjoyable movement in dark. The luminaire glare value calculation formula is:

$LA^{0.25}$,

where,

L = measured luminance between angles of 85-90 from vertical (bright area section of the luminaire light distribution surface),

A = bright luminaire light distribution section.

The maximum values depend on the height of the luminaire:

$LA^{0.25}$ = 1250, h < 4.5m

$LA^{0,25}$ = 1500, 4.5m < h < 6m

$LA^{0,25}$ = 2000, h > 6m.

A practical example: Pedestrian bridge Knoxville, Tennessee, USA

Figure 158. Julle Oksanen’s studio work at the University of Tennessee. Photo: Larwie and Associates, CRJA, Wilbur Smith Associates, S&ME, Sanders Pace Architecture, Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter

The bridge has no visible luminaires at all. Light sources are hidden in almost invisible coves, which are located on the edges of the pedestrian area and the edges of the columns. Each cove has one RGB LED stripe.

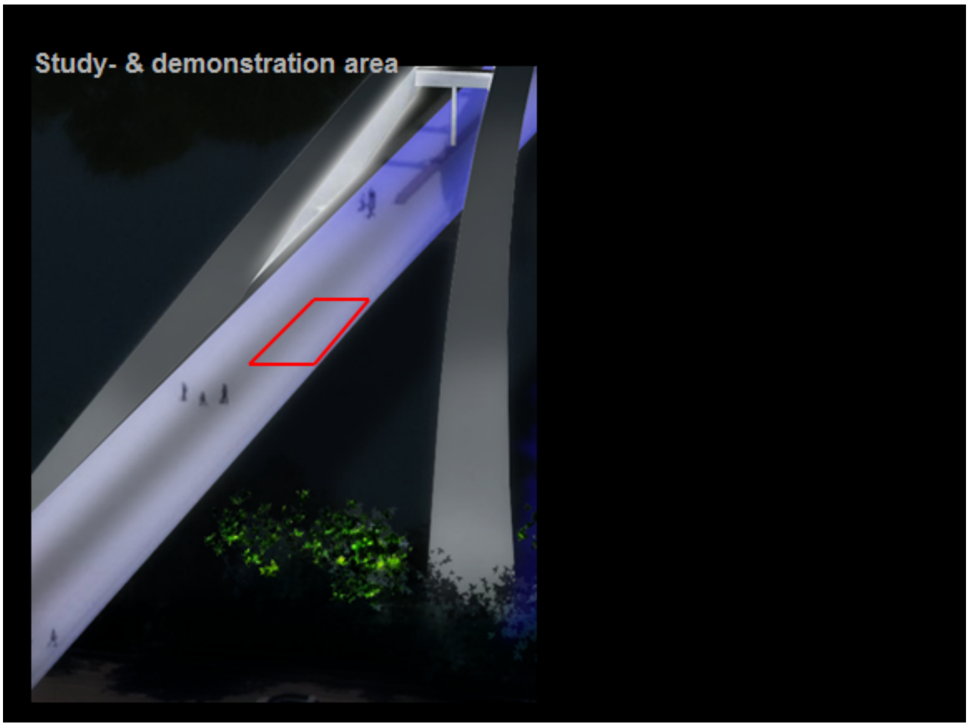
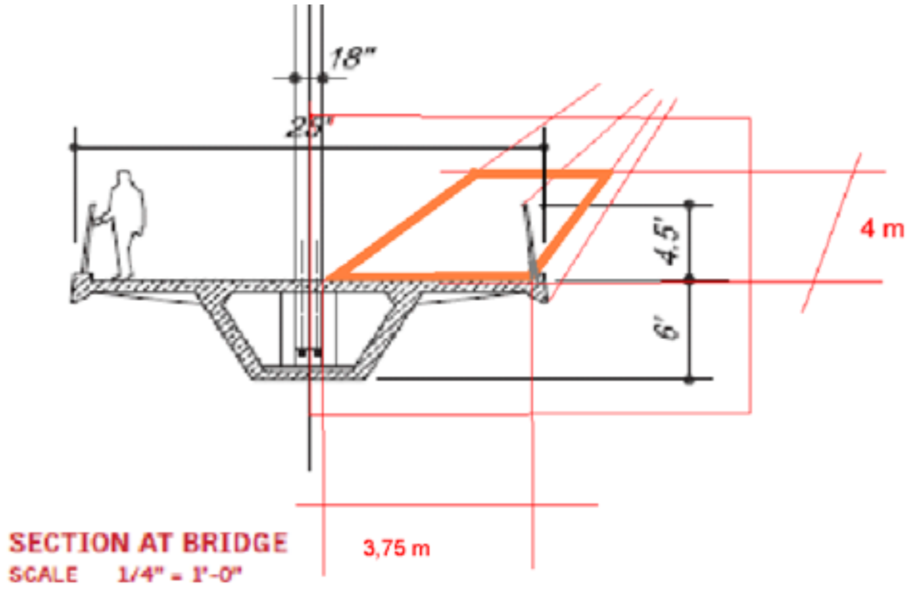


Figure 159. Julle Oksanen’s studio work at the University of Tennessee. Photo: Larwie and Associates, CRJA, Wilbur Smith Associates, S&ME, Sanders Pace Architecture, Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter



The area measured was 3.75m wide & 4m long (half of the total bridge width). Effects on E_{hor} & E_{sc} & E_{v} values from both coves can be measured and calculated with this 1 cove and ½ of the total bridge width. Symmetrical calculus & symmetrical values.

Figure 160. Demonstration arrangement. Photo: Julle Oksanen

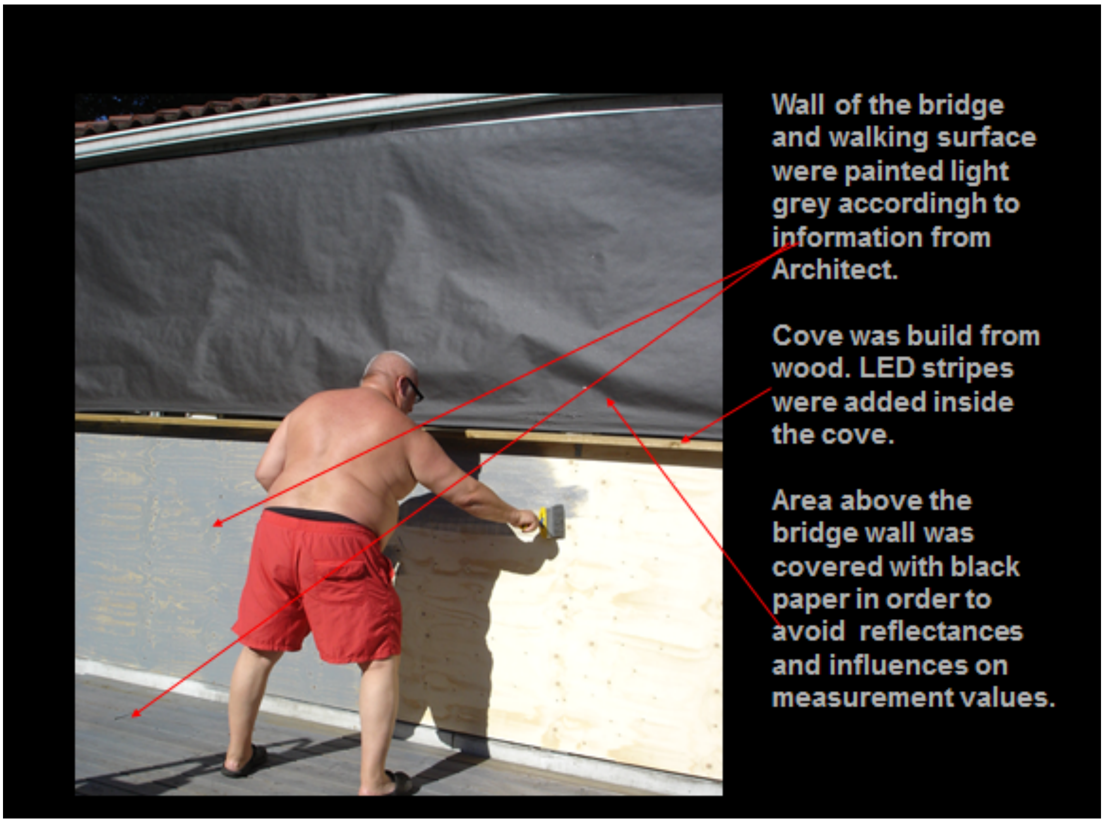


Figure 161. Demonstration arrangement. Photo: Julle Oksanen

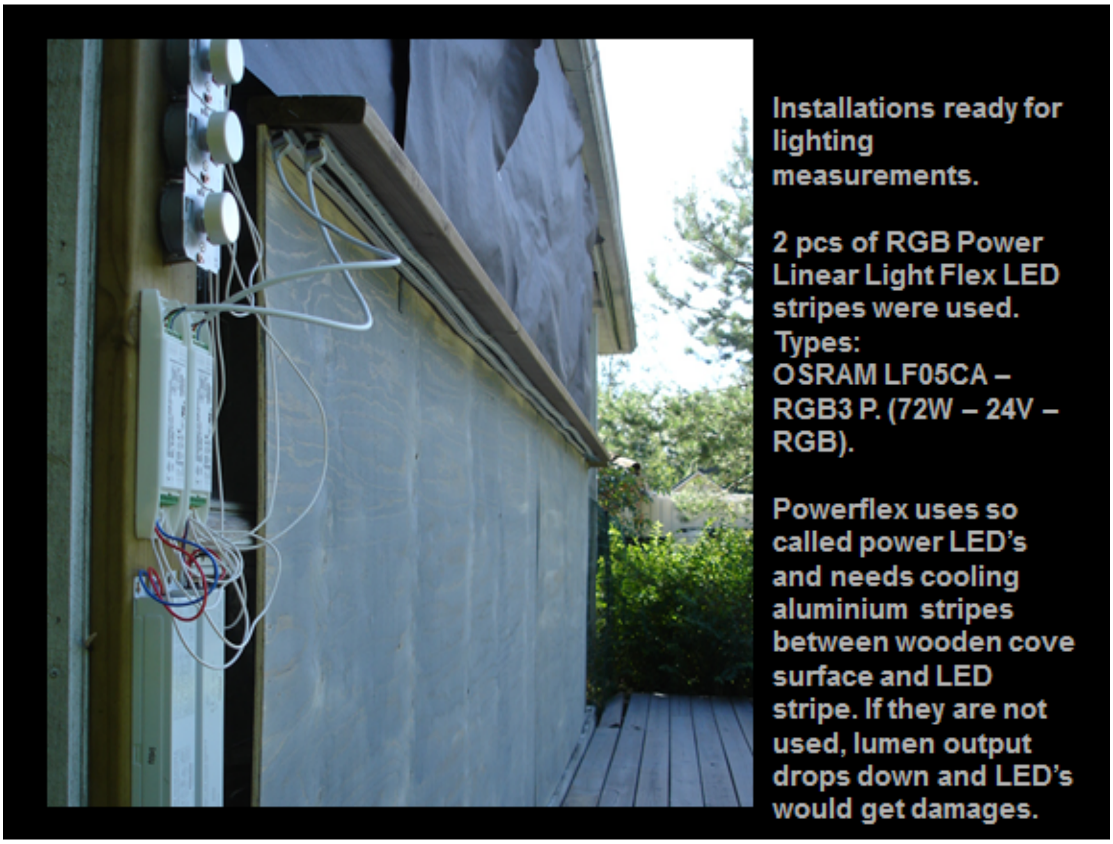


Figure 162. LED stripe and lighting control installed. Photo: Julle Oksanen

In the bridge case LA$0^{,25}$ = 0. Fantastic. It means that all light distribution surfaces are hidden. (LED stripes are located inside coves).

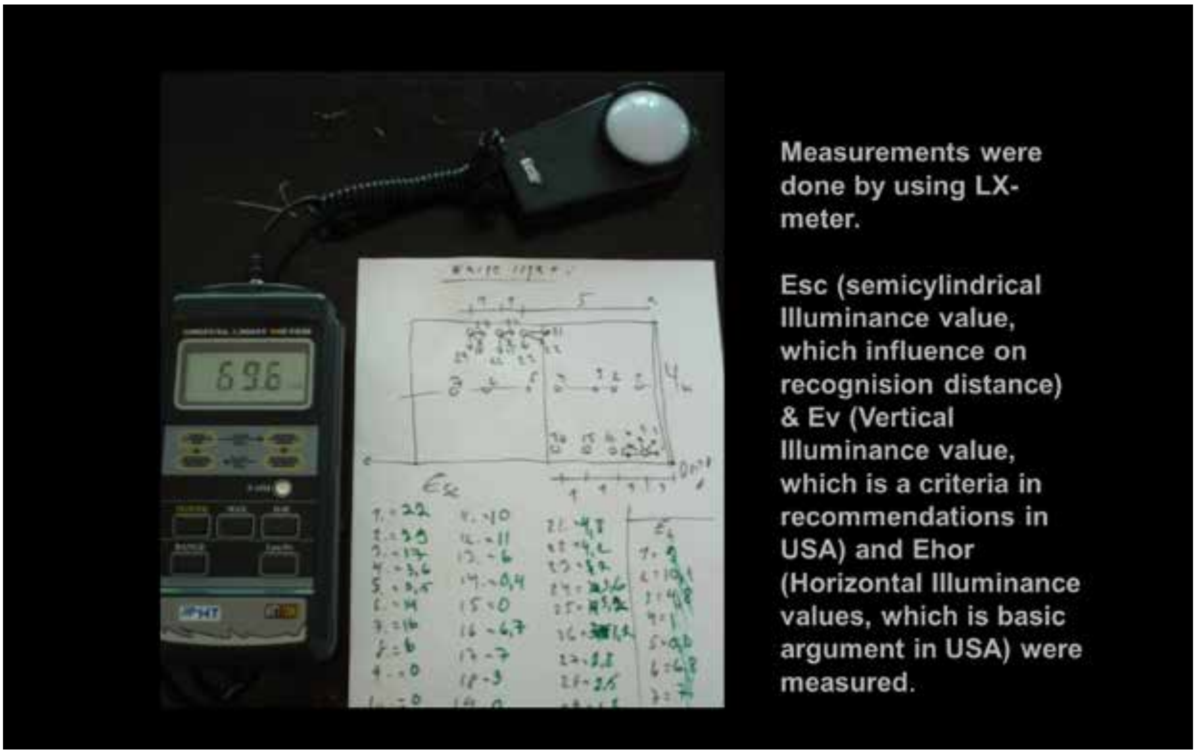


Figure 163. Semicylindrical illumination values and a measurement tool. Photo: Julle Oksanen

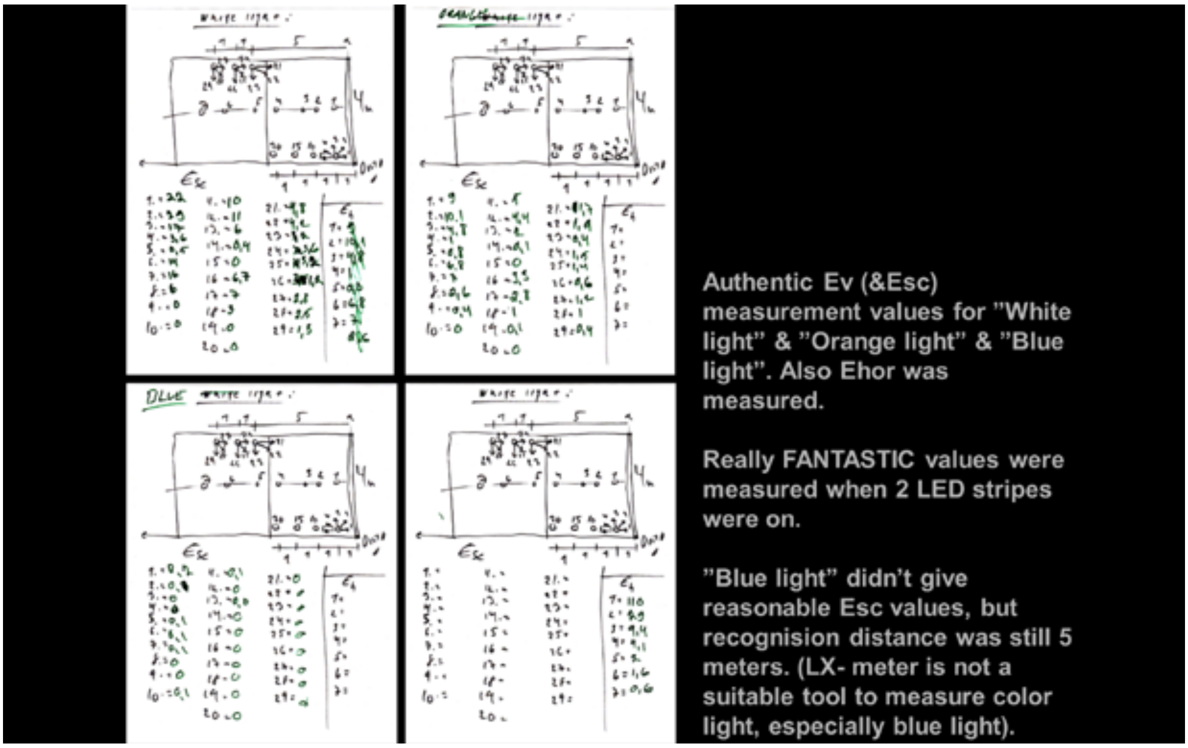


Figure 164. Semicylindrical illumination values for different light colours. Photo: Julle Oksanen

Figure 165. Measurement tool for measurements. Photo: Julle Oksanen

The measurement height was 1.5m (average face height) and 5 different $E_{vertical}$ values were measured (from 0 - 45deg. - 90deg. - 135deg. - 180deg.). The E_{sc} value is the average value of those 5 E_v values. = 7.5lx. Recognition distance on the bridge is over 15 m.

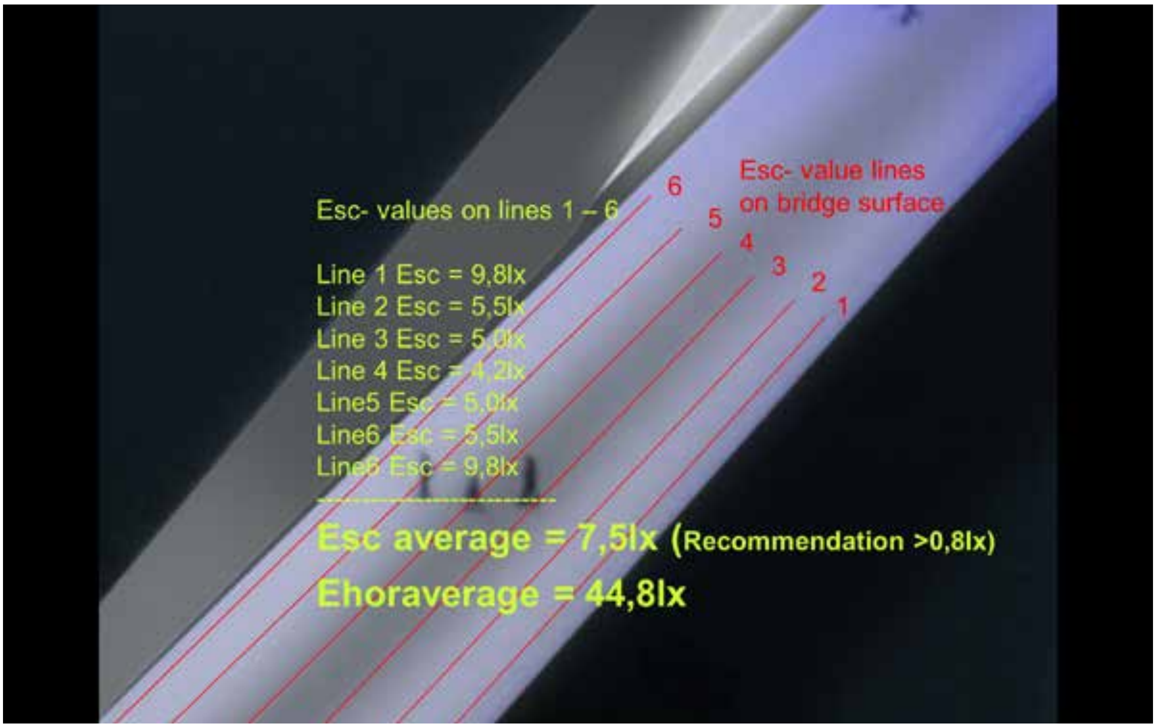


Figure 166. Julle Oksanen's studio work at The University of Tennessee. Photo: Larwie and Associates, CRJA, Wilbur Smith Associates, S&ME, Sanders Pace Architecture, Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter

The measurement height was 1.5m and 5 different $E_{vertical}$ -values were measured (from 0 - 45deg. - 90deg. - 135deg. - 180deg.). The E_{sc} value is the average value of those 5 E_v values. = 7.5lx. The recognition distance on the bridge is over 15 m. This means really relaxing, safe, and enjoyable movement along the bridge in every direction.

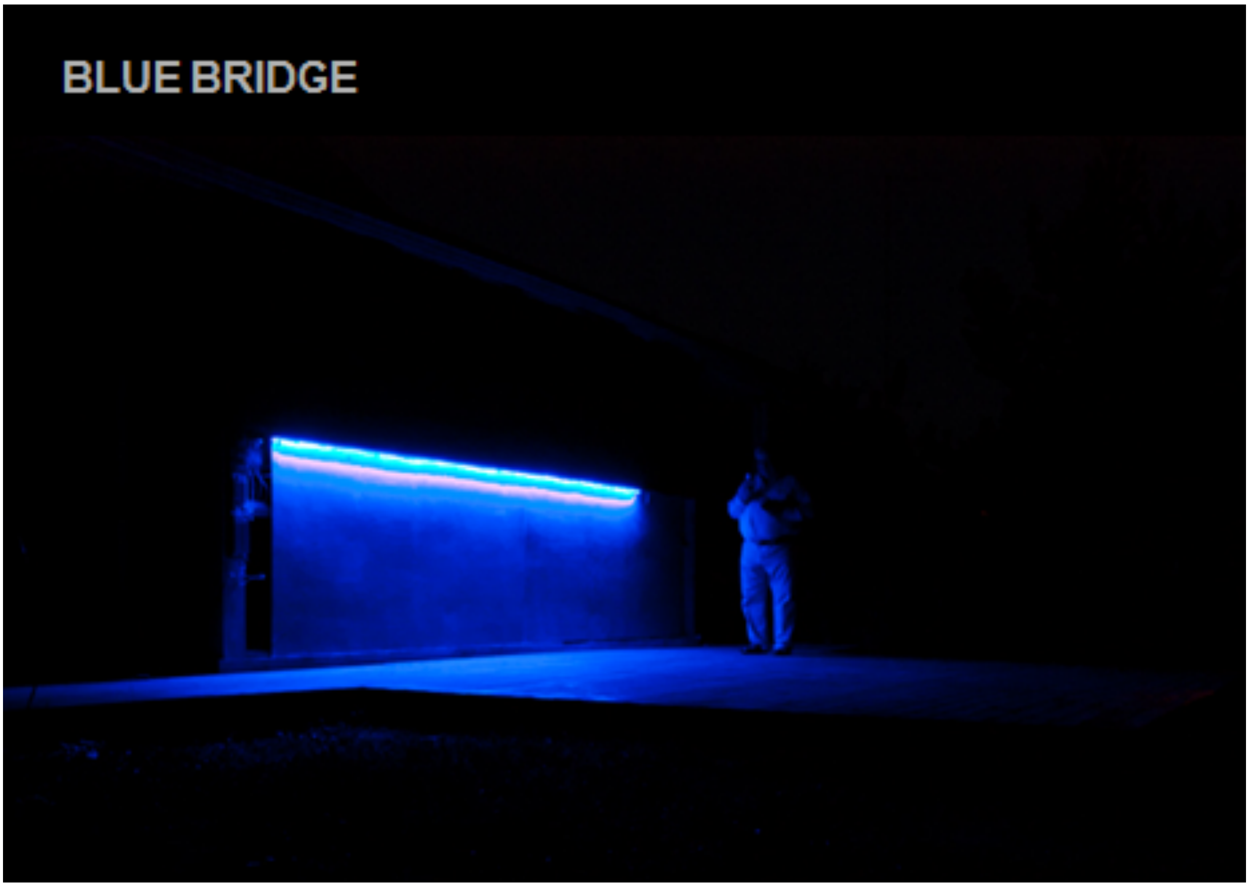


Figure 167. Testing color lights and measurement. Blue bridge. Photo: Petteri Oksanen

The conceptual design process and new metaphors are partly based on lighting composition and mandatory recognition distance when people are approaching in the dark. The lighting composition has clear similarities with music. Light represents a note and darkness represents a pause. As an old violin player I know that a pause is more important than a note and gradually rising passages increase listeners' tension. Some research has been done to try establish analogies between music and light, but there are a lot of conflicting obscurities and uncertainties. My personal experiences force me to ascertain those connecting elements between music and light. I personally always sing our lighting compositions to our customers and surprisingly they all have told me that it clarifies the lighting composition drawing to them perfectly.

3.6.10. The similarity between music and light

Semiotic connections between music and light are based on either lighting composition (relations between shadow and light = contrast gradation) and/or color lighting (focal glow as part of the visual view in space). These elements have not "normally" been taken into account in previous lighting design solutions. The problems involved can be many, like lack of education, engineering oriented approaching to lighting design, technical difficulties in creating colors with light (before color LED), compliance with obligatory use of lighting recommendations, to mention just a few. Last but not least is the fact that light is electromagnetic radiation and invisible until it "touches" the surface, which means that the lighting designer needs three-dimensional perception skills. The next subchapters will focus mainly on connections between music, color and light. Lighting composition has already been addressed in detail in earlier subsection 3.6.8 "Lighting Composition". According to my studies on the connection between music and color lights may stay in darkness forever. This combination clearly belongs to the category “The Great Unknown”. It is part of art which cannot be explained and continues to be a source of fascination. For future researchers it is good to study in this context, too.

3.6.10.1 Prometheus: The Poem of Fire

Alexander Scriabin (1872 – 1915) was one of the most innovative and most controversial of the early modern composers. Leo Tolstoi described Scriabin's music as "a sincere expression of genius". However, Scriabin's importance on the Soviet musical scene, and internationally, declined drastically. According to his biographer, "No one was more famous during their lifetime, and few were more quickly ignored after death".

The system of Scriabin's "colored hearing" was as follows:

C-major- red
G-major - orange
D-major - yellow
A-major - green
B-major – blue,pale

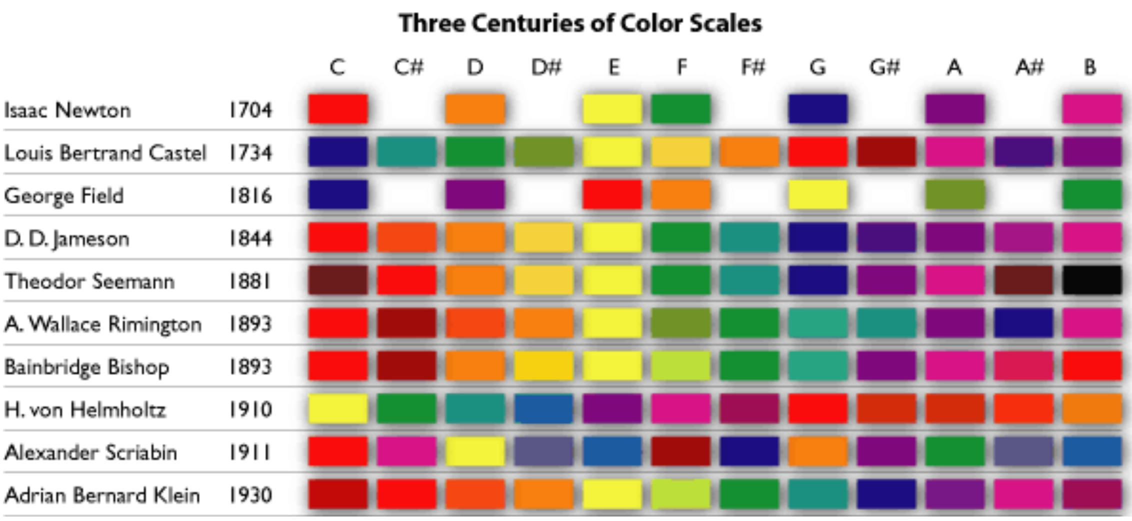
E-major - sky blue
H-major - blue, pale
F-sharp major - blue
D- flat major - violet
A-flat major - purple violet
E-flat major - glitter
B-flat major - of steel
F-major - red

How did such correspondences between colors and tones form in Scriabin's mind?

It is well-known that many musicians attribute certain emotional states and certain meanings to tones. Scriabin, for example, described C-major as "simple", "earthly" and F-sharp major as more "complex", "spiritual". Besides, all of us attribute certain emotional features to colors. We all describe red as an exciting color and blue as a quite, lofty one. These common features serve as a base for comparison between colors and tones of such types as "C-major - red and so on".

My personal opinion is that all colors and tones belong to a “mystic and inexplicable” category of art and/or science.

Fred Collopy, whose research has been published in leading academic and practitioner journals, studied light and music. He drew together the three centuries of the color scale. The results are interesting, but in my opinion somewhat mystifying.



There are also philosophical similarities between music and lighting calculations. E.g. before a symphony orchestra can play, every player must have written notes on manuscript paper. Even though human beings cannot give clear and exact numerical figures for sensations, like noise and visual perceptions, numerical treatment often gives good control and reliability for selected solutions. This is important, especially when the lighting solution selected is complicated, expensive and arduous. The next two examples focus on the importance of calculations in achieving success.

3.6.11. Architectural lighting calculations / The Lumen Method

Lighting calculation is a tool in the architectural lighting design process. The so-called “Lumen Method” is a simple, fast, and heuristic way to ascertain if the architect’s/lighting designer’s great idea is functional and technically feasible without expensive and complicated operations afterwards. In the architectural lighting design process the lumen method is practical for use with “The Law of Pragmatic Truth”, because many elements in the formula used are in abeyance. In the following examples (“Glass Ceiling” and “Airport Light Prisms”) I was unware of the exact details of the materials like glass absorption and penetration factors, exact detailed surface colors, final detailed measurements, etc. These figures for the preliminary lumen method calculations were negotiated between an architect, a glass expert, and myself as a lighting designer. The lumen method used together with “The Law of Pragmatic Truth” simplifies scientific thinking and complicated mathematic parameters. All quantities can be marked as K_{xxx}= factors. Two different kinds of examples are introduced: “Glass Ceiling” calculus and more complicated “Light Prism” calculus.

3.6.11.1. Case: “Glass Ceiling”

Neubrandenburg cathedral was coverted into a concert hall by PSA Architects. A huge glass ceiling was designed to be a luminaire for general lighting purposes.

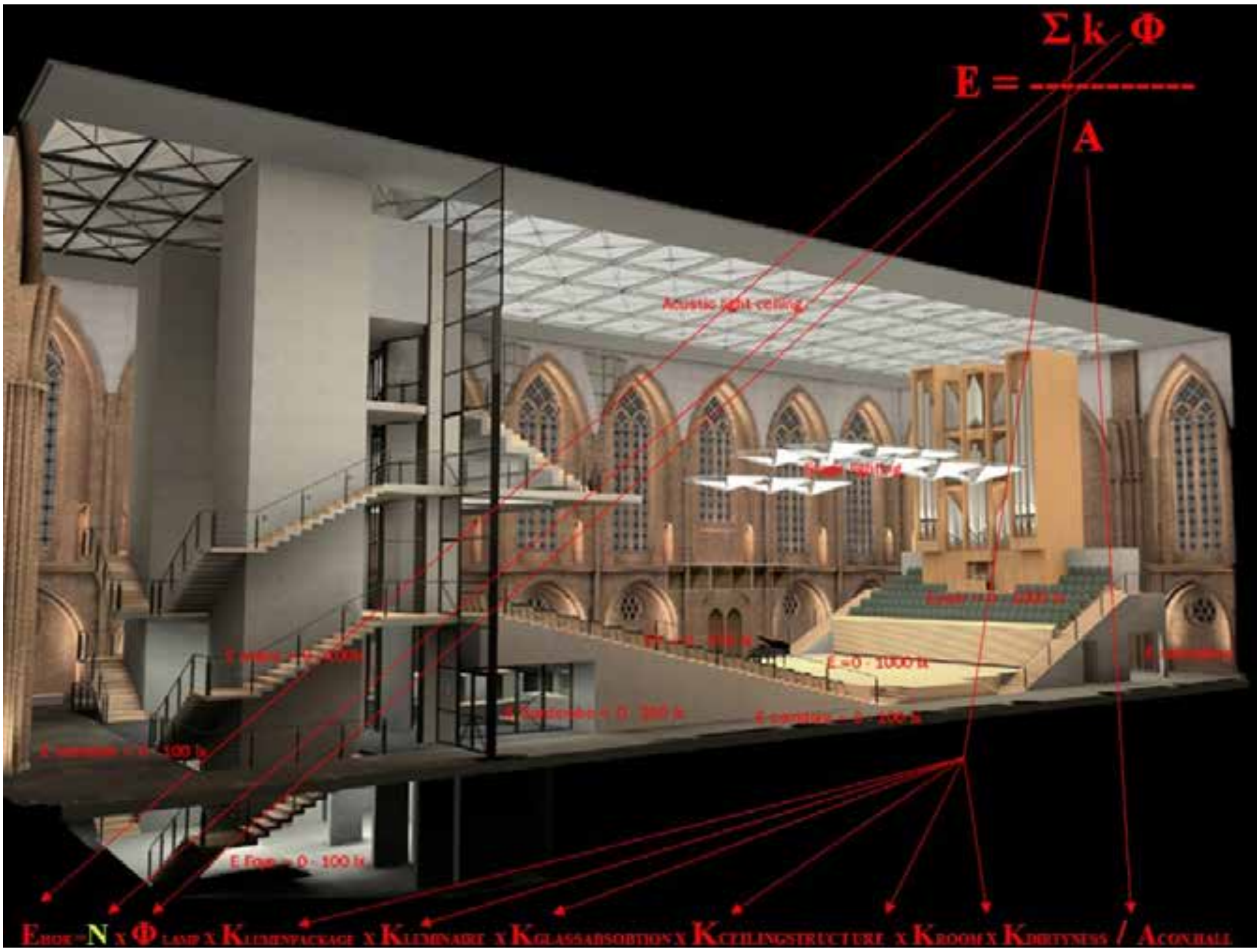


Figure 169. Light ceiling calculation. Photo: Erkki Rousku

The basic formula for the Lumen Method is: E = Φ / A.

In words: “The illuminance value of a certain area A is equal to the light flux Φ (often also called a “lumen package” or “liters of light”) divided by that area A. The formula is very simple in the hypothetical case where all light flux falls on a certain area. Unfortunately this is not always the case. There are many factors that reduce the lumen flux (like lamp aging, luminaire, dust, glass absorption, room surfaces, etc.).

The formula changes its form:

E = ∑ Kx Φ / A

The final formula in the concert hall case is located in the lower part of Figure 169.

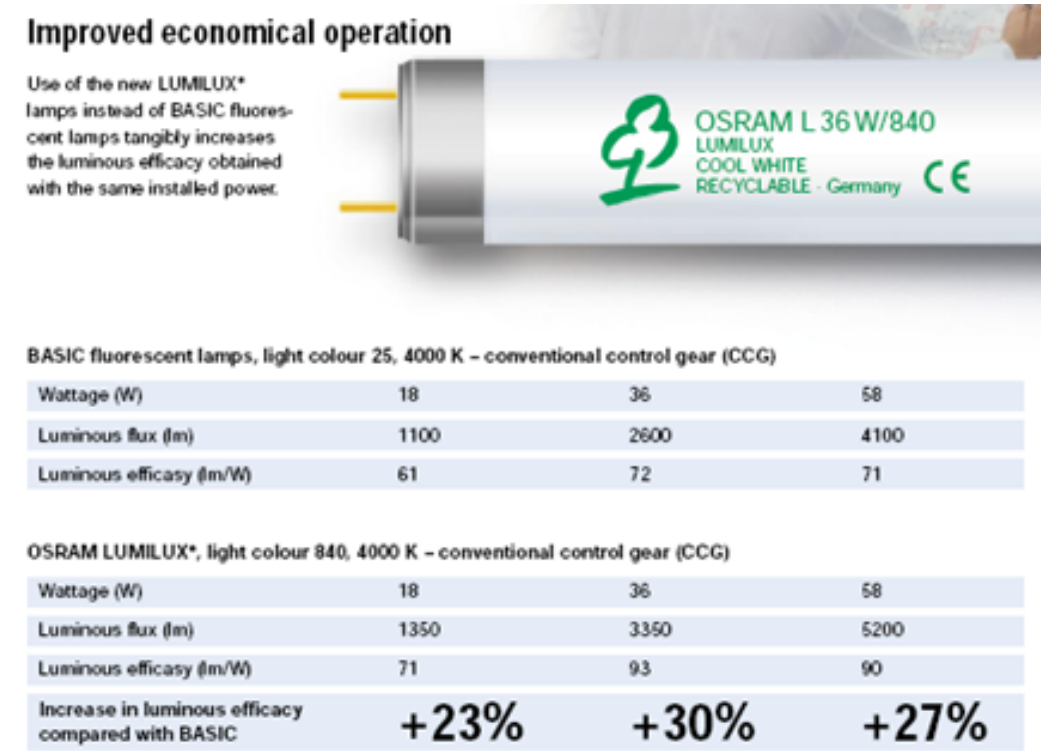
The calculation parameters are:

E = Selected horizontal illuminance value on average floor surface.

N = Total number of lamps needed (the amount that needs to be solved)

Figure 170. Fluorescent lamps are located above the glass ceiling, symmetrically according to the geometry of ceiling structure. Photo: Kyösti Meinilä

Φ_{lamp} = Light flux of one new lamp (lamp with 3350 lm selected)



BASIC fluorescent lamps, light colour 25, 4000 K – conventional control gear (CCG)

Wattage (W)	18	36	58
Luminous flux (lm)	1100	2600	4100
Luminous efficacy (lm/W)	61	72	71

OSRAM LUMILUX*, light colour 840, 4000 K – conventional control gear (CCG)

Wattage (W)	18	36	58
Luminous flux (lm)	1350	3350	5200
Luminous efficacy (lm/W)	71	93	90
Increase in luminous efficacy compared with BASIC	+23%	+30%	+27%

Figure 171. Osram L 36W/840, a Lumilux lamp was selected as a light source. The size and availability were great. Photo: Osram

K light flux = 0,9.

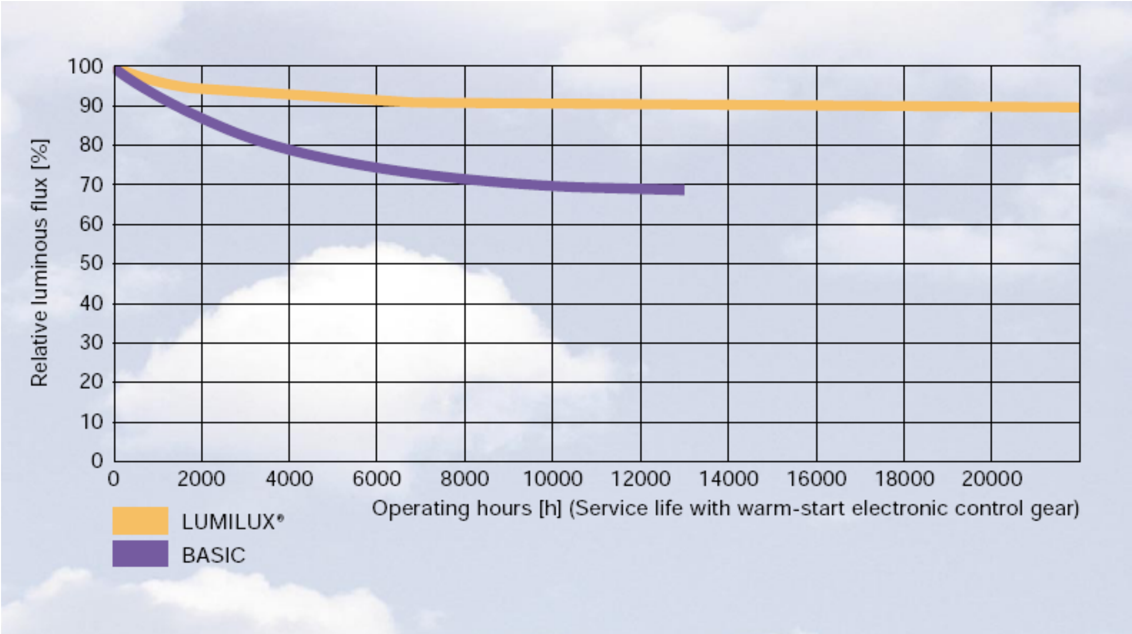
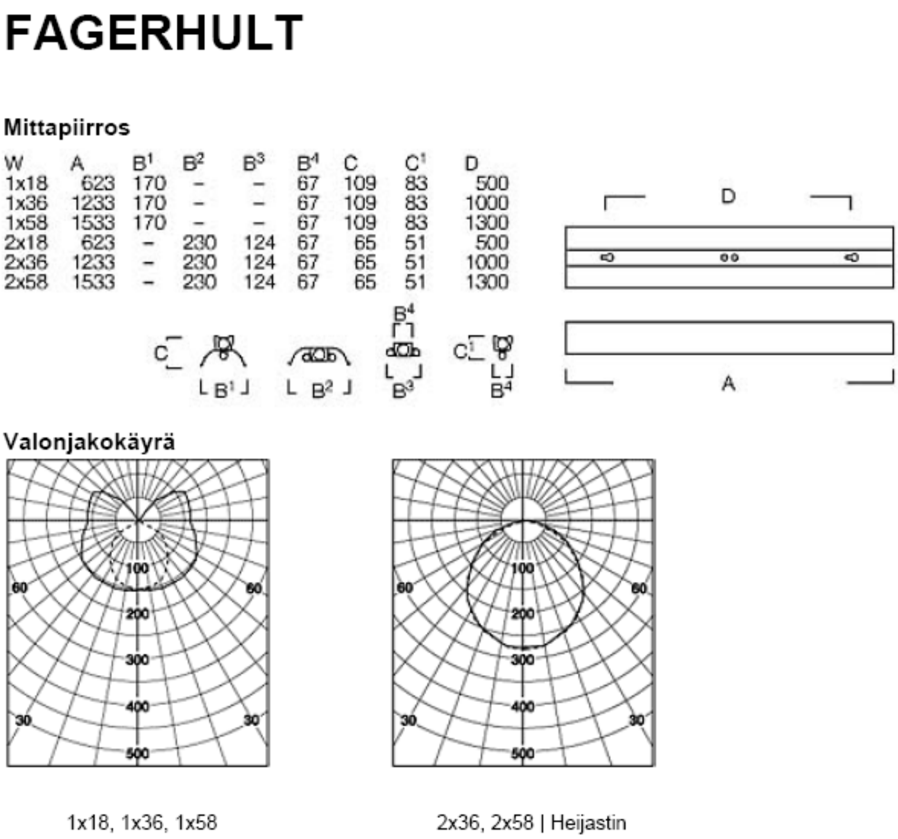


Figure 172. $K_{light\ flux}$ = 0.9 (lamp light flux decreases 10% during its lifetime) Photo: Osram

$K_{luminaire}$ = 0.94



FAGERHULT

Mittapiirros

W	A	B¹	B²	B³	B⁴	C	C¹	D
1x18	623	170	–	–	67	109	83	500
1x36	1233	170	–	–	67	109	83	1000
1x58	1533	170	–	–	67	109	83	1300
2x18	623	–	230	124	67	65	51	500
2x36	1233	–	230	124	67	65	51	1000
2x58	1533	–	230	124	67	65	51	1300

Valonjakokäyrä

1x18, 1x36, 1x58

2x36, 2x58 | Heijastin

Figure 173. Light Output Ratio (LOR) in the selected luminaire is 94%. Only 6% disappears because part of the light flux reflects from luminaire body and body absorbs light. Photo: Fagerhult

$K_{ceiling\ structure}$ = 0,7.

Figure 174. The maintanance bridge blocks some 20% of the light, and 75% of the light flux falls on the glass ceiling surface and some 25% runs up and reflects back on the glass surfaces. The common influence for the factor is 30%. Photo: Kyösti Meinilä

$K_{glass\ penetration}$ = 0,65.

Figure 175. 2 x 6mm ferro oxide free glass with white laminate between glasses absorbs 35% of light, while 65% of light that falls on the ceiling glass on the attic part penetrates the glass ceiling into the concert room.Photo: Kyösti meinilä

K_{room} = 0,47.

Huonepinta	Heijastumissuhde								
katto (vyöhyke)	0,7	0,7	0,7	0,5	0,5	0,5	0,3	0,3	0
seinät	0,5	0,3	0,1	0,5	0,3	0,1	0,3	0,1	0
työtaso / lattia	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0
Huoneindeksi	Valaistushyötysuhde (%)								
k=0,60	37	33	31	37	33	31	33	30	28
k=0,80	42	39	36	42	38	36	38	36	34
k=1,00	47	43	40	46	42	40	42	40	38
k=1,25	51	48	45	50	47	44	46	44	41
k=1,50	54	51	48	52	49	47	48	47	44
k=2,00	58	55	52	56	53	[illegible]	52	50	47
k=2,50	60	57	55	58	56	[illegible]	54	53	50
k=3,00	62	59	57	59	57	56	56	54	51
k=4,00	64	62	60	61	60	58	58	56	54
k=5,00	65	63	62	63	61	60	59	58	56

Figure 176. Room index k = width x length / h (width + length). = 1.5. Approximated reflections of the concert hall room surfaces yield a lighting utilization factor of 47%. This means that 53% of the total light flowing into the concert space is absorbed by the surface structures. Photo: PSA Architects

$K_{dirtyness}$ = 0.75

Huoneen likaantumis-luokka	Valaisimien, lamppujen ja huonepintojen likaantumisen alenemakerroin	Lamppujen valovirran alenemakerroin	Kokonais-alenema-kerroin	Tilojen käyttöalueet
Puhdas	0,85	0,8	0,7	toimistot, elektroniikan kokoonpano, puhdastilat, tietokonehuoneet
Keskinkertainen	0,75	0,8	0,6	laboratoriot, varastot, kokoonpano-teollisuus, hienomekaaninen teollisuus
Likainen	0,6	0,8	0,5	teräs-, kemian-, kaivos- ja kiviteollisuus, hitsaus, pintakäsittely ja puuntyöstö

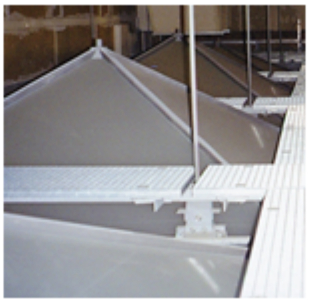


Figure 177. Dirt on luminaires, lamps, glass- and other room surfaces decreases the light production by 25 %. Photo: Kyösti Meinilä

The main question in this calculation is: How many lamps are needed to produce E_h = 200lx (selected as a maximum E-value) on the floor surface? All factors are ascertained except the total number of lamps needed.

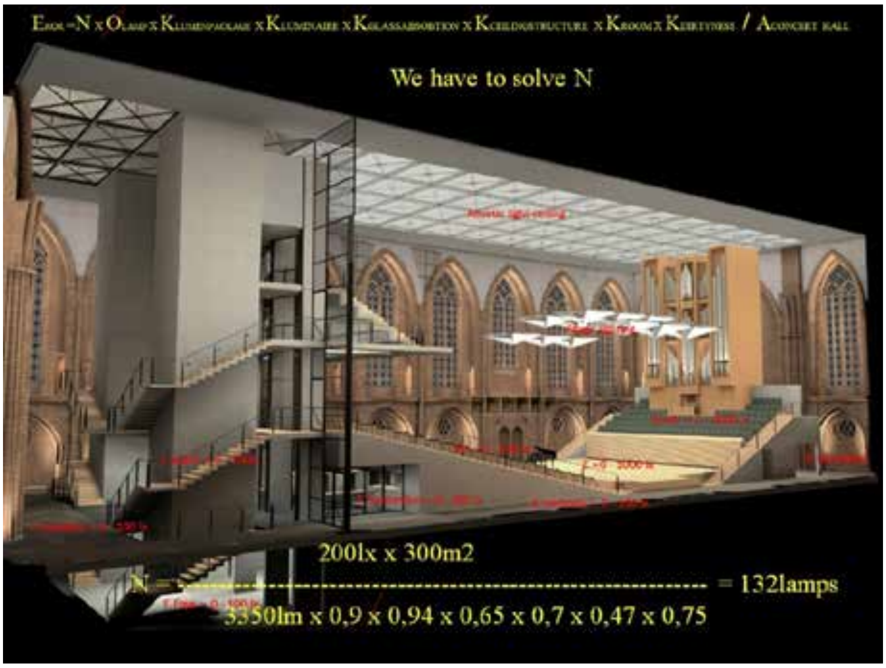


Figure 178. “Heuristically” applied lumen method calculation. Photo: Erkki Rousku

132 lamps are needed to produce the needed maximum Eh value. The lighting solution is dimmable and can be preset according to performance and general use of the building. (solo singers, orchestra, opera, cleaning etc.).

The next question is: How bright is the glass ceiling?

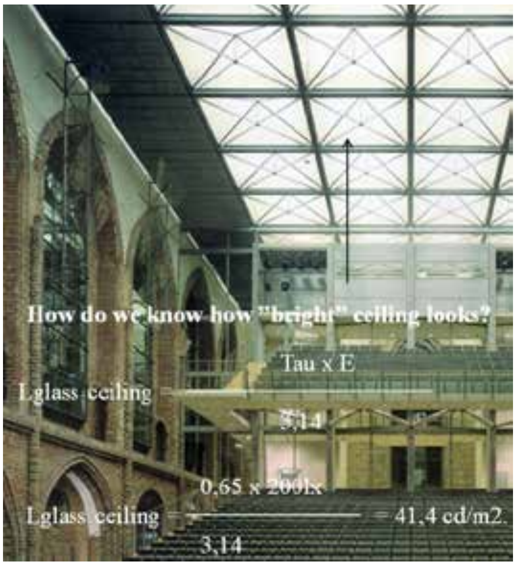


Figure 179. “Brightness determination” using luminance calculation. Photo: PSA Architects.

The glass ceiling is large, but a simple calculation is still advisable to ensure the luminance relations of the room. Multiplying maximum illuminance value (in this case 200lx) by the penetration factor T , (marked “Tau” in the heuristic formula in the photo) and dividing that by π (marked numerically 3.14 in the formula), yield the luminance value of the ceiling. In this case it is very low (41 cd/m^2). For purposes of comparison: The moon is approx. 2000 - 3000 cd/m^2, an urban illuminated black asphalt road surface is approx. 1- 2 cd/m^2 , a Brando luminaire is approx. 330 cd/m^2. A beautiful and harmonius surface.

3.6.11.2. Case: Airport Light Prisms

The Helsinki-Vantaa Airport light prisms are the result of the same lighting calculus procedure as the cathedral at Neubrandenburg. Light prisms may appear very complicated to calculate, but can be solved using the lumen method applied and “the Law of Pragmatic Truth” together. Because this subsection 3.6.11 is devoted the use of the Lumen method, only electric lighting calculus is introduced.

Figure 180. Helsinki-Vantaa International Airport. Architecttural design: PSA architects. Photo: https://www.google.fi/search?q=helsinki+vantaa+lentoasema&tbm=isch

Figure 181. The new EU Hall. The theme of the airport part is a triangle. Photo: https://www.google.fi/search?q=helsinki+vantaa+lentoasema&tbm=isch

The construction sections and elements are all triangles (The green triangle is the new EU Hall, light prisms seen as black dots on the roof of a trienale shaped green EU hall, floor stones, etc.).

3.6.11.2.1.Light Prisms

Figure 182. Independent glowing snow lanterns, ice boulders, ice cubes on the roof of the airport. Same snow lanterns, ice boulders, ice cubes inside the terminal of the airport “. Photo: PSA Architects

On photo pair light “flows” from 400W metal halide lamp luminaires through glass packages onto the adjustable aluminum wings, which are located inside the light prism. From the aluminum wings light is reflected into the EU Hall partly directly and partly by reflecting from the inner part of the light prisms, which creates a glowing ice boulder phenomenon both outside and inside.

The first step is to start to treat these light prisms as huge luminaires.

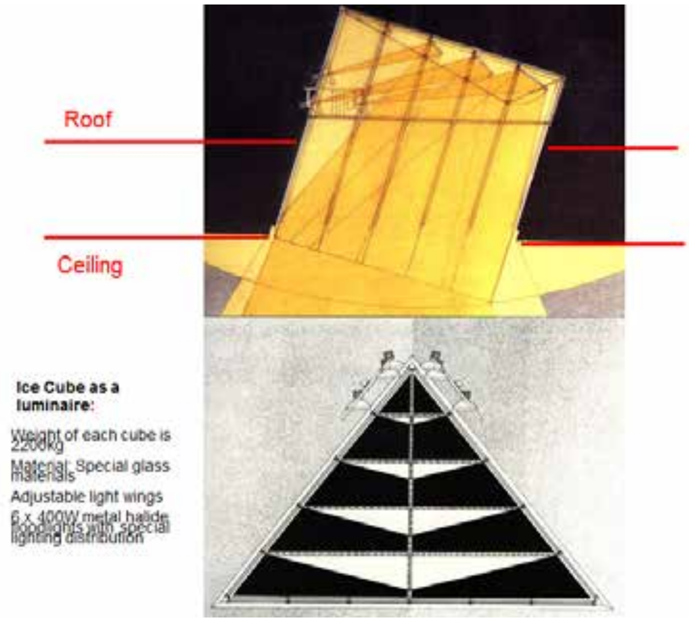


Figure 183. Ice boulders penetrate the roof and the ceiling structures bringing daylight and electric light from outside into the EU Hall interior. Photo/drawing: Vesa Honkonen

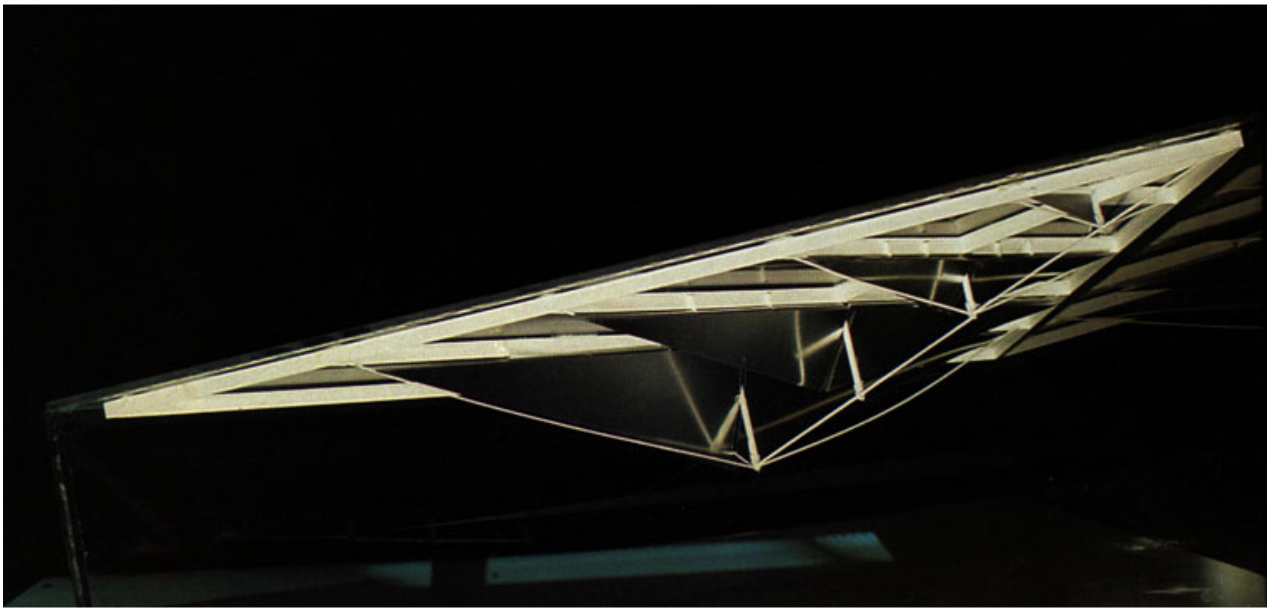


Figure 184. Structure of light wings: Adjustable, aluminum light wings in a scale model of the cube 1:10. Adjustable: Rotation +/- 30 degrees, tilt +/- 60 degrees. Photo: PSA Architects

Figure 185. Aluminum wings in a real-life light prism. Photo: Julle Oksanen

3.6.11.2.2.Computer calculation

The lighting calculation is again based on a train of thought about how much light will be obtained from new light flux values from lamps down to the EU hall floor. In other words: We calculate how much light disappears when in transit via new lamps – air – light prism glass packages – aluminum wings – light prism glass walls – EU hall.

The target is E_h = 200lx, which is the international recommended illuminance value for airport halls and stations generally. The Law of Pragmatic Truth would allow us to use much lower illuminance levels, possibly only E_h = 10-15lx (easy face recognition from a distance of 15m). However, in the case of the airport this airport, the EU hall materials (steel, stone, glass and light) support stronger illuminance values (in contrast to the case of Grand Central Station introduced in chapter 3.6.4.).

Using simple computer calculation programs, like "*DiaLux"*, we calculate the light flux from the lamps to the aluminum wings. All the wings have their "own" luminaires aimed sharply so that maximum light flux reaches the wing. The luminaire had a narrow to wide light distribution.

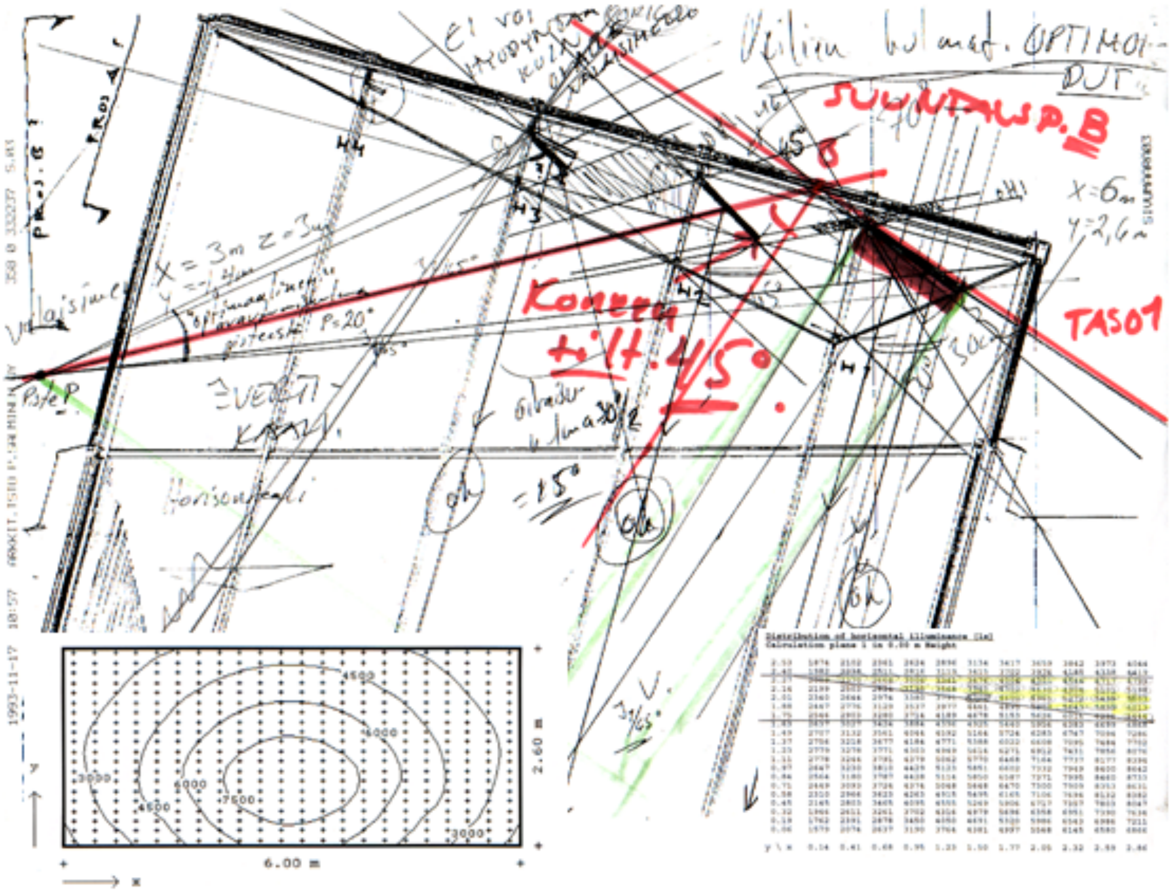


Figure 186. Computer calculus for the largest wing. Photo: Julle Oksanen.

The wing is marked in yellow on the calculation result. The calculation result is the illuminance value E, which is coverted to lumen flux with a simple basic formula: Lumen flux on wing surface = Illuminance value (lx) on wing surface multiplied by wing area A_{wing} .

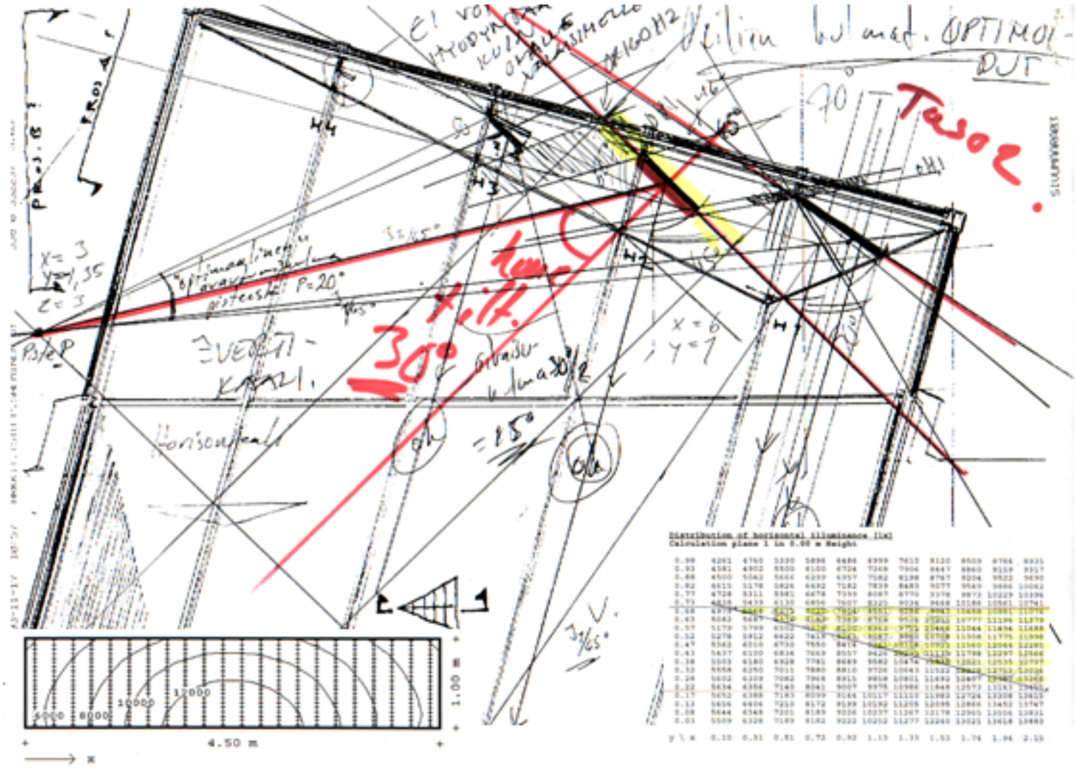


Figure 187. Calculation for a middle-sized wing. Photo: Julle Oksanen

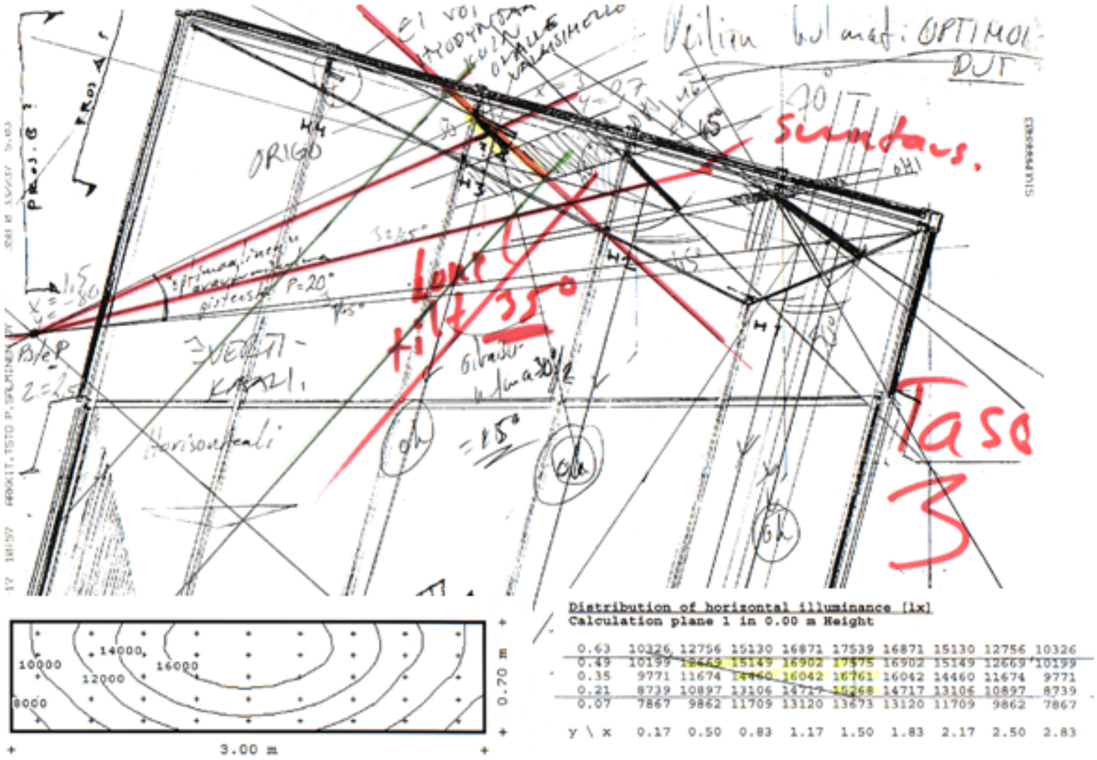
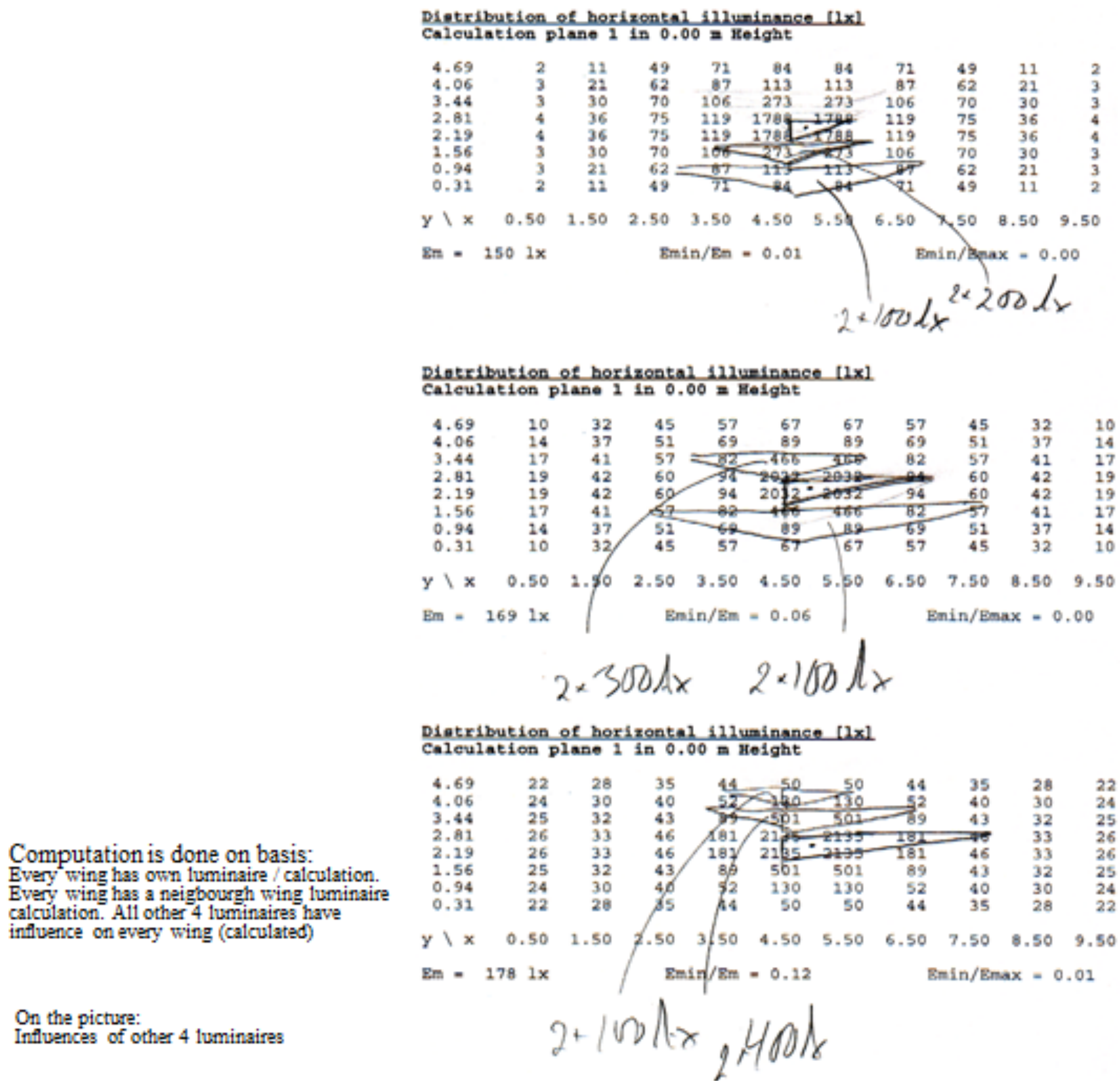


Figure 188. Calculation for a small wing. Photo: Julle Oksanen



Distribution of horizontal illuminance [lx]
Calculation plane 1 in 0.00 m Height

y \ x	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50
4.69	2	11	49	71	84	84	71	49	11	2
4.06	3	21	62	87	113	113	87	62	21	3
3.44	3	30	70	106	273	273	106	70	30	3
2.81	4	36	75	119	1788	1788	119	75	36	4
2.19	4	36	75	119	1788	1788	119	75	36	4
1.56	3	30	70	106	273	273	106	70	30	3
0.94	3	21	62	87	113	113	87	62	21	3
0.31	2	11	49	71	84	84	71	49	11	2

Em = 150 lx Emin/Em = 0.01 Emin/Emax = 0.00

Distribution of horizontal illuminance [lx]
Calculation plane 1 in 0.00 m Height

y \ x	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50
4.69	10	32	45	57	67	67	57	45	32	10
4.06	14	37	51	69	89	89	69	51	37	14
3.44	17	41	57	82	466	466	82	57	41	17
2.81	19	42	60	94	2032	2032	94	60	42	19
2.19	19	42	60	94	2032	2032	94	60	42	19
1.56	17	41	57	82	466	466	82	57	41	17
0.94	14	37	51	69	89	89	69	51	37	14
0.31	10	32	45	57	67	67	57	45	32	10

Em = 169 lx Emin/Em = 0.06 Emin/Emax = 0.00

Distribution of horizontal illuminance [lx]
Calculation plane 1 in 0.00 m Height

y \ x	0.50	1.50	2.50	3.50	4.50	5.50	6.50	7.50	8.50	9.50
4.69	22	28	35	44	50	50	44	35	28	22
4.06	24	30	40	52	130	130	52	40	30	24
3.44	25	32	43	89	501	501	89	43	32	25
2.81	26	33	46	181	2135	2135	181	46	33	26
2.19	26	33	46	181	2135	2135	181	46	33	26
1.56	25	32	43	89	501	501	89	43	32	25
0.94	24	30	40	52	130	130	52	40	30	24
0.31	22	28	35	44	50	50	44	35	28	22

Em = 178 lx Emin/Em = 0.12 Emin/Emax = 0.01

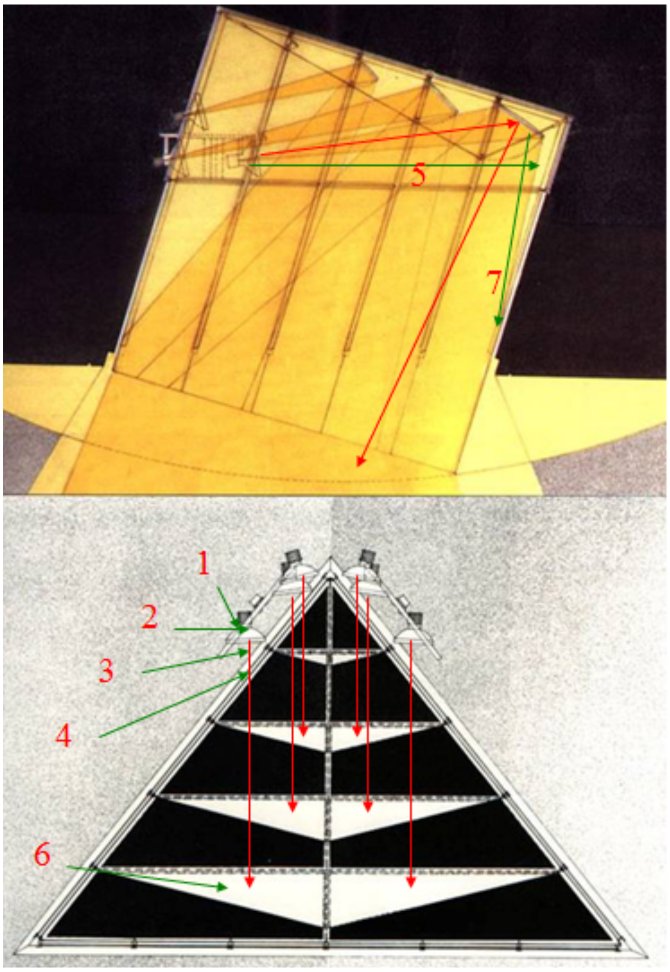
Figure 189. Influence of the other 4 luminaires. Photo: Julle Oksanen.

Not all the lumen flux could be exactly directed to the wing under calculation. Quite a lot of light flux also ran to other wings. Computer calculation was done for this light flux too, because it affects the final result.

The computer calculations were done with computer programs (like DiaLux) which always includes a lamp depreciation factor and the luminaire output ratio, LOR, of the luminaire used. This eliminates the need to find factors for these light losses (as can be seen from the final formula).

3.6.11.2.3.Light losses of light prisms

The next step is to define all the other light loss elements. Now “the Law of Pragmatic Truth” is needed, because there are no scientifically accurate numerical values available in the remaining elements. Air pollution must be approximated according to the area (In China the pollution factor would be greater than in Finland). There are many layers of glass in these huge prisms and the total absorption can be ascertained from the glass designer or by checking the glass manufacturer’s catalogs. Some light passes the wings and that must be approximated by consulting earlier computer calculus results. Wings also “eat” some light, so the lumen flux must be multiplied by the reflection factor of the wing material, when light flux flows away from the wings. That value is called the reflection value and is noted in manufacturers' catalogues. The factor for dirt must also be determined (outer glass material, inner glass material and wings).



1st: **Understand Applied Lumen Method.**

If we could have all new lamp lumens on the EU hall floor surface, calculation would be easy: **Eh** = **Φtotal / Ahall.**

Now we have to check where we loose lumens between its flow from lamps to EUhall.

1) Lamp lumen depresiation = k1
2) Luminaire light loss = k2
3) Airpollution = k3
4) Glass materials absorbation = k4
5) Light which passes the wing = k5
6) Wing reflector = k6
7) From wing to prism glass sides = k7
8) Dirtyness of all elements = k8

ps. Every lightprism have its own area to hadle, so we study 1 lightprism and it's lightproducing.

Figure 190. Heuristic clarification of light losses. Photo: Julle Oksanen & Vesa Honkonen/PSA Architects

3.6.11.2.4. Final formula and results

The final formula is a basic formula for the lumen method: E = Φ / A with the addition of the factors and number of cubes (n_{cubes}) needed, because the total EU Hall area ($A_{gateway}$) was used in the calculation. Another possibility in the calculation would have been to use only one light prism and $A_{gateway}$ divided by the numbers of the light prism.

When the project was complete, the measured Eh average value was 240lx when the lighting design result was Eh average 245lx. That was actually good luck, because there were estimates for factors and lamps which when new have +/- 10% light flux fluctuation.

Final formula:

$$E_{gateway} = \frac{n_{cubes} \times k1 \times k2 \times k3 \times k4 \times k5 \times k6 \left(\sum_{1}^{6} E_{ow} \times A_{ow} + \sum_{1}^{6} E_{nw} \times A_{ow} + \sum_{1}^{6} E_{4ow} \times A_{ow} \right)}{A_{gatewayhall}}$$

where:

$E_{gateway}$ = Average illumination value on the floor of the gateway hall.
n_{cubes} = Quantity of cubes.
k1 = Lamp factor (is in the computer and on the calculated values).
k2 = Luminaire Output Ratio, LOR (is in the computer and on the calculated values).
k3 = Air pollution factor.
k4 = Factor of glass absorbtions (3 different kinds of glass material).
k5 = Reflection factor of the wing material (0,82).
k6 = Absobtion factor of reflections of light between the wing surfaces and the floor of gateway.
E ow = Average illumination value on the "own wing" surface with wings own luminaire.
A ow = Size of "own wing".
E nw = Average illumination value on the "own wing" surface with neighbourgh wing luminaire.
E 4ow = Average illumination value on the "own wing" surface with all other 4 wings luminaires.
$A_{gatewayhall}$ = Area of the gateway hall (calculation).

Calculated value E $h_{gateway}$ = 245 lx.
Measured value E $h_{gateway}$ = 240 lx.

The calculations may initially look complicated, but with common sense and heuristics any designer can use them to calculate lumen method with reasonable accuracy.

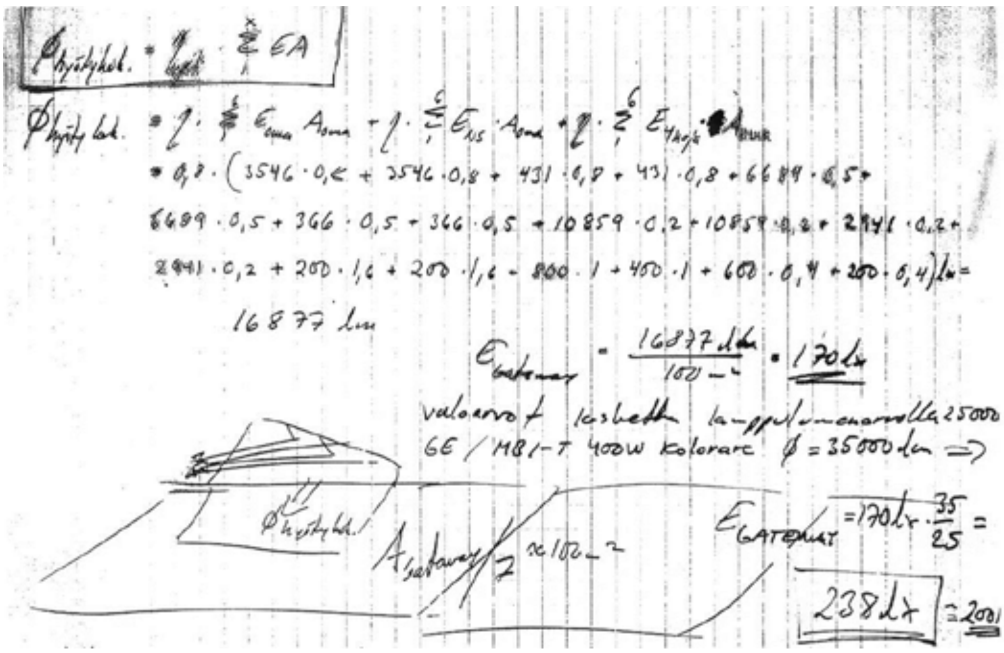


Figure 191. First and original heuristic lighting calculation. Photo and calculation: Julle Oksanen

Conclusion: Shadow design instead of lighting design.

3.7. City lighting master plan strategies

3.7.1. General

Over 95 % of people working in outdoor lighting design projects are self- taught lighting designers. This causes problems at the beginning of the responsible lighting design collaboration in city lighting design. Participants who are partly responsible for city lighting projects are working either in public administration agencies like: town planning offices, electricity utilities, city construction departments, city park maintenance departments etc., or in private companies like electricity design companies, architect offices, landscape architect offices, or various other kinds of consulting companies. Professional lighting design for cities ought to be conducted through "Lighting Master Strategy" lighting design, which requires close collaboration between these actors. There are many reasons why this collaboration does not work properly. Lack of lighting knowhow, visionary differences between engineers and architects, funding problems, etc. These prevent the achievement of successful results. We cannot expect beautiful city lighting solutions before we have well organized and comprehensive, university based lighting design education. According to the architect and lighting designer Gad Giladi's thesis submitted at the Parsons School of Design, New York in the 1980's, lighting education in schools of architecture all over the world provided only one lecture on electricity marks and humble daylight design, or sometimes nothing at all. In the USA most universities have ECS I & II courses, where lighting design is included with acoustic and electricity design. City lighting master strategy design is the right kind of evolution for advanced architectural lighting design evolution.

3.7.2. Lighting Master Strategy for City of North Vancouver

"This project is a prime example of professional co-operation and the right kind of city lighting design. The report is a comprehensive piece of work completed by smoothly collaborating high-quality professionals. Phase 2 "Concepts and Strategies" the report summary of the content of the report stipulates the need for professionalism, collaboration, and the workload:

Report Summary: - "In developing a Lighting Strategy, it is essential to understand night vision - how the eye perceives the effect of light. Adaptation to change and the results of glare affect our ability to see. The night lighting composition must be arranged for maximum impact of relative brightness and color".

One of the primary goals of exterior lighting is to provide illumination to enable distant vision, thus ensuring the ability to anticipate danger. The perception of safety, clarity of circulation, and a sense of place are objectives of improved lighting. Conservation of energy, economics, and maintenance must also be considered. Light that pollutes by escaping into the sky and that trespasses onto adjacent property has become a growing concern.

Existing light in the city of North Vancouver night is mostly from sodium lamp streetlights, designed primarily for vehicular traffic. The effect of light on and in the surrounding environment is not generally considered. From the commercial center at Lonsdale to the waterfront to the wooded hillsides, the city's character should be expressed with variety in the night lighting. Lighting reinforces the movement from major to local streets. Bicycle, bus, and pedestrian routes must also be considered. Light on buildings, monuments and landscape elements adds vertical illumination, gives focus and enhances the city's character at night. To help develop an understanding of typical lighting conditions, four sections of the city are examined in detail.

Not only the street but the sidewalks, store fronts, building entrances and soft landscape comprise the streetscape. The concept for the city of North Vancouver is to develop lighting plans for three typical sections: 1) the Lonsdale main corridor, 2) the primary circulation corridors and 3) the local streetscapes. The strategy is to improve the existing lighting infrastructure and replenish it where it is missing. This is in combination with improvements on private properties. Beyond the street edge, commercial and industrial areas, schools, parks and private developments should follow the guidelines set out in the municipal recommendations. Glare and light trespass must be controlled. With a well-informed private sector, the city will become safer and more inviting.

Recommendations: The city should develop and implement a standard for luminaires on the three basic streetscapes, as defined in this report. On all streets, the existing lights should be replaced with full color metal halide lamps and good glare control luminaires. On Lonsdale, pedestrian scale lights should be added. On the primary and local streetscapes, new lighting infrastructure should be added where required, to fill the existing gaps. Parks should be improved with low glare, post top lighting. Developers, commercial and industrial owners should be required to follow city guidelines for improved building façade lighting and reduced glare and light trespass. Residents and home owners should be encouraged to use porch and property lighting to add safety and comfort to their neighborhoods”. *(Gabriel/design et al. 2001a)*

In this dissertation I will only briefly introduce some material of two reports (those on Phase 1 and Phase 2). This material clarifies the importance of a comprehensive lighting master strategy for cities and towns.

3.7.2.1. Phase 1: Inventory and analysis

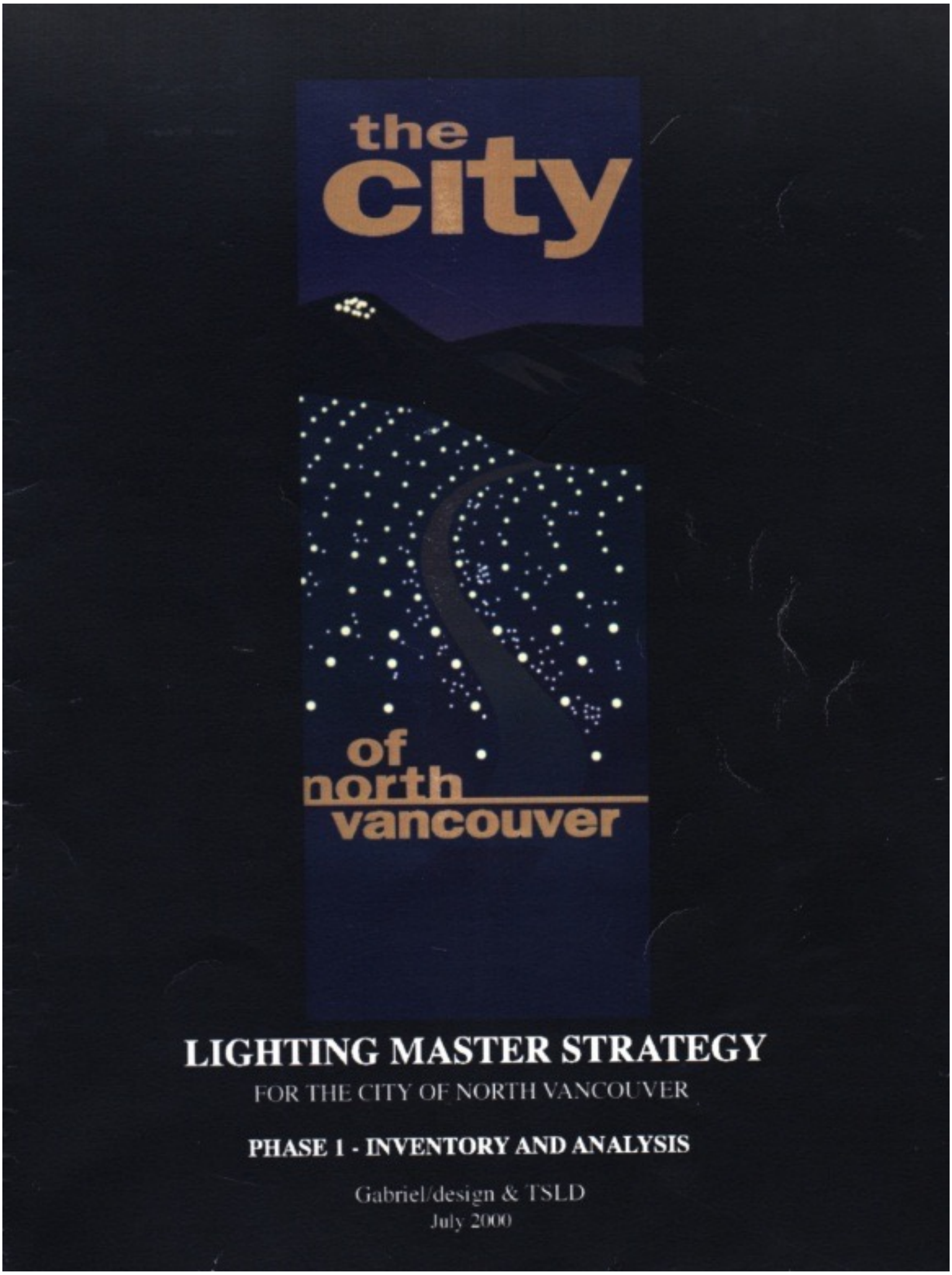


Figure 192. Lighting Master Strategy for the city of Vancouver. Lighting designers Gabriel /Design & Tania Sagoo Lighting Design. Photo: *Gabriel/design & Tania Sagoo Lighting Design, Phase 1 – Inventory and Analysis*

4. INVENTORY

4.1 Existing Lighting Conditions

The majority to the City of North Vancouver is lit with standard "cobra head" street lights, with high-pressure sodium lamps. In the higher density areas they are located close enough to give relatively even light on the roadway. Although this lighting solution is considered standard and it generally provides the recommended illumination to the street, lighting scientists have shown us that the glare and colour of this light is far from satisfactory. In quieter neighborhoods, there is usually one light at the intersection with darkness in between.

Presently, little attention is given to consideration of the interface between public streetlights and the surrounding environment. Lighting for urban spaces needs to include the lighting of surrounding buildings, parking and green space. Coordinated light on vertical surfaces can make a major contribution to the sense of night safety. In the City of North Vancouver today, this important linking element is missing.

Central Lonsdale Day Night

Grand Boulevard Day Night

Figure 193. Lighting evaluation. Photo from the Phase 1 report.

PLAN OF TOWN CENTRE / EXISTING LIGHTING

26

Figure 194. Existing lighting. Photo from Phase 1 report

..all existing light fixtures were located on a plan.

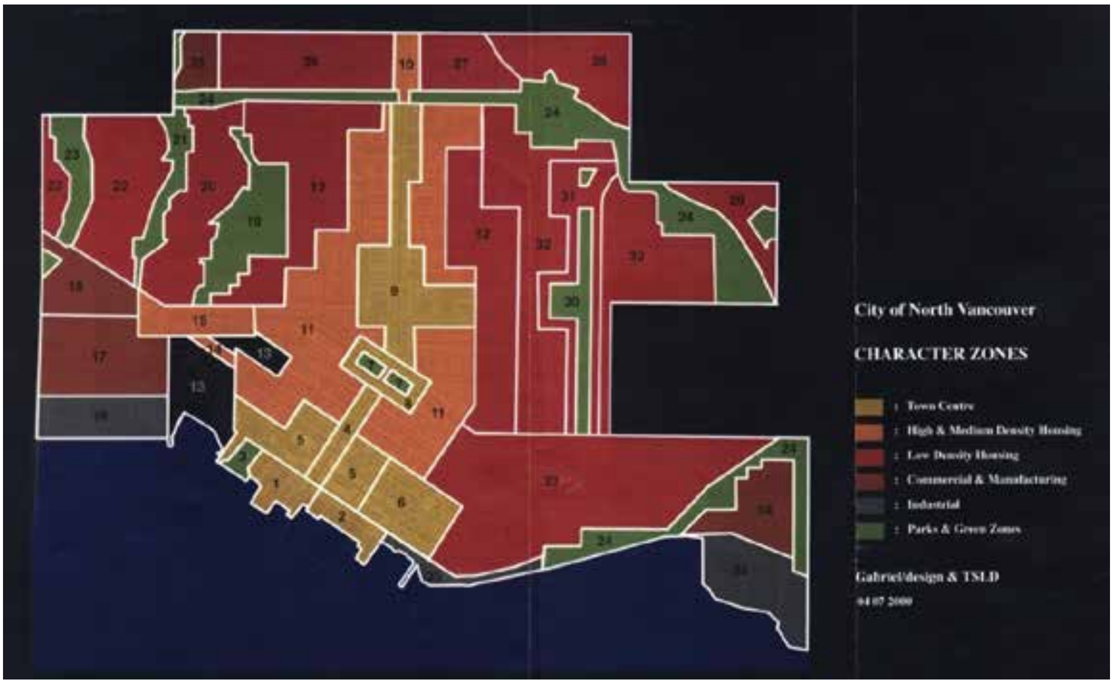


Figure 195. Character zones. Photo from the Phase 1 report

An understanding of the different characteristic areas was developed. From the gold colored busy downtown to the darker red quiet neighborhoods, to the green parkland.

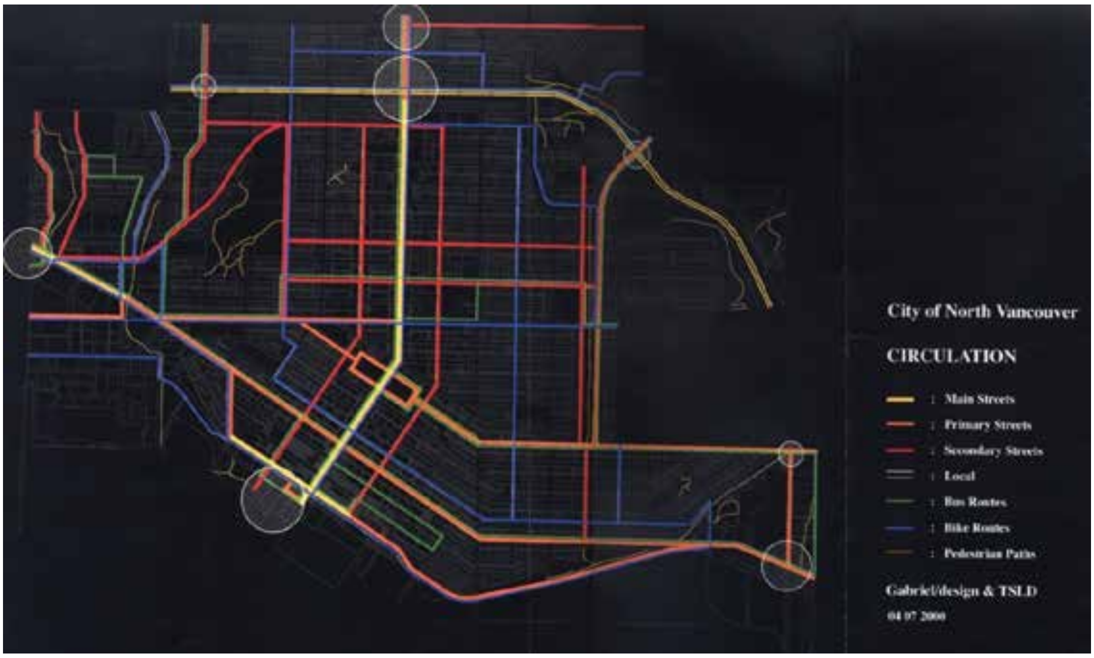


Figure 196. Circulation photo from the Phase 1 report

Another plan was developed to illustrate circulation paths. Bus routes, bike paths, and pedestrian paths are indicated. Entrances into the city are circled.

Figure 197. Night interests. Photo from the Phase 1 report

This plan shows places that will benefit from night lighting by giving landmark recognition. Lit buildings at night help orientation and add a feeling of safe passage.

3.7.2.2. Phase 2: Concept and strategies

“Introduction

This report is the second stage toward developing a Lighting Master Strategy for the City of North Vancouver. In the initial phase, Inventory and Analysis, situations were identified that are typical of the current exterior lighting conditions in the city. The general principles proposed are now applied to more site-specific concerns.

The goal of the Master Strategy is to create a long-term approach to provide a safe, effective, and sustainable night environment for the entire community. The result should lead to a public lighting system and private property policy that will define a positive urban image.

This study is intended to complement the ongoing process of developmental planning currently underway in the city of North Vancouver. All aspects of the Lighting Master Strategy are designed to work in conjunction with the planning, landscaping, and improvement goals of the City”. *(Gabriel/design et al. 2001b)*

Master Lighting Plan

Figure 198. Part of the master plan. Photo from the Phase 2 report

The Master Plan shows the location of the three streetscape types, the routes, and paths. The plan has evolved from previous city studies and the work of this report. It should be considered as a guideline and may be revised as needs and understandings change.

Figure 199. Lighting Strategy Plan. Photo from the Phase 2 report

The Master Plan is coded to show the primary streets in orange and Lonsdale in red. All other streets remain dark. Bicycle, bus, and pedestrian routes are also indicated. Different activity areas, such as commercial, industrial, and schools are color coded. A more detailed understanding will be developed in the studies of the four typical areas.

Figure 200. Street lighting proposal. Photo from the Phase 2 report

The main recommended changes in the town center area are: the additional pedestrian lights on the Lonsdale Avenue poles, new post lights in Victoria Park and along the waterfront, building and grounds lighting at the schools and additional street lights where they are missing. At Lonsdale Quay there is some successful lighting but the authorities should commission a lighting consultant to develop a comprehensive lighting design for the area.

Summary of lighting master strategies for cities:

A good lighting master strategy for cities has many important advantages. It binds city authorities together, like people in the town planning office, the city construction department, the city architects, electricity designers and contractors in the electricity utility, etc. Cities can save money by avoiding overlapping works on same area (e.g. electricity wires into the same excavation with water pipes etc.) when everyone knows in which part of the city the new lighting solution will be build. Cities can also save money by developing a long- term lighting product purchasing plans. Co-operation between design people like architects, electrical engineers, lighting designers etc. can be planned better. All this would create an opportunity to start to work seriously with different kinds of lighting metaphors and heuristics in such a large-scale area and on such a large -scale. (e.g. "whispering lights" for facades, shadow design and compositions for water and natural areas, different white color temperatures for different kinds of streets, general glare avoidance strategy, possibly color lighting for certain buildings etc.).

The kinetic lights of every city, the automotive lighting sector, has also developed quite rapidly, providing opportunities for bold architectural lighting designers and design teams to change overall lighting strategies in city centers.

3.7.3. Development in the automotive lighting sector in 2000–2015

It is important also to study the automotive lighting sector on a wide scale (car lights and road marking) as part of the aesthetical city night- time lighting. Quantitatively (on average) car lamps produce most of the general lighting in cities during darkness. Until now car lights have been aimed only directly forward and down on the road surface reflecting light in an uncontrolled manner. Extra pressure for evaluating automotive lighting as part of city lighting structure has resulted in new, automatized and dynamic car lamp systems. So far technical road lighting recommendations have not addressed vehicular traffic lighting systems at all. Modern dynamic vehicle lighting will change this situation in the future. It is only a question of time. The greatest deceleration problem is luminaire manufacturers, who currently give directions for lighting design. Most of them have high-quality lighting labs and highly educated technical lighting specialists. These engineers form CIE and Illuminating Engineering Societies. Technical lighting design is again gaining strength. It is also important to carefully study the influence of car lamps in city night-time lighting for reasons both technical and aesthetic reasons.

3.7.3.1. General

Modern car lamp technology combined with dynamic vehicle traffic lighting systems development together will radically change road and street lighting in the next few years. At the moment road and street lighting luminaires and poles are the biggest visual elements after buildings in cities and towns. In the near future they will no longer be needed. The entire road and street lighting design will no longer be required. What a paradox: The biggest, and often the only technical lighting design task will disappear. If we do not "activate" architectural lighting design programs at universities, outdoor lighting design may wither away completely if we continue with technical lighting design as accepted practice.

3.7.3.2. Hella Technology with Vision, Audi A6 navigating system and glow in dark road markings in the Netherlands

Hella technology with vision:

Hella was one of the first light-based assistance systems developing companies with dynamic bend lighting function, which was introduced in 2003. In this system, the light modules rotate according to the steering angle, nearly doubling the range of visibility on a curve. This is a very valuable function when car speed is e.g. 80 km/h and a car goes forward 22 meters every second. With this system the driver can earn a lot of proactive time.

One advanced development based on dynamic bend lighting is the Adaptive Frontlight System (AFS). This system uses both the steering angle and the vehicle speed as parameters for illuminating the road. Based on this internal information, a cylinder in the carefully designed Vario X module is used to create various types of light distribution, including town light, country light, adverse weather and motorway light.

The development of the adaptive cut-off line (aCOL) goes one step further. This feature also utilizes data gathered from the vehicle's surroundings to generate the light distribution. A camera detects oncoming traffic and cars ahead, and a stepper motor turns the cylinder of the VarioX module to the required position within milliseconds. This means that the light cone always ends directly in front of oncoming traffic, or just behind the car immediately ahead.

The glare-free high beam function means that drivers can drive with the high beam on at all times. If the camera detects other traffic on the road, the distribution of light from the high beams is adjusted to mask the specific area.

Now used to illuminate broader areas than ever before, LEDs will also perform the opposite function in the future. Targeted spotlighting functions will allow specific illumination of certain types of objects, such as children playing at the edge of the road. This draws the driver's attention to these potential risks ahead of time, enabling faster responses.

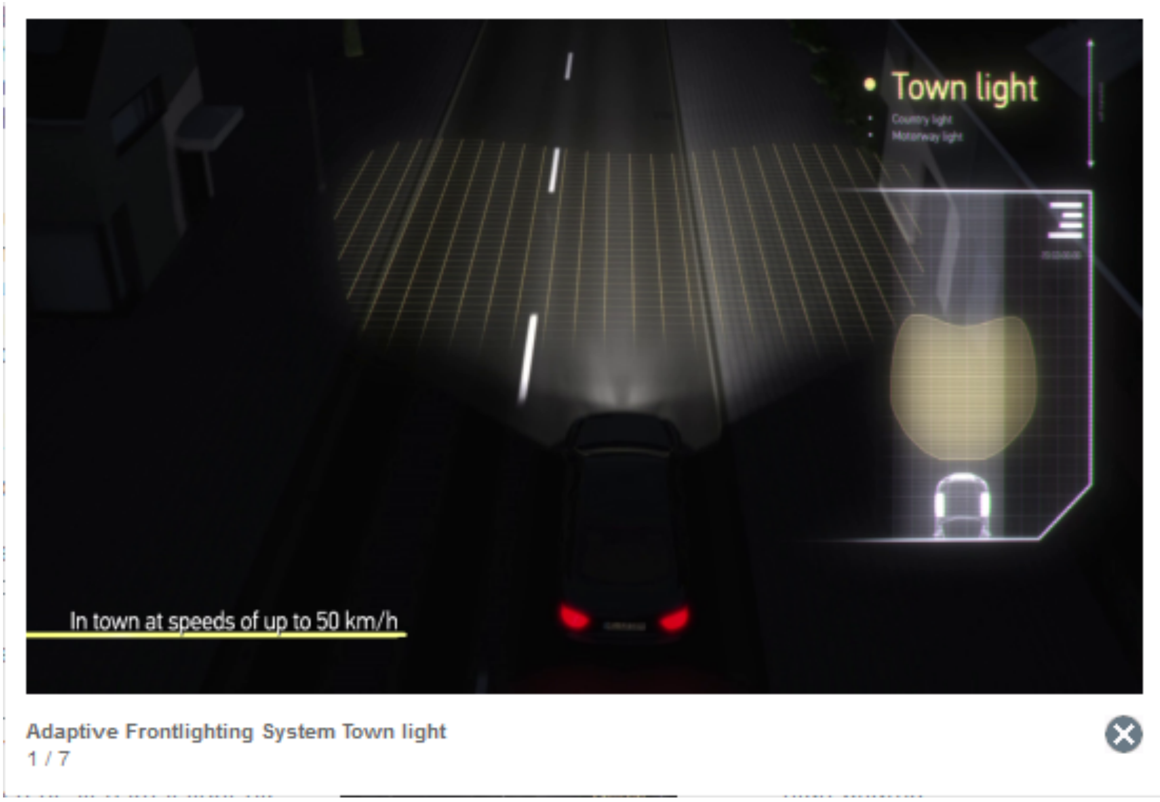


Figure 201. Adaptive Frontline System Town Light. Photo: Hella

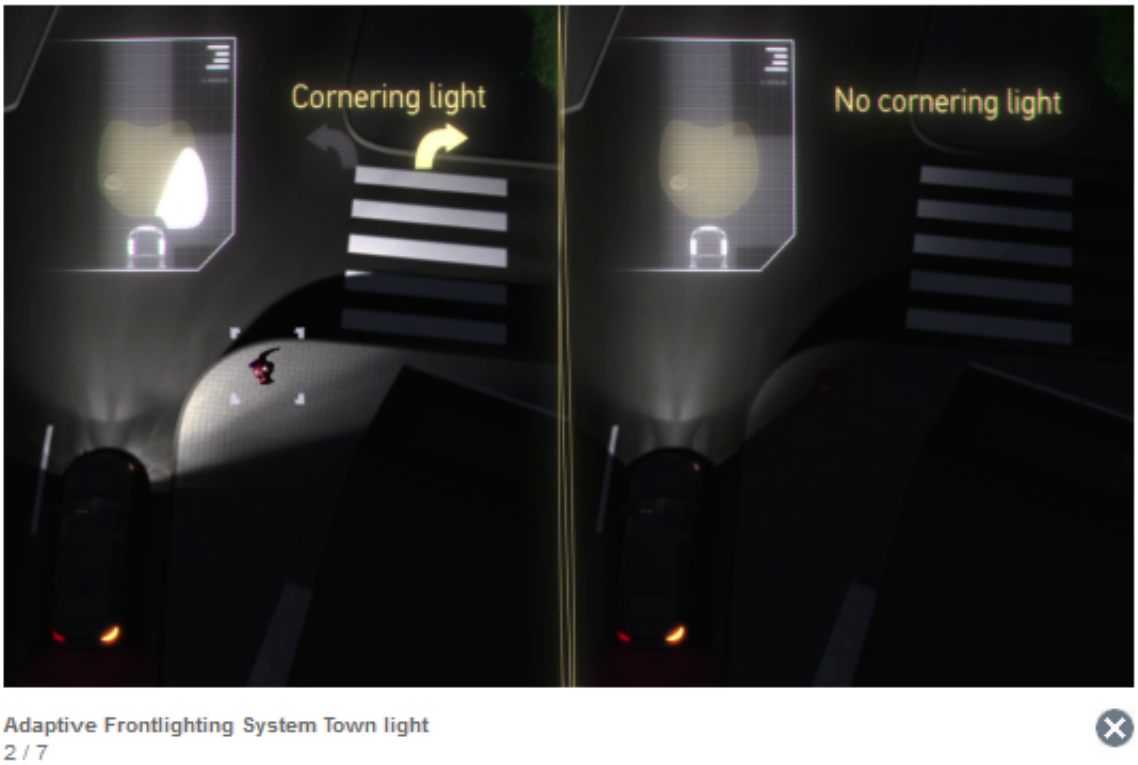
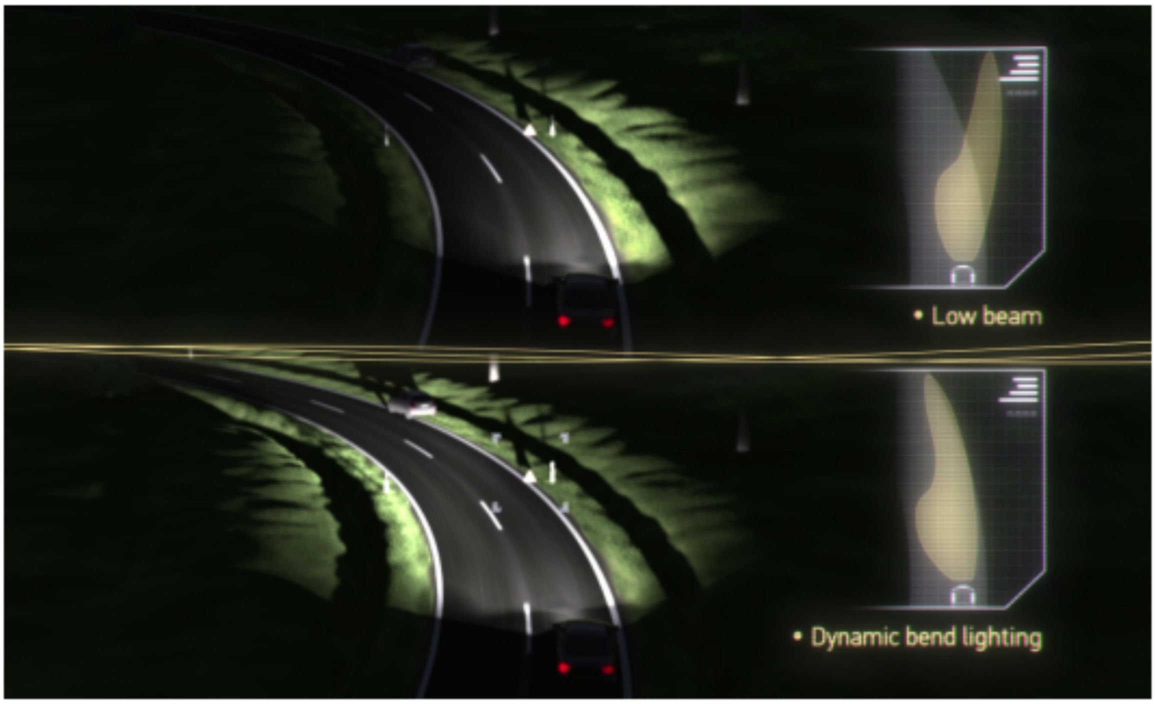


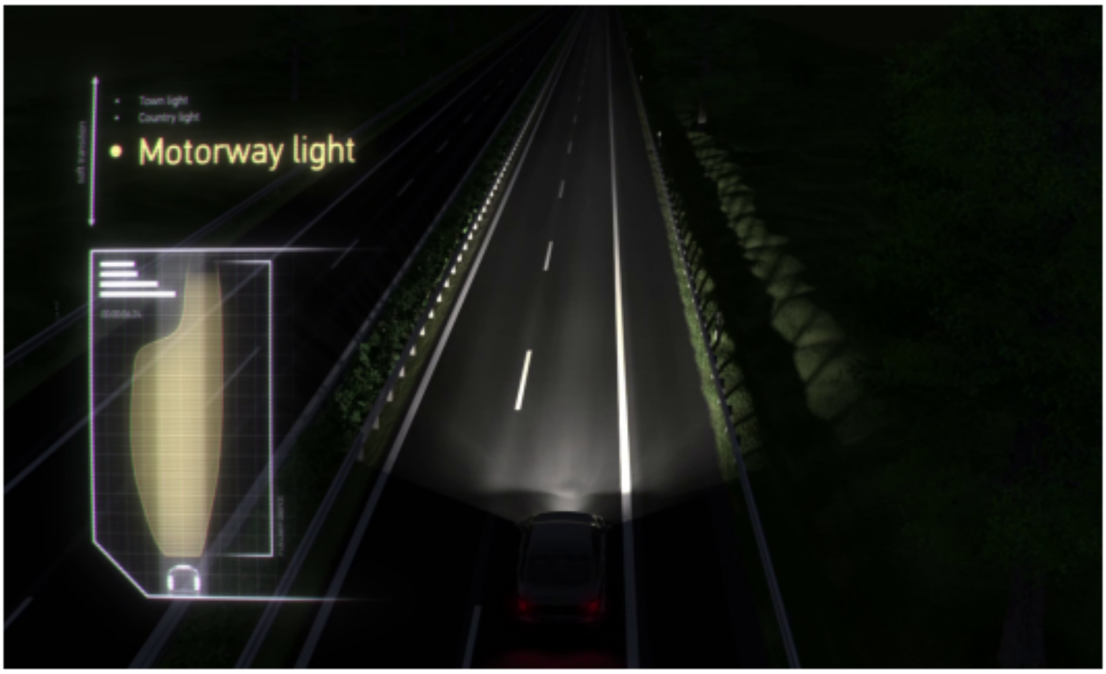
Figure 202. Adaptive Frontline System Concerning Light. Photo: Hella

Figure 203. Adaptive Frontline System Country Light. Photo: Hella



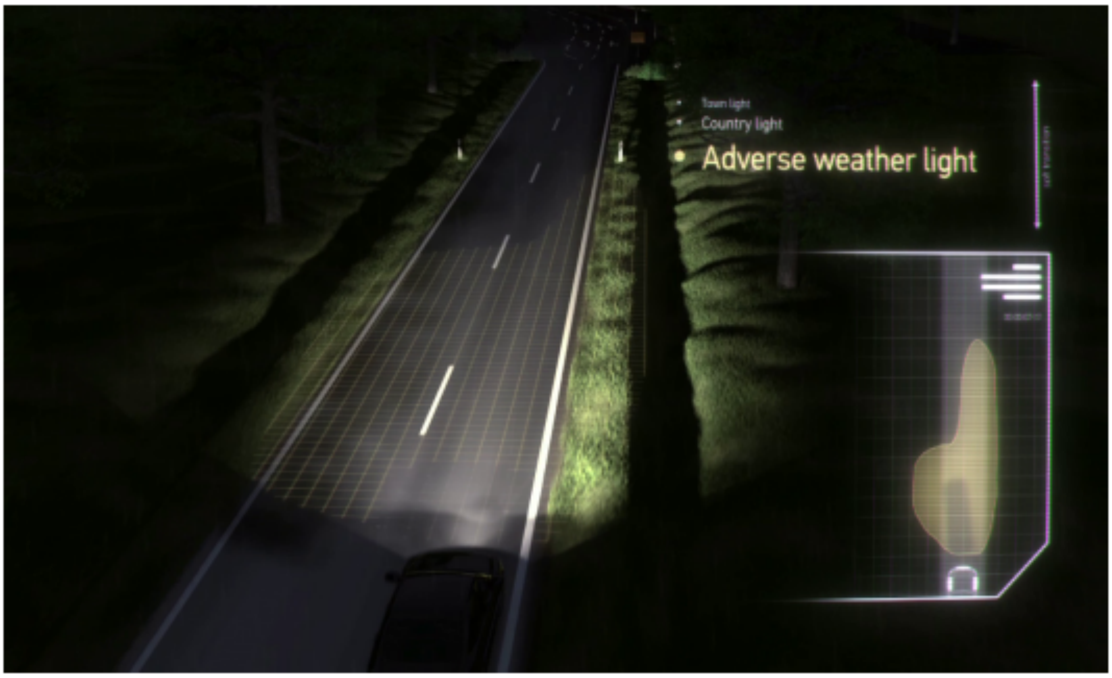
Adaptive Frontlighting System Dynamic bend light
4 / 7

Figure 204. Adaptive Frontline System Dynamic Bend Light. Photo: Hella



Adaptive Frontlighting System Motorway light
6 / 7

Figure 205. Adaptive Frontline System Motorway Light. Photo: Hella



Adaptive Frontlighting System Adverse weather light
7 / 7

Figure 206. Adaptive Frontline System Adverse Weather Light. Photo: Hella

Audi A6 navigating system

When I worked at the Lighting Research Center in Troy, New York, the research personnel were working on a project where car lights were adapted to road conditions. That was in 2012.

“Now the Audi A6 navigation-based light assistance system uses predictive route data to categorize road types – city, motorway, country and junctions – so headlight beam distribution can be adapted for different driving situations.

The city light has a broad horizontal beam, making identifying lateral hazards in town easier. The motorway light offers a wider range of vision.

The country light setting has an asymmetric beam while the junction light switches on dipped beam headlights.

The system can also switch between right and left-hand traffic, triggered by the GPS country code. Mapping data for the system is provided by Navteq, Becker is responsible for the human-machine interface, function programming is done by Hella, while Audi defined the functions for the adaptive light”.

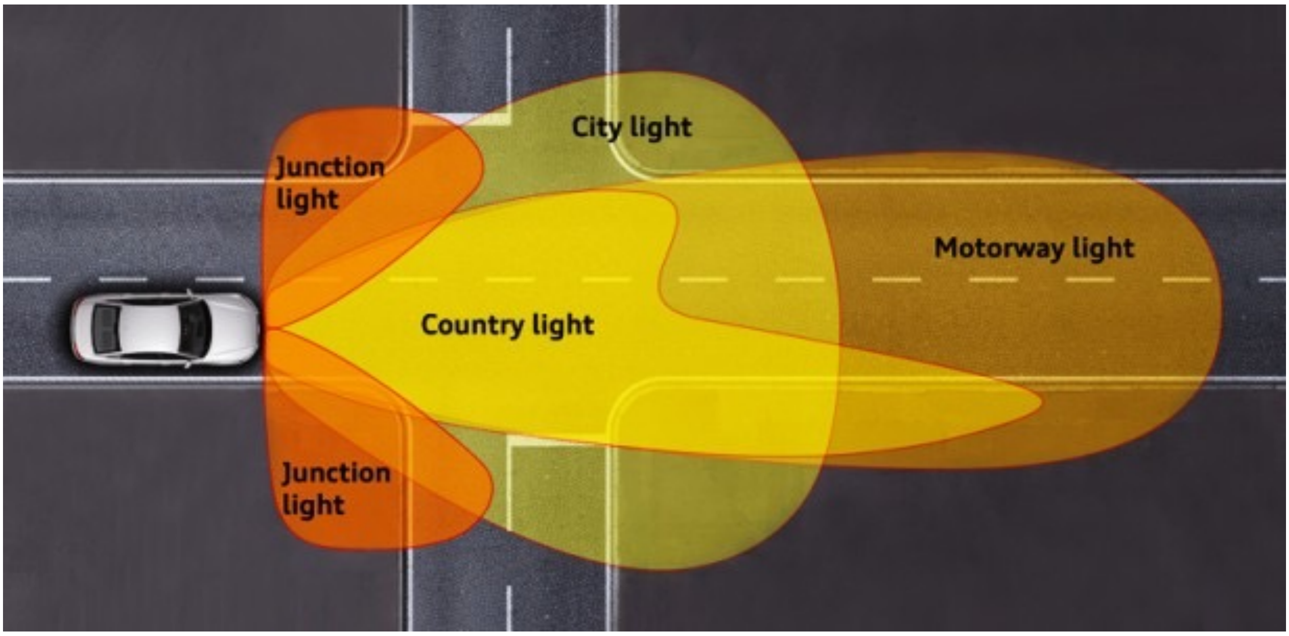


Figure 207. Head light beam distribution adapted for different driving situations. Photo: Automotive engineer.

“

News > Technology

Glow-in-the-dark road markings replace street lights for highway in Netherlands

Experimental project could extend visibility and save money on street lighting „

A practical example:

Figure 208. M9 motorway in Carlow, Ireland with cat's eyes on the road surface and retroreflectors on barriers. Photo: Wikipedia 11.

3.7.4. Lighting Master Strategy for a hypothetical future dream Large Surface Lighting City called “City 2030".

3.7.5. Futuristic “City 2030”

Figure 209. Hypothetical future dream large surface lighting in city 2030: Philosophy and lighting design by Julle Oksanen photo.Oliver Walter and Dan Silberman

Futuristic lighting dream city, “City 2030”, is professionally designed by architects and engineers well trained in lighting. In 2030 all schools of engineering and architecture have architectural lighting design education as a natural and compulsory component on their programs. In 2030 the focus will for a decade have been on quality lighting design instead of “old fashioned” quantity lighting design. Solar energy luminaire elements will be in widespread use and supply free solar energy for road lighting nets with individual inverters during daytime. Large, fully dimmable LED panels, covered with abrasive blasted double glass with light scattering film between will give soft and efficient light in space. Road lighting will have become history and dynamic vehicular traffic lighting systems and “Glow-in-the-dark”-road markings will be in common use in all over the world. Architects will use different kinds of lighting design processes and metaphors daily in their work, leaving the technical details to engineers.

Ambient lighting in the city 2030 structure

Glary road lighting solutions as well as ugly luminaires and poles have changed to modestly glowing large surface emitting planes located in city structures, for example integrated into buildings. Glowing panels are a natural part of city structure and beautification. Light is produced from emitting distribution surfaces equipped with a less than 300 cd/m^2 “Brightness package”. Brightness is 1/100 compared to “old fashioned” road lighting luminaires. Even the surface of the moon looks brighter than City 2030 road lighting solutions (Measured moon luminance 2000–2500 cd/m^2 / Oksanen-Gabriel measurements in Canada and Finland in the 1990’s). All large surface light emitting elements have LEDs as light sources, the upper part of the structure is fully covered with solar panels. They produce free energy for power plants through electricity inverters (marked luminaires 1-11 in lighting calculations annually produce 428000 kWh free solar if the project is in Southern Finland where solar energy availability is 1000 kWh/a). When night falls and road lighting systems ignite normally, the inverters are switched off automatically from the power plants’ remote control rooms. In City 2030 the lighting system produces more energy than consumes. All lighting elements are equipped with “Thinking LED drivers”. When there is no movement in a space, the lighting level can be adjusted automatically to the pre-set luminance value, for example 10%. When moving detectors recognize the movement in the space, the light will automatically increase to the pre-set lighting value (for example, 80% of the maximum). Gradation of shadow design can easily be done using pre-set LED luminaires after installation has been accomplished. Shadow zoning can be done e.g. according to city blocks.

Focal Glow and Play of Brilliants in City 2030 structure

Lighting design teams will have been educated not only to create beautiful shadow gradation zonings in “Ambient Light”- cases, but also to balance the space with the right kinds of “Focal Glow” and “Play of Brilliants” elements. Shop windows and illuminated advertisements will be professionally done. These harmonized elements create a city center of City 2030 like people’s living rooms with beautification accomplished professionally.

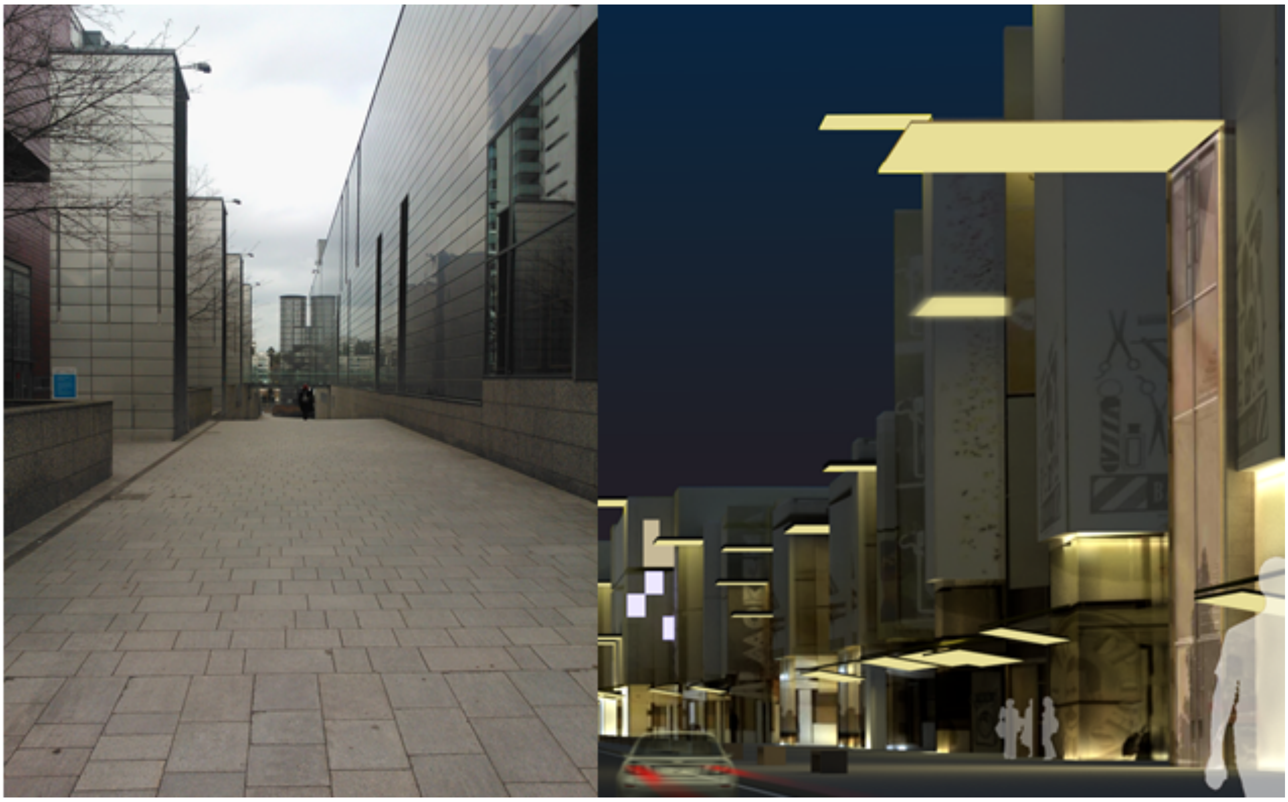


Figure 210. Modern architecture supports large surface lighting solutions. Photo right: Hypothetical Dream City 2030. Photo: Julle Oksanen. Photo left: Leppävaara business area, Espoo, Finland. Photo: Julle Oksanen.

Leppävaara business area, Espoo, Finland includes elements like those of the hypothetical dream City 2030. City structure and building design by the architect Pekka Helin.

3.7.6. Structure of “City 2030”

Figure 211. City 2030 Plan drawing: Design Julle Oksanen. Photo:Oliver Walter

3.7.7. Lighting calculations

3.7.7.1. Calculation area

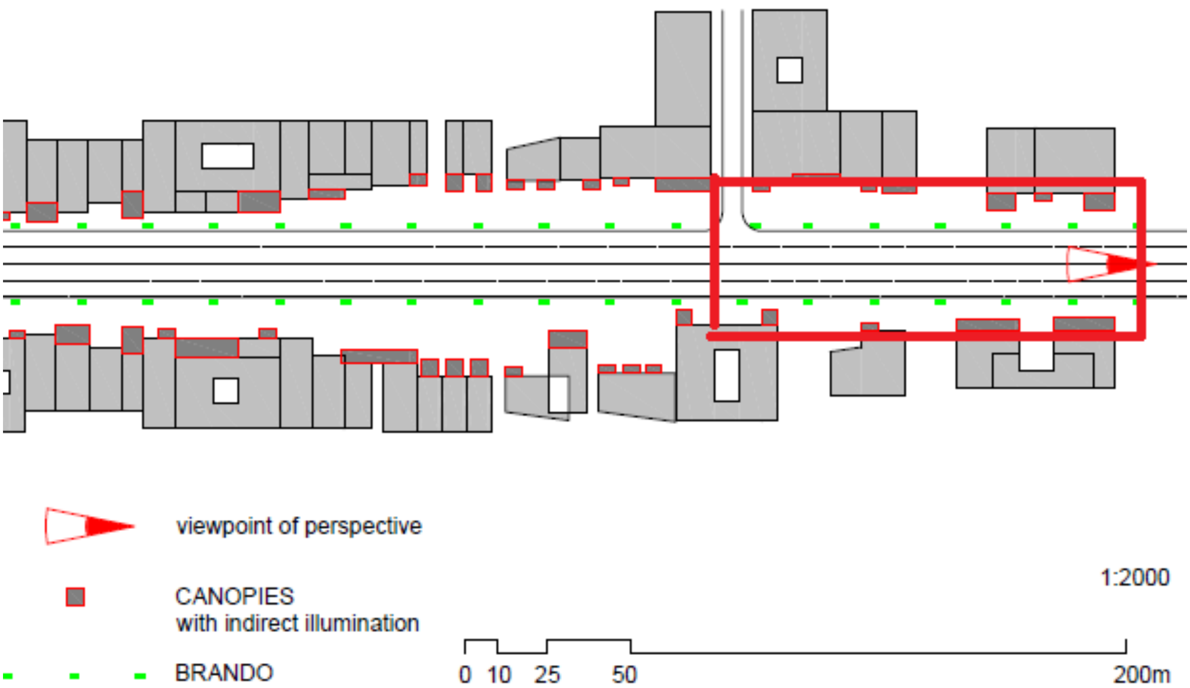


Figure 212. Selected lighting calculation area. Photo: Oliver Walter

3.7.7.2. Luminaires used in the calculation

Figure 213. Simulation luminaire for large surface lighting elements. Photo: ES-System.

The large surface luminaire selected is an ES-System “system FLAT LED” luminaire. In the calculation the emitting area has been enlarged in order to obtain reliable calculation results. The lumen output value in each light element (luminaire) cases 1-11 have been calculated according to the size of the light emitting surface and the luminance value of each light element (1000cd/m²). The light distribution of the simulation luminaire is equal to the light distributions of the light elements. (Totally disruptive).

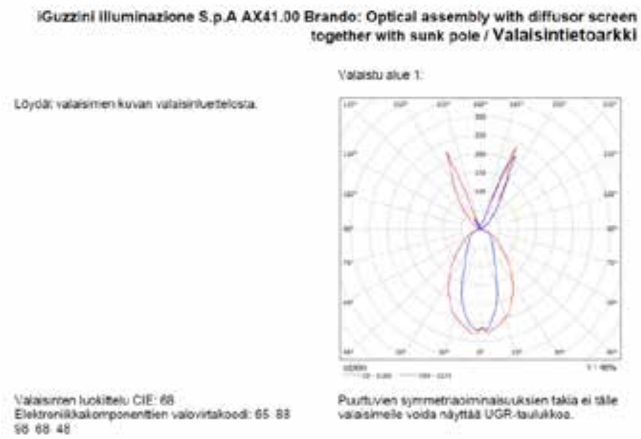


Figure 214. Light distribution for Brando luminaire. Photo: Iguzzini Brando leaflet.

3.7.7.3. Luminaires and basic calculation values

The large surface luminaires selected for the calculation are marked in Figure 215 (Luminaires 1-11 + Brando luminaires in other calculations). The basic luminance value selected for all luminaires in all four calculations is 1000 cd/m². The final "brightness" values of the light emitting surfaces can be determined by multiplying the results of the calculation by the selected luminance value divided by 1000 cd/m². For example: 1000 cd/m² light surface luminance gives 60 lx semi-cylindrical illuminance (E_{sc}). We want average E_{sc} = 6lx on the whole area. This means that we need 100 cd/m² as the final luminance for the emitting surfaces (how bright the surfaces look).

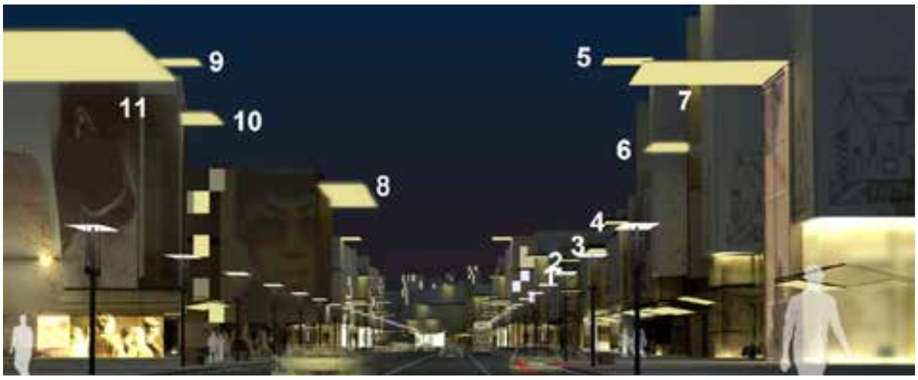
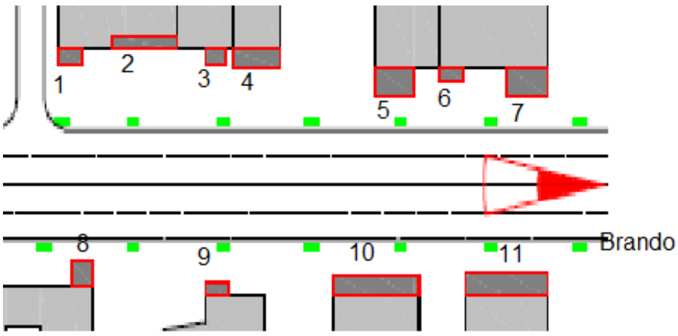


Figure 215. Luminaire numbering in calculations: Design Julle Oksanen. Photo: Oliver Walter and Dan Silberman.



Light element (LE) number	LE area A/m2	LE hight /m	LE luminance L/cd/m2	LE lumen output/lumens
1	10	12	1000	30000
2	40	15	1000	120000
3	10	12	1000	30000
4	40	12	1000	120000
5	60	15	1000	180000
6	10	12	1000	30000
7	60	10	1000	180000
8	20	15	1000	60000
9	18	12	1000	30000
10	80	12	1000	240000
11	80	10	1000	240000
Brando	1,1	5	Values from luminaire data sheet	

Figure 216. Large surface lighting elements and basic calculation values. Only the luminaires mentioned (1-11 + Brando) are included in the calculation. Large surface emitting planes on the lower level and the light from windows are excluded from the calculations.

3.7.7.4. Calculations with basic values without Brando luminaires

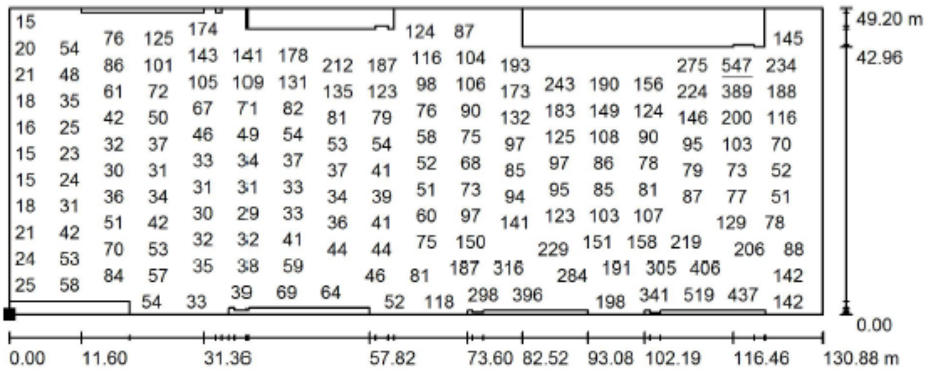
Figure 217. City 2030 without Brando luminaires: Design: Julle Oksanen. Photo: Oliver Walter and Daniel Silberman

Street Project

DIALux
26.02.2015

Tekijä **Engineer** / Pauliina Oksanen
Puhelin
Faksi
Sähköpostiosoite

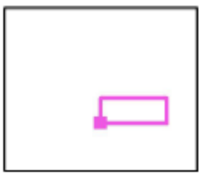
Light elements / Horisontaalivalaistusvoimakkuus / Arvokaavio (E, horisontaali)



Arvot (yksikkö) Lux, Mittakaava 1 : 936

Kaikkia laskettuja arvoja ei voi esittää.

Pinnan sijainti tilassa:
Merkitty piste:
(340.621 m, -140.500 m, 0.010 m)



Rasteri: 128 x 128 Pisteet

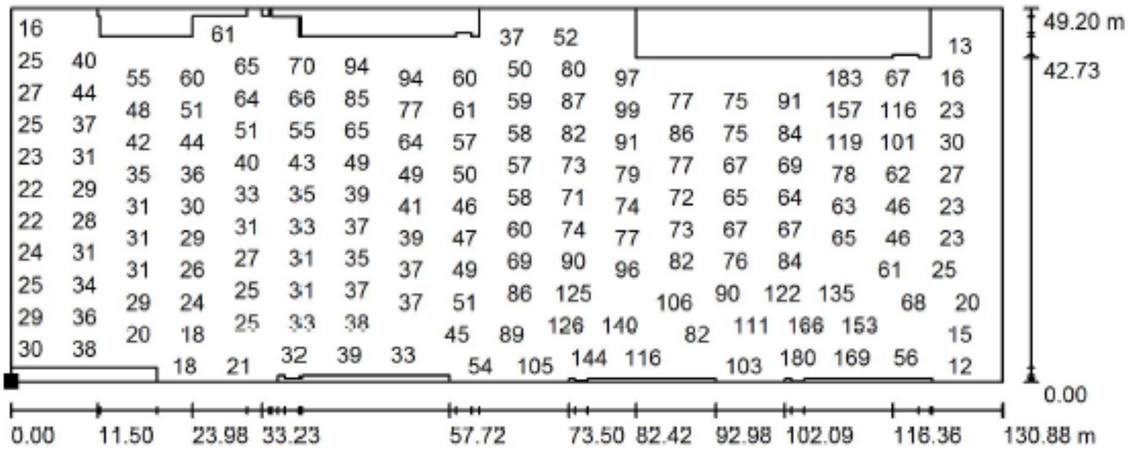
E_m [lx]	E_{min} [lx]	E_{max} [lx]	E_{min} / E_m	E_{min} / E_{max}
109	2.07	547	0.019	0.004

Pyöritys: 0.0

Figure 218. Horizontal illumination values on road and pedestrian surface level. The calculation is done using DiaLux street lighting design calculation program. Lighting calculation by the engineer Pauliina Oksanen.

Tekijä Engineer / Pauliina Oksanen
Puhelin
Faksi
Sähköpostiosoite

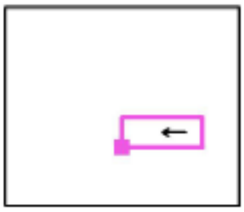
Light elements / Puolisylinterivalaistusvoimakkuus / Arvokaavio (E, puolisylinteri)



Arvot (yksikkö) Lux, Mittakaava 1 : 936

Kaikkia laskettuja arvoja ei voi esittää.

Pinnan sijainti tilassa:
Merkitty piste:
(340.717 m, -140.269 m, 1.500 m)



Rasteri: 128 x 128 Pisteet

E_m [lx]	E_{min} [lx]	E_{max} [lx]	E_{min} / E_m	E_{min} / E_{max}
60	6.11	205	0.102	0.030

Pyöritys: 0.0°

Figure 219. Semi cylindrical illuminanance values (Esc) on average face height 1.5m. The calculation is done using Dialux street lighting design calculation program. Lighting calculation by the engineer Pauliina Oksanen.

3.7.7.5. Calculations of basic values with Brando luminaires

Using Brando luminaires is an option and has little influence on the calculation values because large surface structural lighting emitters are large and they have a lot of lumens (how many liters of light emitters produce). The Brando luminaires in this specific example represent rhythm and human scale.

Figure 220. City 2030 with Brando luminaires: Design Julle Oksanen. Photo.Oliver Walter and Dan Silberman.

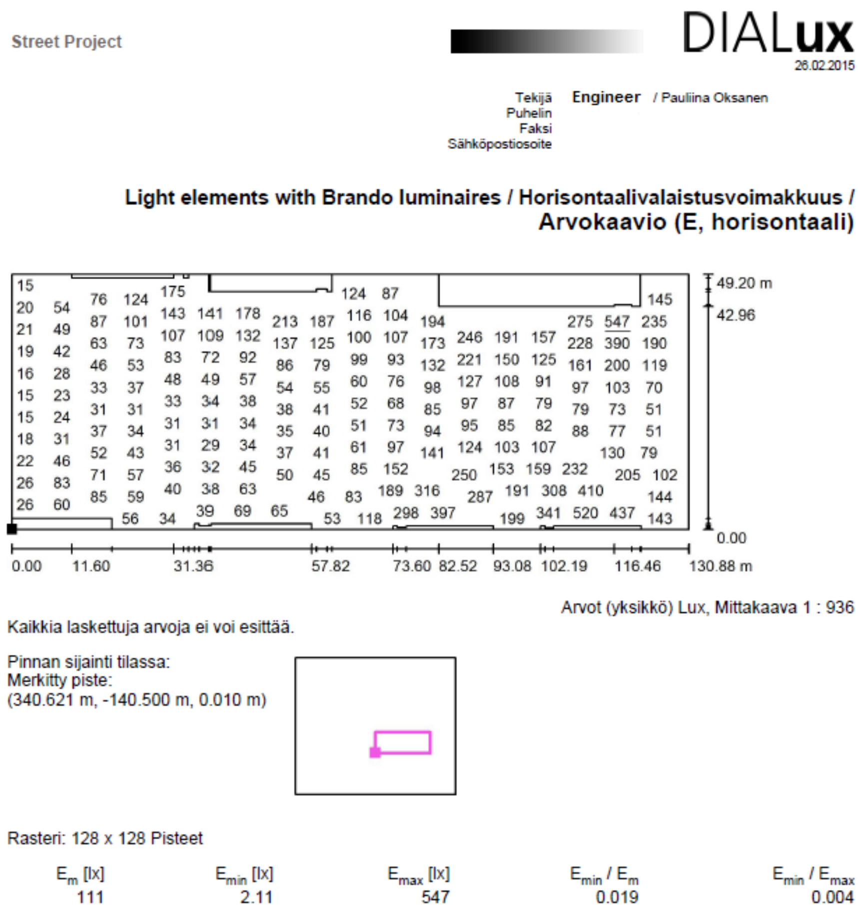


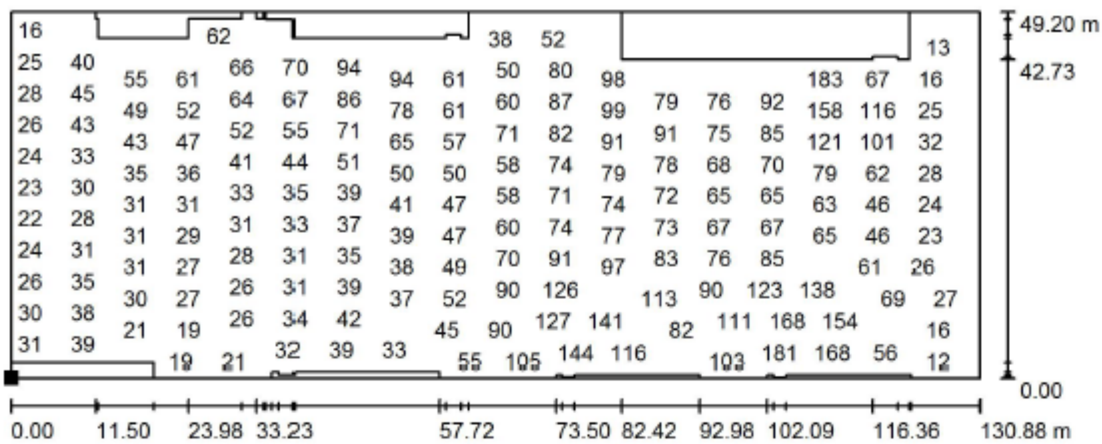
Figure 221. Horizontal illumination values on road and pedestrian surface level. The calculation is done using Dialux Street lighting design calculation program. Lighting calculation by the engineer Pauliina Oksanen.

Street Project

DIALux
26.02.2015

Tekijä Engineer / Pauliina Oksanen
Puhelin
Faksi
Sähköpostiosoite

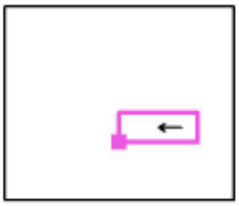
Light elements with Brando luminaires / Puolisylinterivalaistusvoimakkuus / Arvokaavio (E, puolisylinteri)



Arvot (yksikkö) Lux, Mittakaava 1 : 936

Kaikkia laskettuja arvoja ei voi esittää.

Pinnan sijainti tilassa:
Merkitty piste:
(340.717 m, -140.269 m, 1.500 m)



Rasteri: 128 x 128 Pisteet

E_m [lx]	E_{min} [lx]	E_{max} [lx]	E_{min} / E_m	E_{min} / E_{max}
61	6.19	206	0.101	0.030

Pyöritys: 0.0°

Figure 222. Semicylindrical illuminance values at an average face height of 1.5m. The calculation is done using Dialux street lighting design calculation program. Lighting calculation by the engineer Pauliina Oksanen

3.7.7.5.1. Glare calculation and final illumination values for relaxed and enjoyable movement in space. People's new "Living room".

As stated, shadow is the best friend of light and glare is the worst enemy of light. The main and extremely valuable reason for large surface emitting lighting solutions is the combination of total freedom from glare and total freedom of adjustability in shadow gradation. Modern LED technology and intelligent "thinking" electronic control units allow this privilege in practical lighting design solutions. The final lighting value arguments used for City 2030 are introduced in subsection 3.6.9.

“*Meeting in dark/recognition distance and light/minimum darkness in outdoor lighting composition/ contrast* ”. The minimum E_{sc} value is 0.8 lx. This means that 10% of the calculation results in both solutions, with or without Brando luminaires, is more than enough (Esc without Brando luminaires is 6.0 lx and with Brando luminaires 6.1 lx.). This also allows designers to adjust shadow gradations so that an intersection for example has more light than straight stretches of road (even double the amount of E_{sc} means only 20% of the calculated values), and 10% of the E_{sc}- value of the calculations also means that large light emitting surfaces only glow and LEDs last over 100 years without maintenance.

Disturbing glare values are diagnosed by using the formula $LA^{0,25}$

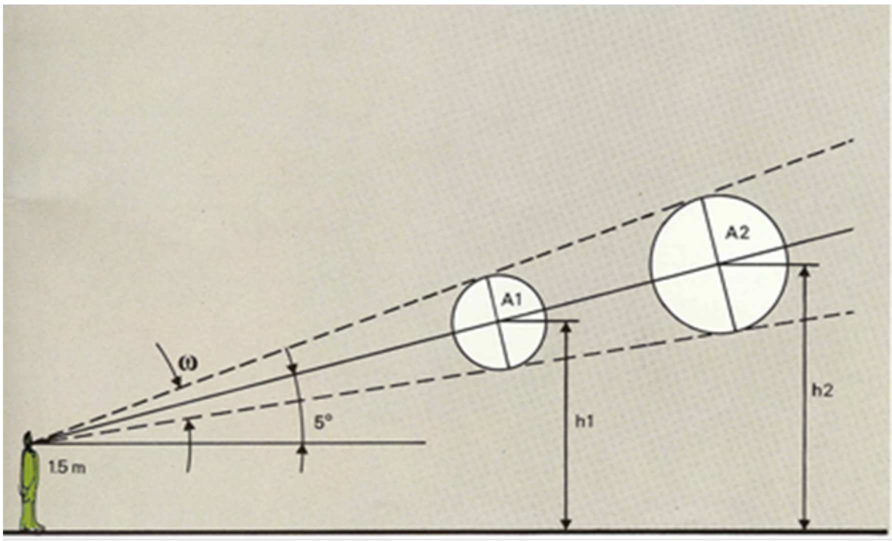


Figure 223. Principle drawing for LA 0,25- value. (Philips ILR 1980 /3)

$LA^{0.25}$

where,

L = measured luminance between angles of 85-90 from vertical (light emitting area of the luminaire light distribution surface),

A = bright luminaire light distribution section.

The maximum values depend on the height of the luminaire:

$LA^{0.25}$ = 1250, h < 4.5m

$LA^{0,25}$ = 1500, 4.5m < h < 6m

$LA^{0,25}$ = 2000, h > 6m.

Light elements higher than 6m means that $LA^{0,25}$ values must be less than 2000.

Calculations:

Figure 224. Luminaire numbering for $LA^{0,25}$ calculations: Design Julle Oksanen. Photo Oliver Walter.

Luminaire	Ara A (m^2)	Hight (m)	Luminance (cd/m^2)	$LA^{0,25}$
1	10	12	100	97
2	40	15	100	137
3	10	12	100	97
4	40	12	100	137
5	60	15	100	151
6	10	12	100	97
7	60	10	100	151
8	20	15	100	115
9	10	12	100	97
10	80	10	100	162
11	80	10	100	162

Sample calculus: Luminaire number 10:

Area seen from an angle of 5 degrees from the vertical:

A projection = A x sin 5

A projection = $80m^2$ x 0.087 = 6.96 m^2

Luminance of emitting surface = 100 cd/m^2

$LA^{0,25} = 100 \times 6.96^{0,25} = 162.4$ <<< 2000 (which is already a great value)

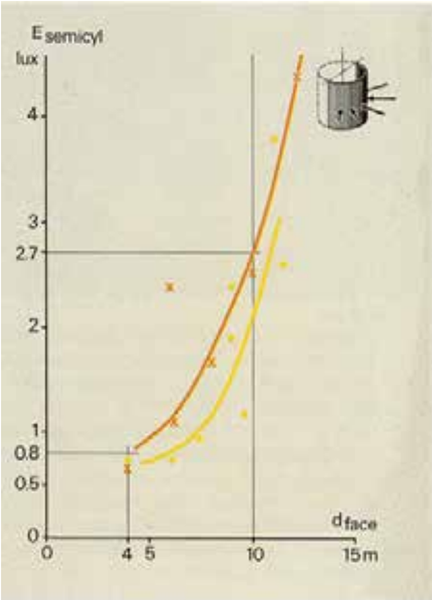


Figure 225. E_{sc} value for face recognition argument when approaching in the dark. (Philips ILR 1980 /3)

In our City 2030 lighting solution the E_{sc} value is 6lx. That means that the distance needed for face recognition is over 15 meters. Relaxed moving guaranteed in “not close zone, > 10m) .

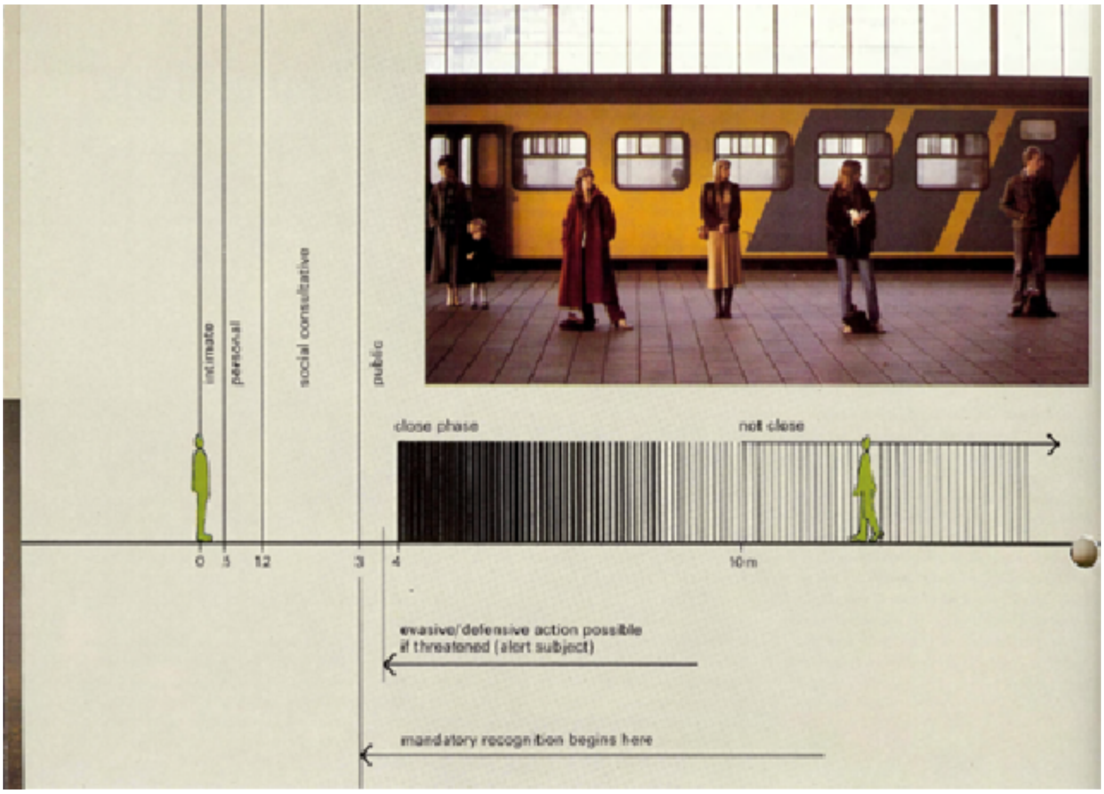


Figure 226. Personal zoning according to research. (Philips ILR 1980 /3). The City 2030 case recognition distance is over 15m >>> mandatory recognition distance 3m.

This “CITY 2030” lighting solution is a new metaphor for light, absolutely fascinating and possibly part of the modern city beautification in future.

3.7.7.5.2. Energy saving calculations using "The Rule of Thumb" (In this case study we have 13 steps)

1st Step:

Hypothesize that this "City 2030" is located in Eugene, Oregon, USA. First a figure for Annual Solar Energy in kWh/m^2 /Day is needed. According to Figure 207, this is 6kWh/m^2/Day/Year

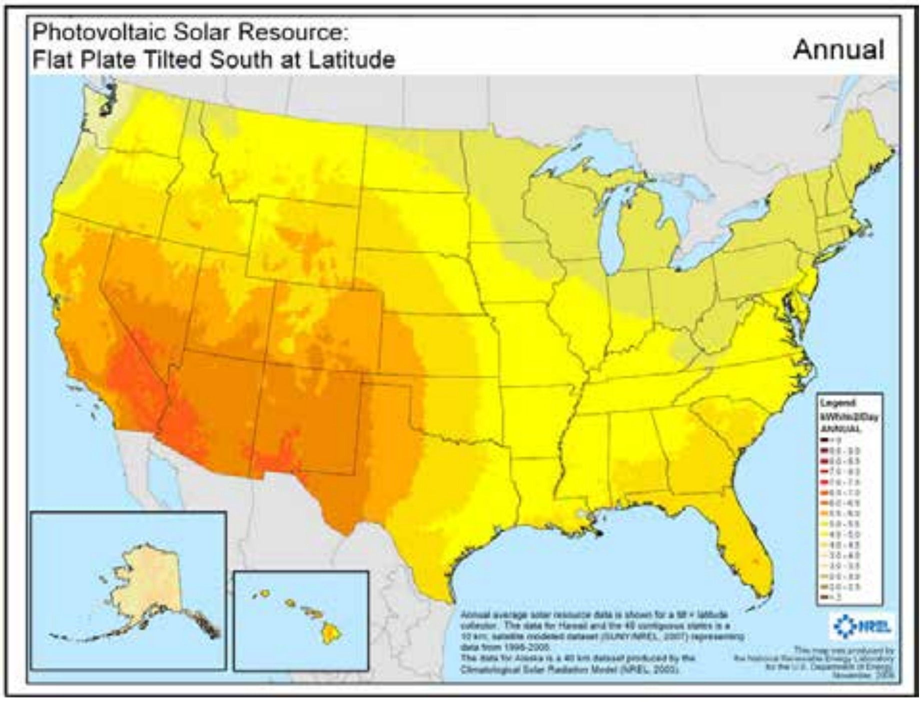


Figure 227. PV Solar Radiation (10 km) Static Maps (1998 to 2005 data). Photo: U.S.Department of Energy 2008.

2nd Step:

Calculate the total area of solar panels on the calculation area (includes the first 11 large surface luminaire areas). A= 420 m^2

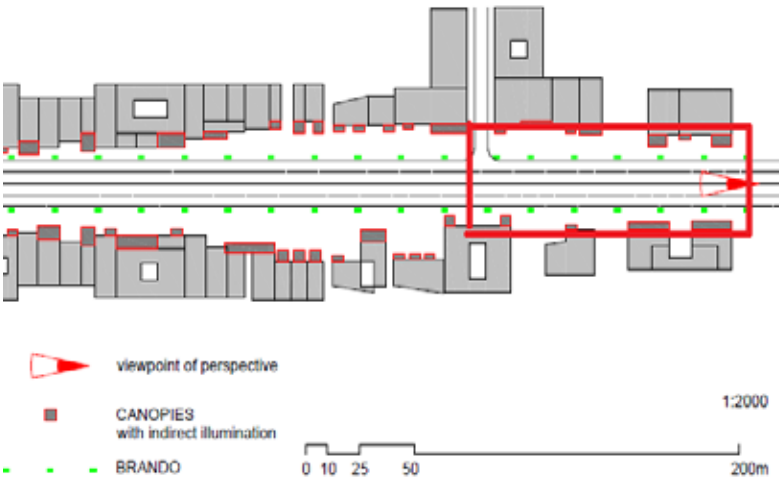


Figure 228. Calculation area. Photo: Oliver Walter.

Figure 229. Numbered large surface luminaires 1-11. Photo: Oliver Walter.

Luminaire	Ara A (m^2)	Height (m)	Luminance (cd/m^2)	$LA^{0,25}$
1	10	12	100	97
2	40	15	100	137
3	10	12	100	97
4	40	12	100	137
5	60	15	100	151
6	10	12	100	97
7	60	10	100	151
8	20	15	100	115
9	10	12	100	97
10	80	10	100	162
11	80	10	100	162

Total area 420 m^2

3rd Step:

Calculate the total annual solar energy / day with these 1-11 large surface solar panels.

6kWh/Day/m2 x 420m^2 = 2520 kWh/Day.

4th Step:

Calculate the total electrical power and energy for LED panels, which produce the needed lighting level in the calculation. The formula is:

$$L = \frac{T \times \Phi / A}{\pi}$$

where:

L is the luminance of the LED panel surfaces (100 cd/m^2)

T is the penetration factor of the LED panel glass (0.5, 50% of lumen flux penetrates the glass)

Φ is the total lumen flux that flow on to the inner parts of all glass surfaces (must be calculated).

A is the total area of LED emitting surfaces ($420m^2$)

$\pi = 3.14$

After simple calculation, the total lumen flux from all LED luminaires that flows onto the calculation area is, $\Phi_{total} = 263760$ lm

Because the LED efficiency is 50lm/W, the total electric power is 263760lm / 50lm/W= 5275 W

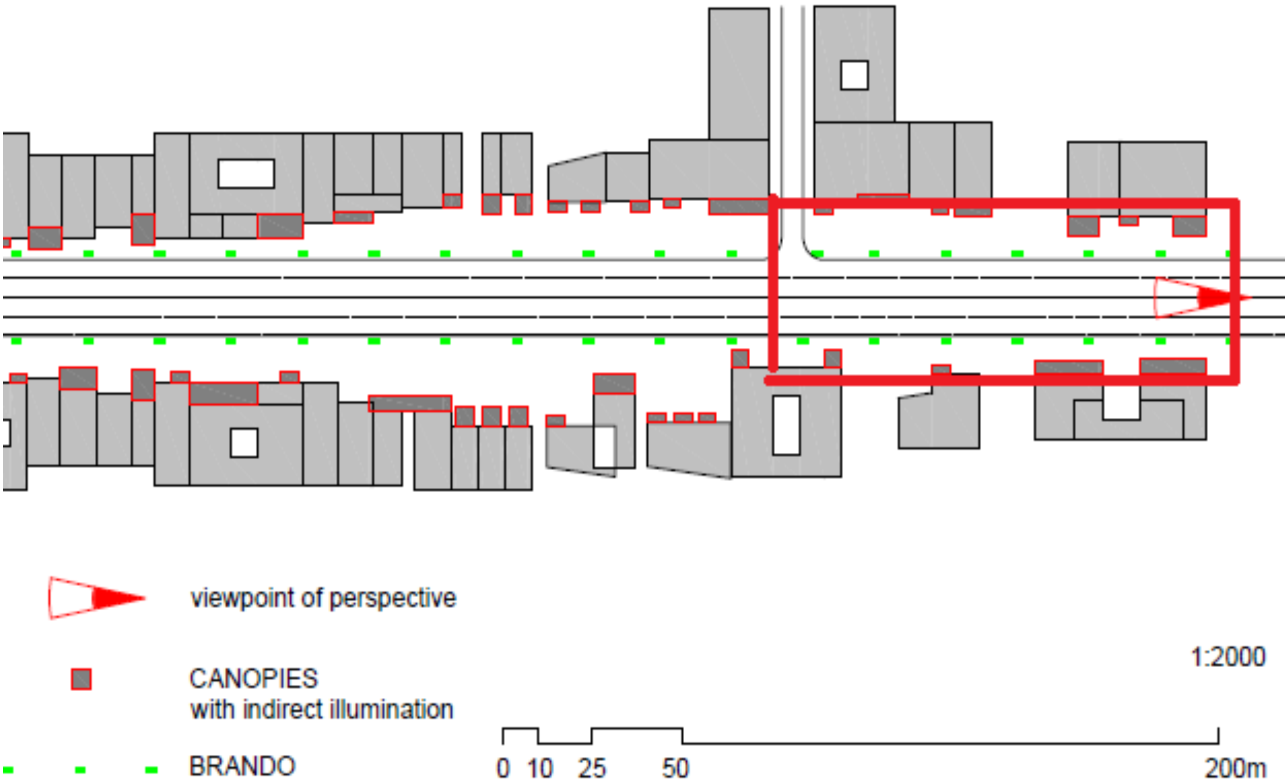


Figure 230. 5.3 kW is needed for LED panels located in the calculation area (marked RED). Photo: Oliver Walter.

The lights are on 10 hours/day. Thus the energy needed is 53 kWh / Day / Year

5th Step:

The energy for lighting and how much is left over can now be calculated. The total solar energy was 2520 kWh/Day and the lighting needs 53 kWh/Day. This means that 2467 kWh/ Day is free to be returned to the electricity grid from the area calculated.

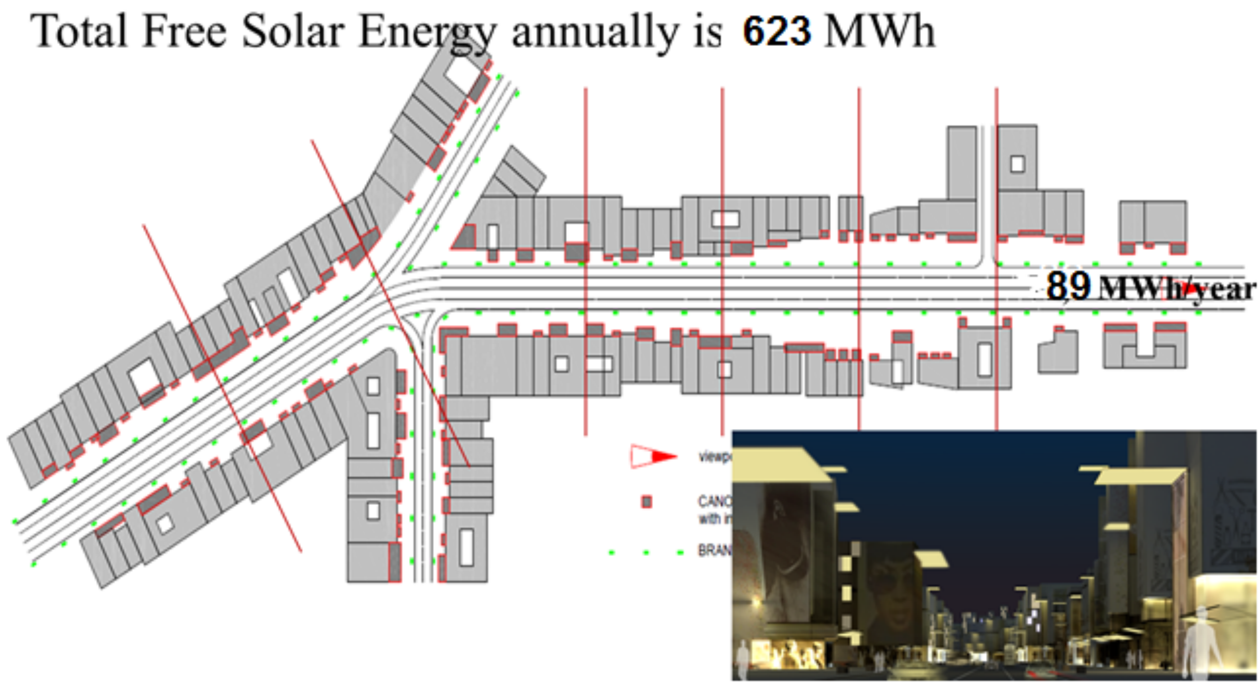


Figure 231. Energy calculation zones. Photo: Oliver Walter.

This project is not only a large surface luminaire project, but also an "ELECTRIC DAYLIGHT PROJECT". (7 zones x 89MWh/zone = 623 MWh)

The system efficacy when supplying energy from a modern solar panel system to the electricity grid is approximately 25%. This means that, heuristically calculated, this whole City 2030 project annually yields 155 MWh free solar energy after part of it has been used on the lighting system.

Figure 232. Caravaggio: The Incredulity of Saint Thomas 1601-02; Oil on canvas, Neues Palais, Potsdam.

4. ARCHITECTURAL OUTDOOR LIGHTING DESIGN CONCEPTS

4.1. General

The lighting design concept is the most important lighting design tool in a creative and successful lighting design process. Without a full understanding of the importance of this tool, city beautification using light is only a matter of luck.

The concept is the most important design element and tool in any lighting design project/process. The concept consists of a the great unknown + personal semiotic connections + ideas + the collective creativeness of the designer/design team. A concept may be created in minutes or it may take a year, depending on how much creativity is accumulated in the designer's or design team's brain and how it can be ”pulled out” together to serve the design task in real life . The lighting designer collects an idea library in his/her brain in the course of professional practice. When a project starts, the designer or the team members together put forward ideas, which are evaluated and the best one is selected to become the concept. Lighting design concept brainstorming can be conducted alone or in a team. When the concept is ready, it ought to be introduced to the right representative of the client (a creative person who understands design). Normally after this presentation the real design work starts with the ”Master Plan” design phase. There are five different conceptual design approach levels which depend on the designer's skills. The nature and special demands of the space also determines the conceptual focus.

4.2. Different conceptual design approaches: Five levels of comprehensiveness

4.2.1. Level 1: *Thought free*

Of course some people who practise design lack a new 'idea'. They see a 'design problem' and apply a 'solution' from their past experience or refer to a 'handbook' for a formula that seems to address the “problem”. There may be a concept involved in this approach, but can it be called 'creative' or with a capital 'D' 'Design'? Probably not, but many designs are not creative. This may be appropriate for a specific project, but 'capital D Designers' are looking to be challenged to find new solutions to some aspect of newly defined needs. It is this 'Design' process we will look at here. Simply following standards and codes can lead to what the lighting designer, Howard Brandston calls a ‘thought-free process’.

Generally this is a process many people use: – define the problem – apply the science – light the space. Usually this is a process of applying calculations and meeting specific quantitative needs. But quality, intuition, and feeling are required for success in most lighting applications. This may not really be a “thought free process” but it is usually devoid of feeling.

Figure 233. Office lighting. Photo http://www.lightsideimages.com/wp-content/uploads/2016/02/office-lighting-2.jpg

4.2.2. Level 2: *Ideas from past*

Gathering ideas from past examples: Many designers, when they have a particular need to meet, for example, lighting a restaurant, will go though their memory, or more likely books and magazines (or the web) and look at examples of restaurant lighting that they like or think would be appropriate for the project. Often they assemble these images and present them to the client as inspiration for their project. At worst, one or more images are chosen and fitted into the restaurant design. Usually these past examples provide the concept for the design and once the idea is applied, it often transforms into an adequate, but probably not imaginative solution. At best, an image of a past project or work of art can provide inspiration for a creative solution. This is at its best when it is recognized with due homage to the original creator.

Figure 234. Photos: Julle Oksanen.

4.2.3. Level 3: *Analytic approach*

This design process – a series of analytical sketches or ideas unfolding in a progressive order - is probably the most commonly taught and used design process. It often leads to a very successful and sometimes a creative result. When the criteria are understood the designer begins a series of drawings, usually giving form to many optional preliminary solutions. These early ideas come from some intuitive sense and reference to past experience. Often the early concept sketches are discussed, evaluated and edited until there is a consensus on best options.

Ideas are then further developed and checked against the criteria to find the 'best' concept. Sometimes, a new idea 'comes up' and over powers the favourite up to that time. This may come from the same designer's growing involvement with the design or often from input from another member of the design team.

Generally, this is an ordered layered process, generating lots of ideas, and using a combination of logic, intuition, and experience to arrive at a preferred concept.

These pictures show the results of the analytical process, combining technical and aesthetic requirements for a corporate control centre.

Figure 235. Control room. Photo: Philip Gabriel.

4.2.4. Level 4: The *Gestalt approach*

The analytical approach could be considered part of a 'Western' (European/American) cultural approach. It is a somewhat scientific, linear and trial-and-error method. For some designers in the 1960's and 70's the influence of Carl Jung and 'Eastern' philosophies, brought another design process to our attention. Jung explained how the Eastern' way of non-linear thinking involved, more being in the moment. All the influences on our experience move together at a point in time to bring us to new realizations. We can gather a knowledge of or intimacy with a situation and a total or "Gestalt' understanding takes place and we see the total appropriate response.

John Lennon spoke of the differences in the creative process after producing the "White Album". The previous album, the groundbreaking "Sergeant Pepper's" had been created in the 'Western' process of many different 'sketches', variations, judgements and tries, until after hundreds of gruelling hours in the studios, the work was finished. Each song took many days of trial-and-error and many discussions.

For the “White Album”, the band spent hours together, sharing feelings and musical thoughts, without any particular direction. At some moment, they would agree on a vague notion and start playing together. Most of the amazingly creative songs were recorded on the first try.

What does this mean to a lighting designer? The process is one of restraining and not giving form to the design until all the criteria and analysis have been thoroughly digested. It means waiting until the form becomes apparent and only then putting it on paper. This is a process worthy of development. When the design is given form, the results usually prove to be appropriate and often quite creative.

Figure 236. Beatles “Sgt Peppers’s Lonely Hearts Club Band” album. Photo: Wikipedia 12

4.2.5. Level 5: The i*ntuitive unconscious / super-conscious approach*

This intuitive/ super conscious form of creative process does not seem to be accessible to many, and those that are successful may border on genius. But it is important to know that some of the most creative designs have come to the designer – in a moment, sometimes in their sleep. Frank Lloyd Wright talks about having a ‘vision’ of the Guggenheim Museum – seeing the complete building at once, in full detail.

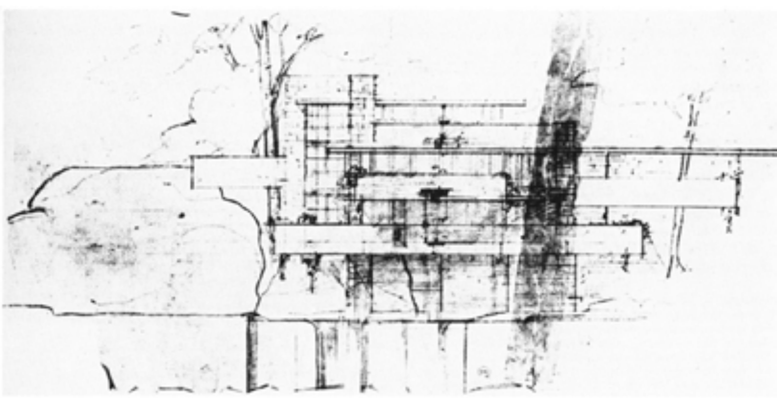



Figure 237. “Falling Water” Photo: Frank Lloyd Wright’s first sketch for ‘Falling Water’.

Figure 238. And the famous picture of it, as it is today. Photo: Unknown.

Another design example of this intuitive/ super-conscious form of creative process is the architect Steven Holl's Nelson-Atkins Museum of Arts (NAMA) project in Kansas City, USA. His "water color approaching" method in light and architecture composition is highly unusual.

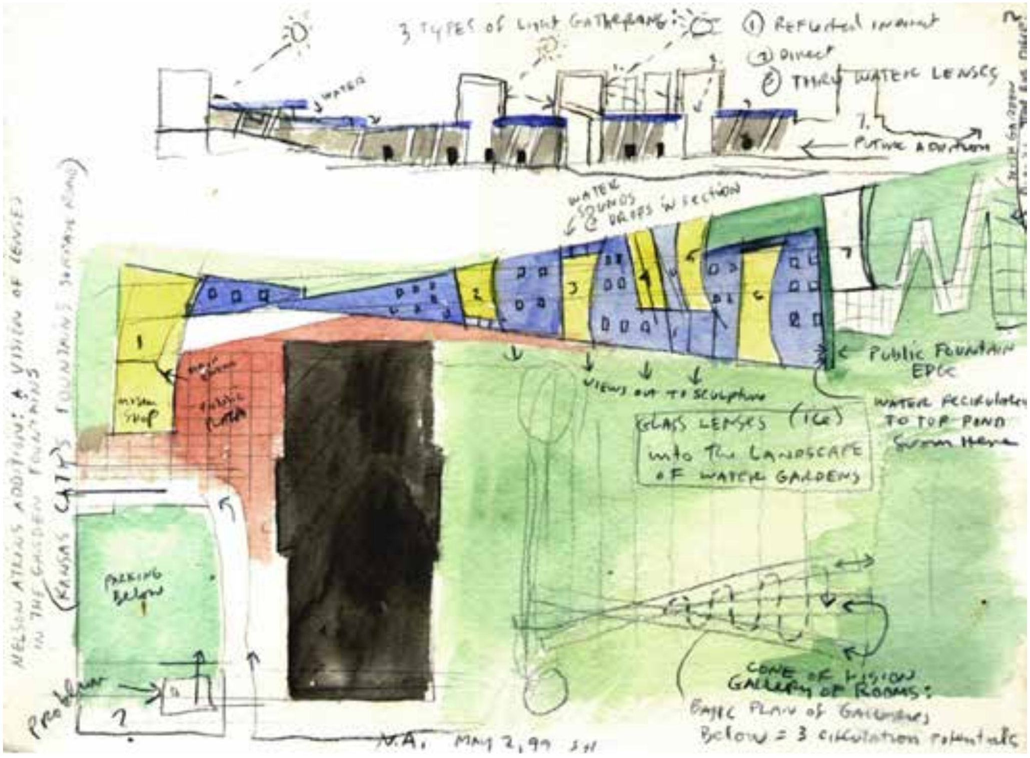


Figure 239. Figure NAMA concept watercolor number 1. Photo: Architect Steven Holl.

Figure 240. Nelson-Atkins Museum of Arts (NAMA). Photo: UMKC homepage.

4.3. Introduction of different conceptual examples

I have chosen five different types of conceptual examples to demonstrate that all kinds of demanding architectural lighting design projects can be solved using different kinds of heuristic metaphors and tools. They all belong to conceptual levels of 3,4 or 5. Conceptual levels 1 (“Thought free”) and 2 (“Examples from the past”) do not include any heuristic metaphorical thinking or conceptual argumentation.

Mariehamn West Harbor, Mariehamn,

Level 3: “Analytic concept” and level 4: “Gestalt approach" / ”Lighting composition concept”

Statue of Liberty, New York, New York,

Level 5: “Intuitive unconscious concept”

Finnish National Opera, Helsinki,

Level 3: “Analytic approach”, level 4: “Gestalt approach” and Level 5: “Intuitive unconscious approach” / “Color concept”

Amphi theatre, Ankara, Turkey

Level 5: “Intuitive unconscious approach” / “Concept of shadow & light”

Pedestrian Bridge, Knoxville,

Level 4: “Gestalt approach” level / “Sustainable concept”

A demanding architectural lighting design project has no standardized strictly rule oriented and systematic process scheme, in contrast to a technical lighting design process. They are always individually treated and project-specific oriented cases. A mature and professional project normally starts with heuristic “tests”. The designer has collected design material in his/her brain and tests if any of those elements can be used in this specific project. He/she can also create and find a new way to do things and/or put different types of ideas together. This thinking normally leads to finding if not always a real new metaphor, at least metaphorical thinking process.

4.3.1. Mariehamn West Harbor, Mariehamn, (“Lighting composition concept”)

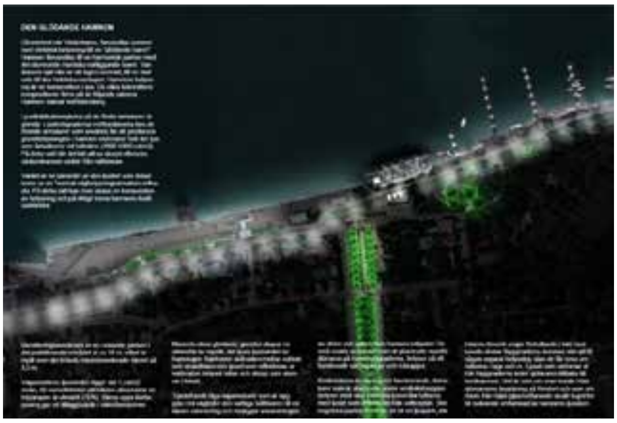


Figure 241. Mariehamn Harbor lighting concept area. Photo: Mariehamn concept report (Appendix 1).

Heuristic metaphor: “Heuristically analyzed lighting design metaphor element” and “findings”: Immediately after visiting the site, music and light combination came to the present author’s mind. Rich nature and an inviting environment supported the idea to use Richard Kelly’s design process. The scary looking sea created at the same time a dream of a modest white veil as a contrast to the black sea. The vessel *Pommern* gave birth to the idea to write a poem on the first page of the concept report, which we did (see: Den *“glödande hamnen”*). Shadow is the best friend of light. Contrast: Black sea and a soft white light veil – Poetic light.

Concept: This concept mainly represents the “*Analytic approach*”. The poetic “touch” and lighting compositions belong to the “*Gestalt approach*” concept category. When darkness falls on the Mariehamn area, electric light embraces the space forming a “Glowing harbor”. The white veil over the harbor forms a strong contrast to the mystic and dark sea, a pair of contrast (a pair of life). The *Pommern*, the biggest four mast bark on earth is sleeping in glowing white mist, the captain is walking alone in the white glow towards his home leaving behind only the slowly escaping smoke from his pipe. The harbour subsides into a dark sleep. Electric light is designed (composed) to serve this nocturnal episode which is more or less a dream, a personal hectic memory of Orson Welles’ “*The Third Man*”.

Figure 242. Lighting sections 1,2,3 and 4. Photo: Mariehamn Concept Report (Appendix 1).

The design area is divided into four architectural lighting sections (Snitt 1-2-3-4). On each section light is composed like music. The vertical element in the diagrams is E, the illumination value is lx at a certain point/spot/area. Yellow areas represent carefully designed lighting compositions. The basic lighting “tone” is a few lx over entire areas. That represents the basic “lighting veil”. Different kinds of bulges represent contrast and very thin ones, “Play of Brilliance” type of light (as in section 3; the illuminated masts of the *Pommern*).

Figure 243. The *Pommern* and lighting philosophy on the lighting section 3. Photo: Julle Oksanen.

As can be seen by comparing the image of the *Pommern* and the lighting composition in section 3, the illuminance values are not scientifically exact. The main idea is that the lighting composition imparts the right kind of mental image of the composition and lighting design goals, not exact lighting values. Of course the main idea is to try to follow the values as exactly as possible. For example the Marine Promenade in sections 1,2 and 3, follows lighting recommendation values (Car Traffic Classification A3 and Light Pedestrian Classification K4).

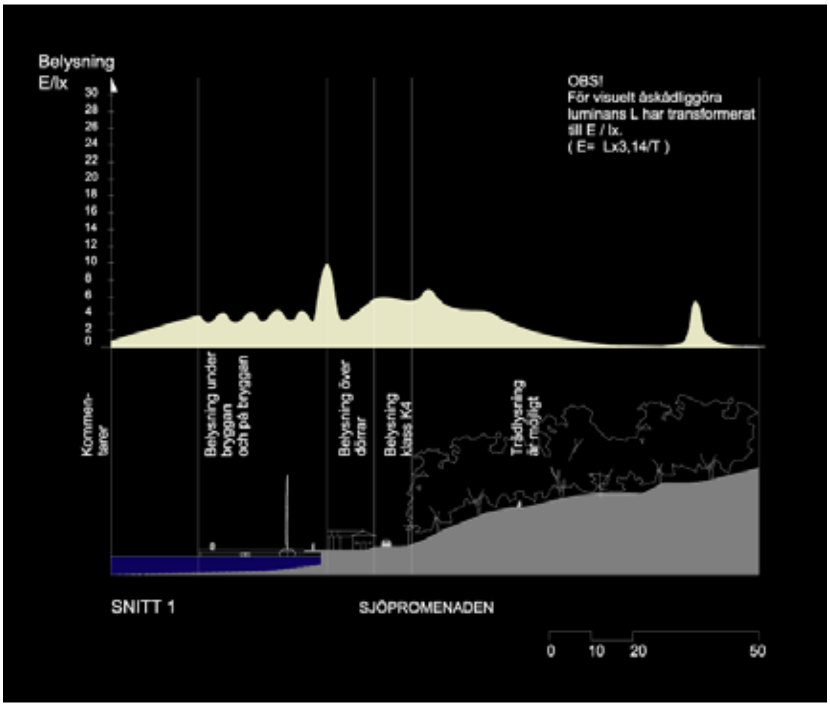


Figure 244. Lighting section 1. Photo: Mariehamn Concept Report (Appendix 1).

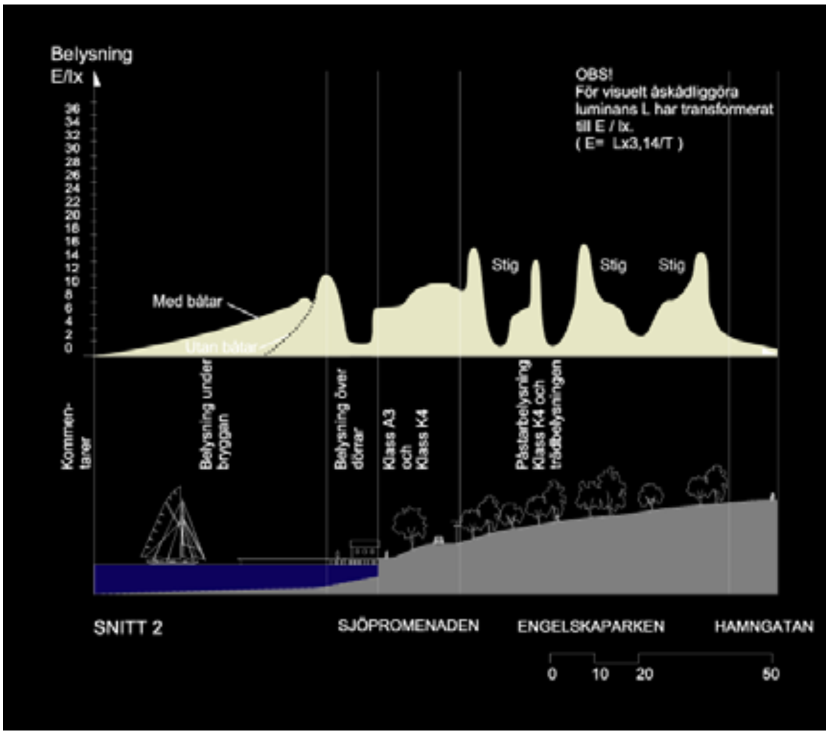


Figure 245. Lighting section 2. Photo: Mariehamn Concept Report (Appendix 1).

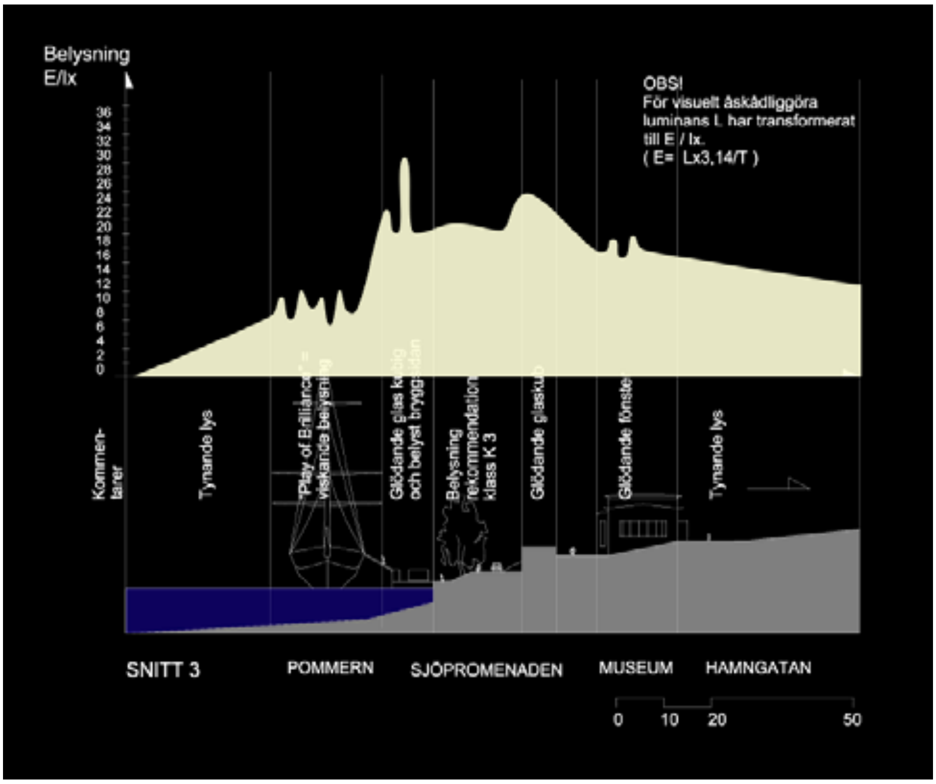


Figure 246. Lighting section 3. Photo: Mariehamn Concept Report (Appendix 1).

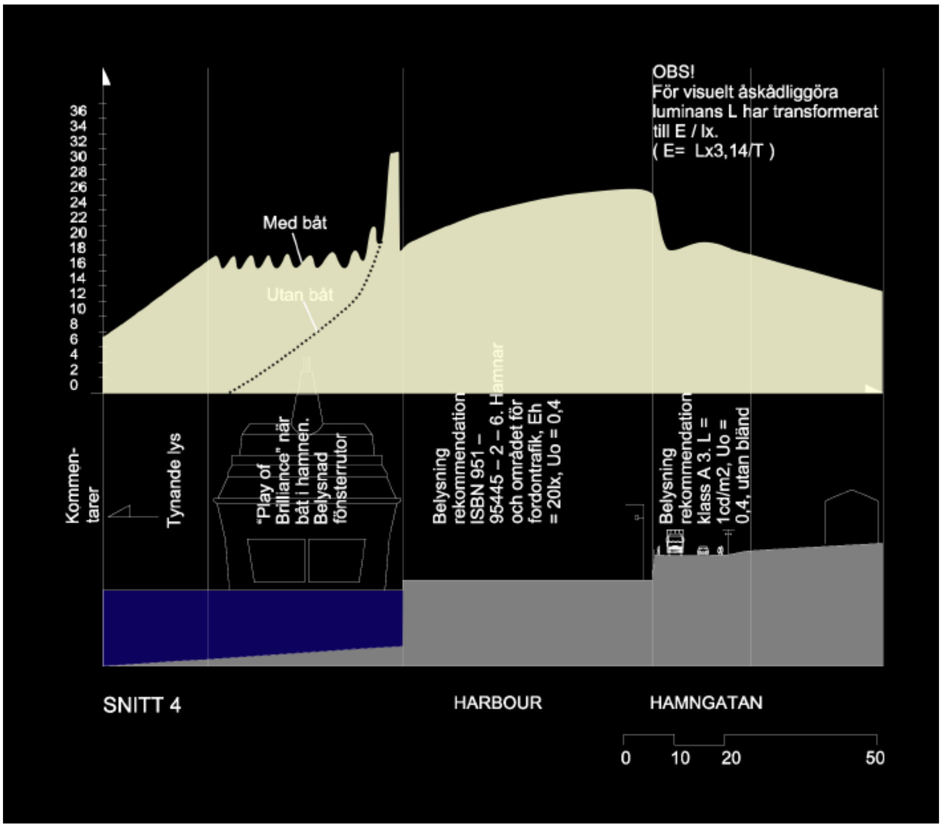


Figure 247. Lighting section 4. Photo: Mariehamn Concept Report (Appendix 1)

4.3.2. Statue of Liberty, New York, ("Intuitive-unconscious concept")

"Lighting the Lady":

Landscape is important in our civic lives, and much of our experience of civic places and monuments occurs at night. The Statue of Liberty is a good example of how lighting design can enhance civic places and create shared memories and iconic images and experiences of our common heritage.

Figure 248. Statue of Liberty, New York, USA. Photo: Howard M. Brandston Lighting Design.

The composition of lighting in this design is outstanding. Light & Shadow are in exquisite balance and the composition works from every viewpoint of the Statue of Liberty. This is remarkable given the variety of vantage points that include the harbor and surrounding sites of New York City, New Jersey and Staten Island. There are also great views to be had from ships and planes flying into JFK, La Guardia and Newark International airports.

The lighting composition demonstrates features of Richard Kelly's design theory. Ambient light exists from the sun-rise and the sky. The lighting of the statue provides the focal glow with balanced light and shadow. The surrounding lights of the metropolitan region give a play of brilliance.

The technical solutions for this scheme should be noted. General Electric created a new metal halide lamp version for this project according to Howard Brandston's specifications. This shows the importance of collaboration between technical suppliers, engineers and lighting designers. Luminaires with special optics were designed and manufactured to provide the precision control of light on this scale. These luminaires allow the color solution to imitate dawn light conditions, remarkable given that the Statue has a green 'skin'!

The Statue of Liberty is a special object with civic significance and symbolism. A gentle and gradated light enhances the symbol, but also imbues it with an almost ethereal presence. The light is softest at the base, allowing the Statue to mysteriously arise from her place on the dark waters. The increase in the intensity of the light draws the gaze upwards to the pinnacle, creating softly glowing brightness on the crown and the torch. This gradation makes the Statue present, and enhances the top of the structure, providing an iconic and memorable image.

Howard Brandston's next statement reveals beautifully how a difficult and complex lighting design problem can be solved and tackled with practical design work which leads to a perfect and valuable concept and result.

"I pondered the challenge of how to illuminate this icon, so I took a boat out into the harbor and observed her from various distances and at every angle. I observed her at dawn, noon, dusk and in the darkness of night. At some point of the process, I walked to the end of the Battery Park Promenade, sat on a stone wall, and it came to me: She looked best in the light of dawn. I took out my little notepad and wrote: "Needed: one light source with spectral power distribution to mimic the morning sun, one to mimic the morning sky and a new light fixture to project light from a great distance – this will create a lady with green skin look good." *(Brandston 2008b)*

Figure 249. Statue of Liberty, New York, USA. Photo: Howard M. Brandston Lighting Design.

4.3.3. The Finnish National Opera, Helsinki, ("Color concept")

This concept is hard to put totally into any of the 5 levels introduced. The Opera exemplifies the "*Analytic approach*", the "*Gestalt approach*" and some hints of the "*Intuitive unconscious approach*".

Figure 250. The Finnish National Opera. Photos: Julle Oksanen & Oliver Walter.

The existing situation: Day

The Finnish National Opera is a bright white and a massive giant, inside which professional people present various performing arts, festive and memorable performances. This involves professionals like management, catering, different types of art exercises, technical services, costume design, production design, orchestra, etc.

The existing situation: Night

When darkness embraces the space, different human emotions seize our minds, no matter where we are. Mystery, romance and a natural kind of interest pervades the mind. The National Opera's outer shell-, however, remains massive, now cold and forbidding at the same time as the background of the building has changed to dark and become mysteriously fascinating . When the interior achieves of creativity, the outer cover is static and cold. During the premiere the interior throbs warmly and the performances transport the audience to ecstasy and artistic pleasures, away from the worries of everyday life. What a contrast from the exterior.

New Outdoor Lighting Concept (presented briefly):

Based on heuristic metaphor elements: “A heuristically analyzed lighting design metaphor element” - “findings” in words: Art and color lighting – Kinetic lights – Changing spirit of the building – Cube as a messenger – Performance day and specialty – Everyday life and light.

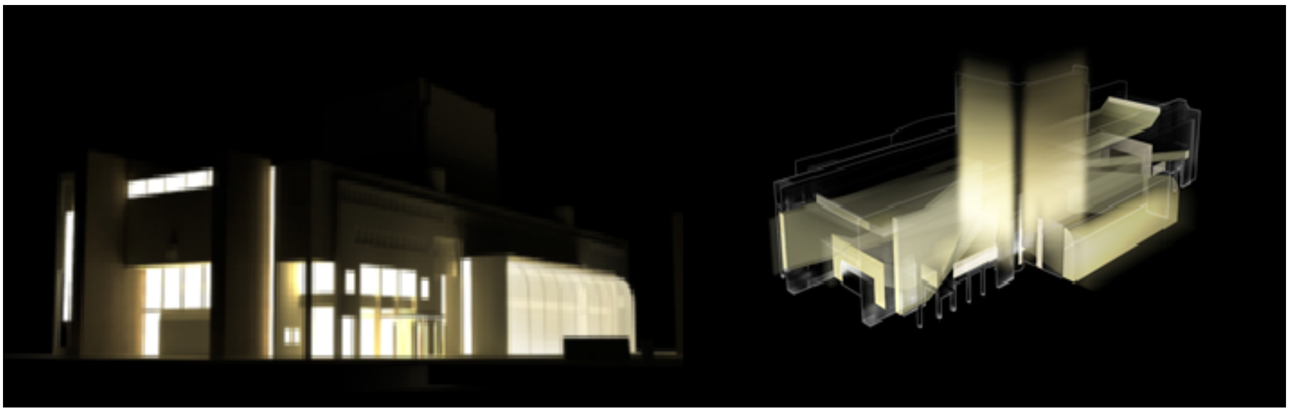


Figure 251. The National Opera as a lantern. Photo: Julle Oksanen Lighting Design Ltd/Julle Oksanen & Oliver Walter.

Lantern light from inside out

The stage and the stage tower with its hidden mechanical equipment are the pulsating, fiery heart of the building. From here the creativity radiates to the surrounding halls, lobbies, foyers and other areas. From these areas it flows from all windows and openings transformed into visible light. The building has become a huge lantern, disseminating warm and interestingly glowing light. When this glowing lantern type of light is in the main role and the rest of the building is in the dark, people understand that shadow is the best friend of light.

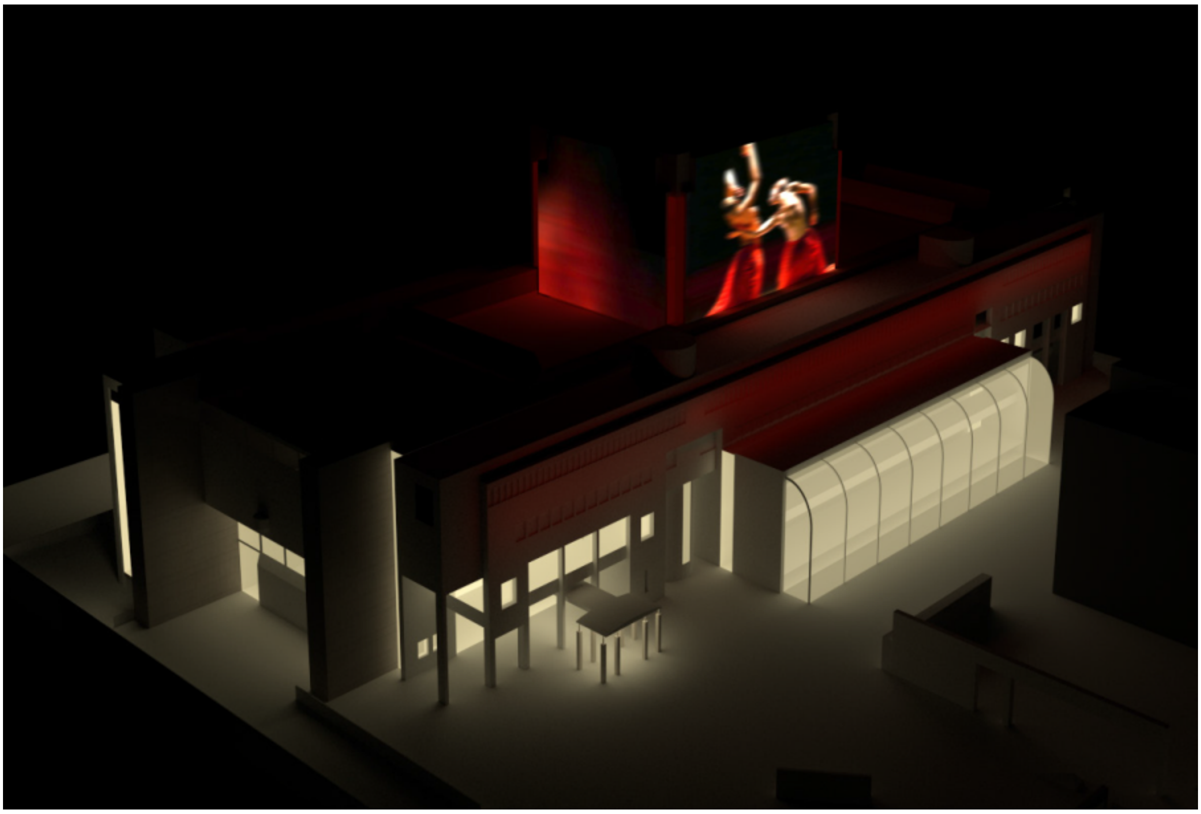


Figure 252. Light as a messenger. Photo: Julle Oksanen Lighting Design Ltd/Julle Oksanen & Oliver Walter.

Light is a message

In the dark the spirit of the National Opera ought to proclaim its inner spiritual soul and aesthetic functions to the outside. This can be achieved by color lighting and variations of light and shadows. The outer shell of the building can also be used in this style and spectacularly herald future events. The light is then the message from the future. When using colored light and projections, the designer needs to answer the question: Why? It is not enough if it is merely fancy or looks nice. Color is not an intrinsic value in lighting design or city beautification. According to experiences in the Middle East, it does not stand the test of time. There must be a clear, professional and robust functionality and a convincing explanation.

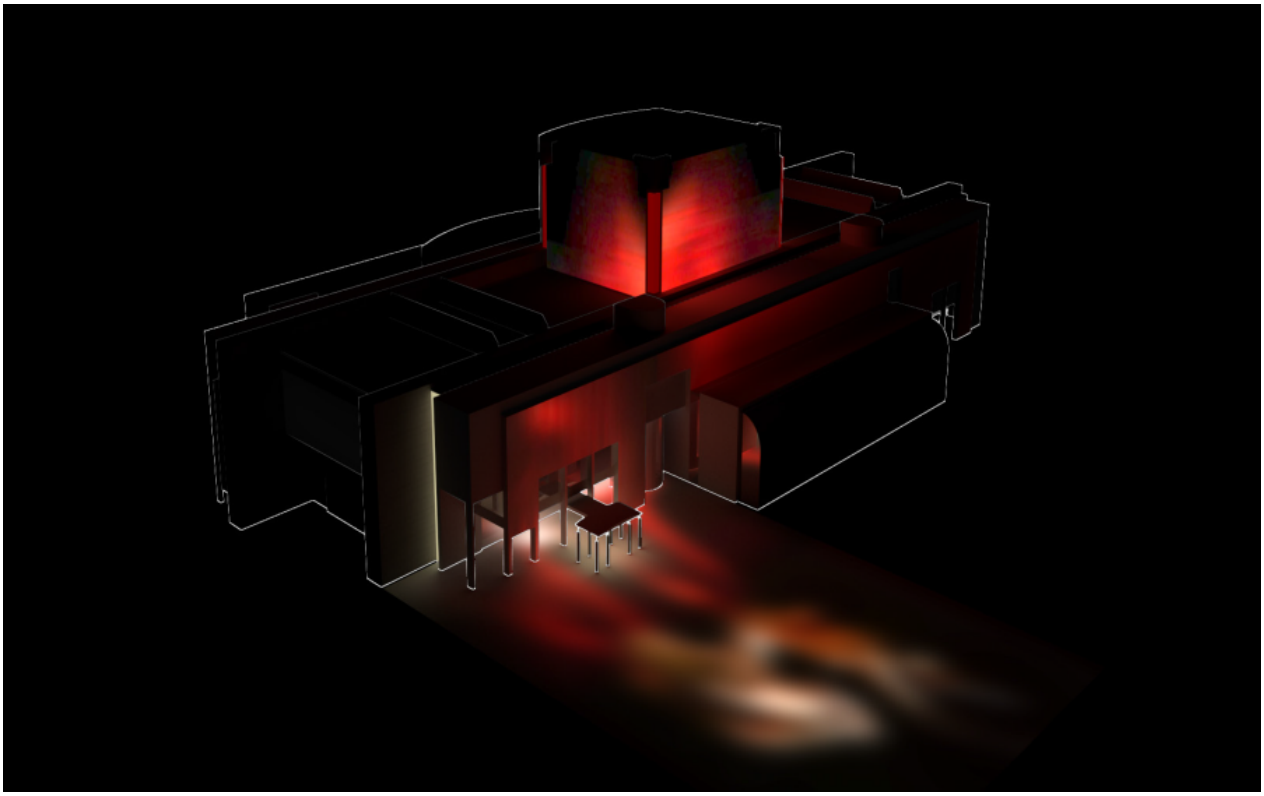


Figure 253. Premiere lighting. Photo: Julle Oksanen Lighting Design Ltd/Julle Oksanen & Oliver Walter.

The entrance and approach to the building

When a person approaches the building and attends the performance, he will transfer from everyday life to art. The building entrance (in the right light) affords a rite of passage for approaching people between everyday life and an artistic experience. The hustle and bustle of Mannerheim Street, a major thoroughfare, is behind the person and great art experiences are in front of him. The dancers of "*Bella Figure*" from the huge cube are as if dropped from the tower T1 inside the building onto the stage waiting for the audience. The tower is only glowing in red light as a reminder of the performance. Facade and Plaza lighting are slowly moving, breathing red light. For once, it is fascinating to cross the Plaza.

4.3.4. Amphitheater, Ankara, ("Concept of shadow & light")

Figure 254. Location of Amphitheater. Photo: Google

Odeon Amphitheater is located in Bilkent University area. Room for 5000 listeners.

Figure 255. The Amphitheater from the outside. Photo: Julle Oksanen.

Concept:

The concept belongs to the category “*Intuitive unconscious approach*”. When I first entered this building with the architect Ergut Sahimbas, who had designed it, I immediately sensed what the solution should be. The amphitheater is located on the slope of a dark hill in Ankara. People approach the area by car. They drive towards the amphitheater guided by car headlamps. The turning car head lamps create an interesting light phenomenon. No specific street or area lighting is needed at all. General lighting is the falling, humble white veil of light which emanates from huge openings of the amphitheater structure.

From their parking places people start to walk in lines like hundreds of ants towards the main stairs and entrance to the building. Expectations are high and slowly art starts to fill their minds.

Cars in the carpark start to sleep together in the embrace of darkness. Their whispering together is almost audible as their engines cool down.

When people have passed the stairs, they have their historical moment to be a gladiator for a couple of minutes. They have to walk bravely through an approximately 20m high and 4m wide stone corridor under the light which falls from the canvas and open ceiling.

After they have entered the amphitheater, they orientate themselves under a mystic indirect light. The huge size of the amphitheater influences their emotions very strongly. People find their places and sit down to await the performance and observe the happenings inside. The excitement is almost palpable. The ants are in the nest.

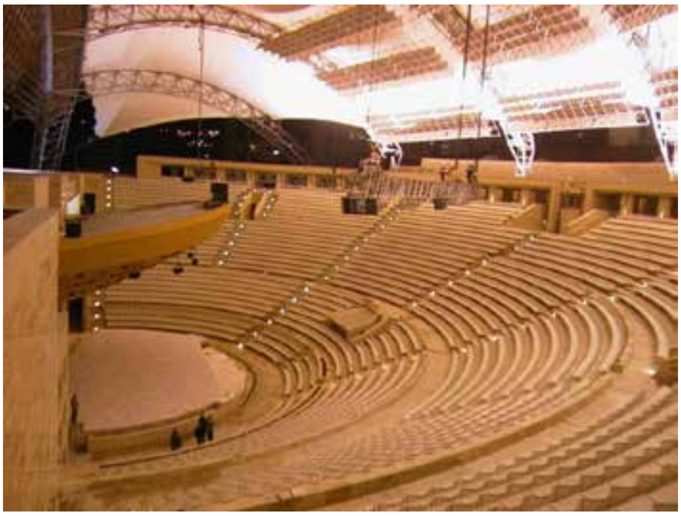


Figure 256. The amphitheater from inside. Photo: Julle Oksanen.

The brightness of the canvas is very peaceful and the maximum luminance value is 170 cd/m2. Luminaires are hidden to avoid any glare or disturbing visible elements. Horizontally installed acoustic elements located in the ceiling cast beautiful shadows onto the canvas. Shadow is the best friend of light. Once everyone is inside, E_{hor} illuminance values decrease step by step. The switched values are 60lx - 40lx - 20lx - 0lx. Just before the canvas light goes down, the stage lighting comes up and creates the atmosphere of the space.

4.3.5. Pedestrian Bridge, Knoxville, ("Sustainable concept")

This example is located in Knoxville, Tennessee, USA. It is campus area of the University of Tennessee.

Figure 257. Design area. Photo: Google.

The design area has lost its shadows, interest and happiness as a place. Its human scale and spirit as a comfortable and enjoyable place are lost. The area serves transportation and activities inside the enormous buildings, the Thompson-Boling Assembly Arena and the Neyland Stadium.

The Gestalt approach to design thinking

The lighting design process was one of restraint and not giving form to the design until all the criteria and analyses were thoroughly processed. That meant that I waited until the form became apparent and only then put it on paper. This was very educational and a process worthy of development to me as a lighting designer. When the design had a given form, the result also proved to be appropriate and according to my professors also quite creative. This "*Gestalt approach*" type of student work was also introduced to the municipal authorities, who wanted to continue the real project together. Unfortunately, the whole bridge project was postponed to the future.

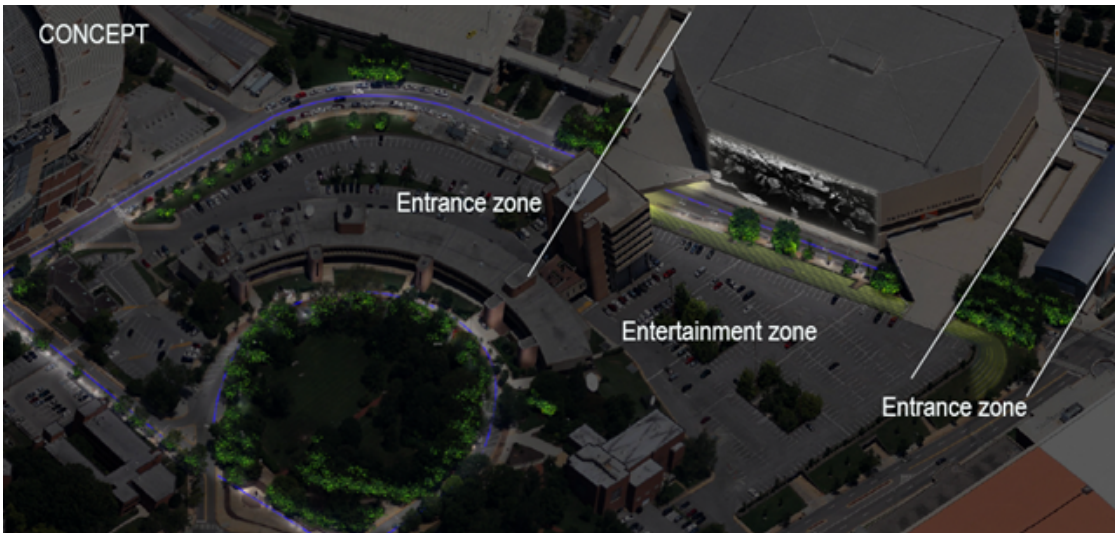


Figure 258. Lighting design concept. Julle Oksanen's studio work at the University of Tennessee. Photo: Larwie and Associates, CRJA, Wilbur Smith Associates, S&ME, Sanders Pace Architecture, Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter.

Concept:

The concept belongs to the "*Gestalt approach*" level. New zoning for light will transform the site into an enjoyable meeting place for students and people in Knoxville. Let's call it the "*Curving Lights of Knoxville*". A blue underground light stripe located in the middle of the driving lanes and glare free large surface luminaires for street lighting purposes create a new and inviting atmosphere.

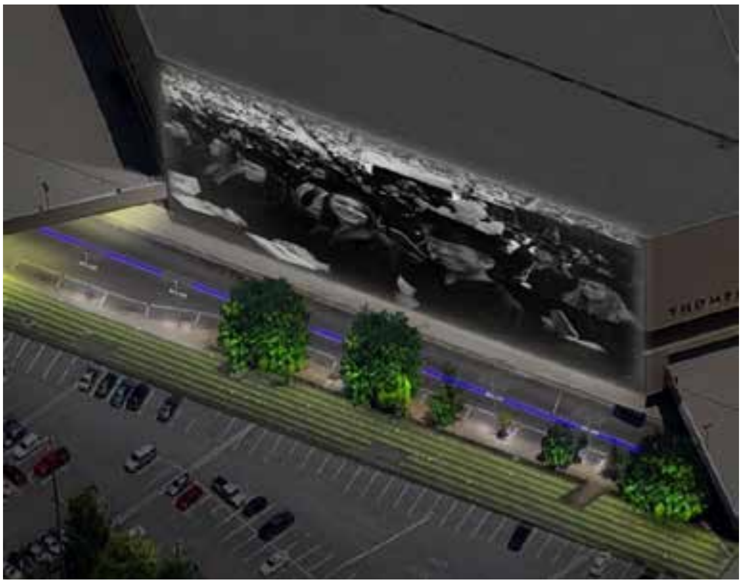


Figure 259. Entertainment zone. Julle Oksanen's studio work at the University of Tennessee. Photo: Larwie and Associates, CRJA, Wilbur Smith Associates, S&ME, Sanders Pace Architecture, Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter.

The entertainment zone now has the humongous façade of the Thompson-Boling Arena as a large movie screen and amphitheater style benches in front of the screen.

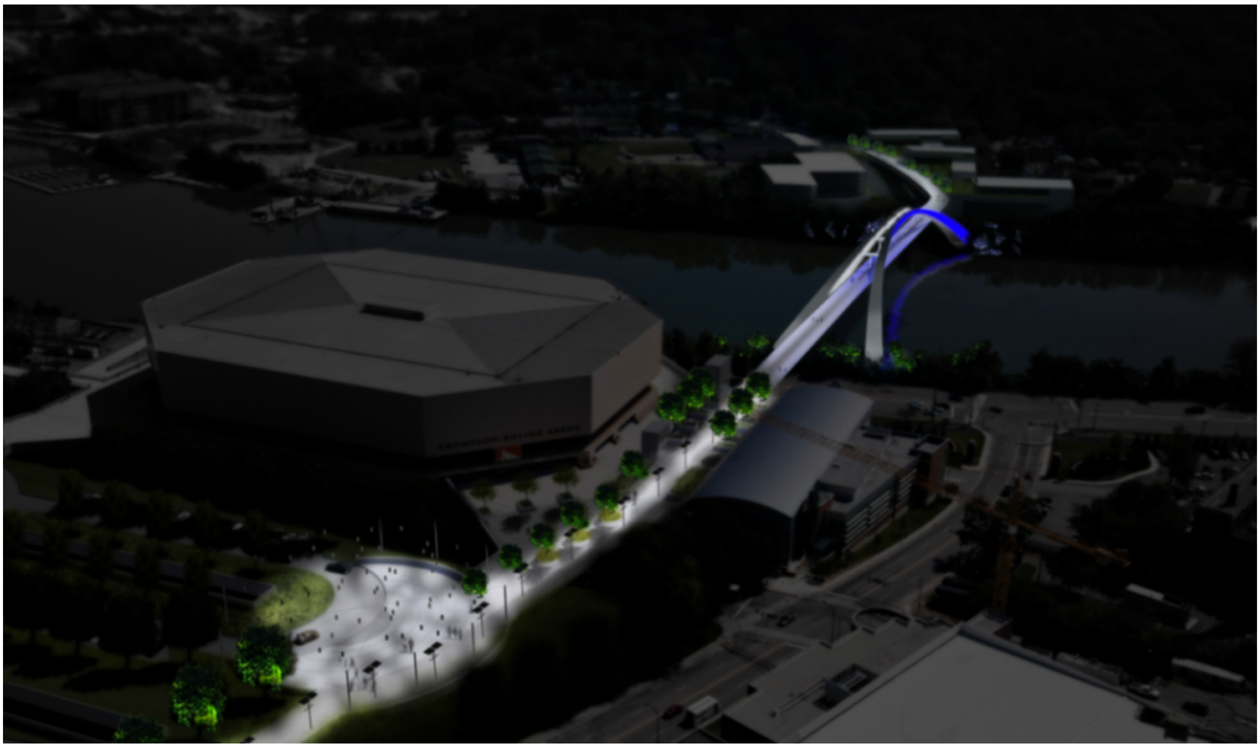


Figure 260. Plaza and “Whispering Lights”Julle Oksanen’s studio work at the University of Tennessee. Photo: Larwie and Associates, CRJA, Wilbur Smith Associates, S&ME, Sanders Pace Architecture, Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter.

Glare-free, peaceful and “Whispering Light” on the small plaza and pedestrian bridge over the Tennessee River generates a lovable and “quiet” lighting pair for pedestrians’ daily crossing.

Figure 261. The bridge on “Game Day”. Julle Oksanen’s studi owork at the University of Tennessee. Photo: Larwie and Associates, CRJA, Wilbur Smith Associates, S&ME, Sanders Pace Architecture, Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter.

During the famous Tennessee “Game Day” in Knoxville everybody (normally well over 100,000 people) has orange clothing, the color of the Tennessee American football team. During game day the bridge is orange, Tennessee orange.

Figure 262. The bridge on weekdays. Julle Oksanen's studio work at the University of Tennessee. Photo: Larwie and Associates, CRJA, Wilbur Smith Associates, S&ME, Sanders Pace Architecture, Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter.

On week-days the color of the bridge is blue. Blue is the color of heaven and the sea. It is perceived to be cool, distant, comforting and trustful. It is a classic heraldic color, often called "*Azure*". In the USA blue is politically the color of the Democratic Party. Other colors can also be used, because the LED stripes are RGB (Red Green Blue) stripes and are operated freely as regards colors.

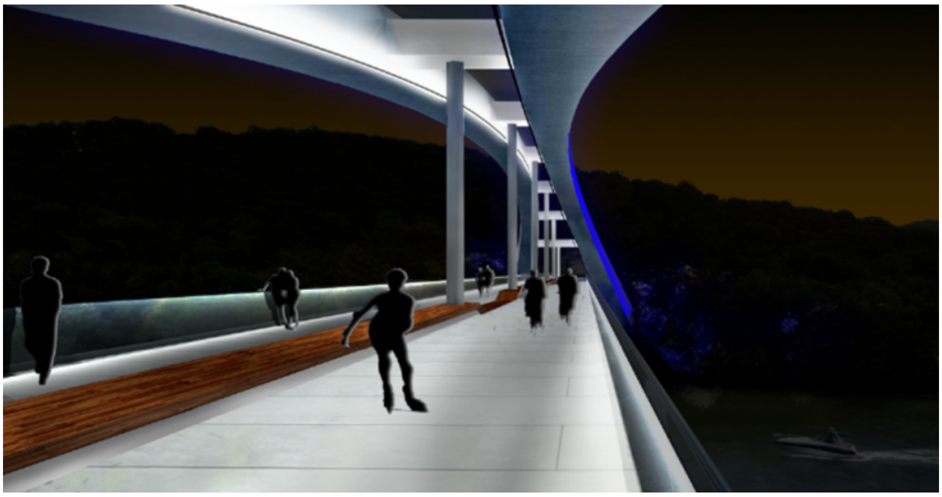


Figure 263. Large surface and glare-free bridge lighting. Julle Oksanen's studio work at the University of Tennessee. Photo: Larwie and Associates, CRJA, Wilbur Smith Associates, S&ME, Sanders Pace Architecture, Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter.

An important part of this "*Gestalt approach*" level lighting concept is also glare-free lighting solutions. Light comes out of the light coves indirectly illuminating large surfaces. The lighting follows the bigger concept.

Project sustainability: All the energy for this lighting project is produced by sun.

5. ARCHITECTURAL OUTDOOR LIGHTING DESIGN METHODS

5.1. General

Since lighting design transferred from the hands of architects to the hands of engineers, lighting design projects have been done without proper methods. Electrical engineering education does not include any elements of design or design methods. Another reason for this Dark Age in lighting design methods is the lack of lighting design education in schools of architecture.

This combination of lack of education on both sides, engineering and architecture, has led to unprofessional final lighting solutions. In this dissertation different kinds of architectural outdoor lighting methods are introduced using two different kinds of comprehensive examples: The Telenor Building in Norway and Mariehamn West Harbor in Finland. In addition, as a method example, the Telenor Building also expands the understanding of the working load in the creative city lighting design process. Telenor could be only one building among hundreds of others in the North Vancouver master plan design (see: Figure 197 Places of Night Interest). Vesa Honkonen and Julle Oksanen won the first prize in a Scandinavian lighting design contest in 2002 with this project. The Telenor example is a new building with its environment. The Mariehamn West harbor project is an existing outdoor space. The methods differ, but include the right kind of attitude and touch in design. In point of fact, design is an attitude, whether it concerns a spoon, a house, a car, a building, the infrastructure of an area or lighting. Design is an attitude.

5.2. Pragmatic lighting design method example: Telenor

In my own architectural lighting design projects my design process I use a method involving four main steps regardless of the type of lighting design project. The steps and elements are:

Heuristic metaphor & Concept design

Master Plan design

Detail design

Demonstrations and implementation

This sounds simple, but needs a professional attitude, skills and education. There is no exactly standardized design process inside these four important steps/elements, because it is critical to structure a place-based method to achieve quality results. Every individual project needs place-based creativity and project management. The Telenor headquarters lighting design project is an outstanding, comprehensive and educational example of this.

Figure 264. Concept example. The Telenor Building in Oslo, Norway. Photo: Telenor.

Telenor is one of the fastest growing providers of mobile communications services worldwide and also the largest provider of TV services in the Nordic region.

Revenues 2006: NOK 91.1 billion

Workforce: 33500 person-years

Listed on the Oslo Stock Exchange and headquartered in Norway.

We are now looking for the Lighting Design Concept of their new headquarters, which is located in Oslo, Norway.

The building has a lot of glass as a construction material and we are now focusing on mainly those glass areas and the Plaza, which was our design task.

5.2.1. The lighting design concept

Figure 265. Telenor aerial view. Photo: Telenor.

This office building is located near a beautiful fjord and in a natural setting. To us, as lighting designers, Norwegians are people of nature. When we started to create the concept, we had in our minds an image of Norwegians wandering on their huge hills and fjords with their famous characteristic Norwegian pullovers and rucksacks.

However, we also kept in mind that Norway is also very wealthy with a lot of oil, great educational opportunities and is a modern nation, of which this Telenor Building is a good example. This is somehow an odd combination for the lighting design concept design phase-wise. Seven thousand employees approach this modern and high technology building every day. They approach the main entrances through the huge plaza, which is approximately the size of four full-size soccer fields.

They enter the building through eight main entrances located on the oval glass edges of the two building blocks.

Through the entryway they arrive at an indoor entrance which is mainly made of glass, steel and stone. After this they proceed to their own office desks using stairs or elevators.

Figure 266 is an architectural section of the office entrance hall block. It is located between the office blocks and is mainly made of glass. A café' is located on the hall.

Heuristic metaphors:

"Heuristically analyzed lighting design metaphor element" - "findings": We started "the metaphor-process" by thinking of what Norway is. Norway has a lot of darkness and beautiful and wild nature, northern stars**.** We wanted to bring the darkness from the fjord to the site floating silently through the building back to freedom from eight glass entrances. We wanted to use the Telenor Buildings as huge luminaires of the plaza. We just wanted the glowing facades to form "whispering lights”. Our dream was that when the darkness engulfs the site and pervades the entrances to the back of the buildings, at the same time the glass facades glow modestly shedding vertical light onto the plaza. We wanted no luminaires for the plaza. New luminaire design – Indoor lighting is outdoor lighting – Light & Darkness, pairs of life.

Based on that metaphorical poetry, our concept was to create a place for employees where they could have a clear and visible connection to nature. There is a person in the café’ looking for the stars and moon in the Nordic sky.

Glass acts like a mirror. The reflection factor of normal ”float” glass is something like 20%. The hall block was full of revolving glass elements at different angles both vertically and horizontally. We therefore decided to use a ”functional lighting concept”, which meant that we wanted to minimize reflections from the glass surfaces. These entrance halls were actually ”light traps” during dark periods. We used large surfaces and placed luminaires so as to avoid or at least minimize reflection.

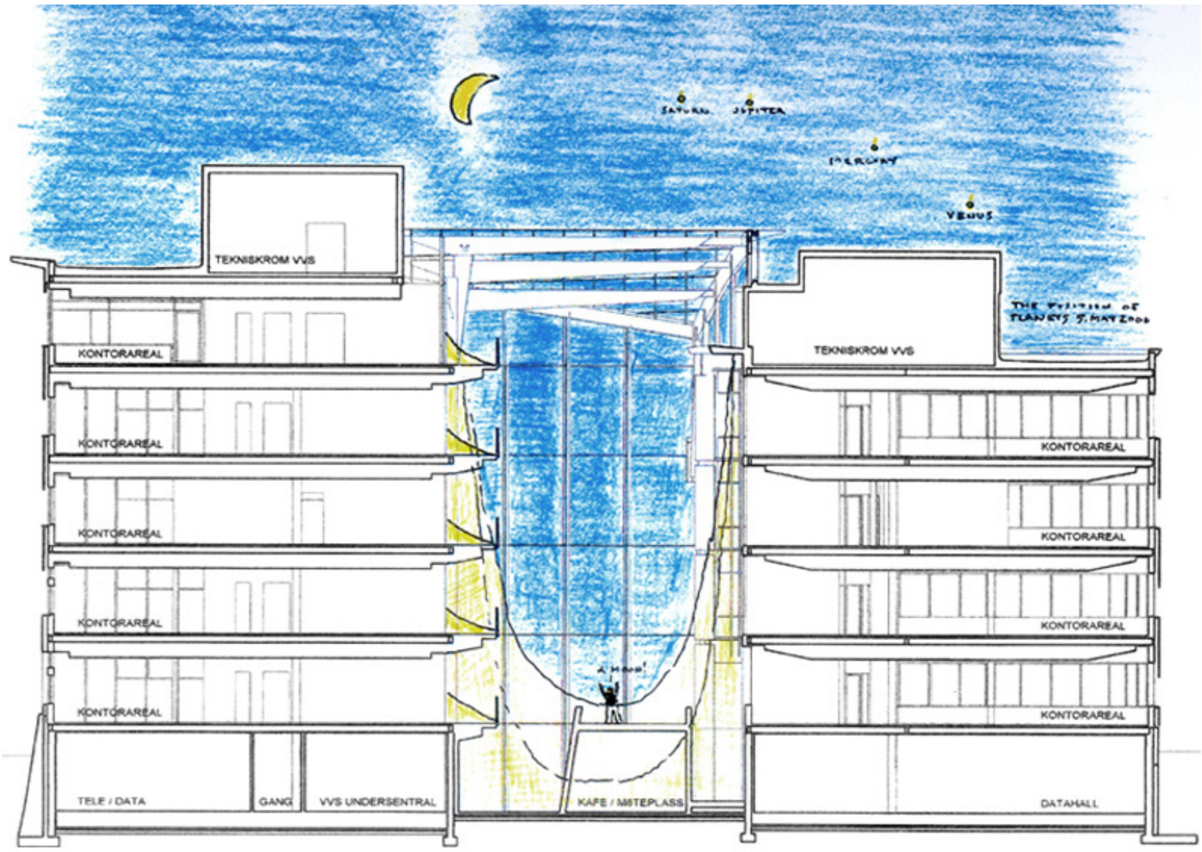


Figure 266. Telenor lighting design concept. Atrium section. Employees can see a Northern sky and stars from café. No glare, no disturbing light distribution surfaces. Photo: Vesa Honkonen & Julle Oksanen.

It would have been easy to integrate downward lights on the beams which were located on the roofing area. We did not want to illuminate only air, which is an invisible material. We also estimated that there would have been hundreds of reflected light sources as a result of this common solution.

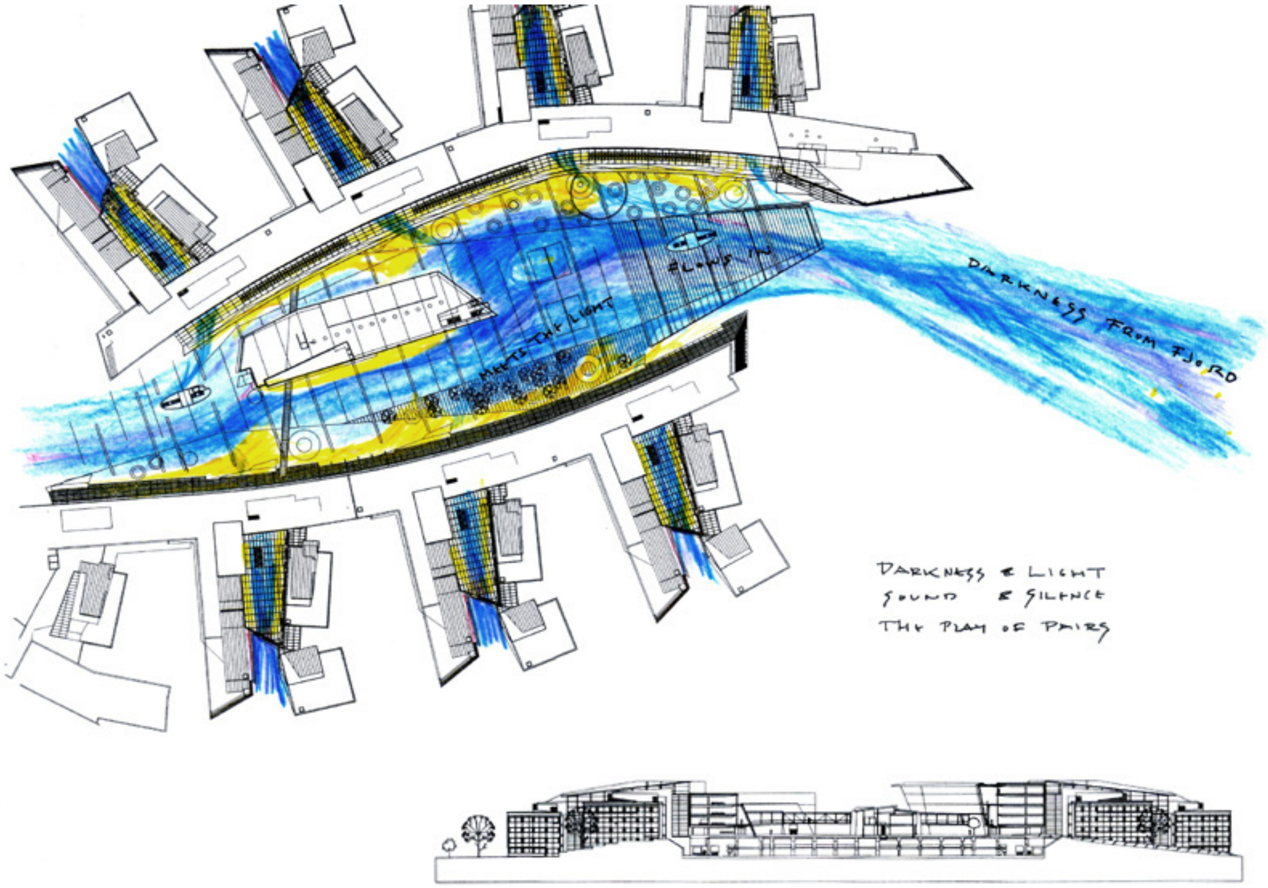


Figure 267. . Telenor lighting design concept. The darkness from the Norwegian fjord was to flow silently through the building back to freedom. Photo: Vesa Honkonen & Julle Oksanen.

Love & Hate

Sound & Silence

Black & White

Light & Dark

Those are the pairs of life. Without pairs life would be boring and dull. Shadow is the best friend of light. We desperately wanted to use this philosophy on that plaza.

We wanted to bring darkness from the fjord to the Telenor plaza. From the plaza darkness runs through the entrance halls back to nature. This somehow a very Norwegian style.

This concept meant to us immediately that we did not want to install any luminaires on the plaza. The huge glass openings of the boulevards of the building blocks were our large illuminators. The education center, which is located on the plaza, also had glowing walls.

This concept was very strong and meant that we had to be able to influence and use the office lighting, which created those illuminators of ours.

5.2.2. Lighting design master plan

A lighting design master plan is a tool which is located in a very strategic place in the lighting design process as a whole. With this tool lighting designers have to find lighting “hardware” and “software” solutions to implement the concept design on a practical level. If the right solutions cannot be found, it may be necessary to change the concept. In some cases it may even be necessary to create a new concept.

Accumulating working experience in the real world and in real projects matures a lighting designer’s perception and understanding of what can be implemented and what cannot be implemented.

Sometimes even a great concept can stay on the level of dreams and the lighting designer gives up hope and is not sustained enough to try to find the right solution, but one should not give up hope. A small change in a concept may save the high-quality result. A minor change in design need not mean the irretrievable loss of great idea / concept.

The master plan phase consists of luminaire selection, lamp selection, preliminary checking of construction solutions, lighting calculations, computer images, etc.

The master plan phase excludes detailed design elements like working drawings, construction detailing and luminaire integration into structural elements. It is a good time to clarify what is in the offer in order to be able to avoid unclear situations later about what is included in the work and what is not.

Figure 268. Telenor Lighting Design Master Plan, general computer image of the site. Photo: Telenor.

In order to give a flavor of design process as a whole, we now focus on the Master Plan Design for Telenor Headquarters in Oslo Norway.

The Master Plan phase affords a deeper understanding of the building itself and its purpose. Then we can “guide” the lighting design process in the right direction in the Master Plan design phase.

Things which are good to know:

- How people use the building during workdays (approaching the building, moving in buildings, floors, cafés, offices, other activities, etc.).
- How the building is used at night.
- Materials of the building.
- Special needs of different activities.
- Who are cooperators and what are their needs.
- National lighting design recommendations and their application “style” and code requirements.
- How to introduce the Master Plan Design and to whom.

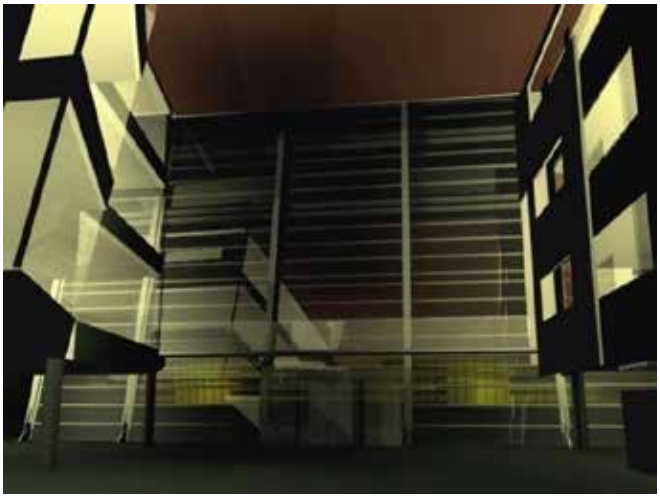


Figure 269. Telenor Lighting Design Master Plan. Computer analysis for the Atrium area. Photo: Erkki Rousku

The master plan phase starts with analysis. In existing buildings, one must analyze the existing situation in order to be able to compare it to the new design proposal. New advantages and solutions are great to introduce to the customer by comparing them to existing and “old ones”. New buildings normally call for more creativity in three-dimensional thinking, because the designer must imagine himself in the building / space to develop ideas and proposals in the right way. In good lighting design three- dimensional thinking is a great way to a successful result.

In the Telenor Building we closed our eyes and thought how it would be to stand in the middle of the atrium and look around. We understood that we had to analyze glass atriums with a computer and we found that glass atriums are “light traps” at night. There are lots of reflections from different surfaces. This fact led us to create a lighting solution that minimized the mirror effects of light distribution surfaces, or luminaires, from hundreds of glass elements. More problems were also caused by the different angles of the huge glass elements, both horizontally and vertically. We also analyzed whether it would be possible to see out of the building at night and in dark periods.

We made a lot of heuristic calculations to solve all the above mentioned problems. One example of the numerous calculations we made in the master plan phase is introduced in Figure 270. The reader is not expected to search for any details in these figures. The main reason for presenting these calculations in this master plan context is to demonstrate how heuristic calculations supported us in our design work in such a project.

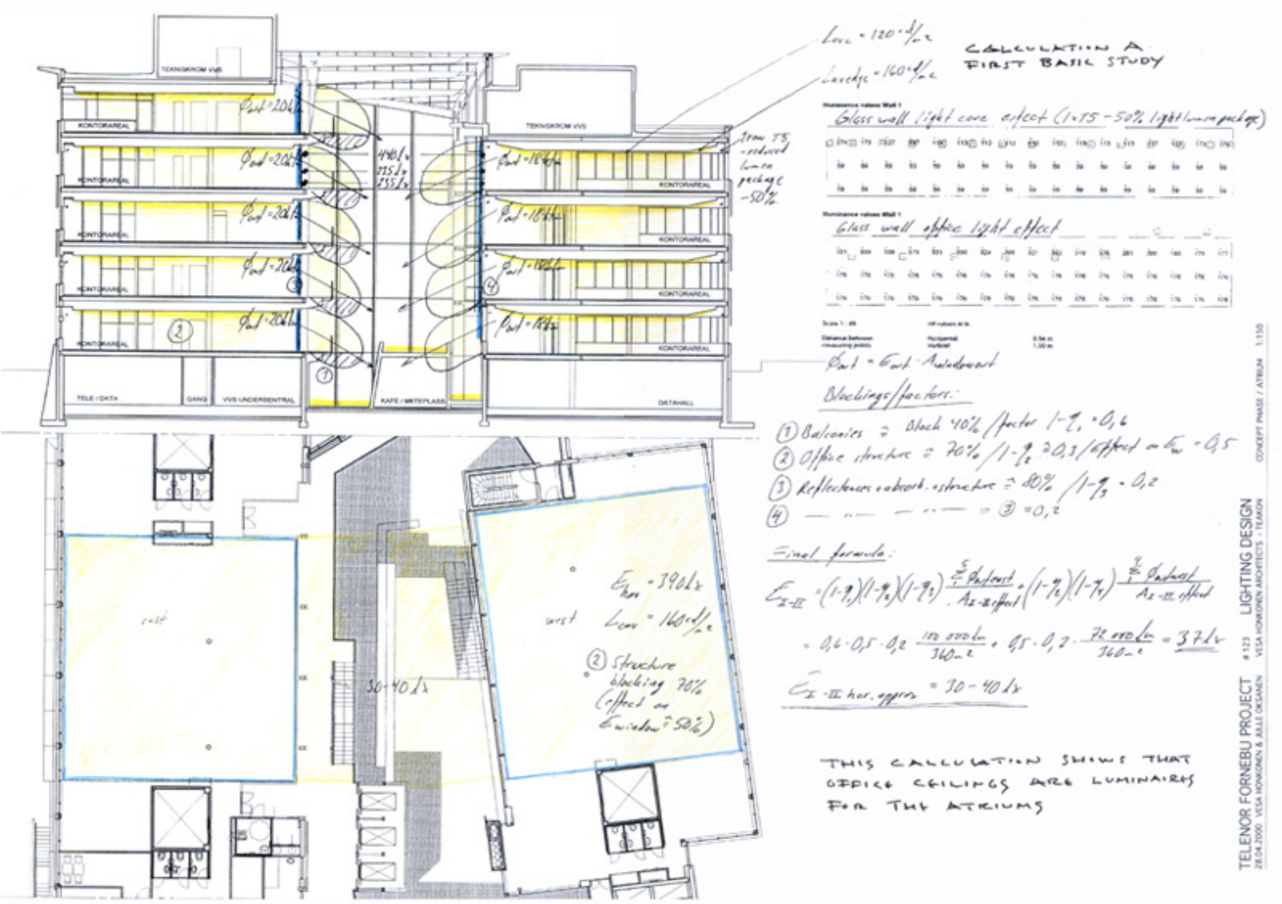


Figure 270. Telenor Lighting Design Master Plan. One result of our seven heuristic calculations. Photo: Vesa Honkonen & Julle Oksanen.

Explanation of Atrium calculation (Figure 270)

Office blocks are located on both sides of the glass atrium. After the analysis we started to figure out how much light actually runs from all those office areas to our design area – the glass atrium.

We contacted the electric designer, who, together with luminaire manufacturers, took care of lighting in the office areas. We asked about the lighting procedure in offices. According to that information we made lighting calculations for the office areas. We were only interested in the vertical illuminance values on windows which were located on both sides of the glass atrium (see Figures 270 and 273).

With the basic formula: E = Φ / A, in words: The Illuminance value on window areas E is equal to Lumen package of window areas Φ divided by illuminated window areas A. From this formula we solved the value of Lumen package Φ on window areas.

Then again the basic formula E = Φ / A was used in a creative way: Now E was the illuminance value on the floor surface of the glass atrium, Φ was the lumen package which runs from the windows to the floor of the atrium and A is the atrium floor area. Of course we had to use additional factors (marked k in the formula) which had effects on the result. K is the product of penetration factor of window glass, construction elements (balconies), direction of outflowing light from windows, reflections from surfaces and the approximated and “corrected” room factor of atrium.

With these master plan calculations we went to the customer and told them that these office designers had completed our work. We only need to send the bill. We had made our analysis calculations conservatively to be on the safe side and the result was 40 lx (4 fc). In reality we told them that it would be closer to 100lx (10 fc) than 50lx (5 fc). Of course we wanted to create contrasts and functional lighting instead of only “Dull 40lx (4 fc)”. We therefore said that we had to design for more light but take these values into consideration, too.

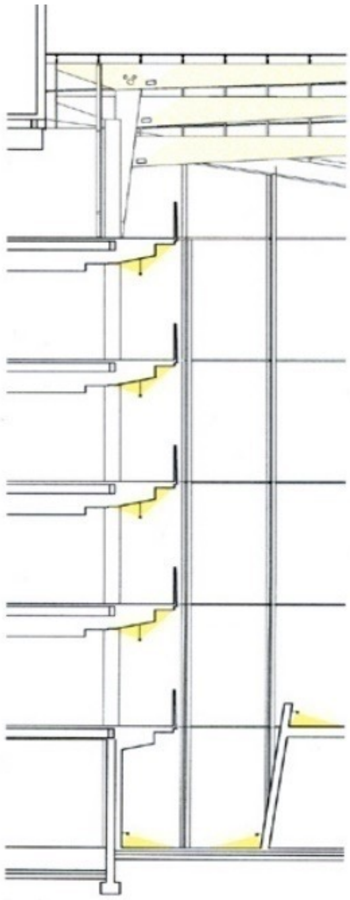


Figure 271. Telenor Lighting Design Master Plan. Atrium section. Indirect lighting solution. Photo: Vesa Honkonen & Julle Oksanen.

In order to be able to avoid reflections of the light distribution surfaces of the luminaires, we had to create a new way to illuminate the glass atriums functionally. We could not accept downward light luminaires, because they would have caused oval reflections (round holes of luminaires seen from different angles and levels.). We could not accept luminaires on the wall surfaces at all (huge reflections), nor wall washers (because of glass walls and difficult tracking systems).

“Normal” fluorescent luminaires were, of course, out of the question due to the earlier reasons.

We created a new kind of functional lighting solution. We designed long indirect fluorescent lighting rows with continuous light – providing light functionally where it is needed and at the same time minimizing reflections.

We could not find fluorescent luminaires with continuous indirect light, with the style, dimensions and invisible pendant and hanging systems, so we designed them ourselves. The Telenor Building had 8 km (26,000 ft) of luminaires in rows, both indirect and direct versions.

Later on this lighting system matured as a standard luminaire range for standard production for the manufacturer.

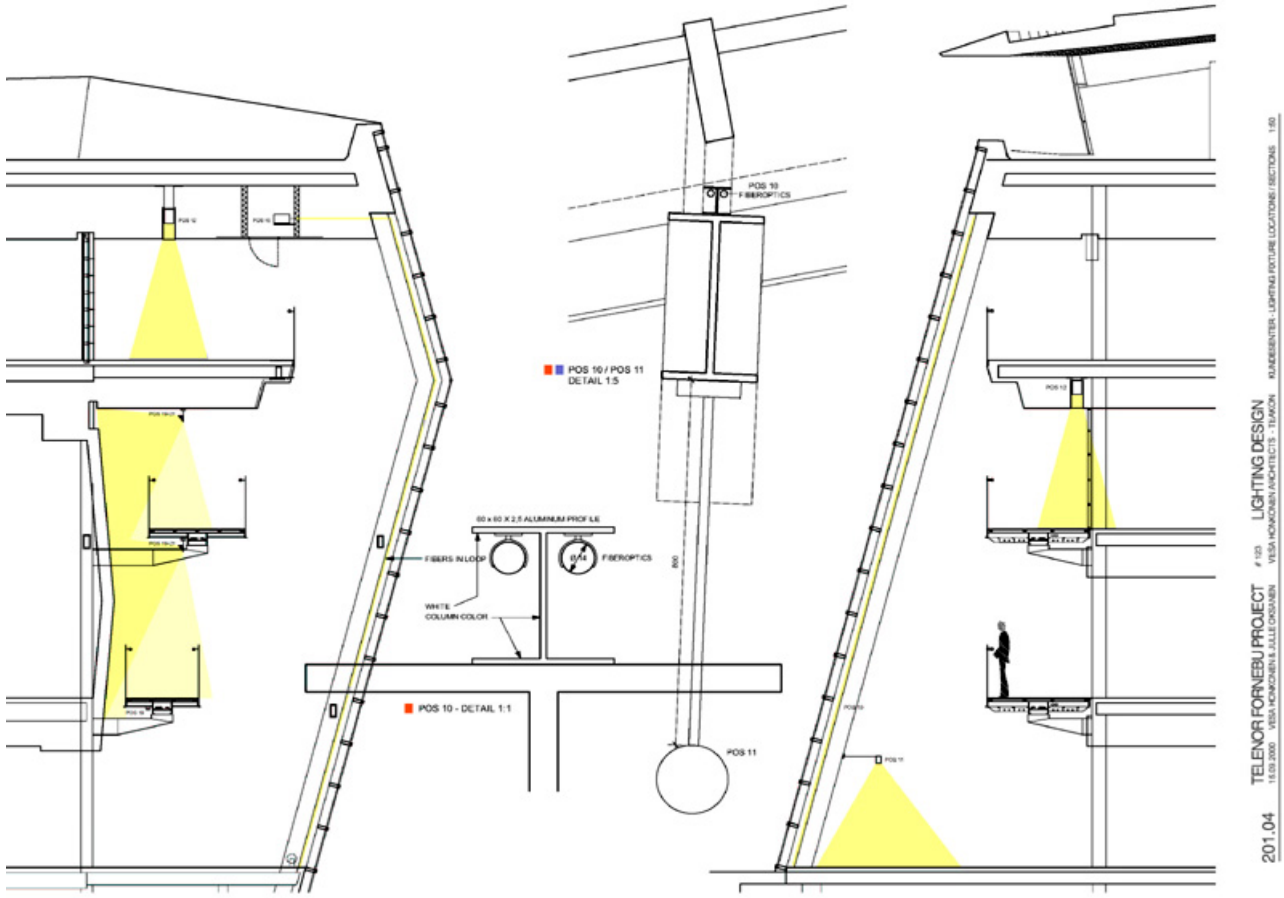


Figure 272. Telenor Lighting Design Master Plan. Bulevard sections. Hidden light distribution surfaces. Photo: Vesa Honkonen & Julle Oksanen.

When a project is very large and complicated, all kinds of innovative hardware solutions are needed to fulfill the concept. We also had some other solutions in addition to the fluorescent light row. To mention just a few examples, we used:

"Black hole" luminaire solution

"Hidden lateral fiber optic" solution" for facade

"Fiber optics pylon" solution

"Wall washing" solution

"Deep down light for orientation" solution

Remember that this is a master plan, no details yet. It is the same in real- life projects. In this phase one need only show innovative solutions to the client and introduce how they "follow" the concept. Representatives of the client, like the architect, interior architect, electricity designer, etc. want to see that the project is feasible. The reason for the interest of other designers is that one designers' solutions also can have a huge influence on other solutions. Co-operation is the key.

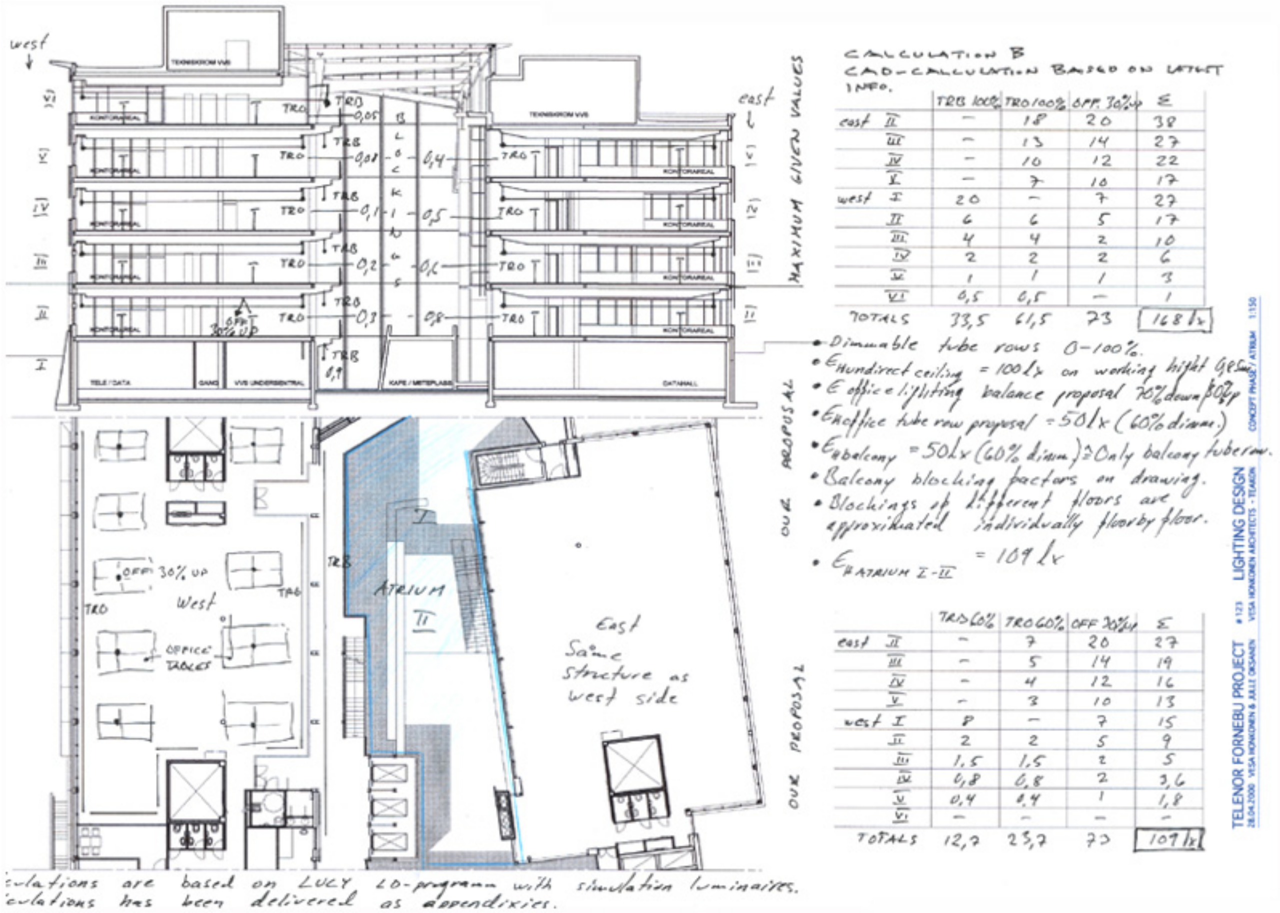


Figure273. Telenor Lighting Design Master Plan. Dimming calculations. Photo: Vesa Honkonen & Julle Oksanen.

After all approvals from the client’s side and maturing master plan ideas, we had to start to create real-life calculations and plan how to use light as a whole. The final calculations took care of all areas, like offices, atrium floors, café area, walking areas, areas in front of elevations, entrance area, stairs and balconies

At this point the reader is not expected to search any details from Figures 273 and 274. The main reason for introducing these calculations in this master plan context is to demonstrate how heuristic calculations supported us in our design work in such a project. We used the simple and free “*DiaLux*” lighting calculation program. That program did not include light distribution values for our new luminaire, so we had to execute simulation calculations by choosing a standard luminaire from the program. After that selection, we manipulated light distribution values to model to our new luminaire. Based on these results we proposed how to use all lighting. We also had to take into consideration that these values also had influence on lighting values on the Plaza, not only for atrium areas.

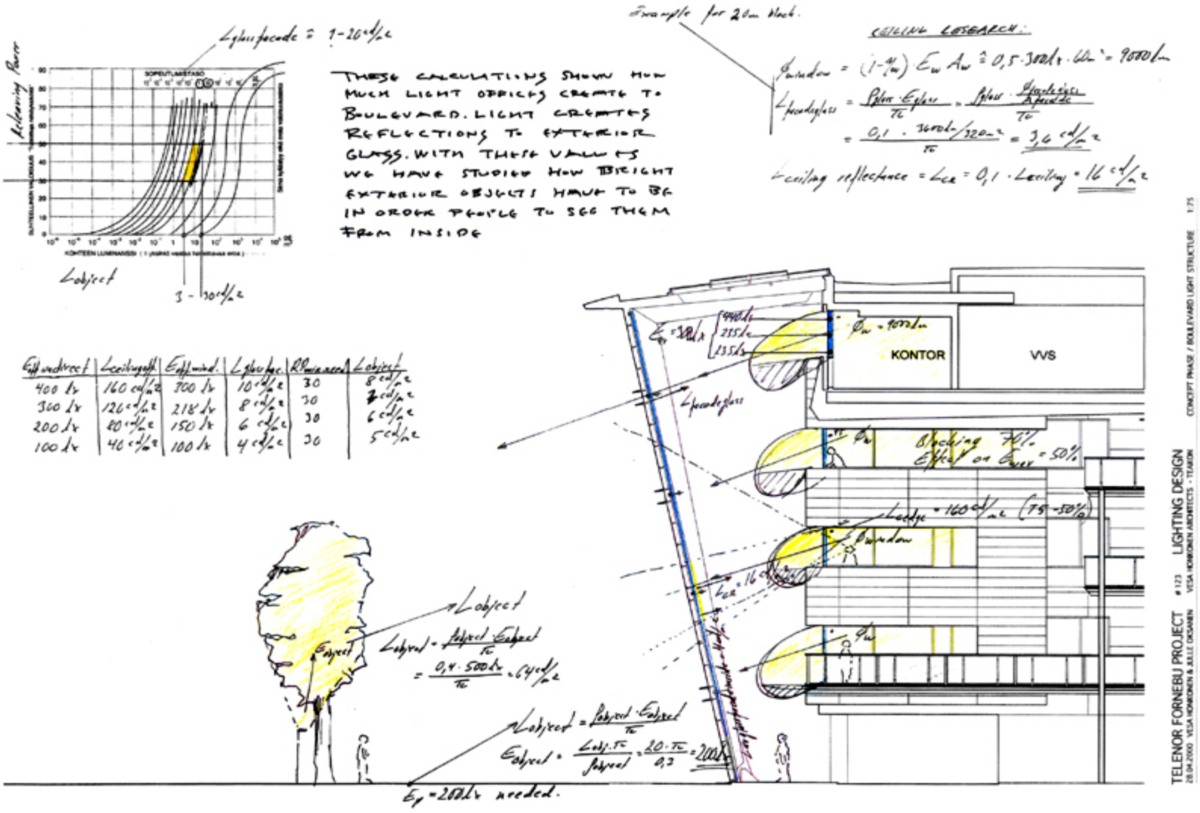


Figure 274. Telenor Lighting Design Master Plan. Contrast calculations to ascertain if people inside the building can see out during dark times. Photo: Vesa Honkonen & Julle Oksanen.

The director of Telenor asked us whether his employees could see out of the building during dark periods. That was a huge challenge for us as designers. We used contrast ladders based on Scales of Apparent Brightness by R.G. Hopkinson, which compares different brightness of objects with the brightness of different ambient conditions. The “heuristic” result is “Earned viewing points”.

Calculation in words:

1) Mr. Svensson is looking out of his office window. He tries to look outside and enjoy the view.

2) There are 2 windows = mirrors between him and Plaza.

3) Let’s assume first that Mr. Svensson has only outer glass elements (façade glasses) and his own window is just a hole (equal to his office window being open).

4) What he sees is ambient light in the contrast ladder diagram (a bunch of curves on left upper corner on Figure 274). The value of that ambient luminance is reflections of interior values from façade glasses. Those values are between 1–20 cd/m^2.

5) In order to “earn” 40 viewing points from the left side of the contrast diagram (e.g. Figure 119) (Officially “Relieving Power”) an object must have a luminance value of approx. 20 cd/m^2. (Horizontal values on contrast diagrams). That means an E value of approximately 200 lx (20 fc) on objects like a tree in Figure 274, for example. This is not possible within reasonable limits.

6) Conclusion: Mr. Svenson can see out clearly only if Telenor will purchase extra glass with a reflection factor of 2% (very expensive glass material and normally used in control rooms). Otherwise Mr. Svensson can only see lots of reflections like his own face, wall bricks, structural elements and outside something. A big mess.

7) Telenor decided to use normal float.

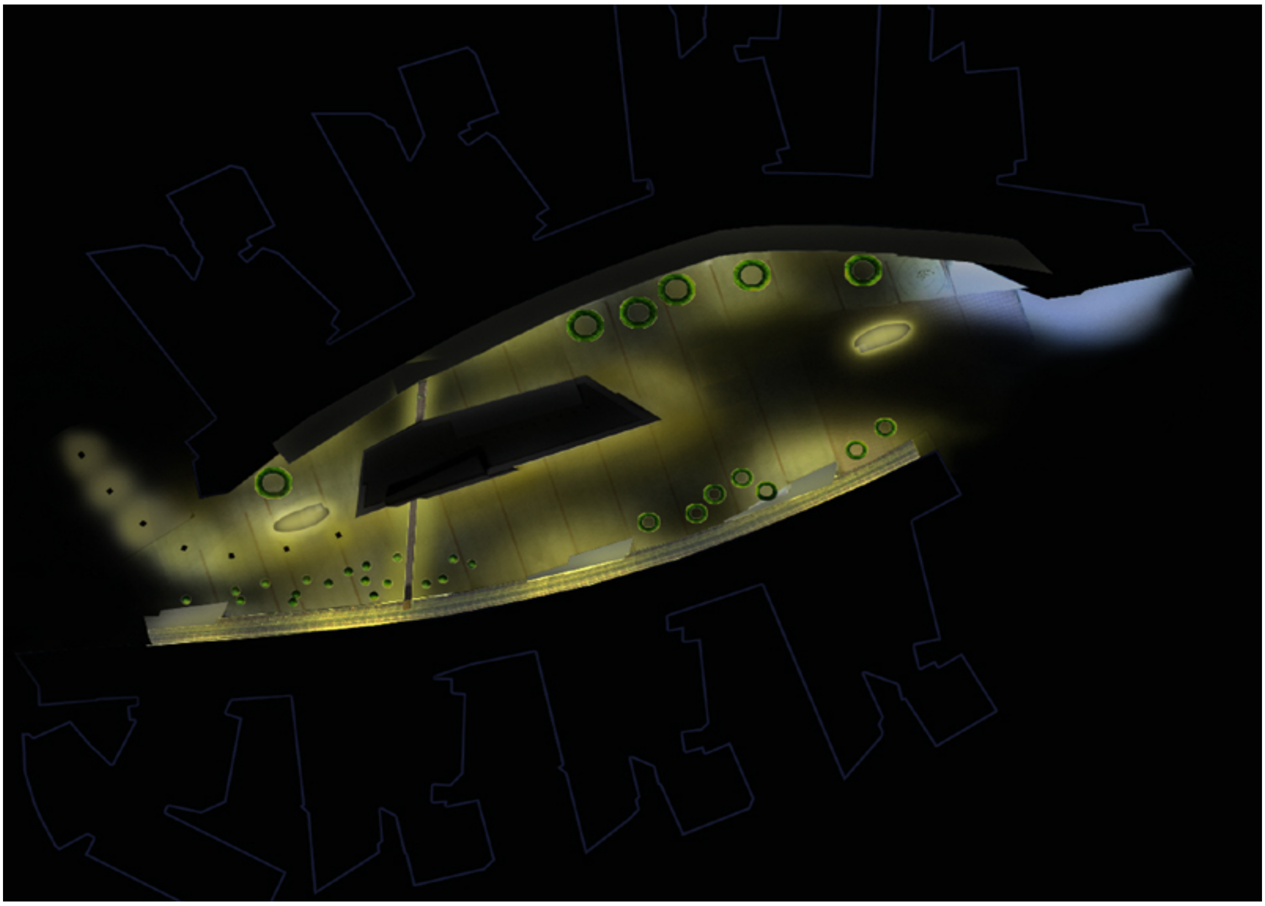


Figure 275. Telenor Lighting Design Master Plan. Computer image for Plaza. Photo: Oliver Walter.

This image was made for the client's directors and decision-makers, who normally do not understand lighting "language". It is a very sensitive issue, in fact, how to introduce project concepts and designs to these people. It is very important not to suggest that they are "dummies" in lighting, but rather that they are in charge. Visual images help them to understand the goals and so facilitates matters.

The Plaza luminaires are those huge glass sides of both buildings. The glowing luminaires hundreds of meters long and tens of meters high give a soft general light to the Plaza. Beautiful vertical values.

The eight entrances had their own inviting lights. The entrance canopies were illuminated by underground luminaires. The Education Center in the middle part of the Plaza was also a huge glowing luminaire with light bridges to buildings. Underground luminaires with asymmetrical light distribution were also used. The head/end part of the building, the nearest part to the fjord, was the so-called "PR part". It has blueish glowing façade lighting with lateral fiber optics. The parking area was located under the Plaza. The two oval holes are approach areas from the car park to the Plaza and also buildings themselves. The seven small dots on the left were indirect luminaires leading from outdoor parking place to buildings. The greenish round shaped elements on the Plaza are illuminated plant areas. They look small on this image but their diameter was many meters in each.

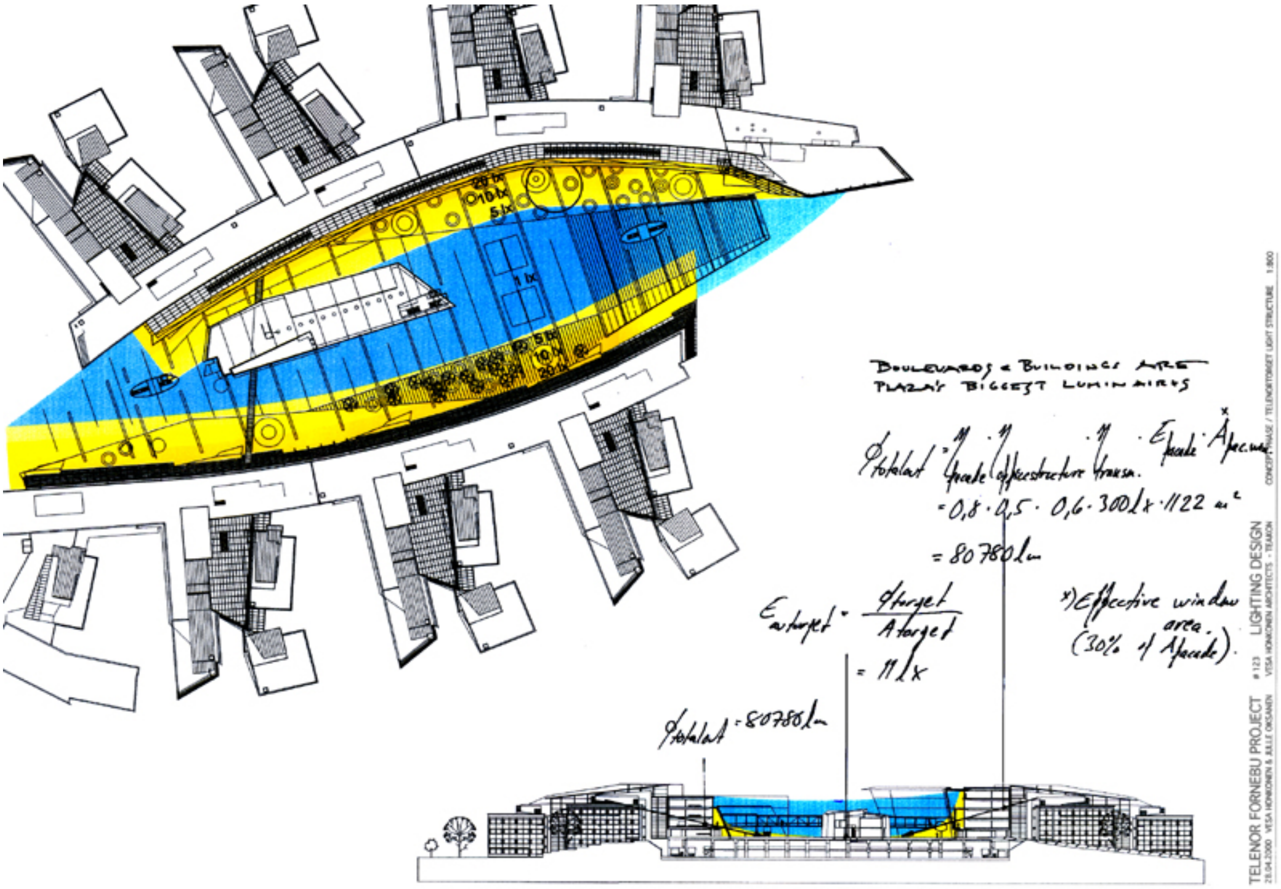


Figure 276. Telenor Lighting Design Master Plan. Heuristic Plaza calculation. Photo: Vesa Honkonen & Julle Oksanen.

The Master Plan calculation for the Plaza was very interesting. Again, we used the basic applied lumen method to calculate illuminance values on the Plaza. (The reader is not expected to seek any details in these figures. The main reason for introducing these calculations in this master plan context is to demonstrate how heuristic calculations supported us in our design work in such a project.)

In words the formula is as follows:

> Calculated the lumen package on the glass surfaces of both building blocks according to earlier calculations for offices.
>
> This value was divided by A, the area of whole Plaza. (E = Φ / A).
>
> This value was multiplied by a sum factor formed of: k_{glass} = Glass penetration factor, $k_{structure}$ = structural elements which reject light coming out of the building to the Plaza (like steel pylons, framing elements of glass etc.), $k_{directional}$ = Factor for how big a part of the light approaches the surface of the Plaza.
>
> $E_{averageplaza}$ = 11 lx (1.1 fc). This meant that of course light mostly fell onto the Plaza near the facades fading beautifully near the center line. Vertical light is beautiful, because it does

not disappear anywhere, but runs on the air vertically to the other side flowing partly into the other building through the window areas and partly reflecting back to the Plaza and other building.

Result:

Figure 277. The result of the Telenor lighting design. The café in the atrium. Photo: Jan Drablos.

Minimized reflections from windows allow people to see stars and other space elements in Northern sky. We were happy and relaxed to have achieved our concept and goal.

Indirect luminaire rows above the balcony give nice contrast in space and soft horizontal light on the floor level.

A nice contrast for café visitors is given by a row of lights located very low on the left side of the image. The height of this row, which is located on the small edge element of the café, is approximately two feet. The light distribution surface is towards the floor, but if needed it can be edirected.

Somehow a cozy feeling is created in the office environment.

Figure 278. The result of theTelenor lighting design. Stairs. Photo: Jan Drablos.

Light rows again installed approximately one foot above the stair surface.

The lines follow the angle of the stairs and the light distribution surface is aimed towards the stair levels. This solution for the stairs looks and sounds somehow easy now when the project is completed, but it was problematic in the real design phase. One possible reason was that nobody else had ever used this kind of method to illuminate stairs. The importance of continuous light on the balcony can also be felt on the right side of this image. Rows of “light tubes” also provide anonymous and functional elements in the space. They do not clash with any architecture and they still fulfill their task as luminaires.

Contrast and a continuous row of light and “tubes” somehow also gives “charisma” to the space.

Figure 279. The result of the the Telenor lighting design. Atrium. Photo: Jan Drablos.

Nice illuminance values, which also fulfill the lighting recommendations in Norway together with great contrasts is an interesting combination.

Shadow is the best friend of light.

Figure 280. The result of the Telenor lighting design. Plaza. Photo: Jan Drablos.

The Plaza seen from the other direction. The plaza is cozy and yet huge, which is an interesting combination.

The vertical illuminance values are beautiful and make it possible to recognize approaching people's faces and attitudes at a reasonable distance. This is an important factor in dark environments. According to research by the anthropologists E.T. Hall and Wout van Bommel, the semicylindrical illuminance value on a height of 1.5m (5 ft) must be E_{scmin} = 0.8 lx (0.08 fc). At this value an observer can recognize the faces of approaching people from the mandatory recognition distance of 3.5 meters (12 ft).

The lighting values are modest, but one is surrounded with illuminated walls imparting a feeling of safety. Contrasts of moving people, even at a distance, creates a sense of comfort.

5.2.3. Lighting design details

Such big projects need a professional coordinator, especially when the construction process is moving at a fast speed. In this case the project coordinator was a talented and experienced project leader Jan Drablos of Multiconsult Norway. He transferred Lighting Concept and Master Plan information to the electrical engineering consultants, whose task was to add lighting solutions as a part of the electricity drawings ready for the electricity contractor. The detailed design phase is a phase where the lighting designer can have only a small role, especially in this kind of big project. For the implementation phase, Jan Drablos of Multiconsult decided to take full control of the whole lighting design and procurement, even though it was a technical turnkey contract. This was to avoid being cheated on types of fixtures (which is common all over the world). Multiconsult decided on all manufacturers and types of all fixtures. Testing was often carried out before the decision on type and installation. The electrical engineering consultant team was instructed to perform the final detailed design according to the lighting designer's concept and Multiconsult's choice of luminaries, with great success!

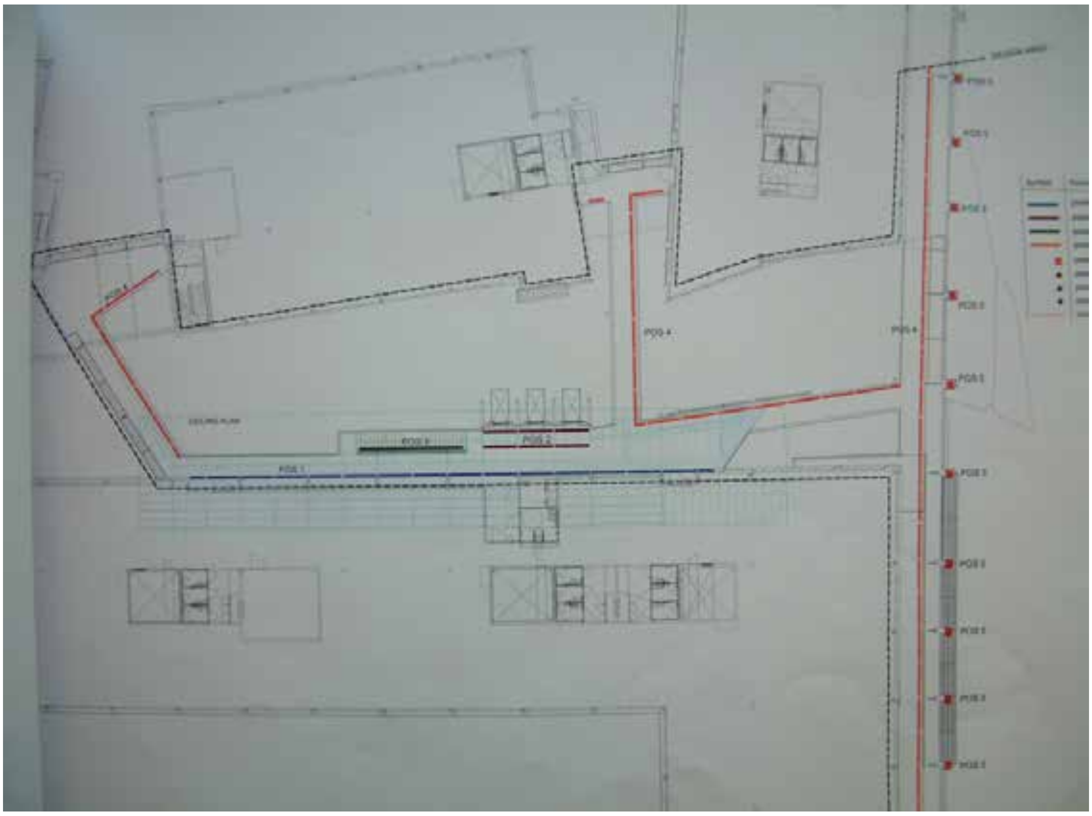


Figure 281. Detail design drawing of Telenor atrium. Luminaire positions. Photo: Jan Drablos, Multiconsult.

Our lighting project was completed successfully with only one luminaire type designed by ourselves (Vesa Honkonen & Julle Oksanen). Notor was manufactured by the international luminaire manufacturer Fagerhult Belysning AB. Fagerhult is one of Europe's leading lighting companies, with 2,200 employees in 20 countries. Fagerhult develops, manufactures and markets innovative and energy-efficient lighting solutions for professional indoor, retail and outdoor environments.

Telenor has over 8,000 meters of Notor luminaires.

5.2.4. Demonstrations and implementation

Before the final implementation, demonstrations are important. Computer images or calculations do not give perfect visible, 3-dimensional effect of designed solutions.

Figure 282. Façade lighting demonstration. Photo: Jan Drablos, Multiconsult.

Conclusion of Telenor: This lighting design project is a great example of how Heuristic metaphor-thinking leads the process in a totally unique direction. The concept created belongs to categories between "*Analytic approach*" (see: 4.2.3. Level 3 – "*Analytic approach*") and "*Gestalt approach*" (see: 4.2.4. Level 4 – "*Gestalt approach*").

As a result of this Heuristic Metaphorical Concept Fagerhult AB manufactured and brought to market the first linear light product, Notor.11 km of Notor light lines illuminate a whole building and its plaza. A new and enormous metaphor.

5.3. Pragmatic lighting design method example: Mariehamn West harbor

It is critical to structure a place-based method to achieve quality results. Each project may be considered unique and special, and several visits and analytical approaches tailored to the site are necessary. A good architectural outdoor lighting design example of this is Mariehamn West harbor project. Our reports that include elements 5.2.1 - 5.2.3 (Concept-Master Plan-Detailed design) appear in greater detail in the appendices 1 (Mariehamn lighting design concept), 2 (Mariehamn Master Plan Design report) and 3 (Mariehamn detail design report).

5.3.1. Site analysis

The lighting designer needs to go to the site and observe the surroundings to understand what areas should be enhanced through focal glow, what ambient lighting is necessary, and where the play of brilliance may occur. A map of the site as it exists and the plan of the new landscape design (if there is one) and camera are important tools to document and locate site conditions of interest. The site must be analyzed in all directions on foot focusing on popular viewing directions. There may need to be several site visits to understand the spirit of the place, how to enhance or create it, and execute the details to create a cohesive and legible lighting composition.

Figure 283. Landscape analysis. Photo: Jens Löngvist.

Landscape architect Jens Löngvist's landscape analytical report provided our lighting design team wirh basic information. Photo: Sample page of landscape analysis report

5.3.2. Sketching

A sketchbook is essential to document ideas. It is important to write clearly, as often the case notes may represent 'the moment', but not be understandable when revisiting the sketchbook. The sketchbook is also important in the design process; it should be available when creating ideas back in the office.

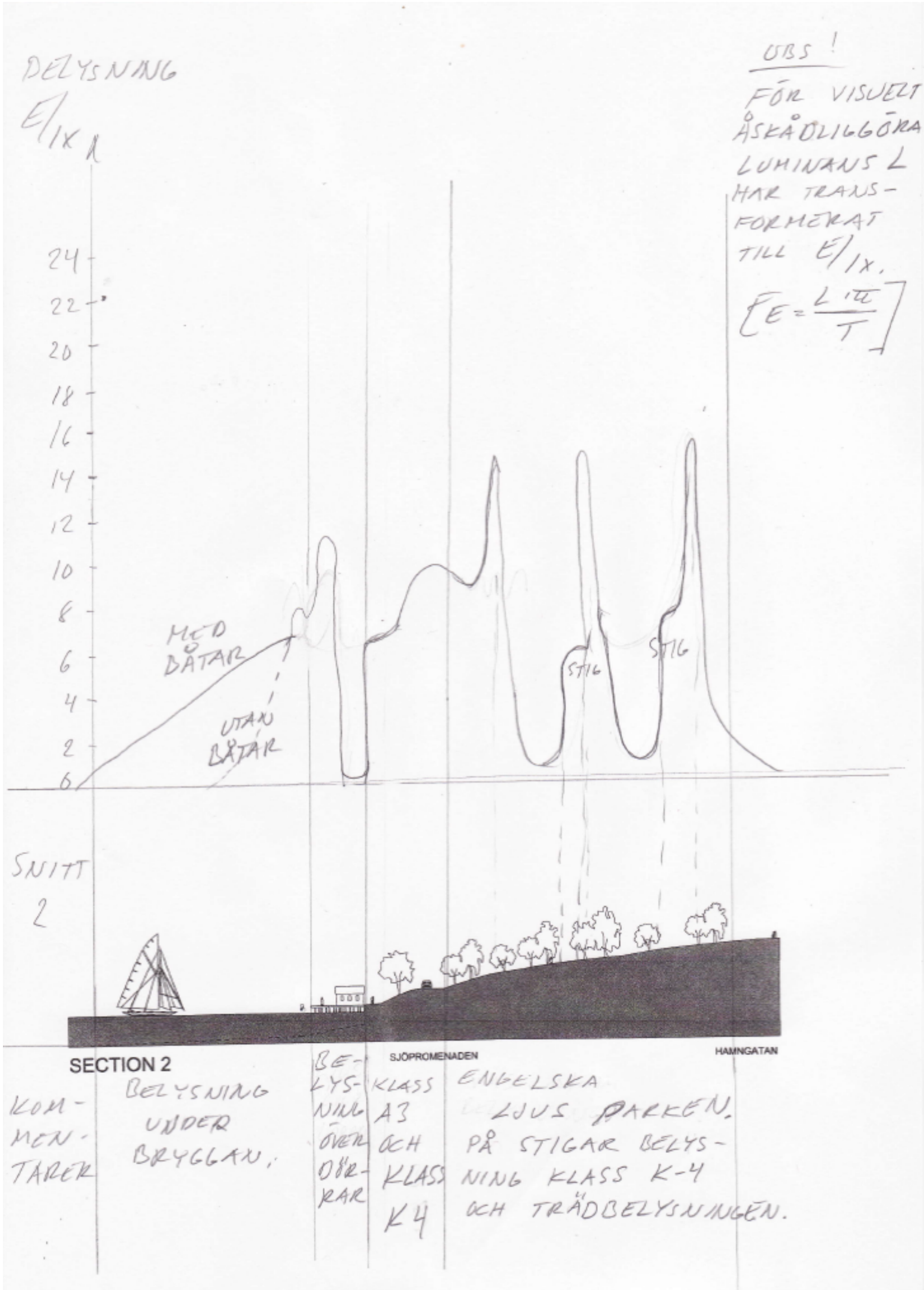


Figure 284. Early sketch of the idea to use lighting composition on the area. Photo: Julle Oksanen.

5.3.3. The lighting design concept

The lighting design concept is the most important part of the project. it follows the heuristic metaphor and consists of how to capture the spirit of the site (genius loci) through personal connections and then to relate this spirit to the design team and necessary requirements for a functional space and place. This concept belongs to the "*Analytic approach*" category (Subsection 4.2.3. Level 3 "*Analytic approach*"). Concepts can be created in minutes or sometimes take a year, depending upon the quality of the analysis, the chemistry of the design team, and the amount of time available to work on the project.

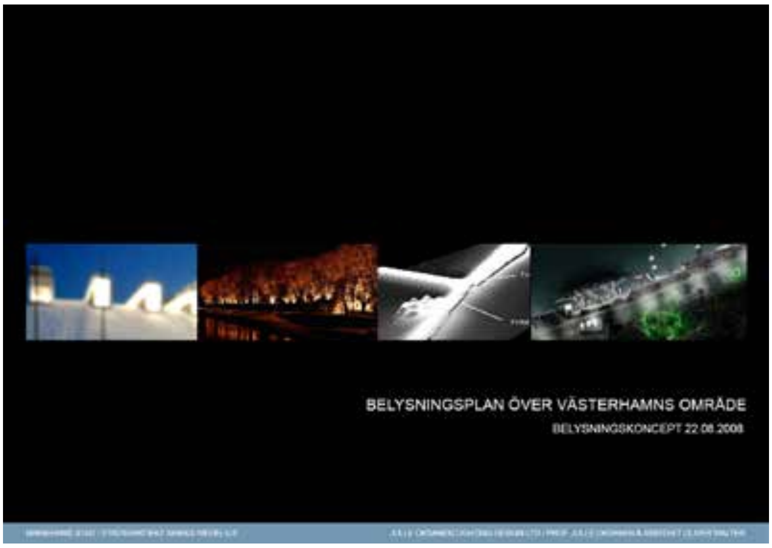


Figure 285. The first page of the concept report. See the whole report presented as Appendix 1

The master plan is a strategic method of documenting and figuring out the concept and communicating it to the collaborators. With the plan, lighting designers have to find lighting “hardware” and “software” solutions to fulfill the concept design in a practical sense. Activities during master planning include luminaire selection, lamp selection, preliminary checking of construction solutions, lighting calculations, and computer modeling.

If the right solutions cannot be found, the concept needs to be changed. It is important to understand a concept as a theory, but if it cannot work in a situation, the theory must be changed. This demonstrates how theoretical concepts, when applied to a specific lighting design, create a pragmatic truth. Experience with real projects matures a lighting designer’s capabilities and understanding of what can be done and what cannot be done. More information about pragmatic truth, master planning and the activities that occur within this phase is presented in earlier chapters.

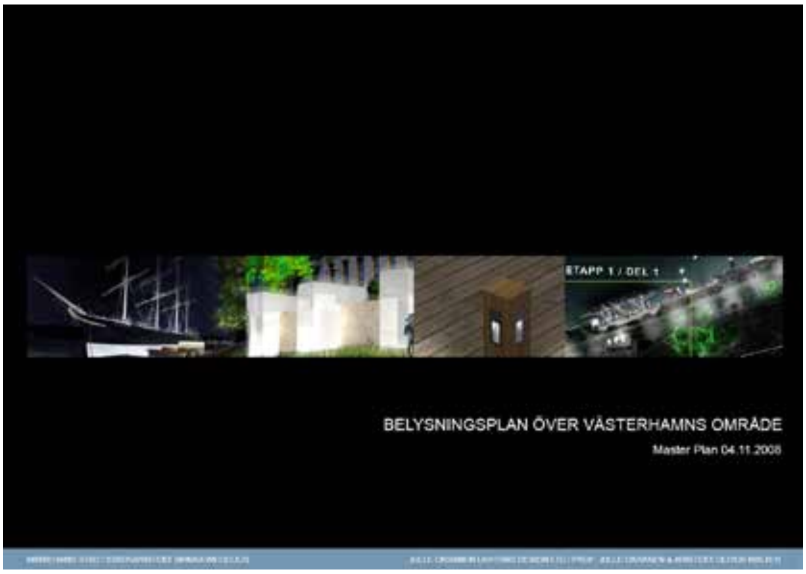


Figure 286. The first page of master plan report. See the whole report presented in Appendix 2.

5.3.4. Physiology, Function, and Luminaire Selection

The process of selecting the right kind of luminaires is important to accomlish the necessary functions of the lighting design. Luminaire selection influences all aspects of the lighting design including; light composition, glare, and recognition distance. It is critical to understand this role and impact of luminaires from the beginning of the conceptual phase. Although fundamentally important, the luminaire selection is not the primary issue in the design process, it still comes after the concept and composition done in the master planning phase.

Figure 287. Brando luminaire. Photo: Britt-Marie Trensman.

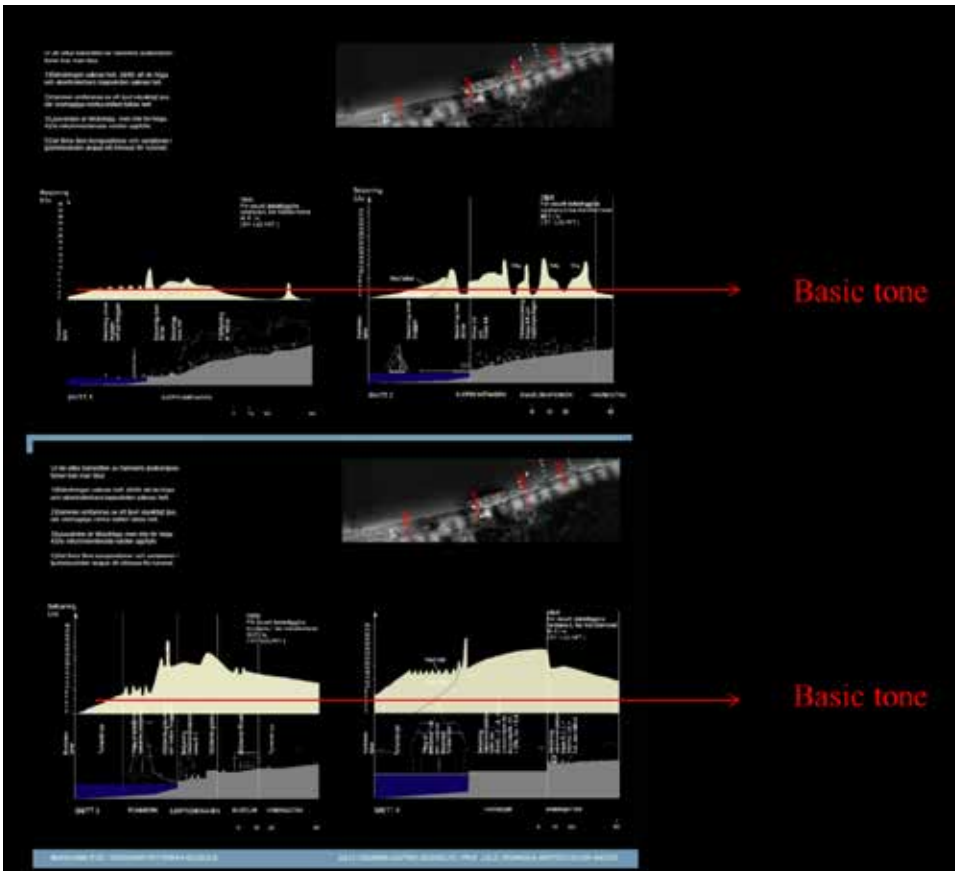


Figure 288. Lighting sections, basic tone and a new metaphor. Design Julle Oksanen. Photo: Oliver Walter.

Brando luminaires produce a beautiful and humble white light veil over the design area. No glare and clear contrasts. The pole distance depends on the mandatory face recognition distance of 3.5 m. The basic tone must be higher than E_{sc} = 1lx in all lighting sections 1-4.

5.3.5. Lighting composition

Once the luminaires have been selected, the composition needs to be re-evaluated. There are many ways to evaluate a lighting design. One way is to make a preliminary composition with photos taken in the sketchbook and analysis phase. One can explore with reasonable precision the play of brilliance, focal glow, and ambient light through modeling in photos and the computer. If resources are scarce, evaluation can be done on, or through, drawings and sketches.

Figure 289. Ambient light, focal glow and play of brilliants study with computer. Photo: Mariehamn Master Plan report.(Appendix 2).

5.3.6. Maintaining the right technical tools

The designer must remember that engineering serves design. Precise technical tools serve lighting design for function and composition. Luminaires, dimming systems, color changes, fixtures and energy supply types like solar, are good to add in the detail design phase.

Figure 290. Example page from the Mariehamn detail design report. Photo: Mariehamn Detail Design (Appendix 3).

5.3.7. The right kind of collaboration

The lighting design process entails collaboration between many professions and people. A team united in the idea according to the concept, working in harmony, is essential for a lighting design concept to reach full potential. Proper working methods and tools are necessary to help communicate the lighting design concept to get everyone involved and aware of how to implement the design. This is often the hardest part of the whole design process, because of the lack of lighting design education in all levels and among all professions.

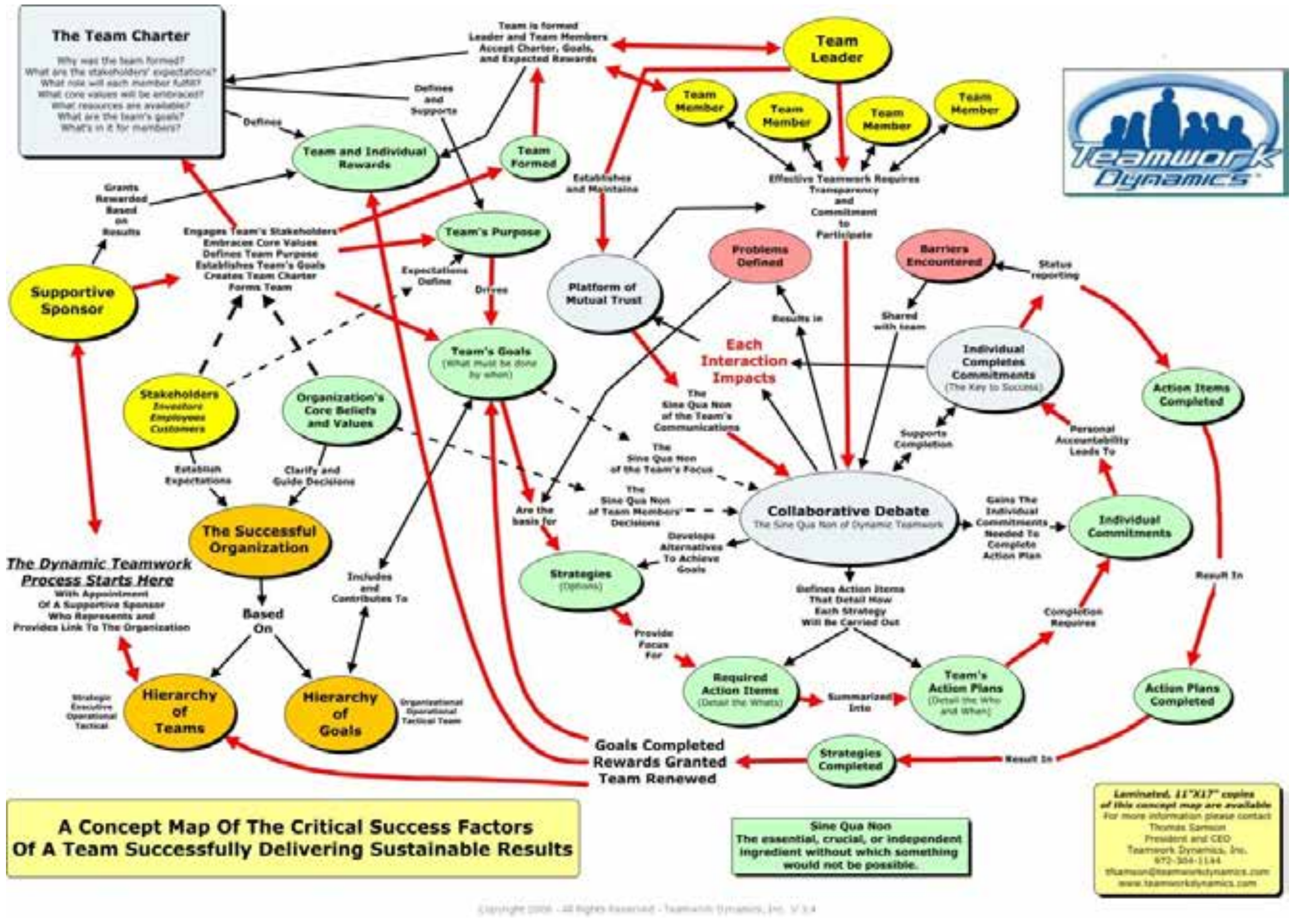


Figure 291. Team work scheme*. Photo: http://www.teamworkdynamics.com/id134.html.*

6. CONCLUSIONS

Architectural lighting design is not an easy task, and there are many parallelities with architecture. Both tasks have a lot of "tools" in use, starting from the context and ending in the detailed design.

A lighting designer has to have a profound and internalized understanding of all the architectural lighting design tools introduced in this dissertation in order to be able to create a successful and aesthetically interesting identity for visual night time city beautification in his/her project.

"Shadow is the best friend of light" and "glare is the worst enemy of light". "The Pragmatic Theory of Truth" as defined by myself is an invaluable key to tackling every emerging issue which both phenomena (shadow and glare) demand. It is also a very important and new tool to bring architects and engineers together.

Answers to my research questions:

Question 1: Is it possible to create a new architectural outdoor lighting design approach by utilizing heuristics and metaphors as a problem-solving tool in lighting design?

Answer to Question 1: Implementations of heuristic metaphor treatments are presented in Chapter 4.3. "*Introduction of different conceptual examples*". In the Mariehamn project (subsection 4.3.1) the heuristically analyzed lighting design, the "metaphor element" and "findings" became obvious to me. Immediately after visiting the site, music and light in combination came to my mind. Rich nature and an inviting environment supported the idea of using Richard Kelly's design process. The scary looking sea created simultaneously a vision of a humble white veil as a contrast to the black sea. The great vessel *Pommern* gave birth to an idea to write a poem on the first page of the concept report, which we did (see: "Den glödande hamnen"). Shadow is the Best Friend of Light – Contrast: Black sea and white soft light veil – Poetic light. These metaphorical elements revolved in my head and led to an "Analytic approach" concept. Poetic "touch" and lighting compositions belong to the "Gestalt approach" concept category. When darkness falls on the Mariehamn area, electric light embraces the space forming a "Glowing harbor". The white veil over the harbor forms a strong contrast to the mystic and dark sea, a pair in life. The *Pommern*, the biggest 4-mast bark afloat is sleeping in a glowing white mist, the captain is walking alone in the white glow towards his home leaving behind only slowly fleeting smoke from his pipe. The harbor falls into a dark sleep. Electric light was composed to serve this night-time episode which is more or less a dream, a personal hectic memory of Orson Welles's "The Third Man". It was easy to go forward from this point.

In the Statue of Liberty, New York project (subsection 4.3.2) the lighting designer Howard Brandston created a marvelous composition of heuristic design style and metaphorical thinking for this icon. The lighting designer and Professor Howard Brandston**:** "I pondered the challenge of how to illuminate this icon, so I took a boat out into the harbor and observed her from various distances and at every angle. I observed her at dawn, noon, dusk and in the darkness of night. At some point of the process, I walked to the end of the Battery Park Promenade, sat on a stone wall, and it came to me: She looked best in the light of dawn. I took out my little notepad and wrote: "Needed: one light source with spectral power distribution to mimic the morning sun, one to mimic the morning sky and a new light fixture to project light from a great distance – this will create a lady with green skin look good." *(Brandston 2008b)*

The Finnish National Opera project (subsection 4.3.3) consists of different design approaches like the "Analytic approach", the "Gestalt approach" and some hints of an "Intuitive unconscious approach". Heuristically the building was treated in many ways. Sometimes the building was like a lantern, shedding light from the inside out. The stage and the stage tower with its hidden mechanical equipment are the pulsating, fiery heart of the building. From here the creativity wanders to the surrounding halls, lobbies, foyers and other living areas. From these areas it flows out from all windows and openings transformed into visible light. The building has changed into a huge lantern, creating warm and interestingly glowing light. When this glowing lantern type of light is in the main role and the rest of the building is in the dark, people understand that shadow is the best friend of light. Sometimes light is a message and the building is a messenger. In the dark the spirit of the National Opera ought to introduce its inner spiritual soul and aesthetic functions outside, too. This can be done by color lighting and variations of light and shadow. The outer shell of the building can also be used in the style and spectacularly to proclaim future events. The light is then the message from the future. When a person approaches the building and gets to the performance, he will transfer from everyday life to art. The building entrance (in the right light) is the space for approaching people between everyday life and artistic experience. The hustle and bustle of Mannerheim Street, a major thoroughfare is behind and great art experiences are in front. The dancers of Bella Figure from the huge cube are as if dropped from the tower T1 inside the building onto the stage waiting for the audience. The tower only glows in red light as a reminder of the performance. Facade and Plaza lighting are slowly moving, breathing red light. For once, it is fascinating to cross the Plaza. This nationally important building deserves this kind of heuristic and metaphorical thinking at the beginning of the lighting design process.

The Amphitheater in Ankara (subsection 4.3.4) was a lighting design project where I felt that I reached an "Intuitive unconscious approach" level in design. A strong metaphor created really fast**.** When I entered this building for the first time with the architect Ergut Sahimbas, who had designed it, I immediately felt what the solution should be. The Amphitheater is located on the slope of a dark hill in Ankara. People approach the area by car. They drive towards the amphitheater guided by car head-lamps. The turning car head-lamps create an interesting light phenomenon. No specific street or area lighting is needed at all. General lighting is the falling, humble white veil of light which flows out from the huge openings of the amphitheater structure. From their parking places people start to walk in line like hundreds of ants towards the main stairs and entrance to the building. Expectations are high and slowly art starts to fill their minds. Cars in the carpark start to sleep together on the embrace of darkness. You almost can hear their whispering together when their engines cool down. When people have passed the stairs they have their historical moment to be a gladiator for a couple of minutes. They have to walk bravely through an approximately 20-meter high and 4-meter wide stone corridor under the light which falls from the canvas and open ceiling. After they have come inside the amphitheater, they orientate themselves under a mystic indirect light. The huge size of the amphitheater influences the emotions very strongly. People find their places and sit down to await the performance and observe the happenings inside. The excitement is palpable. You almost can touch the exciting atmosphere. The ants are in the nest. The design process was easy to start after these thoughts.

Pedestrian Bridge, Knoxville (subsection 4.3.5). The design area had lost shadows, interest and happiness as a place. Human scale and spirit as a comfortable and enjoyable place were lost. The area serves transportation and activities inside the enormous buildings, Thompson-Boling Assembly Arena and Neyland Stadium. Because of the structure and the multipurpose use of the site/space, the "*Gestalt approach*" of design thinking was somehow natural. The lighting design process was one of restraining and not giving form to the design until all the criteria and analysis were thoroughly digested. That meant that I was waiting until the form became apparent and only then put it on paper. This was very educational and a process worthy of development to me as a lighting designer. When the design had a given form, the result also proved to be appropriate and according to my professors also quite creative. Many new heuristic and metaphorical elements were found and used like zoning the area (entertainment, approaching, whispering lights zones), using only solar energy, totally glare free lighting and color lighting. This "*Gestalt approach*" type of student work was also introduced to the municipal authorities, who wanted to continue the real project together. Unfortunately, the whole bridge project was postponed to the future.

Question 2: Can we find executable design tools to change the direction of 100 years of lasting technical lighting design practice into more artistically orientated architectural lighting design processes?

Question 3: Can we use those tens of thousands of pages of technical lighting research results for this transition process to achieve aesthetic lighting solutions?

Answers to Question 2 & Question 3: Most of the important executable design tools are introduced on the first page figure. Most of them have been recognized after they were discovered, but the communication deficiency and the lack of “transferring” tools between academic research results and practical lighting design have led to a situation in which those elements have never been used in a conscious manner in real-life projects. This fact has also had a strong influence on the relation between artistic people (mainly architects) and technical people (mainly engineers) in the lighting field. There has been a confrontation lasting almost 100 years between these two professions. Technical lighting already has a history over 100 years and a legacy while architectural lighting is in its genesis phase. This long-lasting lack of a common lighting “language” and fruitful communication between architects and engineers is now at an end, if we want and have energy to go forward with the most important tool: “The Pragmatic Theory of Truth”, also sometimes called “*The Law of the Pragmatic Truth*”. With this important tool, we can “transfer” the lighting research results to “serve” practical architectural lighting design. It helps the communication between architects and engineers to find a common language and leads to a completely new architectural lighting design world which can fully exploit the other important tools appearing on the figure in the first page. Awareness of those tools also leads designers to create new metaphors, lighting design concepts, lighting compositions, etc. This leads to a change of the architectural lighting design paradigm.

More details for Answer 2 can be found in Chapter 3.6. “*Shadow and darkness design*” and subsection 3.6.5. Modified use of “Contrast Ladders”, based on R.G. Hopkinson’s work on Scales of Apparent Brightness, the Law of Pragmatic Truth and whispering lights.

More details for Answer 3 can be found in contrast ladders, based on Hopkinson’s Scales of Apparent Brightness “modified” with “*The law of the pragmatic truth*” factor to produce aesthetic lighting solutions in subsection 3.6.5.6 *“Student’s Sibley Hall façade study at Cornell, New York, USA”*, subsection 3.6.5.7. *“Façade luminance studies on own projects”* and subsection 3.6.5.8. “*Practical use of Contrast Ladders; Cathedral in Arras, France*”.

Question 4: What are the benefits of using the first-generation pragmatism of C.S. Peirce and William James in order to utilize pragmatic light technical research results to serve architectural lighting design?

Answer to Question 4: The answer to this question can be found in the use of “*The Law of Pragmatic Truth*”. In this dissertation it has been used as a modification tool to define pragmatic and collectively accepted “tolerances” between scientific research results of the use of the “*Contrast Ladders*”, based on R.G. Hopkinson’s work on the Scale of Apparent Brightness and practical values in architectural outdoor lighting projects. Wise use of this tool can also save huge amounts of energy in public lighting. Modified use of the “*Contrast Ladders*” can be transferred to serve practical lighting design, especially in the case of low lighting levels, where this modification process works perfectly without any kind of saturation of sight. If Hopkinson’s abstruse work on Scales of Apparent Brightness can be modified to serve aesthetic architectural outdoor lighting projects by using “*The Law of the Pragmatic Truth*”, then why would this law not work for hundreds of more basic technical lighting research results? It is also very important to remember that we cannot give numerical values for human sensations (smell, noise, vision). Technical research results are mostly based on numerical values. The benefit is that technical lighting research results can be applied to serve real-life projects.

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Conclusion: My dissertation proves that heuristically analyzed metaphors at the beginning of the project can create successful architectural lighting design concepts, which are specified for five different approach levels in subsections 4.2.1. “*Thought free*”, 4.2.2. “*Ideas from the past*”, 4.2.4. The “*Gestalt approach*” and 4.2.5. the “*Intuitive unconscious/super-conscious approach*”.

The conceptual process in turn leads to an “efficient” use of design tools introduced in Chapter 3 of the dissertation: “*Modern architectural outdoor lighting design elements and tools*” (Subsections 3.1. – 3.7.).

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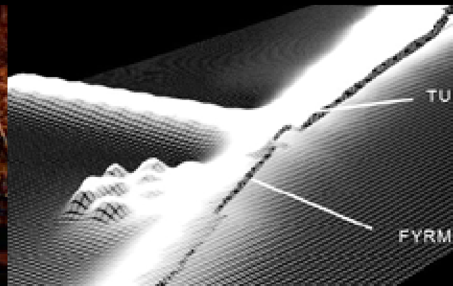
8. APPENDIXES

Appendix 1 – “Mariehamn West Harbor Concept Design” by Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter

Appendix 2 – “Mariehamn West Harbor Master Plan Design” by Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter

Appendix 3 – “Mariehamn West Harbor Detail Design” by Julle Oksanen Lighting Design Ltd, Julle Oksanen & Oliver Walter





BELYSNINGSPLAN ÖVER VÄSTERHAMNS OMRÅDE

BELYSNINGSKONCEPT 22.08.2008

DEN GLÖDANDE HAMNEN

Då mörkret når Västerhamn, förvandlas rummet med elektrisk belysning till en ”glödande hamn”. Hamnen förvandlas till en harmonisk partner med det slumrande mystiska närliggande havet. Vandrarens själ nås av ett lugn i rummet, till en motsats till den hektiska vardagen. Hamnens belysning är en komposition i ljus. De olika tvärsnittens kompositioner finns på de följande sidorna. Hamnen saknar helt bländning.

Ljusdistributionsytorna på de flesta armaturer är gömda. Ljushetsgraderna i reflexskivorna hos de Brando-armaturer som används för att producera grundbelysningen i hamnen motsvarar helt det ljus som åstadkoms vid fullmåne (3000-5000 cd/m2). På detta sätt blir det lätt att se skarpt eftersom vävluminansen uteblir från näthinnan.

Värdet är en fjärdedel av den ljushet som åstadkoms av en ”normal vägbelysningsarmaturs reflexyta. På detta sätt kan man skapa en komposition av belysning och på riktigt forma hamnens kvällsarkitektur.

Identifieringsavståndet av en mötande person i det parkliknande området är ca 10 m, vilket är rejält över det krävda rekommenderade värdet på 3,5 m.

Vägavsnittens ljusvärden ligger vid 1 cd/m2 nivån, då sannolikheten att bilisten observerar en fotgängare är utmärkt (75%). Bilens egen körbelysning ger ett tilläggsvärde i säkerhetstermer.

Museets stora glödande glasytor skapar en atmosfär av mystik, det ljuva ljusbandet av hamnkajen framhäver skillnaden mellan vattnet och strandlinjen och ljuset som reflekteras ur vattenytan belyser båtar och skepp som slumrar i havet.

Tjärdoftande låga kajarmaturer som är byggda i trä vägleder den nattliga båtföraren till en lättare orientering och möjliggör användningen av ström och vatten som hamnen erbjuder. De små svarta armaturer som är placerade ovanför dörrarna på hamnbyggnaderna, belyser på ett funktionellt sätt ingångar och trätrappor.

Kontrasterna är vackra och fascinerande. Armaturer som är placerade under småbåtsbryggan belyser med sina indirekta ljusstrålar båtarna med ljuset som reflekteras från vattenytan. Den engelska parken kommer att bli en ljuspark, där trädens lövverk svajar förtrollande i takt med havets vindar. Byggnaderna kommer inte att få någon separat belysning utan de får sova om nätterna i lugn och ro. Ljuset som strimmar ut från byggnaderna leder sjöfararen tillbaka till hemhamnen. Det är som om man kunde höra sjömannens knackning på fönstret och som om röken från hans pipa fortfarande skulle lugnt förbli svävande omfamnad av hamnens ljussken.

Exempel: (Vuosaari- projekt)

LJUSKUBER

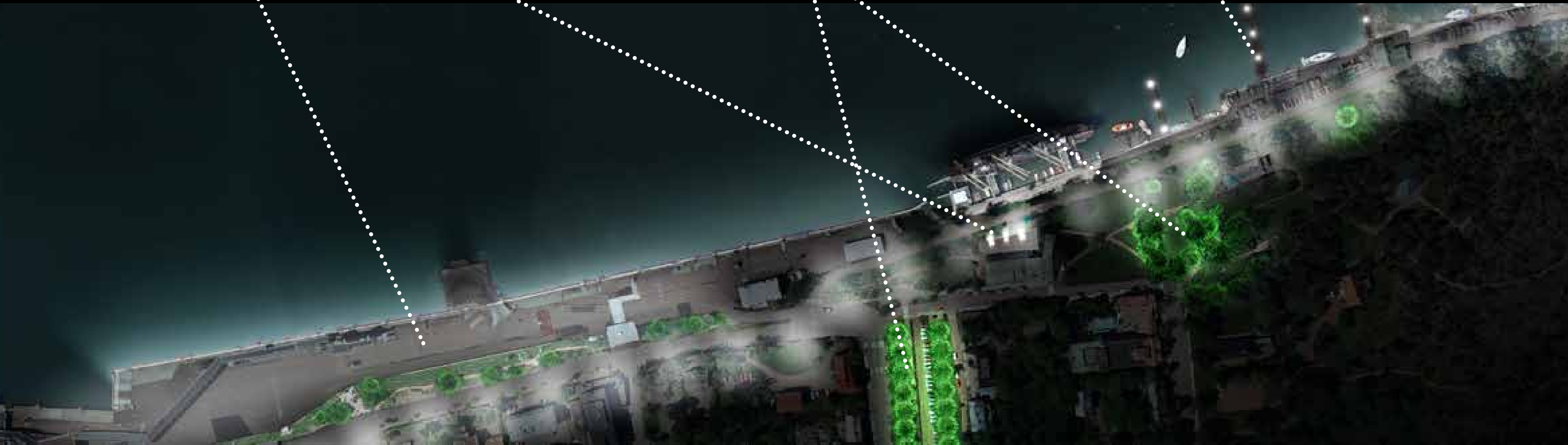
Museets glödande ljuskuber åstadkommer en mystisk atmosfär och fungerar som intressanta rumselement (exempel: KUMU – projektet i Tallinn)

TRÄDLYS

Den Engelska parken belyses med armaturer av trä så att de ljusreflekterande ytorna inte kan ses. På detta sätt åstadkommer man en mystisk atmosfär, det är lätt och behagligt att se och kontrasterna kan urskiljas tydliga och skarpa (som exempelvis i Åbo)

KONTRASTER

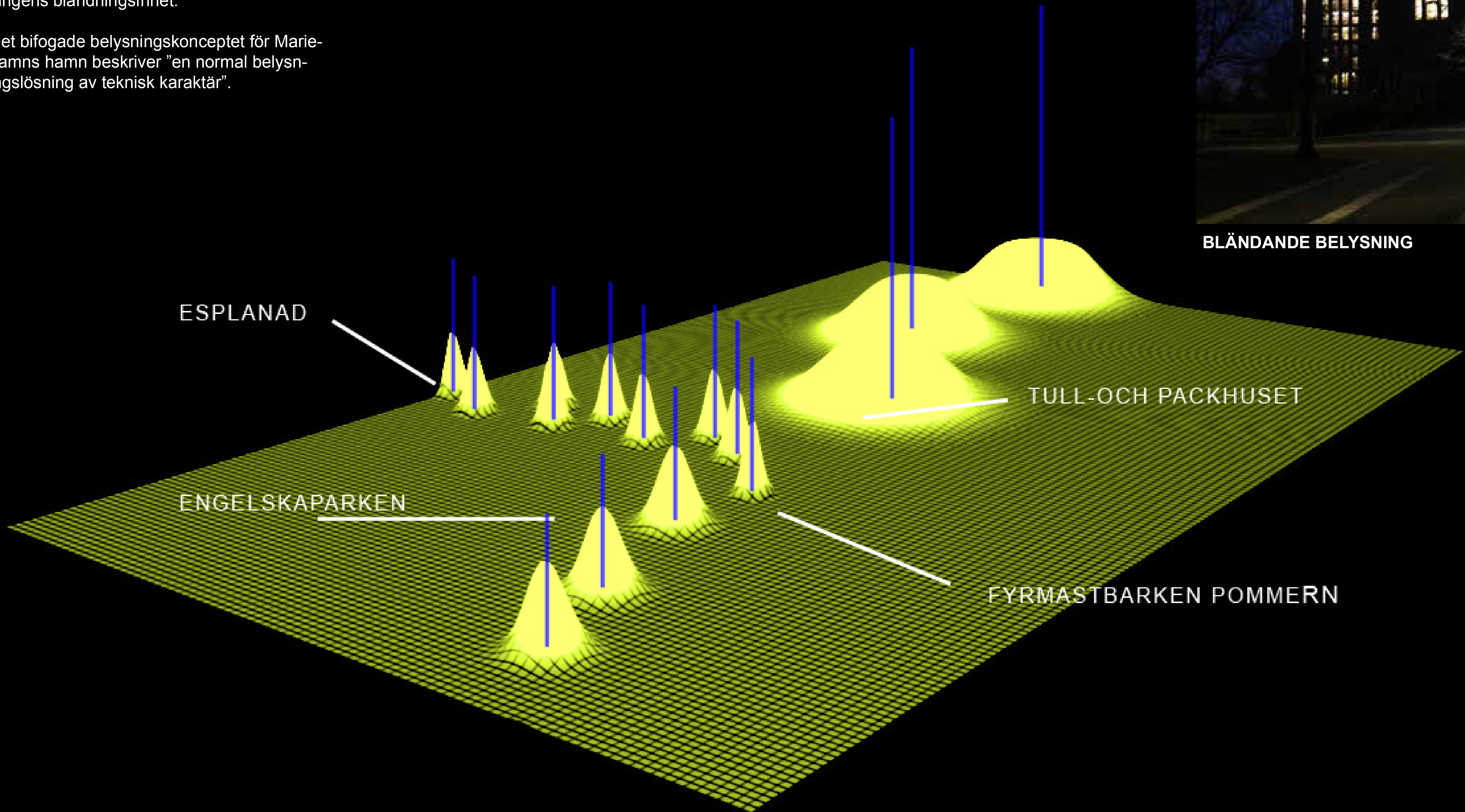
I hamnens ljuskomponering åstadkoms kontrasterna utan några bländningar. Det är en av nyckelfaktorerna bakom en lyckad ljusplanering (exempel: Fiskars – projektet)



De nyaste resultaten inom belysningsforskning och den stigande värderingen av arkitekturbelysninsplanering istället för att tillämpa belysningsplaner med rekommenderade belysningsvärden har snabbt ändrat ljusets värld. Tack vare de nyaste forskningsrönen, och kretsar som förstår sig på arkitektur och för att arkitekter som ansvarar för allmänna utrymmen har utrymmet fått två ljuskvalitetshöjande förändringsbenägenheter till stånd. De är det vita ljuset samt belysningslösningens bländningsfrihet.

Det bifogade belysningskonceptet för Mariehamns hamn beskriver ”en normal belysningslösning av teknisk karaktär”.

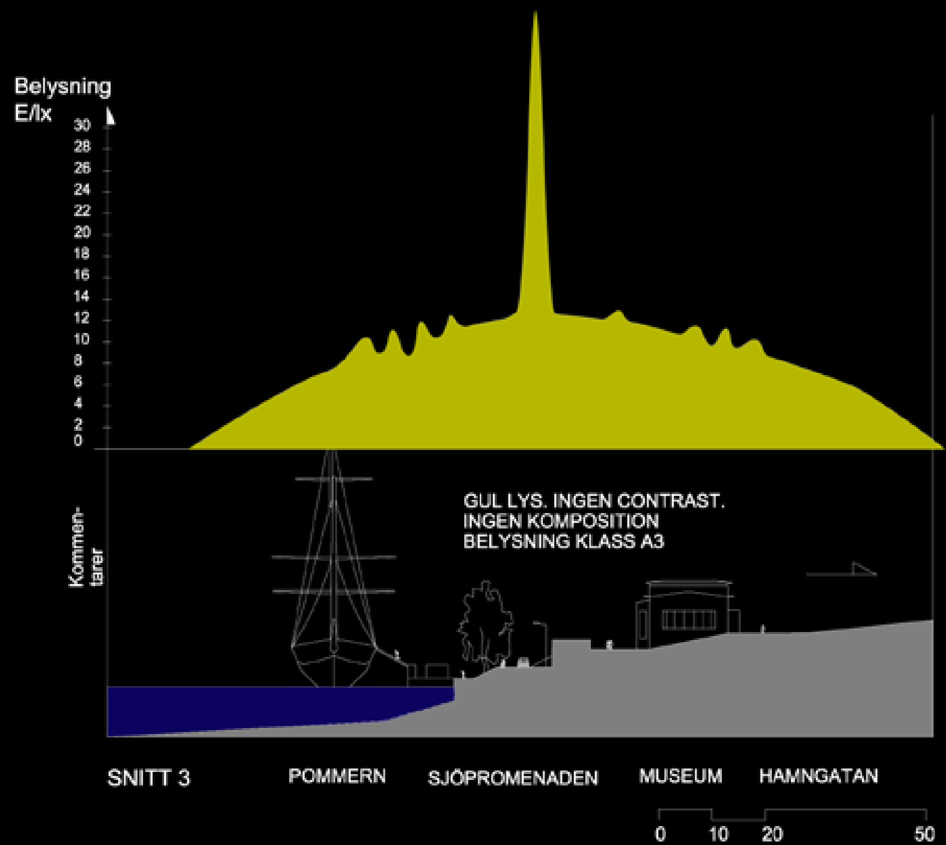
BLÄNDANDE BELYSNING



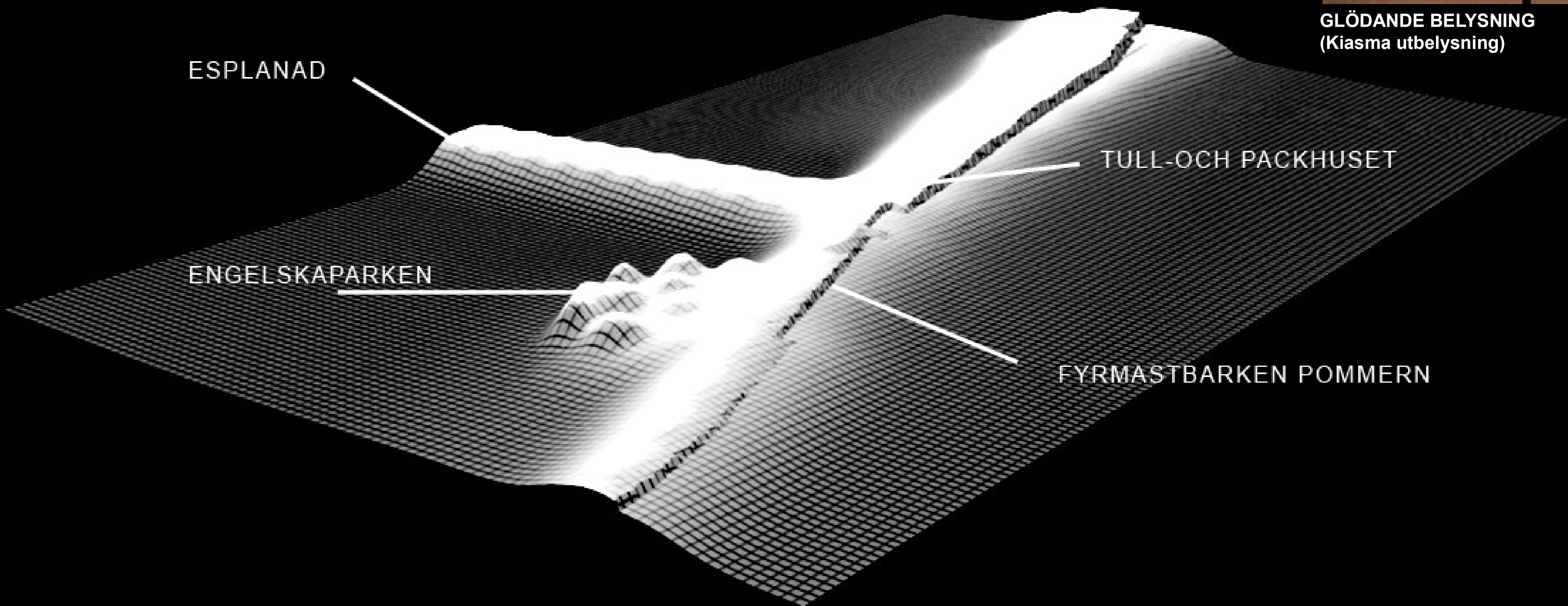
Vi har bifogat en presentation av en dylik lösning för en arkitektursnittbild med ljushetstvärsnitt. Ur ljushetstvärsnittet framgår dess okontrollerade formgivning. Ljuset är bländande (vägbelysningens luminans=hur skinande ljuset är på en reflekterande yta i storleksklassen 20.000-30.000 cd/m2). Det höga toppvärdet beskriver detta. Det orsakar på ögats näthinna en vävluminans och därmed blir förmågan att urskilja kontraster i utrymmet sämre (man ser inte bra trots att det verkar finnas mycket ljus). Om man endast beaktar de tekniska värden i lösningen kommer den arkitektoniska komponeringen att fattas. Ljuset i ljushetstvärsnittet motsvarar ett jämnt skri, och man kan inte skåda de intressanta kontrasterna, endast de bländande toppvärden i vägbelysningen.

Det kan nämnas som en kuriositet att de tekniska belysningsrekommendationerna även har blivit mål för revidering. Saken har påverkats av olika värden i olika länder (trots att ögats fysiologi är densamma i alla länder), det vita ljusets fördelar mot det typiska gula ljuset (högtrycksnatrium belysning), samt inverkan av fordonsljus på ljusvärden och energibesparing.

Mariehamn med sina lösningar kommer att bli en internationell föregångare.



DEN GLÖDANDE HAMNEN



GLÖDANDE BELYSNING
(Kiasma utbelysning)

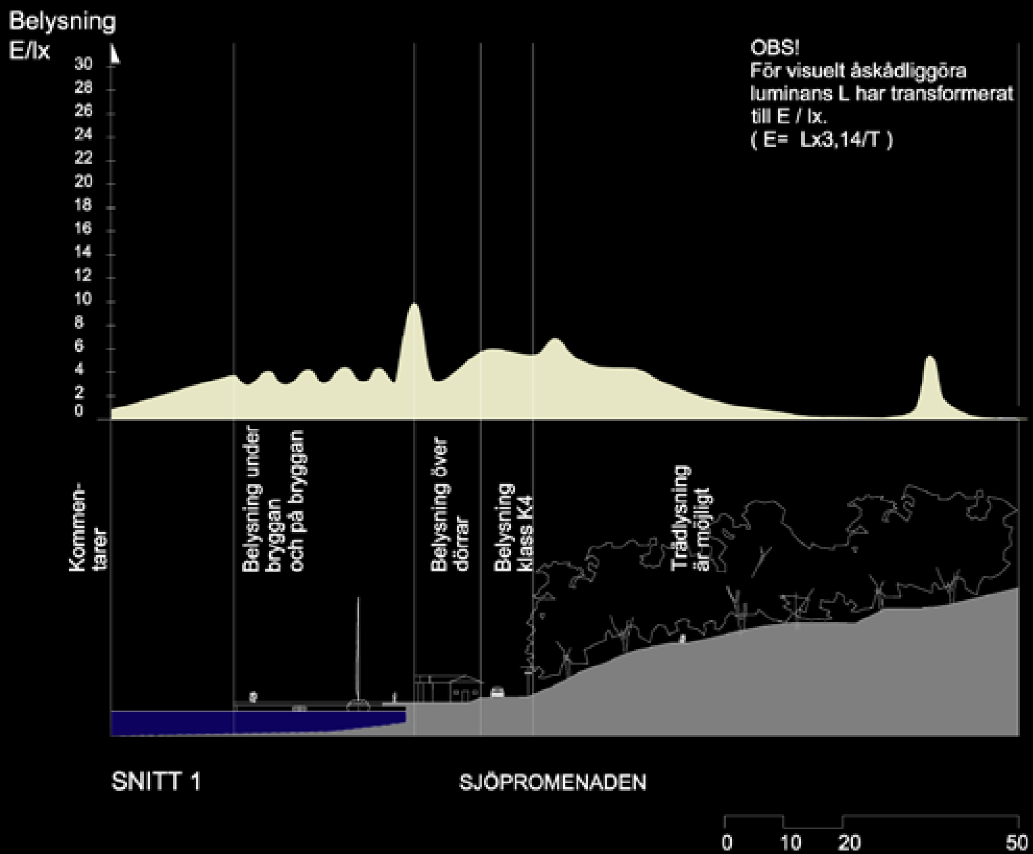
Ur de olika tvärsnitten av hamnens ljuskompositioner kan man läsa:

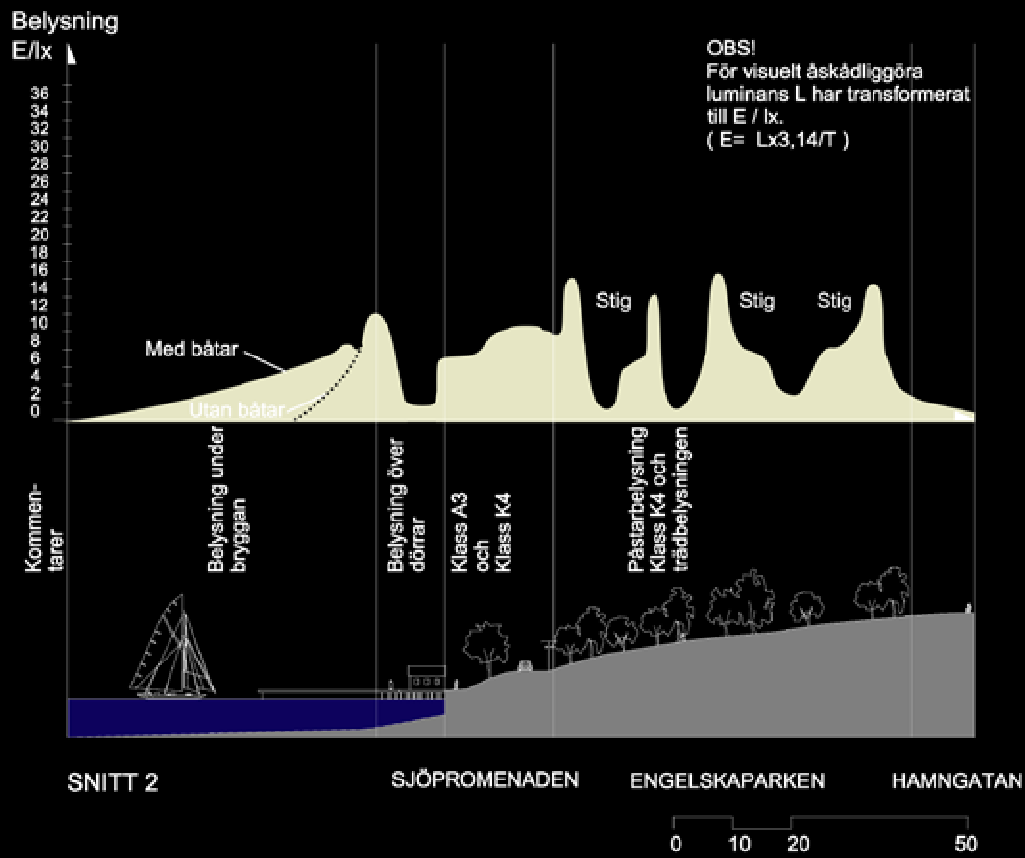
1)Bländningen saknas helt, därför att de höga och okontrollerbara toppvärden saknas helt.

2)Hamnen omfamnas av ett ljuvt vävaktigt ljus, där obehagliga mörka ställen fattas helt.

3)Ljusvärden är tillräckliga, men inte för höga.
4)De rekommenderade värden uppfylls

5)Det finns flere kompositioner och variationer i ljushetsvärden skapar ett intresse för rummet.





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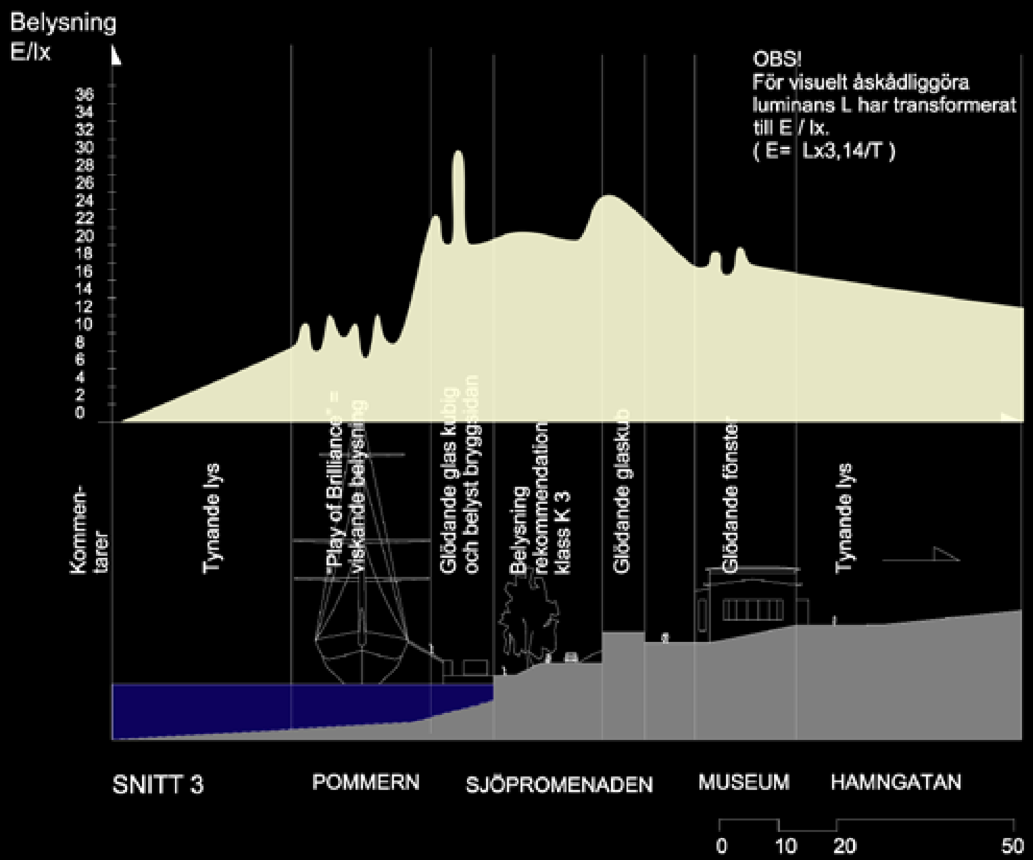

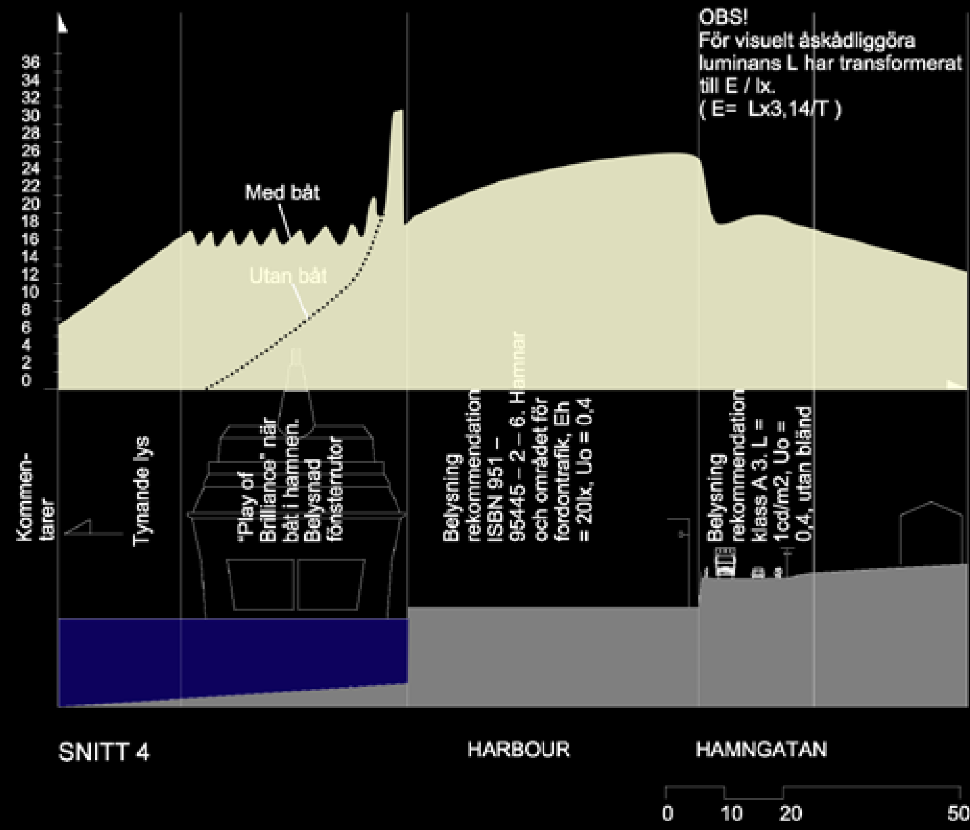

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Architectural office Oliver Walter
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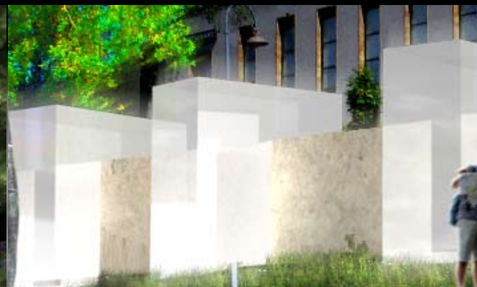
Members of Punavuoridesign

Översättning: Patrik Boström, Ekon.Mag.



BELYSNINGSPLAN ÖVER VÄSTERHAMNS OMRÅDE

Master Plan 04.11.2008

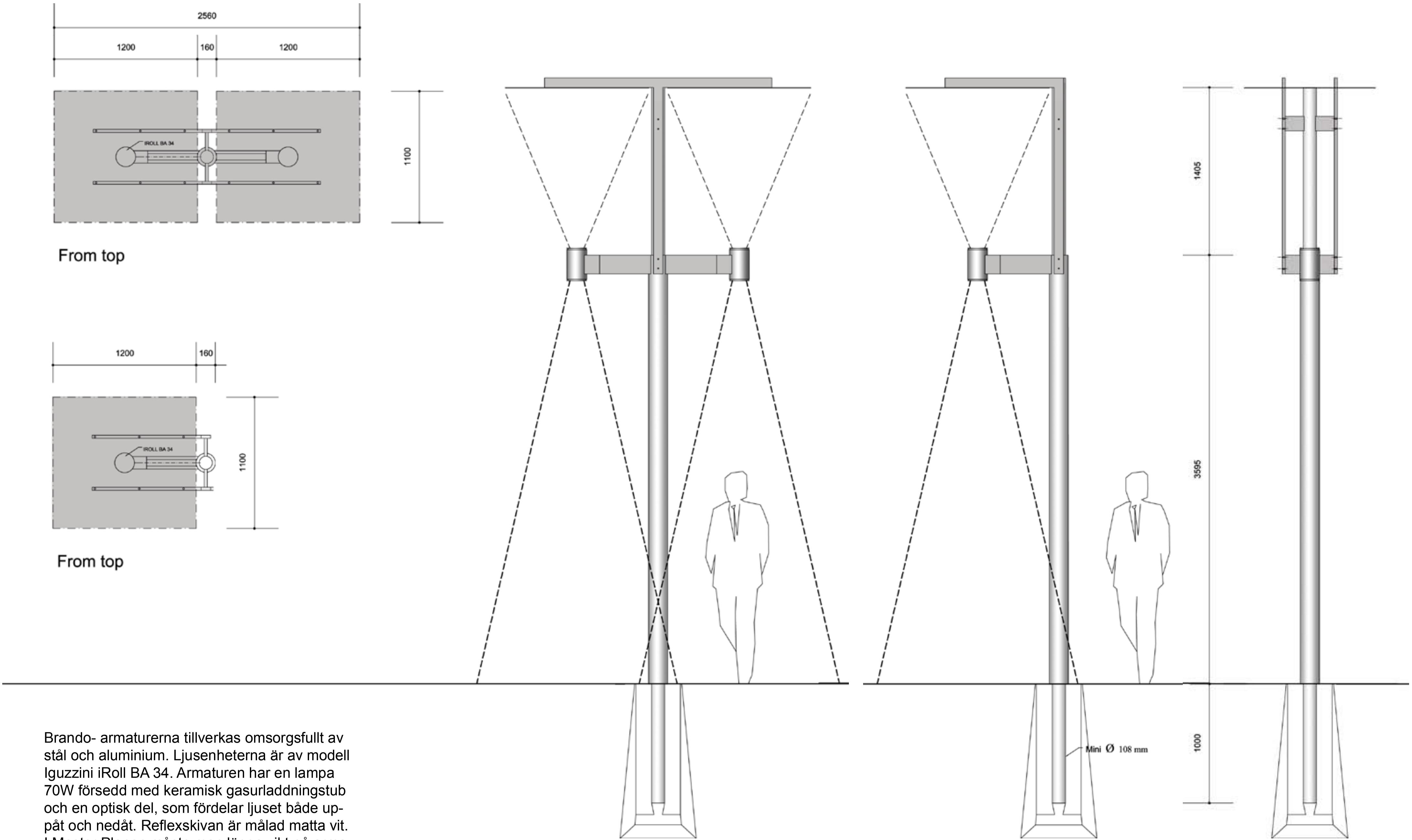
MASTER PLAN OCH ETAPP 1

Master Planen omfattar de preliminära valen av belysningsarmaturer, deras preliminära placeringar, antal ,samt en uppskattning för en helhetskalkyl för armaturer och lampor. Vi ämnar påvisa med valen av armaturer och lampor samt genom demonstrationer hur konceptet ”Glödande hamnen” genomförs på ett praktiskt plan.

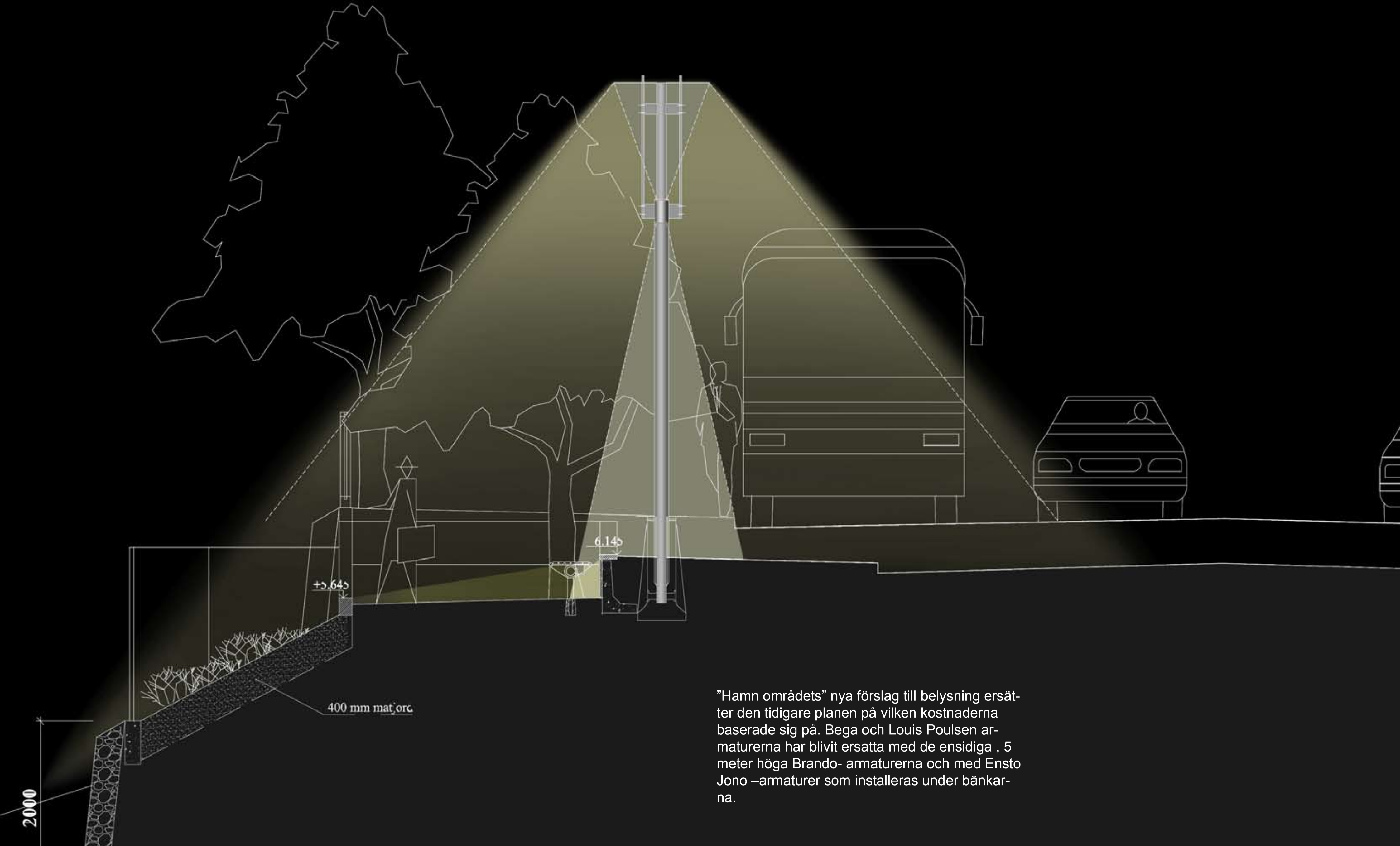
Vi har tagit i beaktande i valet av belysningslösningar de kommande EUP direktiven. Vi har omsorgsfullt utvecklat Brando- och Toccata belysningsarmaturerna i samarbete med internationella tillverkare. Under projektets gång har vi på egen bekostnad rest omkring i Italien och Tyskland flere gånger. Vi önskar att Mariehamns Västerhamn blir en pionjär och föregångare inom belysning. Filosofierna bakom och designen av armaturerna har blivit antagna i producenternas produktsortiment. Brando tillverkas av en känd italiensk arkitekturbelysningstillverkare vid namn Iguzzini medan Europas största tillverkare producerar Toccata- armaturerna. Bryggornas Tjärbelysningsarmaturer är av modell ”Mariehamns Tjärbelysningsarmatur”, vilka använder som ljuskälla Bega 2009 orienteringsarmaturer av aluminium.

Alla armaturer använder som ljuskälla, enligt kommande EUP direktiv, keramiska multimetall lampor (eng. metal halide lamp), glödlampor för utebruk och miniatyrglödlampor samt vita LED-ljus

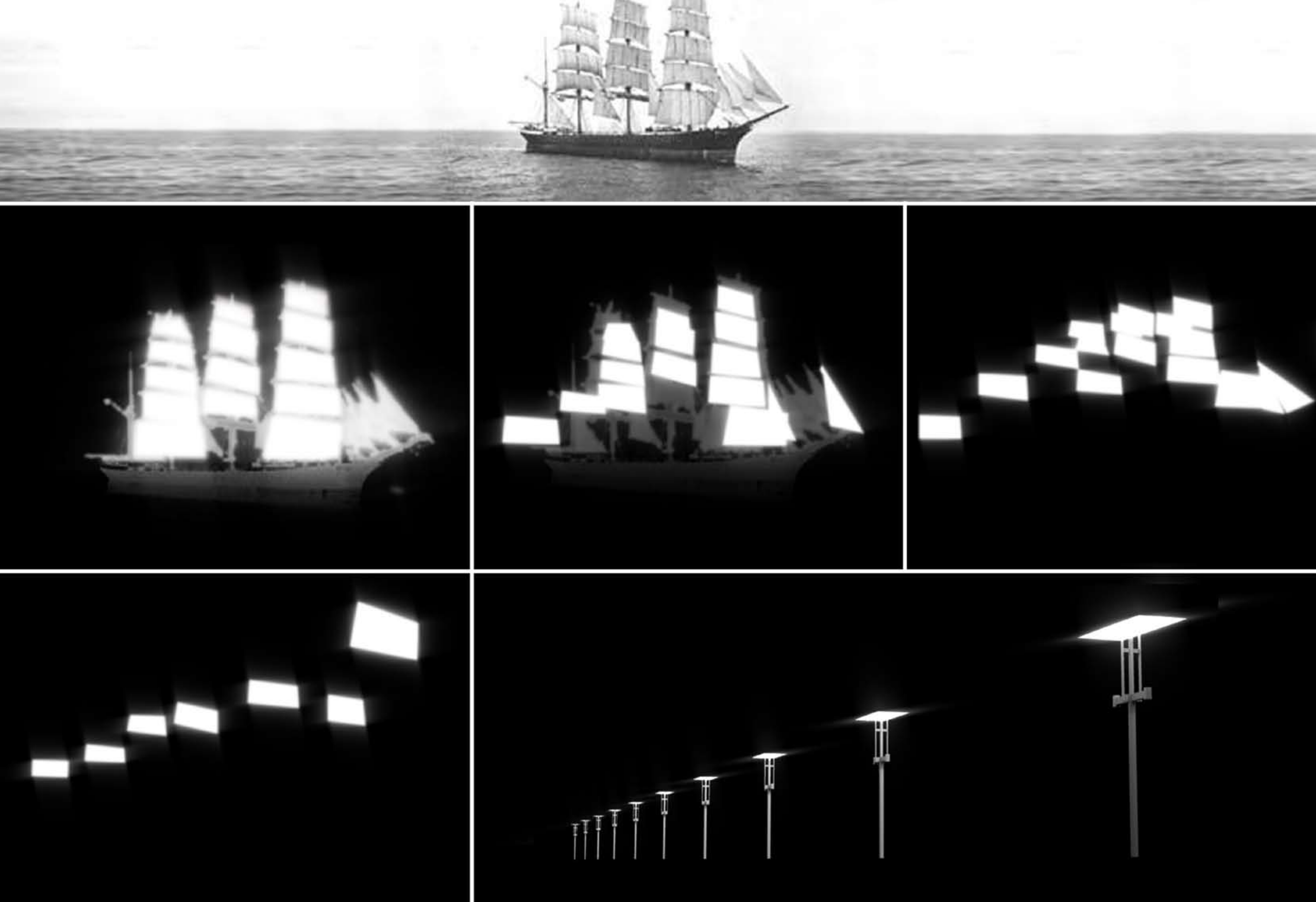
Master Plan och Etapp ! områden är märkta på bilden

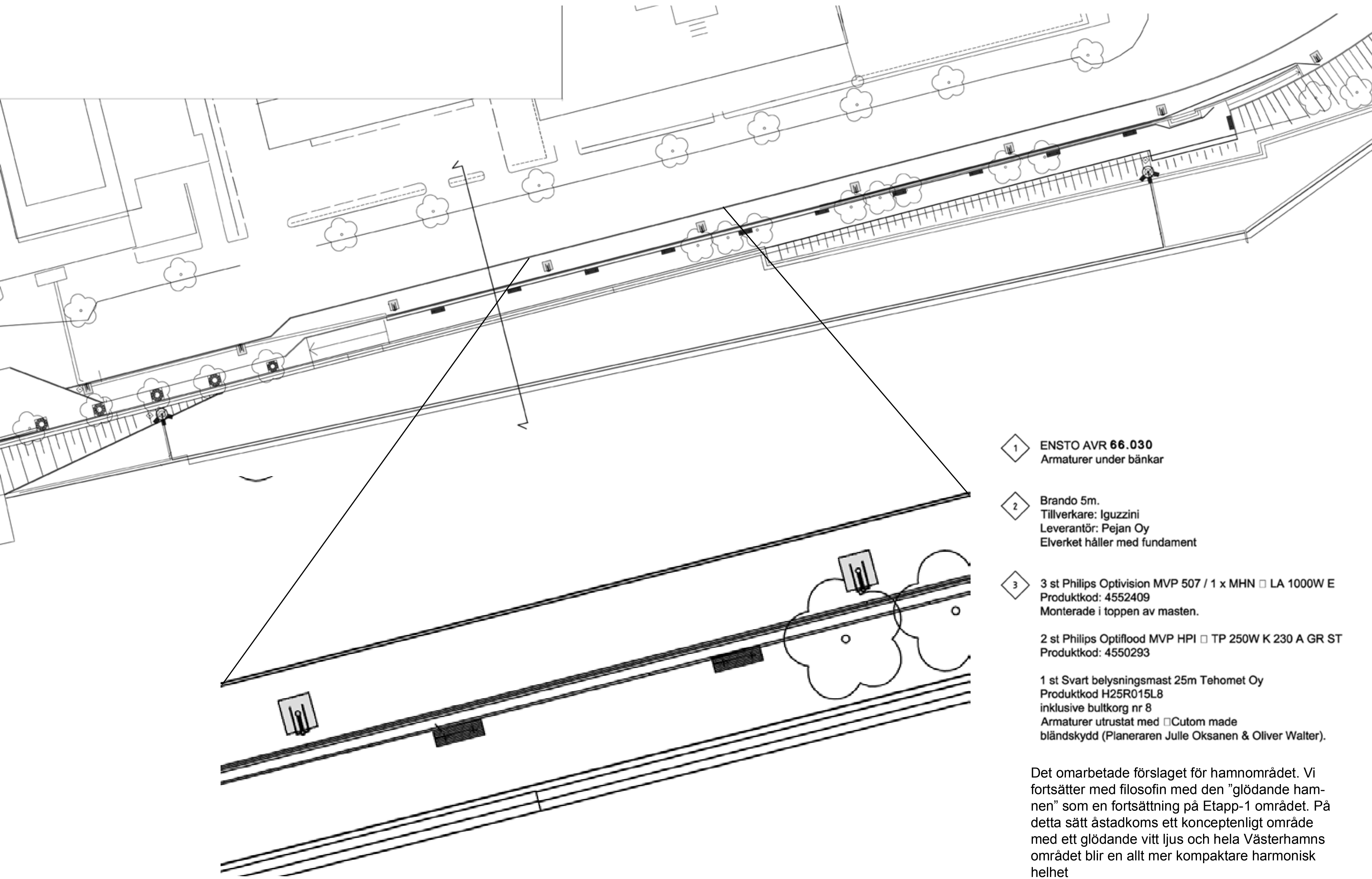


Brando- armaturerna tillverkas omsorgsfullt av stål och aluminium. Ljusenheterna är av modell Iguzzini iRoll BA 34. Armaturen har en lampa 70W försedd med keramisk gasurladdningstub och en optisk del, som fördelar ljuset både uppåt och nedåt. Reflexskivan är målad matta vit. I Master Planen måste man lägga vikt på armaturfästets mått och grundläggningsutredningen.



”Hamn områdets” nya förslag till belysning ersätter den tidigare planen på vilken kostnaderna baserade sig på. Bega och Louis Poulsen armaturerna har blivit ersatta med de ensidiga , 5 meter höga Brando- armaturerna och med Ensto Jono –armaturer som installeras under bänkarna.





1 ENSTO AVR **66.030**
Armaturer under bänkar

2 Brando 5m.
Tillverkare: Iguzzini
Leverantör: Pejan Oy
Elverket håller med fundament

3 3 st Philips Optivision MVP 507 / 1 x MHN □ LA 1000W E
Produktkod: 4552409
Monterade i toppen av masten.

2 st Philips Optiflood MVP HPI □ TP 250W K 230 A GR ST
Produktkod: 4550293

1 st Svart belysningsmast 25m Tehomet Oy
Produktkod H25R015L8
inklusive bultkorg nr 8
Armaturer utrustat med □Cutom made
bländskydd (Planeraren Julle Oksanen & Oliver Walter).

Det omarbetade förslaget för hamnområdet. Vi fortsätter med filosofin med den ”glödande hamnen” som en fortsättning på Etapp-1 området. På detta sätt åstadkoms ett konceptenligt område med ett glödande vitt ljus och hela Västerhamns området blir en allt mer kompaktare harmonisk helhet

BRANDOS VISUELLA UTTRYCK

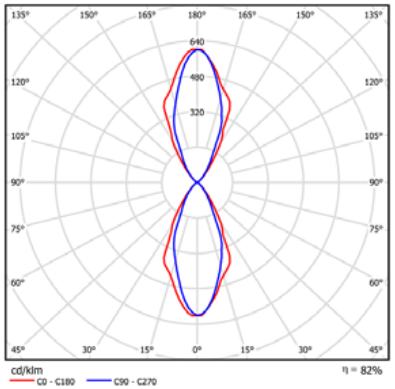
Brando armaturen har fått sitt namn av Marlon Brandos breda skuldror och av Humphrey Bogarts obestridliga karisma. Den fungerar som en enskild ljuskälla, vars ljusproducerande reflektskivor är som delar av Pommerns avlägsnade segel, som leder vandraren i ljuset av den glödande hamnen.

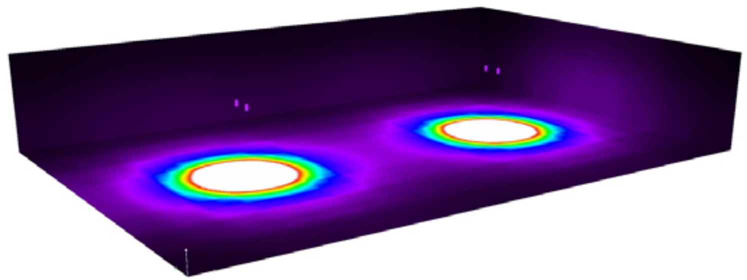
BRANDOS LJUSPRODUKTION

Brando-armaturerna installeras i de redan existerande stolpfötterna med ca 17 m stolpavstånd från varandra. Den bifogade datorkalkylen visar, att Brando kan skapa förutom ett skönt och jämnt ljussken i utrymmet även ett robust ljusfenomen i den omedelbara närheten av armaturerna. På detta vis skapas visuell rytm i utrymmet helt utan bländning.

LJUSVÄRDEN SOM BRANDO PRODUCERAR

Med belysningen uppnås den högsta möjliga klassificeringen K1 för den lätta trafiken med de en-och tvåsidiga Brando armaturerna. Brando har som ljuskälla de mycket ljuseffektiva och energisnåla, med keramiska utloppsrör utrustade 70W multimetallampor. Deras ljuseffektivitet är över dubbelt det som de existerande kvicksilverlamporna kan producera. Brandos ljusreflexskivor ger ett lugnt sken. Deras ljushetsgrad är under den nivå som månskenet har och på detta sätt skapas det inte någon slöjluminans och förmågan att urskilja kontraster förblir utmärkt. Även det att armaturernas ljusreflekterande ytor är nedåtriktade orsakar varken slöjluminans eller störande bländning.



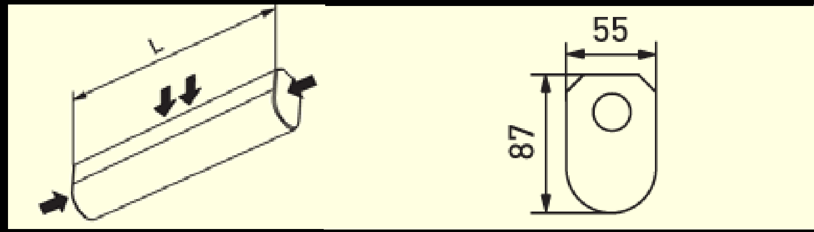


1.33	1.71	2.73	3.14	3.16	3.22	2.77	1.92	1.71	1.70	1.92	2.77	2.79	3.24	3.15	2.73	1.72	1.33
1.55	2.21	3.79	4.77	4.86	4.78	3.78	2.42	2.01	1.99	2.42	3.75	3.87	4.90	4.81	3.82	2.23	1.56
2.14	3.29	6.03	8.51	9.18	8.44	5.92	3.44	2.71	2.70	3.44	5.84	6.68	9.15	8.69	6.14	3.49	2.16
2.50	4.05	8.40	15	18	14	8.00	4.16	3.11	3.09	4.11	7.75	11	17	16	8.80	4.72	2.54
3.11	5.38	13	31	55	28	12	5.37	3.69	3.68	5.29	11	19	52	40	14	6.42	3.14
3.26	6.05	16	76	287	65	15	6.07	3.85	3.83	5.96	13	33	267	142	19	7.20	3.31
3.27	6.14	17	116	471	97	15	6.11	3.85	3.84	6.00	14	41	380	236	21	7.32	3.31
3.20	5.74	14	51	122	45	13	5.71	3.80	3.78	5.60	12	26	109	77	17	6.69	3.24
2.94	4.83	11	21	31	20	10	4.86	3.53	3.51	4.79	9.59	15	29	25	11	5.54	2.98

10.00 m
3.00
0.00
0.00 7.50 22.50 30.00 m

1.26	1.48	2.03	2.12	2.12	2.25	2.15	1.84	1.63	1.63	1.84	2.15	2.15	2.25	2.12	2.02	1.47	1.26
1.48	1.86	2.43	2.62	2.62	2.74	2.53	2.20	1.84	1.84	2.20	2.53	2.54	2.75	2.61	2.42	1.85	1.48
2.09	2.81	4.42	5.01	5.03	5.19	4.54	3.30	2.75	2.75	3.30	4.54	4.58	5.22	5.01	4.41	2.84	2.09
2.57	3.68	5.44	7.26	7.33	7.25	5.50	4.15	3.30	3.30	4.15	5.50	6.01	7.42	7.29	5.43	3.83	2.58
3.96	5.45	10	14	15	14	9.99	5.98	4.97	4.94	5.98	9.94	11	15	14	10	6.20	3.97
4.41	7.11	14	23	27	23	14	7.40	5.86	5.64	7.36	14	17	26	24	15	8.39	4.81
5.55	9.74	22	47	75	44	21	9.76	7.35	6.84	9.62	20	31	71	57	24	12	6.18
5.65	10	26	109	348	90	25	10	7.50	6.92	10	23	49	324	183	31	13	6.36
6.00	12	31	203	769	158	29	11	7.98	7.31	11	26	73	659	381	40	15	6.82
5.98	11	30	169	561	134	28	11	7.95	7.30	11	25	67	467	302	38	14	6.78
5.58	9.93	24	67	133	60	23	9.91	7.39	6.88	9.72	21	39	123	93	27	12	6.23
4.56	7.78	17	30	39	29	16	7.95	6.01	5.73	7.88	16	22	38	33	18	9.51	5.08
3.99	5.96	11	16	17	16	11	6.34	5.02	4.97	6.34	11	13	17	16	12	6.94	4.04
2.60	3.83	6.20	7.65	7.82	7.89	6.24	4.28	3.33	3.31	4.28	6.18	6.99	8.16	7.80	6.26	4.07	2.63
2.11	2.84	4.49	5.08	5.13	5.19	4.50	3.32	2.76	2.76	3.32	4.58	4.62	5.29	5.08	4.48	2.86	2.12
2.10	2.82	4.44	5.00	5.01	5.12	4.46	3.30	2.76	2.76	3.30	4.55	4.57	5.18	5.00	4.44	2.83	2.11
1.48	1.85	2.43	2.61	2.61	2.74	2.54	2.21	1.85	1.85	2.21	2.54	2.55	2.75	2.61	2.43	1.85	1.48
1.26	1.48	2.04	2.13	2.13	2.27	2.17	1.85	1.64	1.64	1.85	2.17	2.17	2.27	2.13	2.04	1.47	1.26

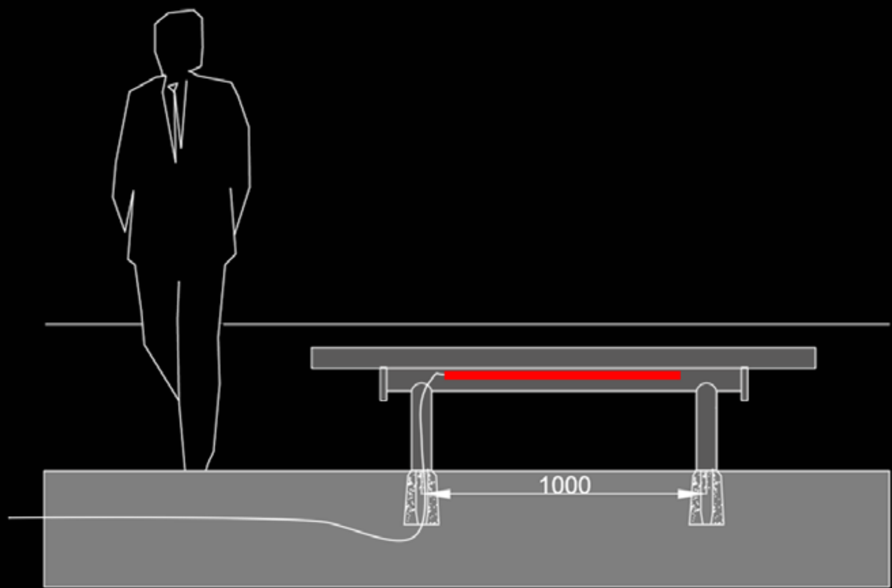
20.00 m
10.50
9.50
0.00
0.00 7.50 22.50 30.00 m

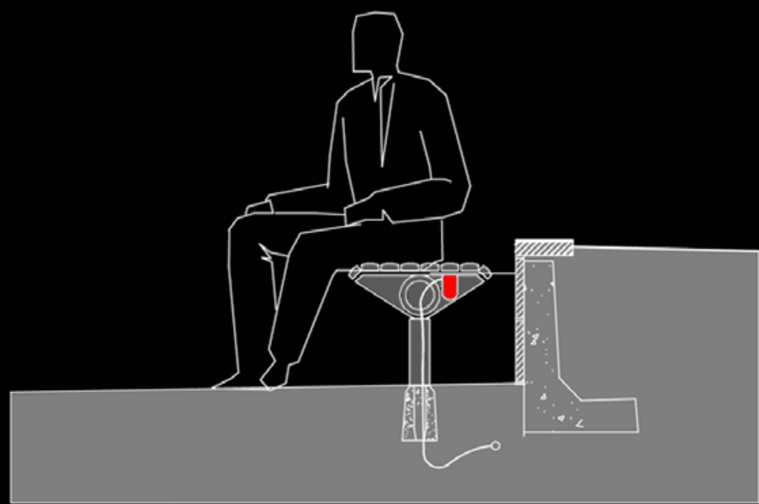


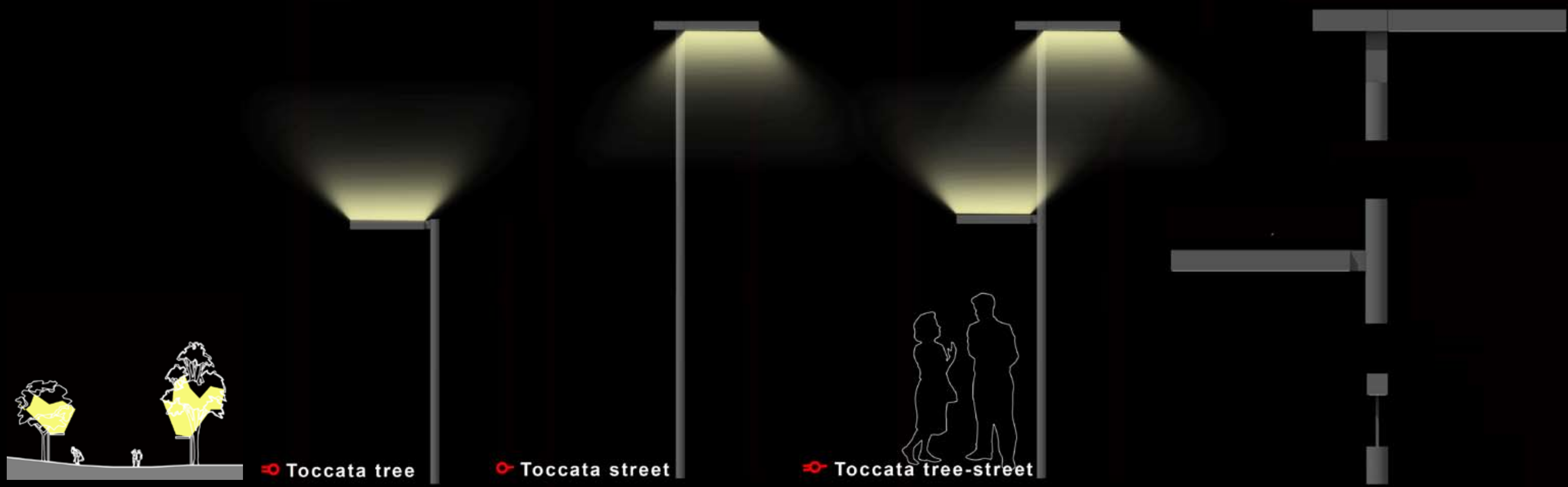
Tyyppi: AVR66.030
EAN: 6410042170694
Snro: 4217069
Nimi: Jonovalaisin
1x30W T8/G13 230V 50Hz, 936mm
Pakkaus: 1/80
Yksikkö: KPL

Under bänkarna i hamnområdet installeras Ensto Oy:s AVR 66.030 armaturer. Armaturen är av sådan typ att den går att seriekopplas och den är tillverkad i aluminium. Kåpan består av polykarbonat. Ljuskällan är ett 30W T8 lysrörlampan.

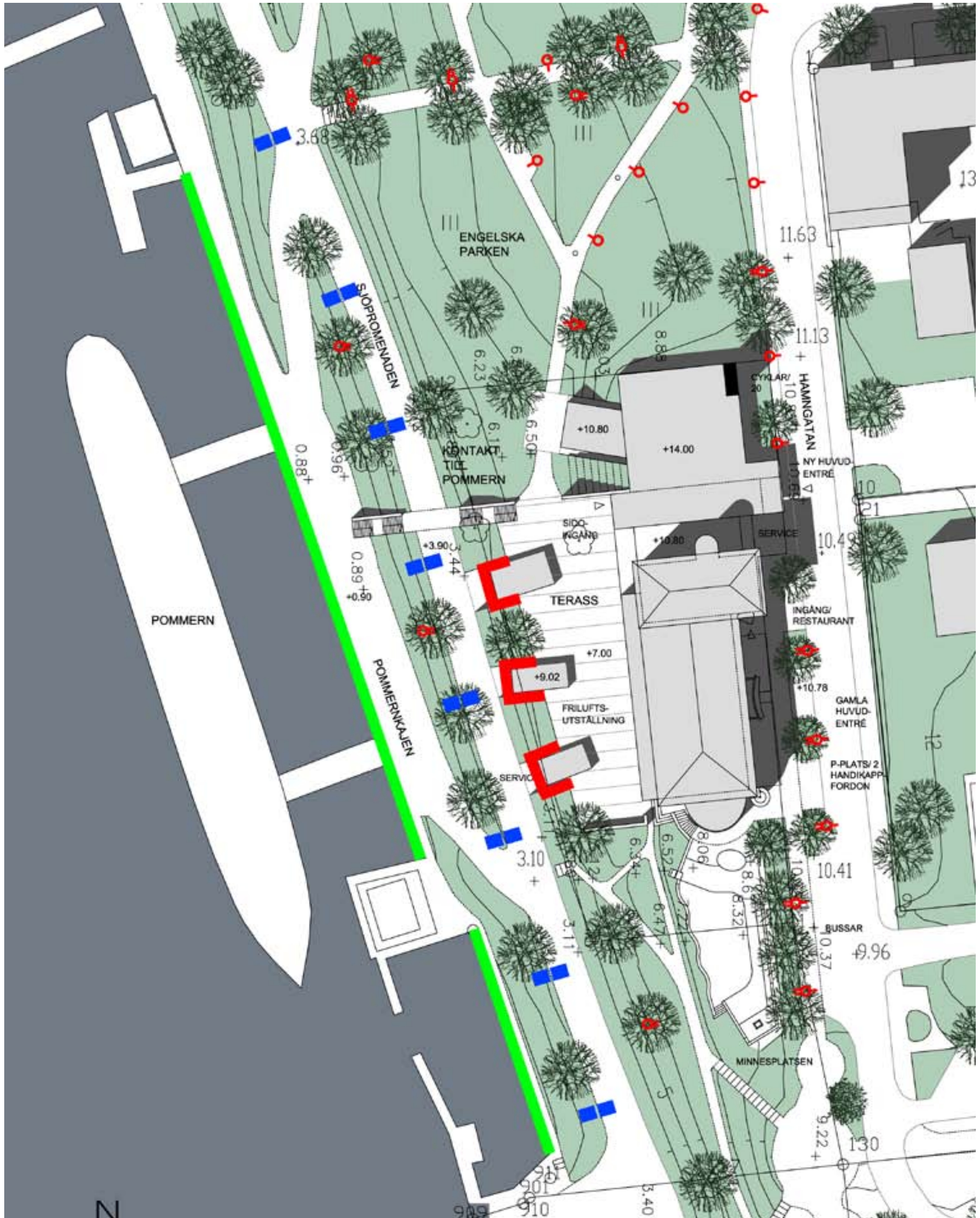
Bänkbelysningen skapar en intressant upplyst serie av utrymmen. Den roliga och bländningsfria belysningslösningen skapar kontrast i rummet och pekar ut rastställen åt vandraren i skymningen.







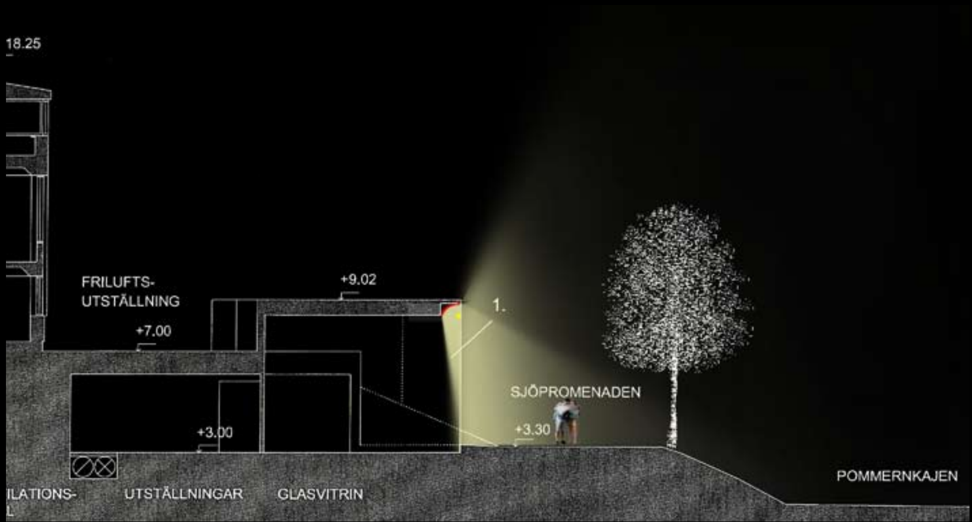
Toccata- armaturen består av aluminium och rostfria stålkomponenter samt ett skyddsglas. Ljuskällan är en miniatyrlysrörlampan för utebruk av modell Osram DULUX L CONSTANT 55 W. Armaturen kan installeras att lysa både uppåt och nedåt. Toccata- enheten som lyser uppåt används för att belysa trädkronor och träd. Modellen som sprider ljuset nedåt används för att lysa upp stigar och de romantiska leden för lätt trafik. Det går även bra att kombinera riktningarna som ljuset sprids.



- Toccata pier
- Light cubes
- Brando
- Toccata street
- Toccata tree
- Toccata tree-street

LISTA ÖVER BELYSNINGS ARMATURER OCH LAMPOR.
FÖR ETAPP 1 DEL / DEL 1

108 st.	armatur	Toccata Pier IP 67 / 54W	tillverkare / leverantör	Seelux / Pejan
108 st.	lampa	Osram FQ 54W / 840 HO Constant	tillverkare / leverantör	Osram
8 st.	armatur	Brando 5m / Dubbelsidig 2 x 70W	tillverkare / leverantör	Iguzzini / Pejan
16 st.	lampa	Osram Power HCI–TC 70W/830WDL	tillverkare / leverantör	Osram
10 st.	armatur	Toccata Street	tillverkare / leverantör	Seelux / Pejan
10 st.	lampa	Osram Dulux L Constant 55W	tillverkare / leverantör	Osram
5 st.	armatur	Toccata Tree	tillverkare / leverantör	Seelux / Pejan
5 st.	lampa	Osram Dulux L Constant 55W	tillverkare / leverantör	Osram
9 st.	armatur	Toccata Tree – Street	tillverkare / leverantör	Seelux / Pejan
9 st.	lampa	Osram Dulux L Constant 55W	tillverkare / leverantör	Osram

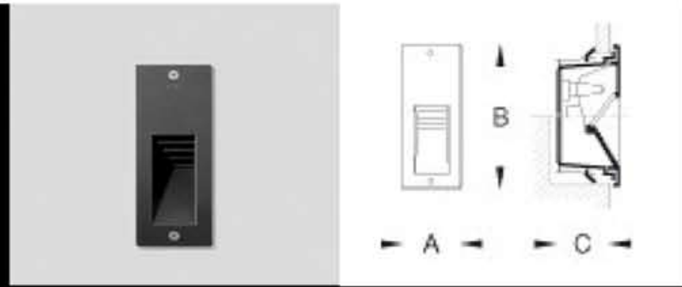


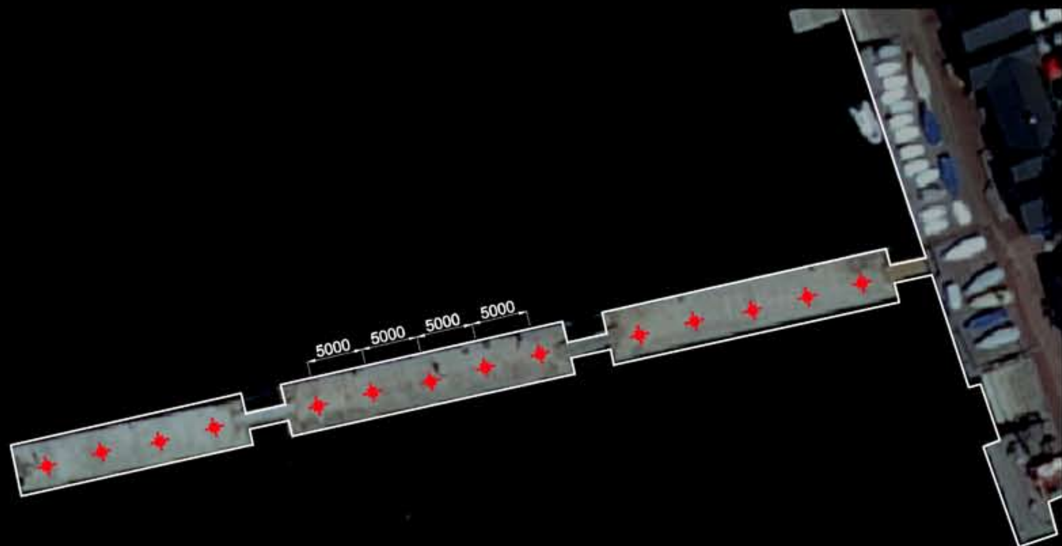
Museets glasblock är en väsentlig del av Västerhamns glödande färgfilosofi. De, alldeles som Pommerns nya "välkomstvägg" i glas ,föreslår vi att skall sandblästras på bägge sidor. Ifall glasblocken lamineras, föreslår vi att de lamineras med en klar film. På inre sidan av glaselementen föreslår vi installation av fickor med lysrör, vilka sprider sitt ljus uppåt på glasblockens glasytor. Då det börjar skymma i hamnområdet glöder glasblocken lockande och fungerar i harmoni och samklang med Brando-armaturerna. Ljusfickorna planeras i detaljplaneringsskedet.

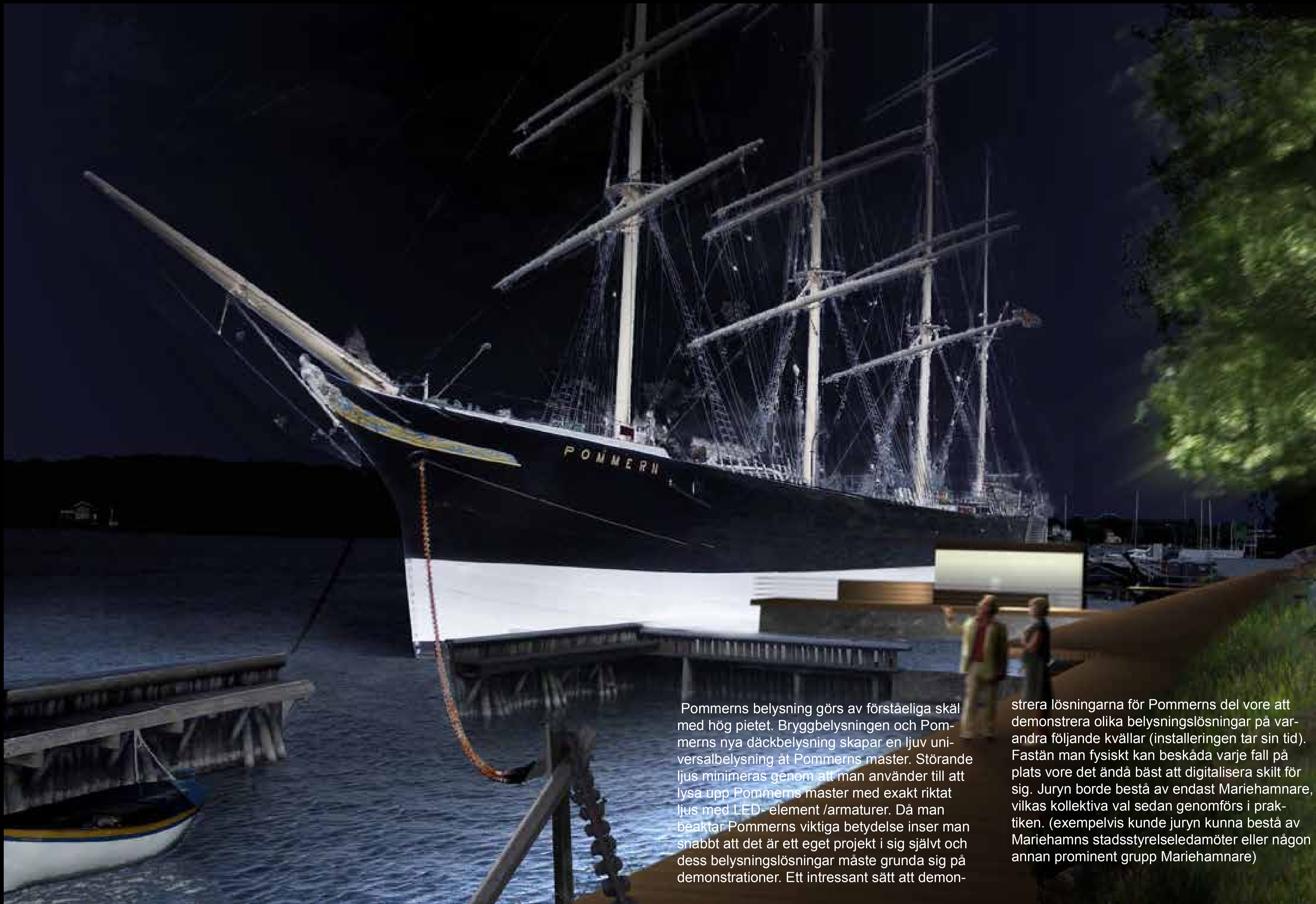
På småbåtsbryggorna installeras med 5 m mellanrum ”Tjärarmaturer”. Tjärarmaturerna fästs i bryggan med hjälp av 2 stålskivor av rostfritt stål som bultas fast. Tjärarmaturen är med riktig tjära genomtjärat trä för att få till stånd en så stark tjärdoft som möjligt i hamnen.

Belysningsarmaturerna är Begas orienteringsarmaturer Bega 2009, som sänks i tjärat trä på en höjd av 500 mm. På varje sida av tjärarmaturen finns en egen orienteringsbelysningsarmatur. Bega 2009 armaturen har som ljuskälla en 4W LED- enhet. Livslängden är lång och ljusalstrandet är på hög nivå. Armaturens ljusreflektor är gömd och dess ljus är helt bländningsfritt och riktat endast nedåt.

LED			Lumen	A	B	C	Recessed opening
2009	4 LED	4 W	250	80	190	80	70 x 180 x 85







Pommerns belysning görs av förståeliga skäl med hög pietet. Bryggbelysningen och Pommerns nya däckbelysning skapar en ljuv universalbelysning åt Pommerns master. Störande ljus minimeras genom att man använder till att lysa upp Pommerns master med exakt riktat ljus med LED- element /armaturer. Då man beaktar Pommerns viktiga betydelse inser man snabbt att det är ett eget projekt i sig självt och dess belysningslösningar måste grunda sig på demonstrationer. Ett intressant sätt att demonstrera lösningarna för Pommerns del vore att demonstrera olika belysningslösningar på varandra följande kvällar (installeringen tar sin tid). Fastän man fysiskt kan beskåda varje fall på plats vore det ändå bäst att digitalisera skilt för sig. Juryn borde bestå av endast Mariehamnare, vilkas kollektiva val sedan genomförs i praktiken. (exempelvis kunde juryn kunna bestå av Mariehamns stadsstyrelseledamöter eller någon annan prominent grupp Mariehamnare)

BELYSNING AV BRYGGKANTEN

Enligt konceptet skall bryggkanten få en ljuvlig belysning. Den skall fungera som en dämpande gräns mot det dystra havet och mot Västerhamns nya glödande hamnbelysning. Armaturerna är av typ Toccata vilka använder som ljuskälla Osrams Constant lysrör for utebruk.

Armaturens skyddsklass är IP 67.

IP-klassificeringssystemet är ett system som används i Europa för att definiera elektriska apparaters täthet. Klassificeringen anger apparatens skydd mot yttre hot såsom damm och vatten.

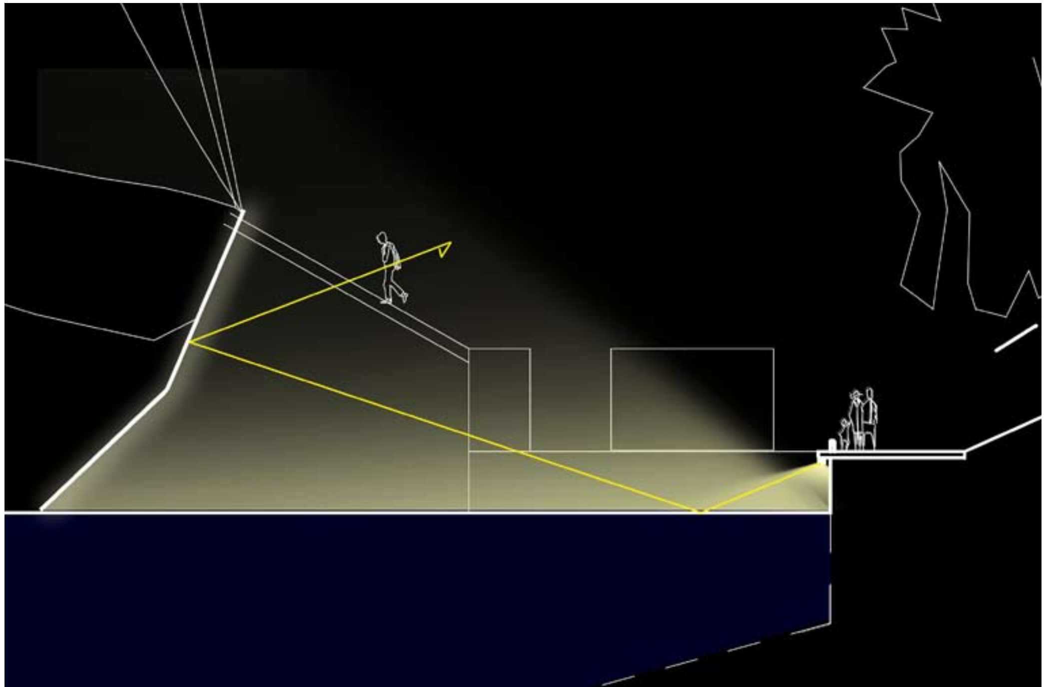
Klassificeringskoden består vanligtvis av 2 siffror. Den första siffran anger hur bra apparaten är skyddad mot främmande föremål osv. och damm, medan den andra siffran anger hur väl apparaten är skyddad mot vatten.

IP 67-klass betyder alltså:

6: Fullständigt skydd. Dammtät

7: Tål kortvarig vattenkontakt

Det må nämnas, som en kuriositet, att Etapp 1-områdets bryggkants belysningslösning förbrukar mindre energi än en kaffekokare, men den skapar en mystisk och avslappnande mysighet för Mariehamns användare av området . Det är värderingar det handlar om.



Ljusreflexytorna i multimetallampastrålkastarna hos hamn projektets master behöver täckas med ett Custom Made-bländningsskydd så att den störande bländningen inte orsakar störande bländning på området utan man får ljuset riktat dit vart det är menat. Fastän ”nyttoljuset” inte sprids alltför långt utanför området, är de högt belägna högeffektiva strålkastarnas ljusreflexytor så klara att störande bländning lätt kan förekomma utanför området.

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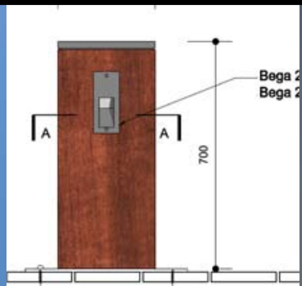
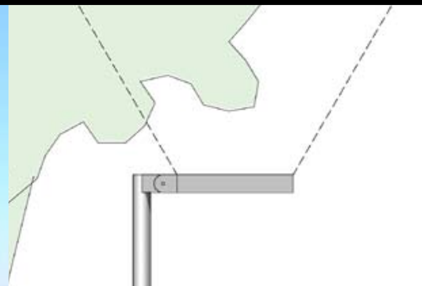


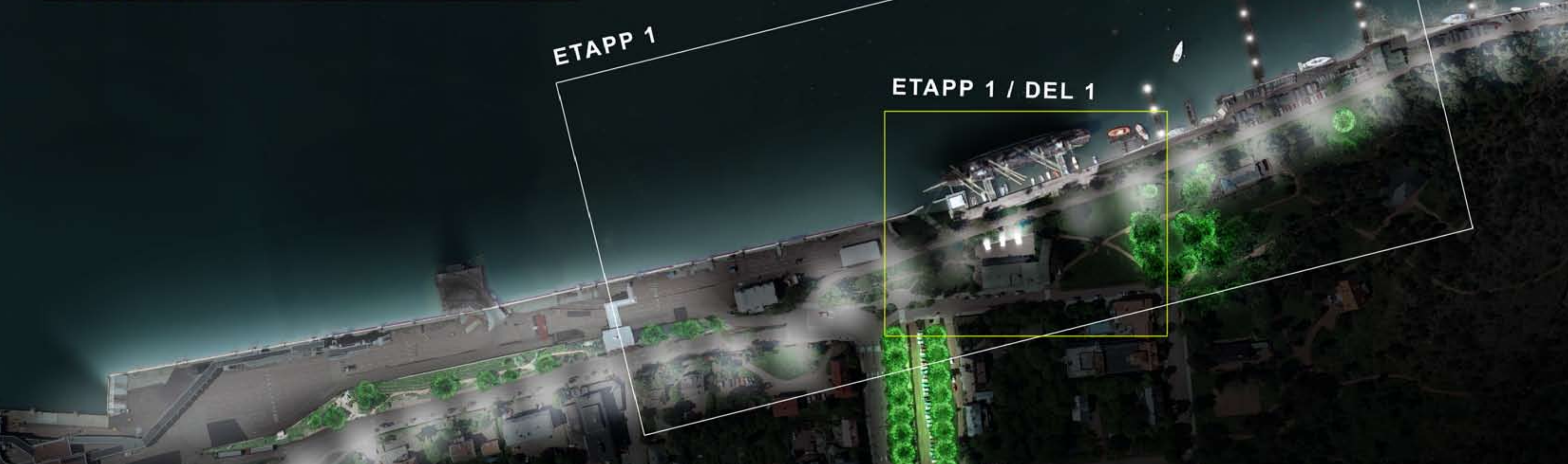


BELYSNINGSPLAN ÖVER VÄSTERHAMNS OMRÅDE

DETALJ PLANERING 28.11.2008

MARIEHAMS STAD / STADSARKITEKT SIRKKA WEGELIUS

JULLE OKSANEN LIGHTING DESIGN LTD / PROF. JULLE OKSANEN & ARKITEKT OLIVER WALTER

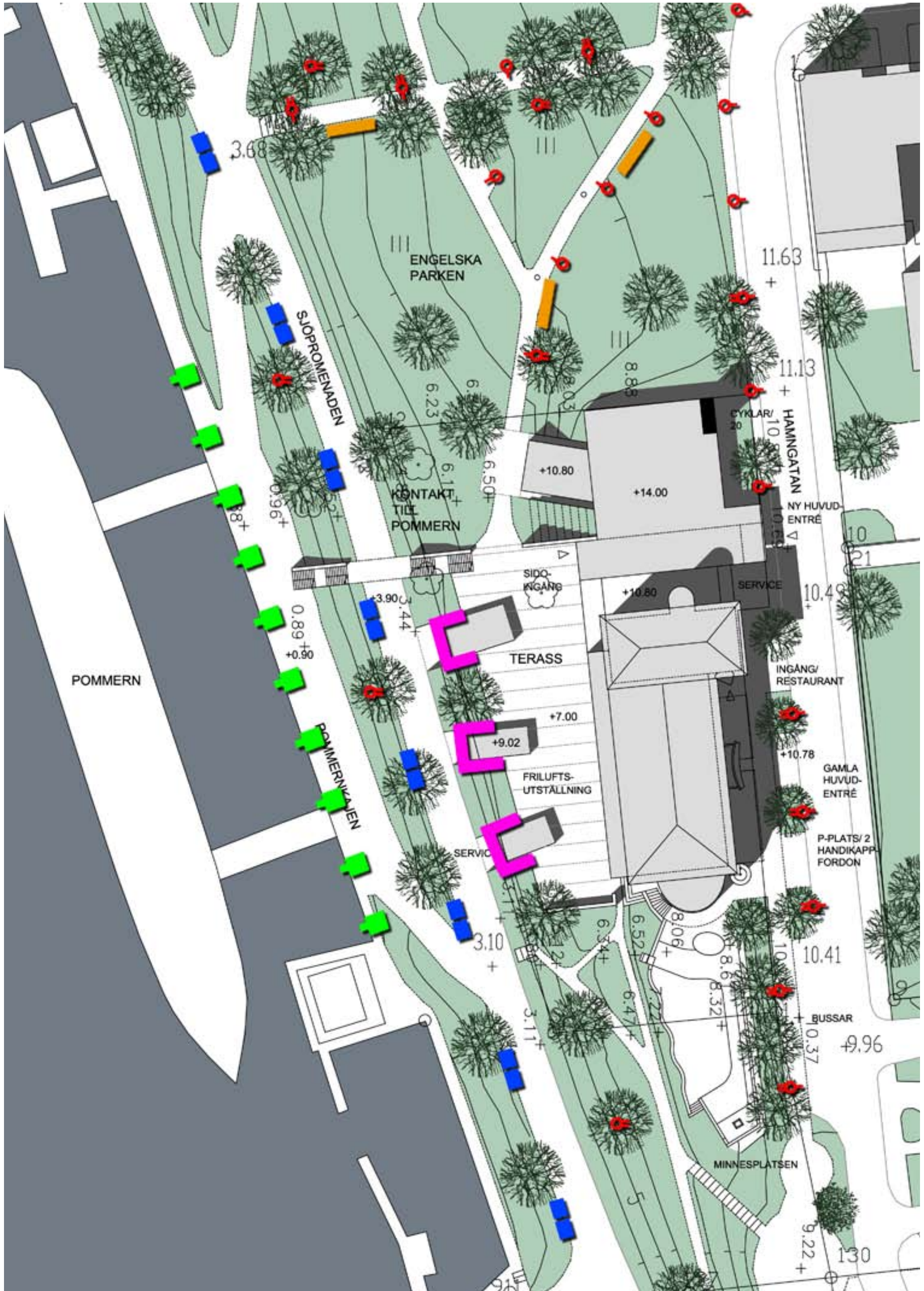


DETALJPLANERING

Detaljplaneringen innehåller armaturspecifika detaljplaneringar för ETAPP 1 / DEL 1-området. Ur planeringen framgår bl.a :

1)Måtten på armaturerna.
2)Fundament till armaturerna.
3)De preliminära slutplaceringarna av armaturerna. I praktiken bör slutplaceringen göras på plats genom att märka platserna med markeringspålar. På detta sätt säkerställs den rätta slutplaceringen av armaturerna.
4)Belysningskalkyler för de armaturers del som det ännu inte fanns tillgång till under Master Plan fasen (Toccata Street).
5)Energiförbrukning och kostnadskalkyl för armaturtillbehör till Etapp 1/ Del 1.
6)För styrningen av armaturerna ges ett förslag, som fungerar som grund för elverkets experter till planering av elmatningssystem.

Toccata Pier- armaturerna i Master Planen ersätts med "tjärarmaturer", därför att vattennivån kan täcka Toccata Pier- armaturerna för flere dygn i följd. Toccata Pier-armaturerna har en IP-67 skyddsnivå som tillåter endast kortvarig direkt kontakt med vatten (svallar mm). På den Pommerska sidan av tjärarmaturerna installeras 55W Osram Constant miniatyr lysrörlampor, vilka ger Pommerns sida ett ljus utan bländning. Demonstrationen genomförs i samband med testningen av Pommerns mastbelysning.



- Brando
- Toccata street
- Toccata tree
- Toccata tree-street
- BEGA3*2009+1*2048
- Bench / Ensto Jono (ARMATURER INGÅR INTE I KOSTNADSBEKRÄSNINGEN)
- Light cubes

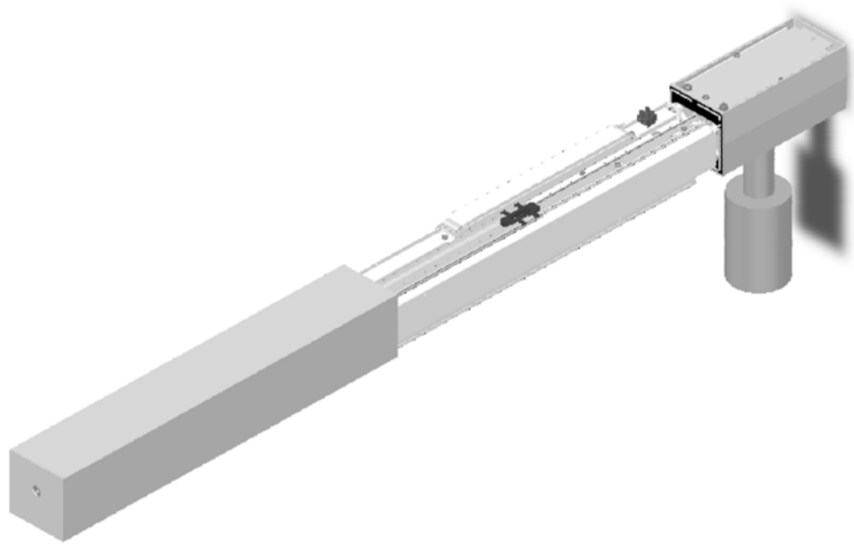
Årliga Energikostnader

ARMATUR TYP	st.	EFFECT/st./kW	TOTAL EFFECT/kW	DRIFT TID/ÅR	ENERGI PRIS CENT/kWh	ÅRLIG DRIFTS KOSTNAPER/E
BRANDO	8	0,17	1,36	3900	0,08	445,54
TOCCATA STREET	10	0,06	0,61	3900	0,08	199,84
TOCCATA TREE	5	0,06	0,31	3900	0,08	99,92
TOCCATA STREET-TREE	9	0,12	1,1	3900	0,08	359,70
TJÄRARMATUR TYP 1 (POMMERN)	10	0,04	0,42	3900	0,08	137,59
TJÄRARMATUR TYP 2 (BRYGGAN)	2	0,02	0,04	3900	0,08	13,10
					TOTAL->	1255,69

Helhetskostnader

Armatyr typ	Armatur st.	Armatur +stolpe/ st.	Armatur +stolpe/ total	Armatur installation/ total	Fundament och fundament arbete/ total	Kabelarbete/ total[x]	Total
BRANDO DUBBELSIDIG	8	2900	23200	1600	1840	-	26640
TOCCATA STREET	10	2191	21910	1000	2000	4800	29710
TOCCATA TREE	5	1610	8050	500	1000	4800	14350
TOCCATA STREET TREE	9	3210	28890	900	1800	4800	36390
TJÄRARMATUR TYP 1	10	1200	12000	1000	1000	3840	17840
TJÄRARMATUR TYP 2	2	1480	2960	200	200	720	4080
TOTAL			97010	5200	7840	18960	129010

[x] I kostnaderna är: kabel, skyddskör, nerläggning av kabelrör och kabeldragning, grävmaskin, återställning av gräsmattor, borttagning av stenar och dylikt -> TOTAL 48€/m



Selux- Prototyp för utveckling av produktionsmetoder

I bilden : Selux´ fabriksprototyps “Stillbild” av forskningsmodellen som används till att utforska produktionsmetoderna och ljusalstring (ljusalstringsförmåga)

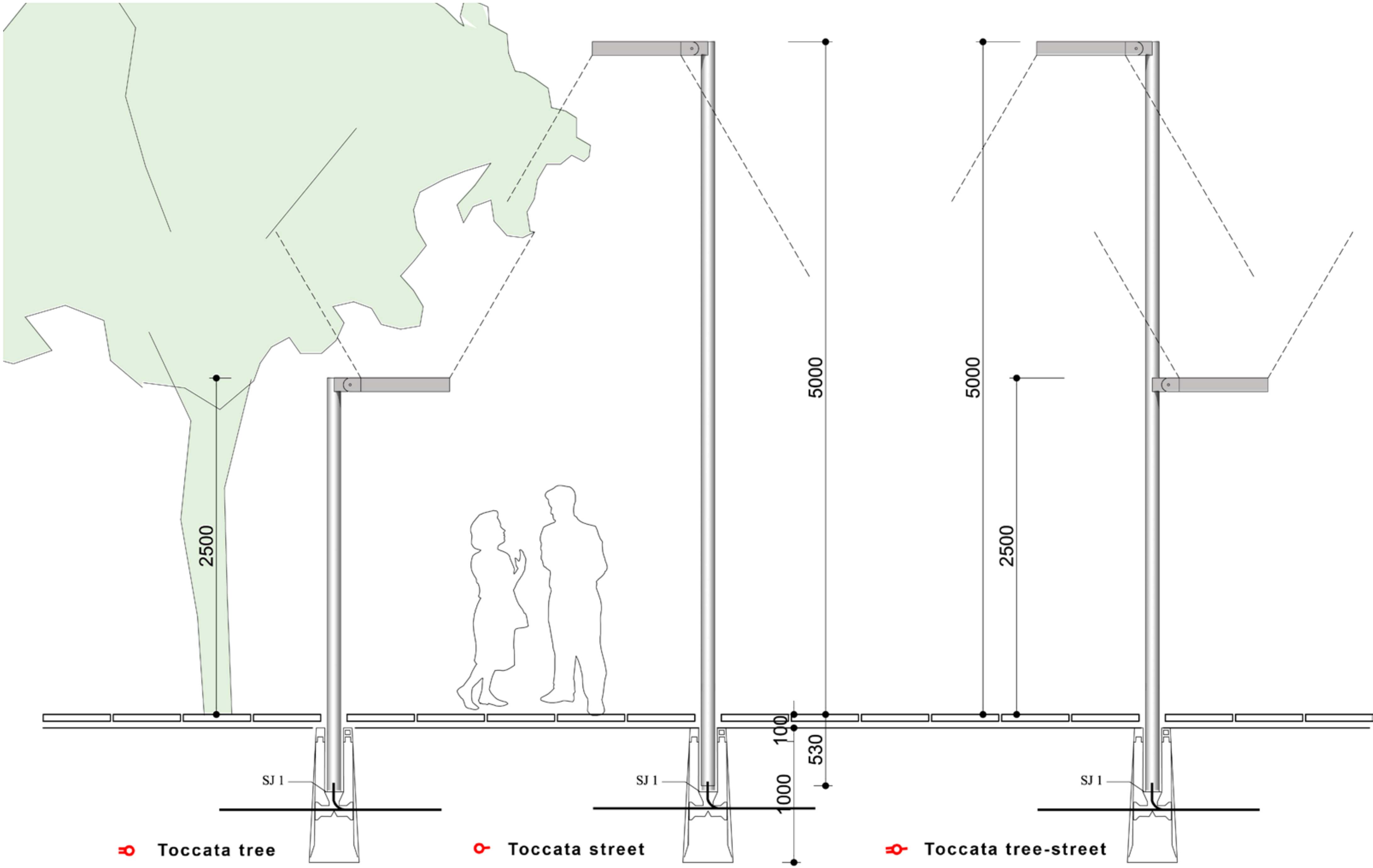
TOCCATA

Toccata- armaturerna representerar de senaste resultaten inom belysningsbranschen. De är utrustade med nya enkla lampfästlysrörlampor som är optimerade för utebruk (t.ex. Osram Dulux L 55 Constant), vars ljuseffektivitet är ca 90 lm/W. De är dagens svar till de ineffektiva gasurladdningslamporna som genom de nya EuP- direktiven avskaffas. Enligt de senaste uppgifterna skall EuP- direktiven förbjuda användningen av alla kvicksilverlampor till år 2016 (Ljuseffektivitet ca.50 lm/W).

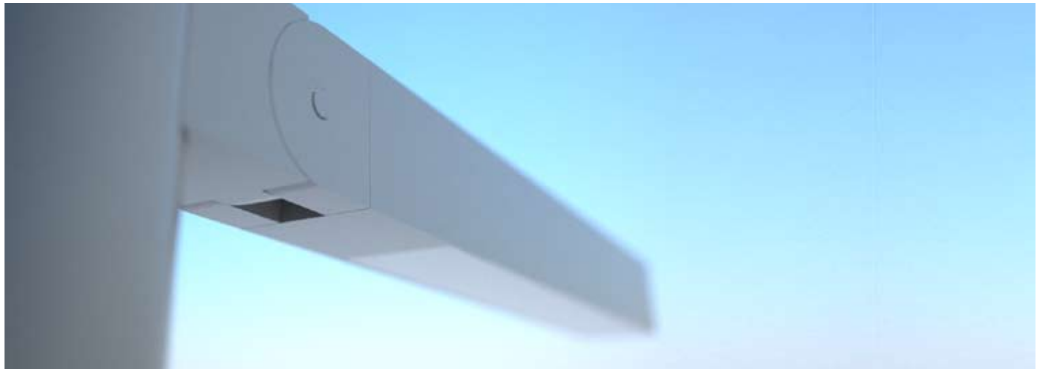
I Toccata- armaturen används miljövänliga material av hög kvalitet och dess skyddsklass IP 65 är mycket hög för att ge skydd mot smuts och fukt. Armaturerna tillverkas av den tyska tillverkaren Selux GmbH som är känd för sin höga kvalitet.

Armaturerna levereras med stolpor som en helhet för att säkerställa kvaliteten av helheten. Ljusalstringen- och fördelningen av ljuset är noga optimerade med hjälp av datoriserade kalkyler för ljusoptimering till de mysiga små vägarna, gatorna, skvärerna och parkerna.

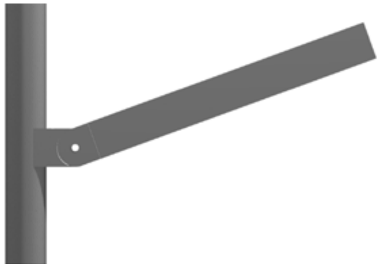
Ljuskulören och ljusupprepningsindexet hos armaturen är enligt DIN-norm 5035 talet 840. Ljusupprepningsklassen är 1B (Ra=80-89) och ljustemperaturen är 4000K (vit)



DE KOMMERSIELLA TOCCATA ARMATURERNA



Luokka	Kuivan ja märän ajoradan luminanssi				Esto-häikäisy	Ympäristön valaistus
	Kuiva			Märkä		
	L_m cd/m², min	U_o min	U_l min	U_o min	TI % max	SR min
AL1	2,0	0,4	0,6	0,15	10	0,5
AL2	1,5	0,4	0,6	0,15	10	0,5
AL3	1,0	0,4	0,6	0,15	15	0,5
AL4a	1,0	0,4	0,4	0,15	15	0,5
AL4b	0,75	0,4	0,4	0,15	15	0,5
AL5	0,5	0,4	0,4	0,15	15	0,5

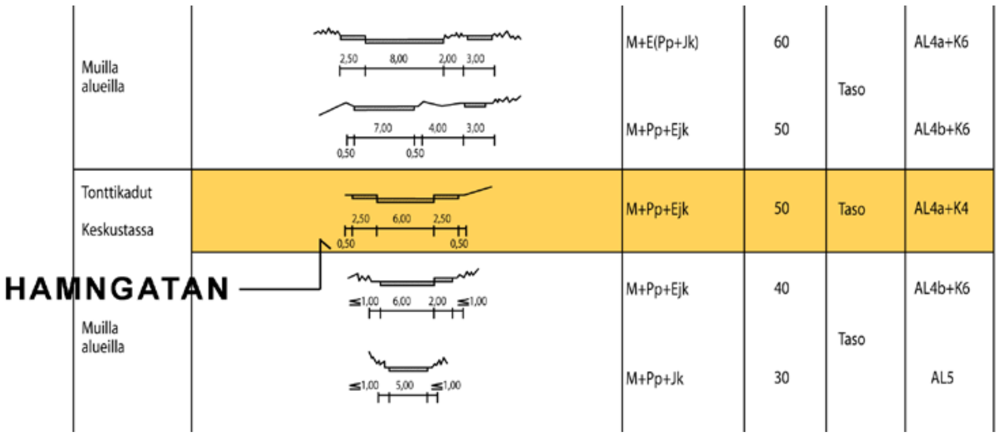


Hamngatan och Toccata- belysningen

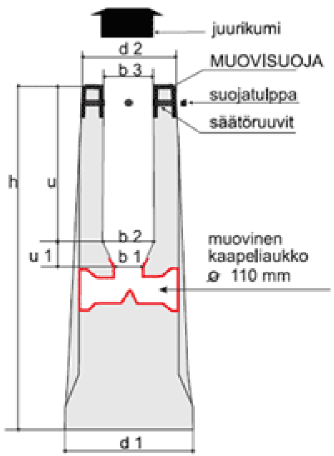
Hamngatan kunde p.g.a. sin geometri klassificeras, enligt de klasser som Vägverket använder som en ”tomtgata i stadscentrum”, där körbanans bredd är 6 m och lederna för lätt trafik är 2,5m på vardera sidan om vägen. Hastighetsbegränsningen är under 50 km/h och området har endast plankorsningar.

Belysningsklassen för körbanan är AL4a och klassen för den lätta trafiken är K4.

Det goda med AL4a- klassen är att sannolikheten att observera ett hinder är i klassen av över 75 %, vilken är en hög nivå. Detta åstadkoms då den medeltaliga luminansen överskrider värdet 1 cd/m2.
Armaturens ljusalstring är i sådana vinklar, att den våta vägytans klassificering för belysningsjämnhet 0,15 lätt uppnås.

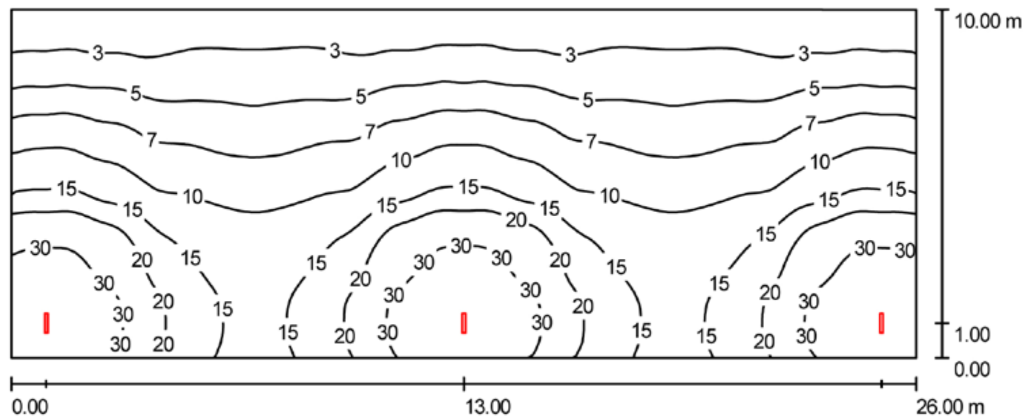


Luokka	Vaakatason valaistusvoimakkuus	
	Em [1] lx, min	E lx, min
K1	15	5
K2	10	3
K3	7,5	1,5
K4	5	1
K5	3	0,6
K6	2	0,6

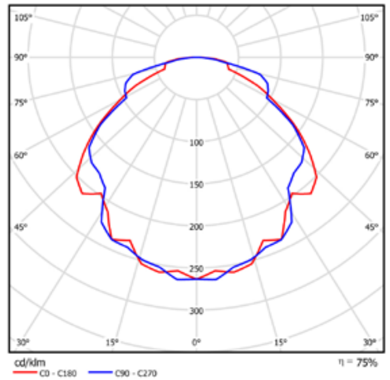


kuva 1

Hamngatan med Toccata Street 5m höga 12meter plasering



Valaistu alue 1:



SJ-JALUSTAT (kuva 1)

Sähkö-	Tyyppi	Pylväälle	korkeus	Paino	h	d1	d2	u	u1	b1	b2	b3
4607615	SJ-1	100-136	1-6	130	1000	370	240	430	80	80	138	150

Toccata Street belysningsvärden

Toccata Street- armaturens ljusalstrings egenskaper är mätta enligt CIE- standarden hos Semperlux/Selux´s belysningslaboratorium i Berlin. Ljusberäkningen har gjorts enligt Hamngatans geometri där stolphöjden är 5m, medan avstånden mellan stolparna är 12m. Armaturerna är i vågrät ställning (med möjlighet till montering i 15 graders lutning). På museisidan är belysningsnivån för lätt trafik i klass K1 och ljusvärden är utmärkta. På den motsatta sidan är belysningsklassen för lätt trafik en god K5. Fordonsklassificeringen för körbanan är en god AL4a.

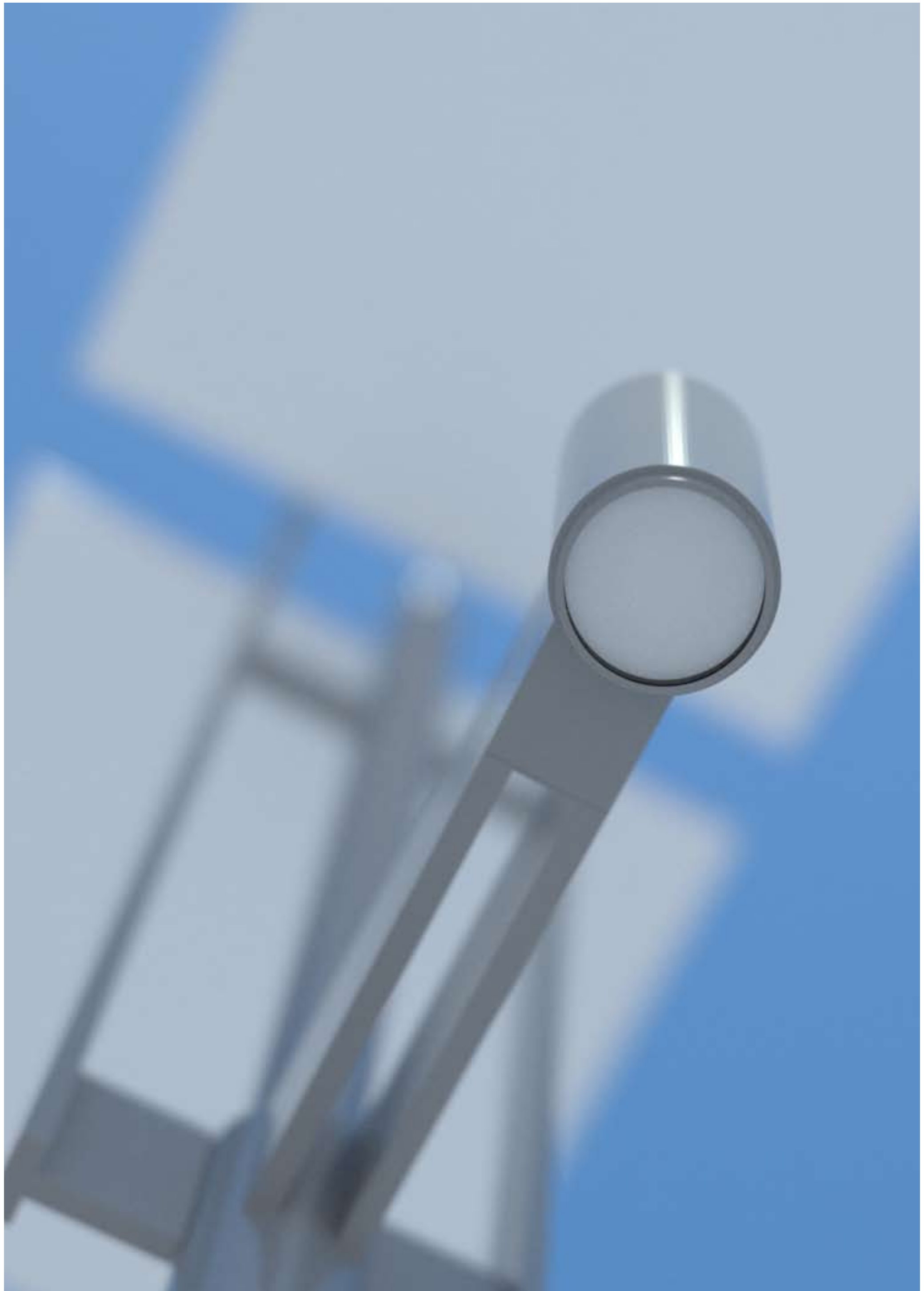
Det regelbundna utbytet av lampor hos Toccata-armaturerna borde göras med jämna 5 års mellanrum. Lampans livslängd är 20 000 timmar och den årliga förbränningstiden uppgår till ca 4000 timmar.

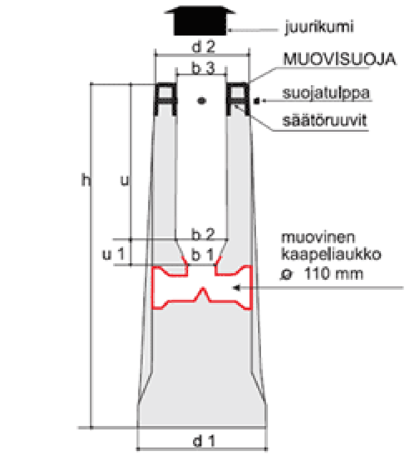
Monteringen av Toccata Street

Toccata Street- armaturerna monteras i SJ 1-stolpfundament. Toccata stolpens diameter är 110 mm och SJ-1 fundamentet lämpar sig för stolpar med 100-136 mm diameter. Vindbelastningen på armaturen är obetydlig p.g.a. dess geometriska mått och p.g.a. dess formkoefficient.

Elmonteringen sker ”normalt” i installationsutrymmet som är beläget bakom monteringsluckan.

Selux har ett internationellt försäljningsnätverk och därför följer Toccata- armaturens mekaniska, eltekniska och belysningstekniska värden alla erforderliga normeringar och direktiv. Exempelvis kunde man nämna: CIE, DIN, CEN och EuP .



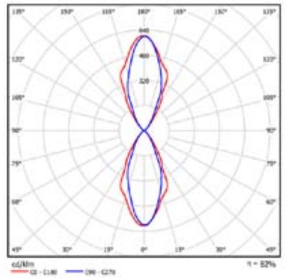


1.26	1.48	2.03	2.12	2.12	2.25	2.15	1.84	1.63	1.63	1.84	2.15	2.15	2.25	2.12	2.02	1.47	1.26
1.48	1.86	2.43	2.62	2.62	2.74	2.53	2.20	1.84	1.84	2.20	2.53	2.54	2.75	2.61	2.42	1.85	1.48
2.09	2.81	4.42	5.01	5.03	5.19	4.54	3.30	2.75	2.75	3.30	4.54	4.58	5.22	5.01	4.41	2.84	2.09
2.57	3.68	5.44	7.26	7.33	7.25	5.50	4.15	3.30	3.30	4.15	5.50	6.01	7.42	7.29	5.43	3.83	2.58
3.96	5.45	10	14	15	14	9.99	5.98	4.97	4.94	5.98	9.94	11	15	14	10	6.20	3.97
4.41	7.11	14	23	27	23	14	7.40	5.86	5.64	7.36	14	17	26	24	15	8.39	4.81
5.55	9.74	22	47	75	44	21	9.76	7.35	6.84	9.62	20	31	71	57	24	12	6.18
5.65	10	26	109	348	90	25	10	7.50	6.92	10	23	49	324	183	31	13	6.36
6.00	12	31	203	769	158	29	11	7.98	7.31	11	26	73	659	381	40	15	6.82
5.98	11	30	169	561	134	28	11	7.95	7.30	11	25	67	467	302	38	14	6.78
5.58	9.93	24	67	133	60	23	9.91	7.39	6.88	9.72	21	39	123	93	27	12	6.23
4.56	7.78	17	30	39	29	16	7.95	6.01	5.73	7.88	16	22	38	33	18	9.51	5.08
3.99	5.96	11	16	17	16	11	6.34	5.02	4.97	6.34	11	13	17	16	12	6.94	4.04
2.60	3.83	6.20	7.65	7.82	7.89	6.24	4.28	3.33	3.31	4.28	6.18	6.99	8.16	7.80	6.26	4.07	2.63
2.11	2.84	4.49	5.08	5.13	5.19	4.50	3.32	2.76	2.76	3.32	4.58	4.62	5.29	5.08	4.48	2.86	2.12
2.10	2.82	4.44	5.00	5.01	5.12	4.46	3.30	2.76	2.76	3.30	4.55	4.57	5.18	5.00	4.44	2.83	2.11
1.48	1.85	2.43	2.61	2.61	2.74	2.54	2.21	1.85	1.85	2.21	2.54	2.55	2.75	2.61	2.43	1.85	1.48
1.26	1.48	2.04	2.13	2.13	2.27	2.17	1.85	1.64	1.64	1.85	2.17	2.17	2.27	2.13	2.04	1.47	1.26

20.00 m
10.50
9.50
0.00
0.00 7.50 22.50 30.00 m

SJ-JALUSTAT (kuva 1)

Sähkö-numero	Tyyppi	Pylväälle halkaisija	korkeus m	Paino kg	h mm	d1 mm	d2 mm	u mm	u1 mm	b1 mm	b2 mm	b3 mm
4607621	SJ-2	128-168	6-10	290	1200	550	330	570	80	120	180	190



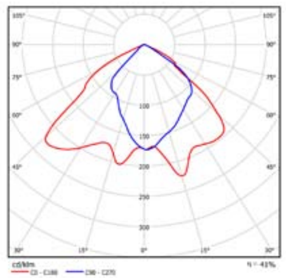
Fresnell- linsen BZ01 förvandlar Brandos direkta runda ljusfenomen till en elliptitisk (ljuskägla)form. På dett sätt förbättras belysningen på den lätta trafikleden mot ett jämnare ljus. Detta passar väl ihop med den ensidiga Brando- armaturerna på hamnområdet.

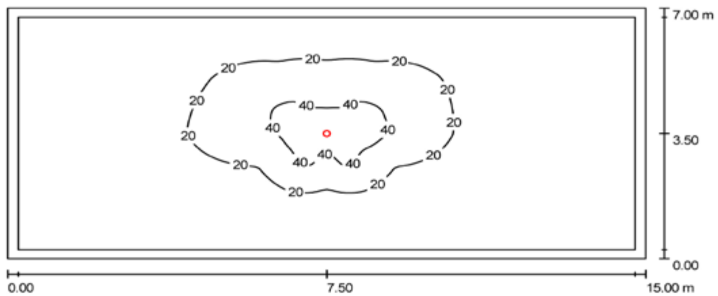
Refractor for elliptical distribution
for BA05-BA06-BA07-BA11-BA15-BA16–BA09-BA10-BA13
BA14-BA17-BA19-BA21-BA27-BA28-BA23-BA24-BA29
BA32-BA34-BA37-BA38
Colour 24

BZ01

Spill ring fixed Flood, Wide Flood and Very Wide Flood optics
for BA13-BA14
Colour 04

BZ05





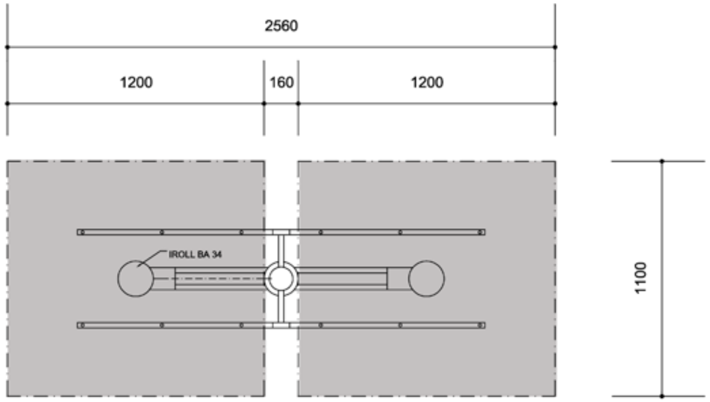
BRANDO

Den dubbelsidiga Brando-armaturen är en armatur, vars optik för direkt ljus lyser upp ett starkt ljusfenomen som fortgår oavbrutet och som framhäver rytmen i rummet. Ljusfenomenets diameter är 15 meter. Ljuset infallsvinkel är skarp vilket förhindrar en störande bländande effekt och gör att rummet blir behagligt att gå i.

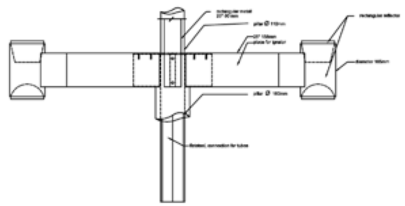
Den indirekta andelen av ljuset skapas genom användning av en 1m x 1m vit reflexskiva. Dess ljus motsvarar ljushetsgraden av månsken, och man undviker störande bländning, som sedan sprids som en slöja över omgivningen enligt konceptet.

Brando- armaturen har en Iguzzini IP-61-klassens ljusenhet vars iRoll BA 34- armatur är av hög kvalitet.

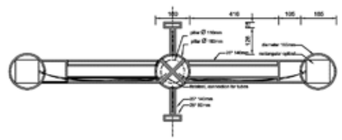
Brando- armaturerna tillverkas av den kända italienska arkitekturbelysningstillverkaren Iguzzini Illuminazione SpA som är känd för sina höga kvalitet. Verksamheten på den breda internationella marknaden har haft som följd att Brando-armaturen fyller alla eltekniska och mekaniska internationella normer och rekommendationer. (CIE, CEN, IQM/ENEC, VDE, EuP, o.s.v.).



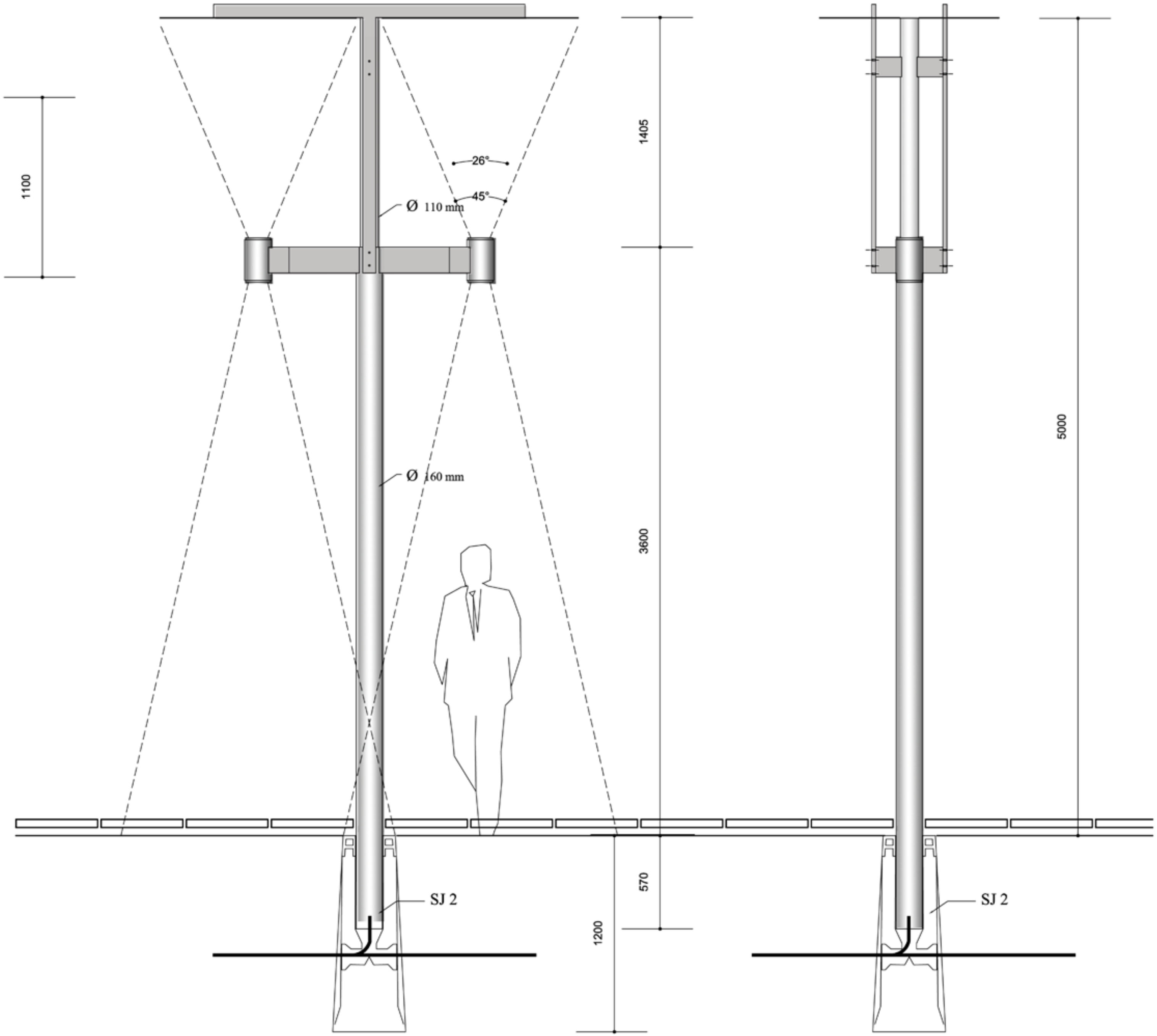
From top

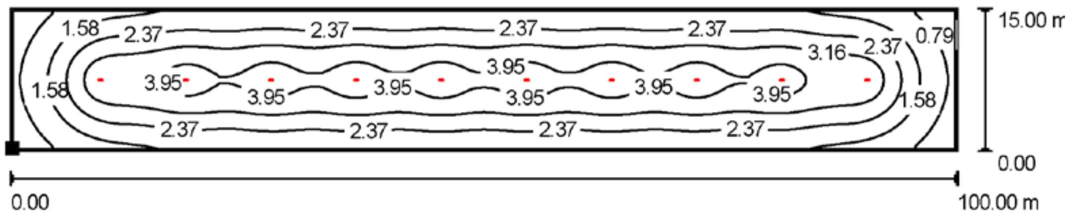


Connection details

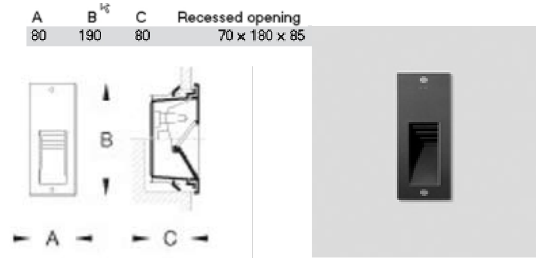


Section 1- 1

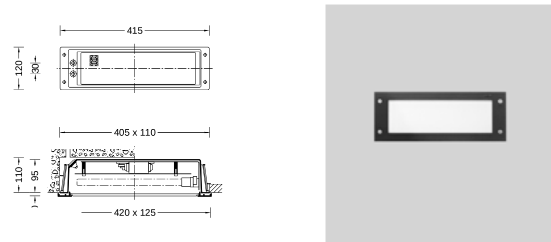


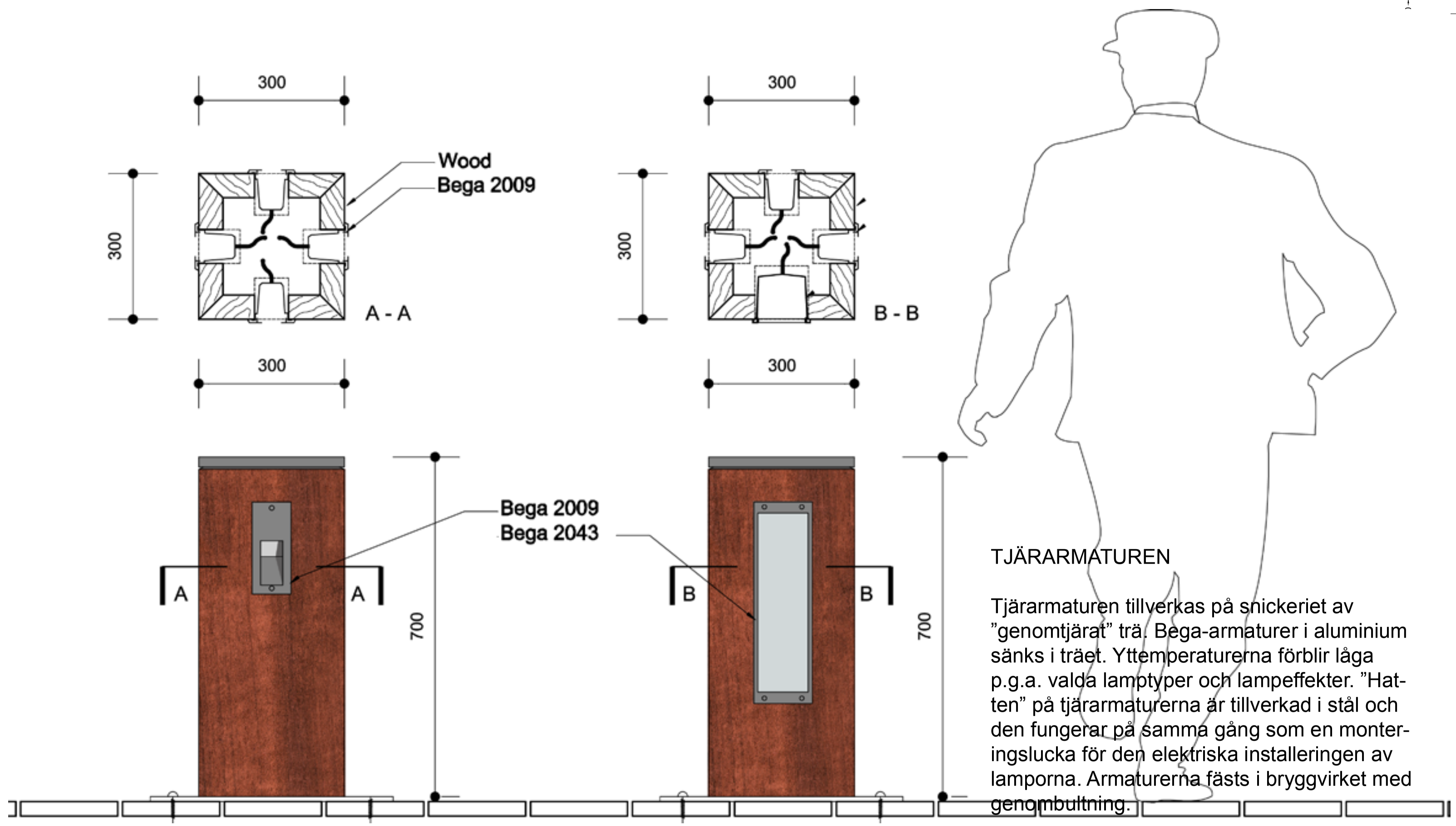


BEGA 2009



BEGA 2043



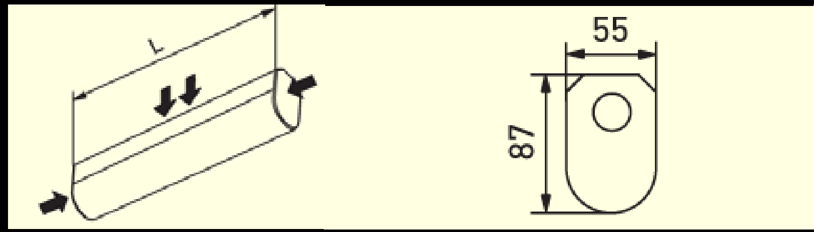


TJÄRARMATUREN

Tjärarmaturen tillverkas på snickeriet av ”genomtjärat” trä. Bega-armaturer i aluminium sänks i träet. Yttemperaturerna förblir låga p.g.a. valda lamptyper och lampeffekter. ”Hatten” på tjärarmaturerna är tillverkad i stål och den fungerar på samma gång som en monteringslucka för den elektriska installeringen av lamporna. Armaturerna fästs i bryggvirket med genombultning.

Armaturerna skapar för sin del rytm i rummet och fungerar även som orienteringsbelysning. Vi eftersträvar inte att skapa en jämn belysning.

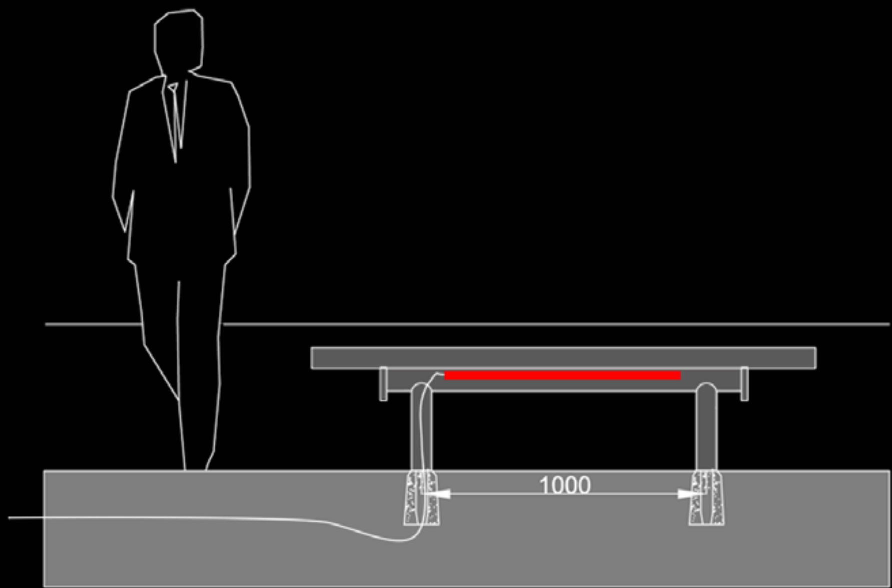
De 10 tjärarmaturerna framför Pommern utrustas med Bega 2043- armaturer, vilka ger ett ljuvligt sken åt Pommerns sidor och mot havet. Den bifogade kalkylen visar att vi kan skapa ett sken som motsvarar månskenets ljus. Armaturernas reflexytor syns endast från gästbryggorna och sedda ur skeppsperspektiv från havet. Vid demonstrationen borde läggas stor vikt på att granska bländningsegenskaperna. Ifall den störande bländningen är på störande nivå, bör Bega 2043-armaturen sänkas in i tjärarmaturen så, att ljusspridningen förblir god, men så, att reflexytorna förblir gömda. Ur dess vinklar blir armaturerna sällan sedda.

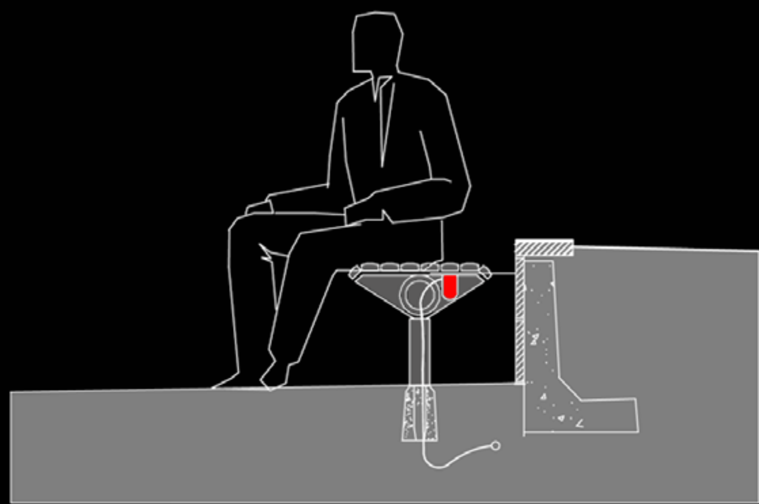


Tyyppi: AVR66.030
EAN: 6410042170694
Snro: 4217069
Nimi: Jonovalaisin
1x30W T8/G13 230V 50Hz, 936mm
Pakkaus: 1/80
Yksikkö: KPL

Under bänkarna i hamnområdet installeras Ensto Oy:s AVR 66.030 armaturer. Armaturen är av sådan typ att den går att seriekopplas och den är tillverkad i aluminium. Kåpan består av polykarbonat. Ljuskällan är ett 30W T8 lysrörlampan.

Bänkbelysningen skapar en intressant upplyst serie av utrymmen. Den roliga och bländningsfria belysningslösningen skapar kontrast i rummet och pekar ut rastställen åt vandraren i skymningen.





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He is also a PE (electricity) from Helsinki Technical College.
He has visiting professorships and other academic positions at various universities in London, New York, Ithaca, Philadelphia, Oregon, Tennessee and Norway. Julle Oksanen and the architect Professor Hannu Tikka are part of Group X, a focus group at the Department of Architecture at Aalto University. They form a “Light & Space Academy” arranging travelling educational activities in the USA, Asia and Europe.

Aalto-DD 73/2017

"SHADOW IS THE BEST FRIEND OF LIGHT" (author)

Architectural outdoor lighting design, as a process, is at the same time also darkness and shadow design. Darkness fascinates us as human beings, but its design needs exceptional skills, open-mindedness and courage.

Let us imagine a hypothetical situation in which the lighting designer begins to design a lit environment with total darkness as the starting point. The lighting designer begins to remove, or eliminate, dark layers from the total black background, removing darkness layers one at the time, until the desired lighting degree on the designed surface (e.g. on a facade) is achieved. This kind of "shadow design" is a professional way to do lighting design.

The lighting designer is a shadow designer, who treats his/her task as an artist treats the canvas by painting gradations of darkness using light sparingly on illuminated surfaces, thereby using a whispering light palette as the design tool. Shadow design can be compared to oil painting techniques. French researchers studied Leonardo da Vinci paintings, including the Mona Lisa, to analyze the master's use of successive ultrathin layers of paint and glaze – a technique that gave his works their dreamy quality.

Almost 100 years of this intransigent technical lighting design era have made glary and high illumination level city structures a context for new lighting designs. The fascination of darkness is totally missing. The only way to succeed with such city structures is to dismantle the old lighting installations and start from darkness. Some cities are considering such lighting renovations in certain parts of the city structure.

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