

THE BEACON PROJECT

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ABSTRACT

Prior to transferring to TCU, I had no knowledge of Architectural Lighting Design (ALD) and how vital it is to the overall design of the built environment. Over the past three years, I have learned a great deal about the ALD field. The more I learned about ALD in the classroom, the more I wanted to know, which inspired me to pursue the Departmental Honors Project. The journey has been a road filled with independent exploration and research while simultaneously continuing the standard lighting minor curriculum.

This honors project began with research into the history of Architectural Lighting Design from its inception to the current day. The more I delved into the research, the more questions arose. Unlike other design professions like architecture, interior, and furniture design, ALD history is not as well documented. This sparked a desire to create a resource that would incorporate the results of my research and other sources for academics and professionals, as well as prospective and current students of Architectural Lighting Design and current ones. After careful consideration with Alyssa Humpries-Stewart, lighting designer, professor, and mentor, I decided a website would be the best to disseminate my findings. This website will be a combination of the history of architectural lighting design, designer interviews, educational resources, as well as links to external resources such as competitions, scholarships, and other opportunities waiting to be pursued by aspiring professionals in the field would be the best.



DEPARTMENTAL HONORS MAY 2021
ARCHITECTURAL LIGHTING DESIGN
VANESA GJECI
RESEARCH PAPER

From Light as Necessity to Architectural Lighting Design

Introduction

The first source of light known to man is the sun, secondly came fire in the Paleolithic age, which marked the first controlled use of fire as a source of light (Gowlett and Wrangham). Life was made easier by using light, therefore the objects to adapt it were born. Objects such as the torch, and even objects from advanced civilizations such as oil lamps and candles, were popular. From the use of fire to illuminate spaces to the advances of today's technology in architectural lighting design, lighting design remains an emerging design field. Because of these advances, the art and science of designing with light has created a bridge of communication between the architecture and the user experience of the natural and built environment.

Using light to enhance the experience of a space and people was a concept that was introduced in the classic Greek and Roman theatrons. These were structures usually built on a hillside and placed so that the afternoon sunlight would come from behind the audience and flood the performing area with natural light. Indoor theaters among the Italian aristocracy would grab the attention of Sebastiano Serlio an Italian architect (Tripp et al). In his book Complete Works of Architecture and Perspective, he discussed theatre construction and the creation of lighting effects. He recommended placing candles and torches behind flasks filled with amber- and blue-colored water (Serlio). Architects of the time used sunlight light and fire to design stages, but despite of all the advances of the humanity, the fire remained the only source of light until 150 years ago (Roos 33).

The Industrial Revolution in England would spark a desire to innovate and use other materials to produce light. William Murdoch, a Scottish engineer, invented gas lighting in early 1790s. Boulton & Watt, the company he worked for, used the gas lighting to illuminate the factory (Tripp et al). The desire to perfect artificial lighting continued, inspiring Joseph Wilson Swan, and English physicist, chemist, and inventor, to invent the first incandescent light bulb, he received a British patent for his device in 1878, about a year

before Edison's U.S. patent. He later collaborated with Edison for the commercial development of electric lamps, under the brand name Ediswan (Cleveland et al).

Origins of Architectural Lighting Design

The invention of the electric lamp was a turning point in the history of humanity and would later play a great role in the design world. The beginning of architectural lighting design is a blurred line. Late 1800s and early 1900s mark a time where design areas developed parallel with one another. Architecture, furniture design, homewares, and light fixtures, amongst others, created a ground for the collaboration of all disciplines while designing. Le Corbusier, a Swiss-French architect, once said "light creates the feel of a place, as well as the expression of architecture." Richard Kelly, an American lighting designer, one of the pioneers of the field, established his lighting design practice in New York in 1935.

Over the course of his career, Richard Kelly made extraordinary contributions to architectural lighting design. He is one of the pioneers in the field, having worked on over 300 major projects, with 80 different architects. His reverence for, and his understanding of the behavior of light was promulgated as the design value known as focal glow, play of brilliants, and ambient luminescence (Kelly 24). In his college art journal by the title of Lighting as an Integral Part of Architecture, he states that "focal glow is the campfire of all time... It is the pool of light at your favorite chair." Kelly goes on to explain how the focal glow draws attention, pulls together diverse parts, sells merchandise, separates the important from the unimportant, helps people see (Kelly 25).

Kelly's definition of ambient luminescence is "the uninterrupted light of a snowy morning in the open country" (Kelly 25). What differs ambient luminescence from the focal glow is that it produces a shadowless illumination, minimizing form and bulk, suggesting freedom of space and infinity, and quieting the nerves. Lastly, Kelly described the play of brilliants as "Times Square at night. It is the eighteenth-century ballroom of crystal chandeliers and many candle flames... It is a cache of diamonds in an opened cave... It is the trees outside your window interlaced with the beams of spotlights. It is a sparkling cabinet of fine glassware" (Kelly 25). The three terms that Kelly coined, revolutionized the world of

design, making sure that not only functionality was considered, but calmness and excitement as well. The incorporations of these concepts brought attention to the layers of lighting which we use today. A few of his most recognized accomplishments are the Seagram Building, Mies van der Rohe and Philip Johnson, architects; Philip Johnson's Glass House and The New York State Theater at Lincoln Center, Philip Johnson, architect; the Kimbell Museum of Fine Arts and the Yale Center of British Art and Studies, Louis Kahn, architect (Petty).

This marked a time when architects started to see value in lighting design. Richard Kelly first collaborated with Philip Johnson on the design of The Glass House. Johnson described his concept for the house: "My plan was first of all a shelter, which is the goal of every home. But having used transparent walls to enclose myself within a decorative landscape, instead of hiding behind conventional walls, I wanted to enjoy that environment at night. I did not want to clutter the place with drapes and shut myself in. Neither did I want to live in a goldfish bowl" (Petty 198). Kelly suggested that the house be illuminated from the outside in. Johnson was not convinced of the approach and walked away from the suggestion. Johnson was unable to adapt the traditional lighting technologies to the glass house, leaving him displeased with the results (Petty 199).

The remodeling of the John D. Rockefeller III's Manhattan townhouse brought Kelly and Johnson together again. When Johnson sought Kelly's advice again, Kelly returned to his original concept for Johnson's design, explaining that the best way to effectively illuminate the interior of the structure without incurring the problem of glare and reflection was to illuminate the exterior. In this way, Kelly argued, the interior would be illuminated indirectly, and the glass would retain the desired transparency. Moreover, he suggested that, following his program, the glass walls would not only serve as transparent protection from outside elements but also as frames for planned compositions made visible through select nighttime illumination of the landscape. In this way, the external illumination would serve a two-fold purpose: one of fitness, allowing continued transparency of the glass at night, and one of aesthetics, creating decorative scenery from the surrounding environment (Petty 199).

Kelly's innovative approach to architectural lighting design had a significant impact on the look of modern American architecture in the mid-twentieth century. His extensive portfolio of works with different

architects helped shape a variety of modern American architecture, including corporate headquarters, universities, theatres, auditoriums, and airports (Petty 212). Lighting design has been a form of art that falls through the cracks in academia and history; however, Kelly started the path to building a career that many follow today. In his experience as a lighting designer, Kelly faced challenges as a designer that treated his knowledge and artistry as an afterthought. Despite that, he did not limit his lighting design expertise to only the electric lighting, but in daylight as well.

Natural and Artificial Lighting Design

In 1952 Kelly writes: "The last two decades have developed by invention new sources of artificial light, its control equipment, and more knowledge of daylight and its control equipment than were developed in the preceding two millenniums (our known technical history)" (Kelly 26). In the *College Art Journal*, he pointed out that the study of daylight and the proper treatment of the relationship between architecture, daylight, and apertures would maximize the use of daylight while minimizing glare (Kelly 27). Moving forward a few decades, where the need to preserve the planet exceeds the need to meet the personal desires of people, has evolved the attitude toward lighting design, making it sustainable.

According to the Merriam-Webster dictionary, sustainability is "of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged".

Sustainability has been applied to a range of areas in life – lighting design being one of them. The invention of solar panels in 1954 and the evolution of it, has contributed in the evolution of lighting design, and the incorporation of natural resources to minimize on the resources used while maximizing on the design. Sustainable design principles include the ability to optimize site potential, minimize non-renewable energy consumption, use environmentally preferable products, protect and conserve water, enhance indoor environmental quality, and optimize operational and maintenance practices (Sustainable Design). According to the U.S. Energy Information Administration, the electricity used for lighting in residential and commercial setting was respectively 6.2% and 10.3% in 2018; however, In the Annual Energy Outlook 2019 Reference case, EIA projects total U.S. electricity use to grow an average of less than

1% annually from 2018 through 2050 (EIA). The reasons for this development in energy use are a few such as dictation from building code, renewable energy regulations, and the net zero movement. After a certain amount of years, a structure of any kind requires renovation and improvement. Along with the improvement of structures, comes the improvement of building codes that apply to construction in a gestalt way. The U.S. Department of Energy plays a crucial role in the technicalities of energy use, challenging the designer to tackle more than one task when designing.

Architectural lighting design has transformed over the years not only in the aesthetic aspect, but in the use of light and design to make an impact in wellbeing of the user and the planet. Active in around 70 countries, the World Green Building Council's ambitious mission is to eliminate the buildings and construction sector's emissions by 2050 (WGBC What is Net Zero?). The WGBC's goal is to address real-world issues such as global warming, creating sustainable and thriving communities, and driving the economic growth. The benefits of a green buildings are grouped in three main categories: environmental, social, and economic (WGBC The Benefits of Green Buildings).

On the environmental level, green buildings have a global level impact, as well as building level. On a global level, the building sector has the largest potential to reduce greenhouse gas emissions with a potential of emissions savings of 84 gigatons of CO₂ by 2050 through direct measures in buildings such as energy efficiency, fuel switching and the use of renewable energy (UNEP 2016). The building sector has the potential to make energy savings of 50% or more in 2050, in support of limiting global temperature rises to 2°C (above pre-industrial levels) (UNEP 2016). At a building level, Green buildings achieving the Green Star certification in Australia have been shown to produce 62% fewer greenhouse gas emissions than average Australian buildings, and 51% less potable water than if they had been built to meet minimum industry requirements. In the U.S and other countries, green buildings achieving LEED (Leadership in Energy and Environmental Design) certification have shown to consume 25 per cent less energy and 11 per cent less water than non-green buildings (WGBC The Benefits of Green Buildings).

On an economic level, the benefits of green buildings expand to a few different people. These benefits include savings on utility bills for tenants and households, lower construction cost and higher property value for developers, and increased occupancy rates (WGBC). The global energy efficiency could save an

estimated 280-410 billion Euros in savings on energy spending (European Commission, 2015). On the scope of job creation, the green building industry is projected to account for more than 3.3 million U.S. jobs (WGBC The Benefits of Green Buildings).

Green buildings have shown benefits on social impacts as well as environmental and economic. In the 2013 study of the correlation between workplace daylight exposure and sleep, activity, and quality of life, showed that the exposure to daylight in the work place sleep an average of 46 minutes more per night and are more physically active than the counterparts who are not exposed to natural light as much or lack of exposure (American Academy of Sleep Medicine, 2013). This shows how a holistic design and environmentally friendly design affect the quality of life in the users of the green buildings.

In a first-hand experience in architectural lighting design for a net zero residence, the designer learns how to define space, function and aesthetics with natural light. As lighting design is still a new profession, a new generation of designers is being educated and encouraged to practice design in a sustainable way. Millennials and generation-Z are growing up in a world where improving the current state of our planet is in the core of their conscience. Eating habits, shopping manners, and housing of young adults now differs greatly from the previous generations. Housing in particular has taken a different, sustainable route. Living Big in a Tiny House is a YouTube show hosted by Bryce Langston and co-produced by Rasa Pescud. This show explores an extensive variety of tiny houses, apartments, container homes, buses and everything in between. This show started in 2013, and since then, the couple has been traveling and documenting an alternative way of living in unconventional architecture (Living Big in a Tiny House). Langston's interest on exploring tiny and sustainable houses sparked from the strong desire to break free from the expensive housing market. Having visited so many houses all over the world, there is a lot of commonalities behind the choice of living in a tiny house.

The housing market has dictated who can and cannot own a house, or even rent. All the facts and data that the World Green Building Council states, the inhabitants of tiny houses have confirmed it all. From the cost of building, to monthly utilities, flexibility of the structure (e.g. mobile homes), practicality in maintenance and the value of the property, living in a sustainable property has made a great difference in their lives. These are the places where sustainable lighting design thrives. All houses built from a

sustainability standpoint, the use of daylight is optimized; heating, cooling and ventilation are naturally controlled via insulation, strategic placement of the windows and solar panels becomes crucial.

Often times, the daylight that comes through a space is a product of a façade that is aesthetically pleasing to the architect, but the potential effects not only on the cost, but health and well-being are overlooked.

Architect Thomas Schielke goes into detail about 7 different ways that daylight can be a highly cost-effective mean of reducing energy for electrical lighting and cooling. If all the steps are taken into consideration when designing, they will reduce the initial investment alongside the operating costs. Optimizing the urban design and building orientation depending on the specific location and climate is crucial (Schielke). The Köppen climate classification and the characteristics of that climate dictate most of the sustainable design decisions (National Geographic Society). If the climate is hot and humid, then the designer would mold the structure to easily cool and dry the air.

The design process continues with exploration of the perfect size, form, and glazing treatments for windows (Schielke). If the location of the structure is in the northern hemisphere, the south façade of the building is exposed to the sun the most. This fact will inform the decision on the windows, the glass used, and the treatment to protect the interior from glare and heat. The designer needs to differentiate between daylight and the view to optimize the functions individually. Daylight contributes to the heat gain of the interior if the apertures are not treated properly, so shading for visual comfort and cooling would be a critical (Schielke).

Maximizing the use of shading implies that the shades are placed on the outside, filtering the sun prior to hitting the glass. This allows for the interior to not overheat, resulting in a lower energy consumption for cooling. Trees by the apertures also reduce glare and heat in the summer, and once the leaves fall in the autumn, it will allow for the winter sun to brighten the space up as well as heat the interior. Using the daylight to illuminate interiors could be maximized by working with bright interior spaces (Schielke). Brighter spaces have a high reflectance, which helps the light bounce off the surfaces and illuminate other areas.

The next step would be to move task areas close to windows (Schielke). Workspaces should have the

most access to the light as they are the spaces use the most, leaving the utility rooms in the core of the building. Reflector systems above eye level can help avoid glare and amplify the light coming in from the apertures (Schielke). Lastly, solar panels would be your final step into making the building as sustainable as possible while cutting down the carbon footprint (Schielke).

Conclusion

Lighting design has had an interesting development course and will continue to develop as technology advances and as it becomes more accessible to the average income families. The art and science of designing with light has created a bridge of communication between the architecture and the user experience of a space. The relationship of lighting design and architecture is still young yet healthy. This symbiotic relationship will continue to be worked on as the new and old generation of lighting designers continue to perfect it to maximize the impact of the architecture and also improve the wellbeing of the user.

Access to website:

Log In Email: vanesa.gjeci@tcu.edu

Password: Lighting20.

THE
BE  CON
PROJECT

VANESA GJECI

INTRODUCTION

What is Architectural Lighting Design?

Architectural Lighting Design (ALD):

Imagines

Creates

Integrates

Infuses

Organizes



LIGHTING



Coordinated system

Factors for natural light

Electrical light

Serves & advances human action



KIMBELL ART MUSEUM



WHY DOES ALD MATTER?

LIGHTING MATTERS

Why is ALD Important?

ALD Matters Because:

Fosters spatial experience

Influences mood, textures,
colors & space

Has a specific purpose

Serves & enhances the
architecture



LIGHTING



Helps architecture achieve
its true purpose

Has an emotional impact in
the occupants

Aids occupants in
maximizing the use of the
space



THE GLASS HOUSE



LIGHT AS NECESSITY

Sun and Fire as Light Sources

Sun as Light Source

Most visible light

Influences the human
Circadian rhythm

Affects melatonin synthesis

Reduces the risk of Seasonal
Affective Disorder

Perfect color rendering



Fire as Light Source

Paleolithic Age

First controlled source of
light

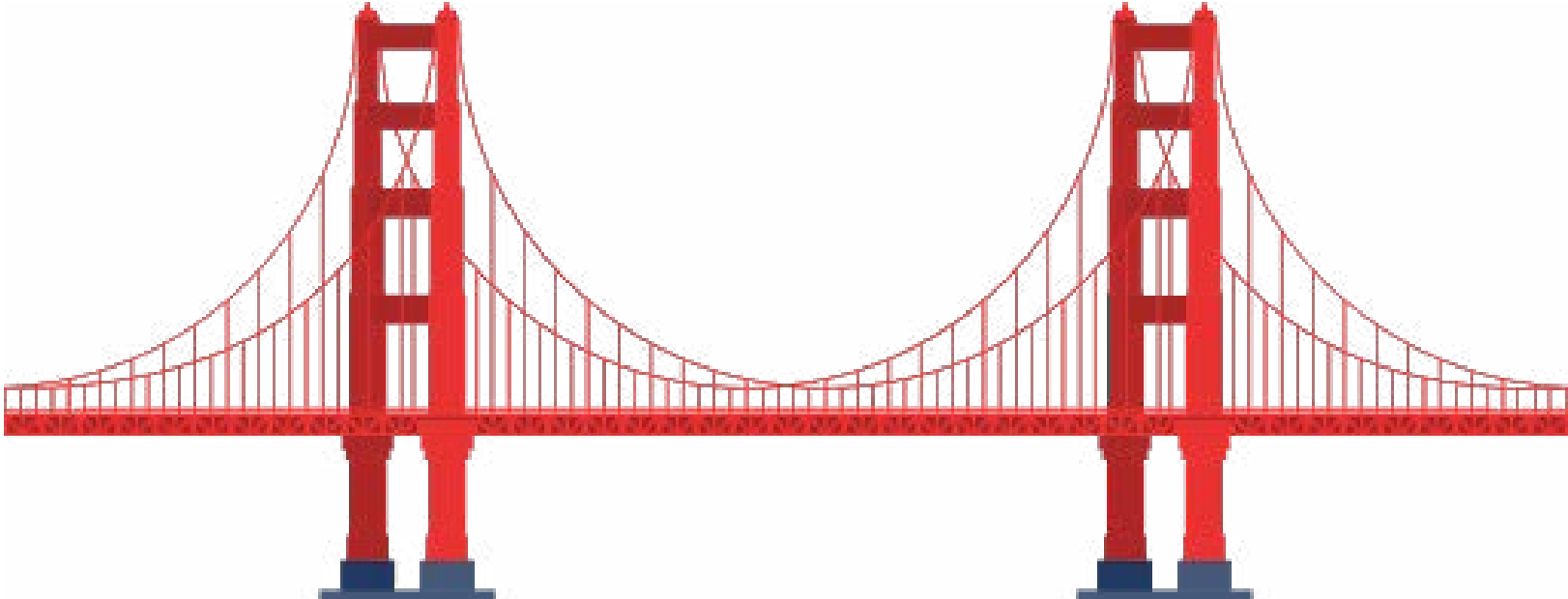
Artifacts to harness it - oil
lamp, candles, torches



FROM FIRE TO TODAY'S TECHNOLOGY

The Art and Science of Designing with Light

ARCHITECTURE



USER EXPERIENCE OF
THE NATURAL AND
BUILT ENVIRONMENT

GREEK AND ROMAN THEATRONS

Use of Light to Enhance Experience

Space and User Experience

Built on hillside

Afternoon light would flood the stage - due to careful and purposeful study of solar geometry

Sebastiano Serlio discussed the creation of lighting effects

Recommended placing candles and torches behind flasks filled with amber and blue-colored water



THE GREEK THEATRE IN EPIDAURUS



THE ROMAN THEATRE IN AMMAN

INDUSTRIAL REVOLUTION

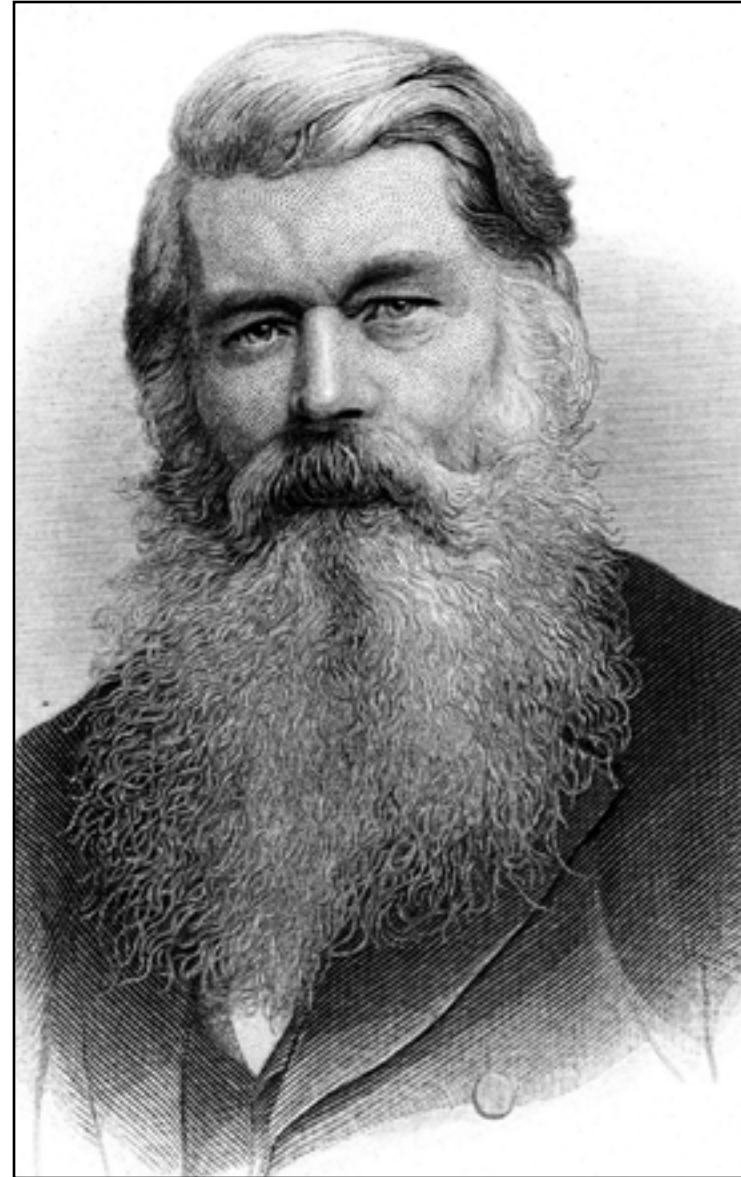
Innovation and Invention

WILLIAM MURDOCH



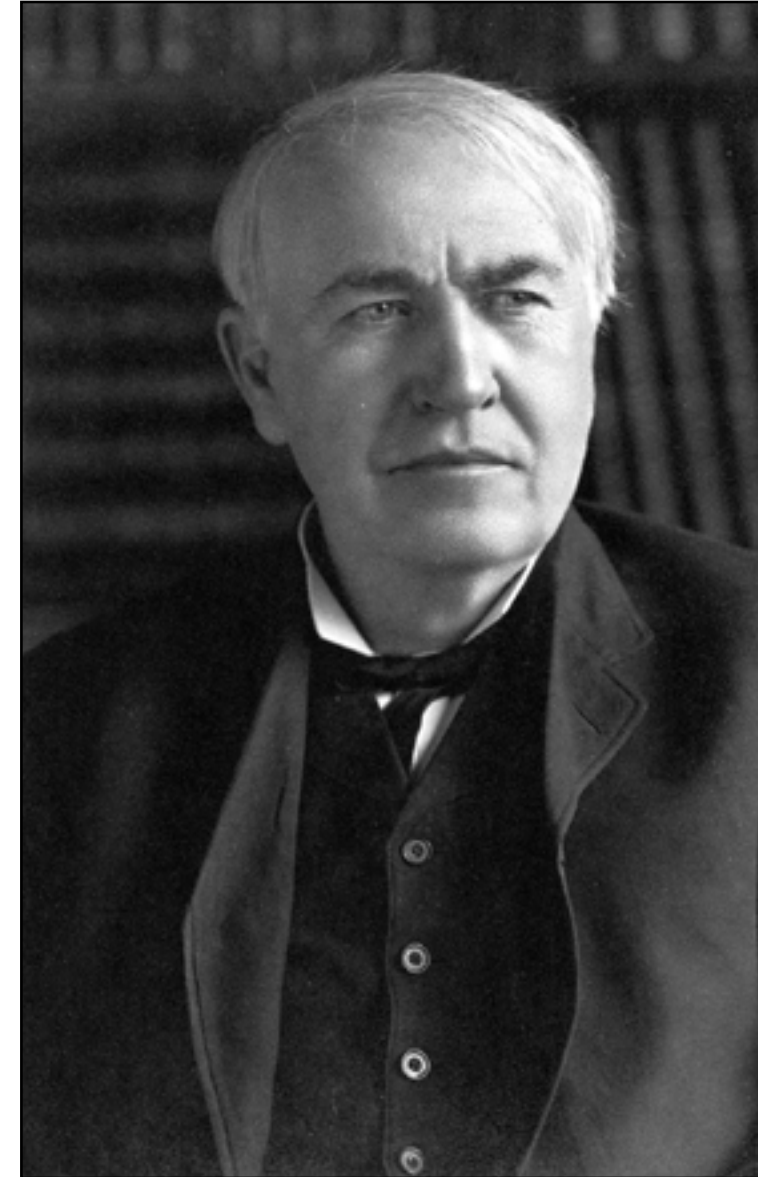
Gas Lighting 1790s

JOSEPH WILSON SWAN



Incandescent Lamp 1878

THOMAS EDISON



Incandescent Lamp 1880

LATE 1800s - EARLY 1900s

Different Design Areas Development

Parallel Development and Collaboration

Architecture

Furniture design

Home wares

Light fixtures

ANTONI GAUDI



Casa Batlló 1906

CHARLES RENNIE MACKINTOSH



Hill House Ladderback 1903

JOSEPH HOFFMAN



Hoffman Cutlery 1906

CHARLES RENNIE MACKINTOSH



Floor Lamp 1900

RICHARD KELLY - ALD PIONEER

Background

Yale School of Architecture graduate

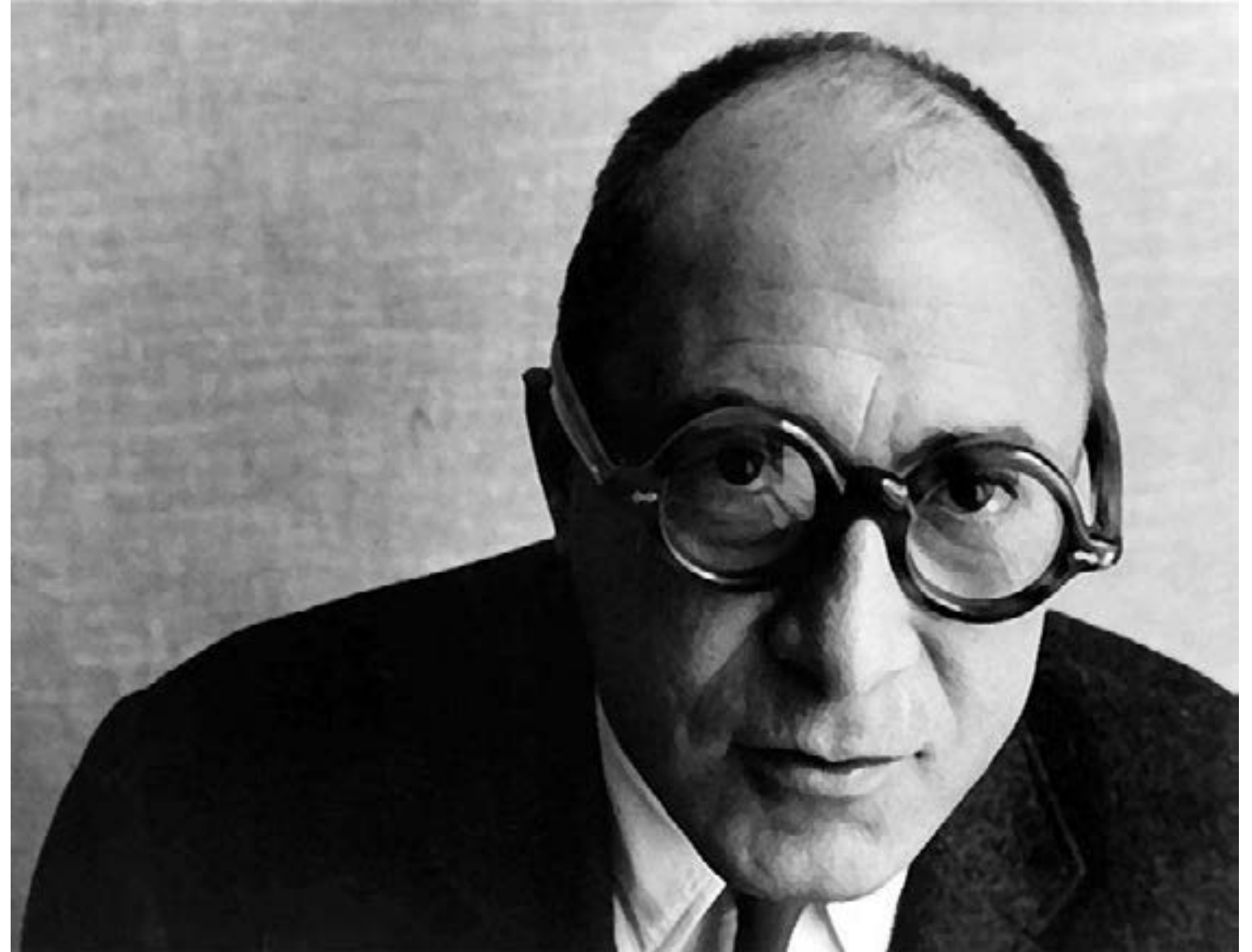
Has worked on 300 major projects with 80 architects

Opened his lighting practice in 1935

Lectured at Yale, Harvard and Princeton University

Coined three terms

- Focal Glow
- Play of Briliants
- Ambient Luminescence



RICHARD KELLY

RICHARD KELLY

Coined Terms

AMBIENT LUMINESCENCE

This is also known as general or ambient lighting. It's the background lighting that illuminates and entire space. It should be even and uniform, casting no shadows and makes people in the space feel safe.

1

FOCAL GLOW

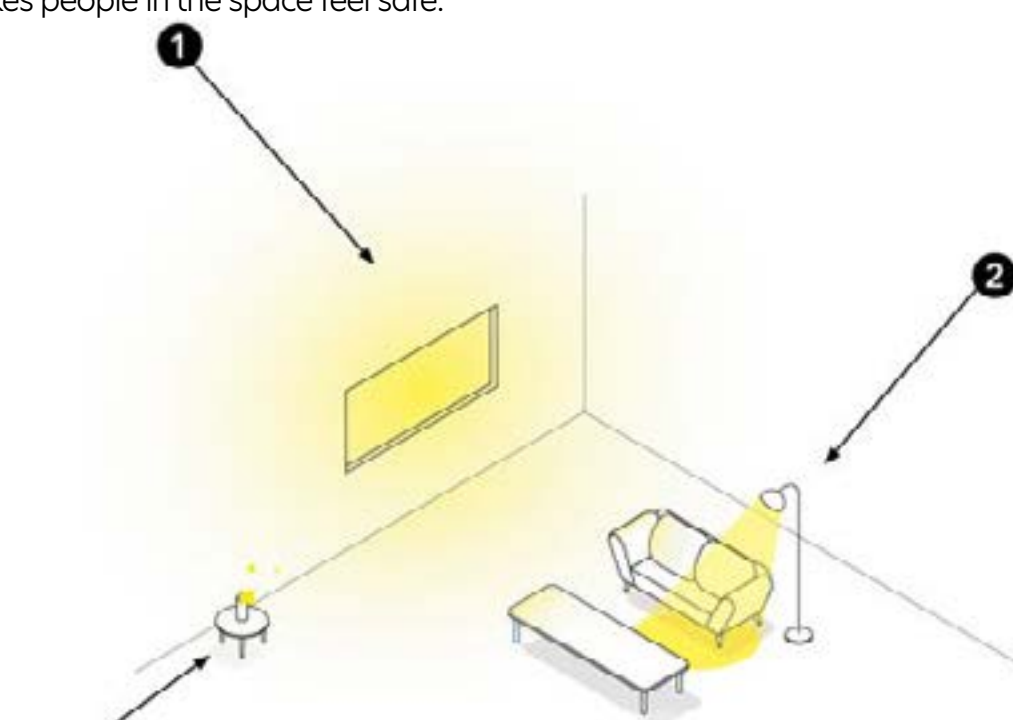
Today, this kind of light is referred to as task lighting. It points out important elements and draws attention to areas, all while making it easier to see.

2

PLAY OF BRILLIANTS

Also known as accent lighting, this layer can be dynamic and colorful and it aims to stimulate people and emotions.

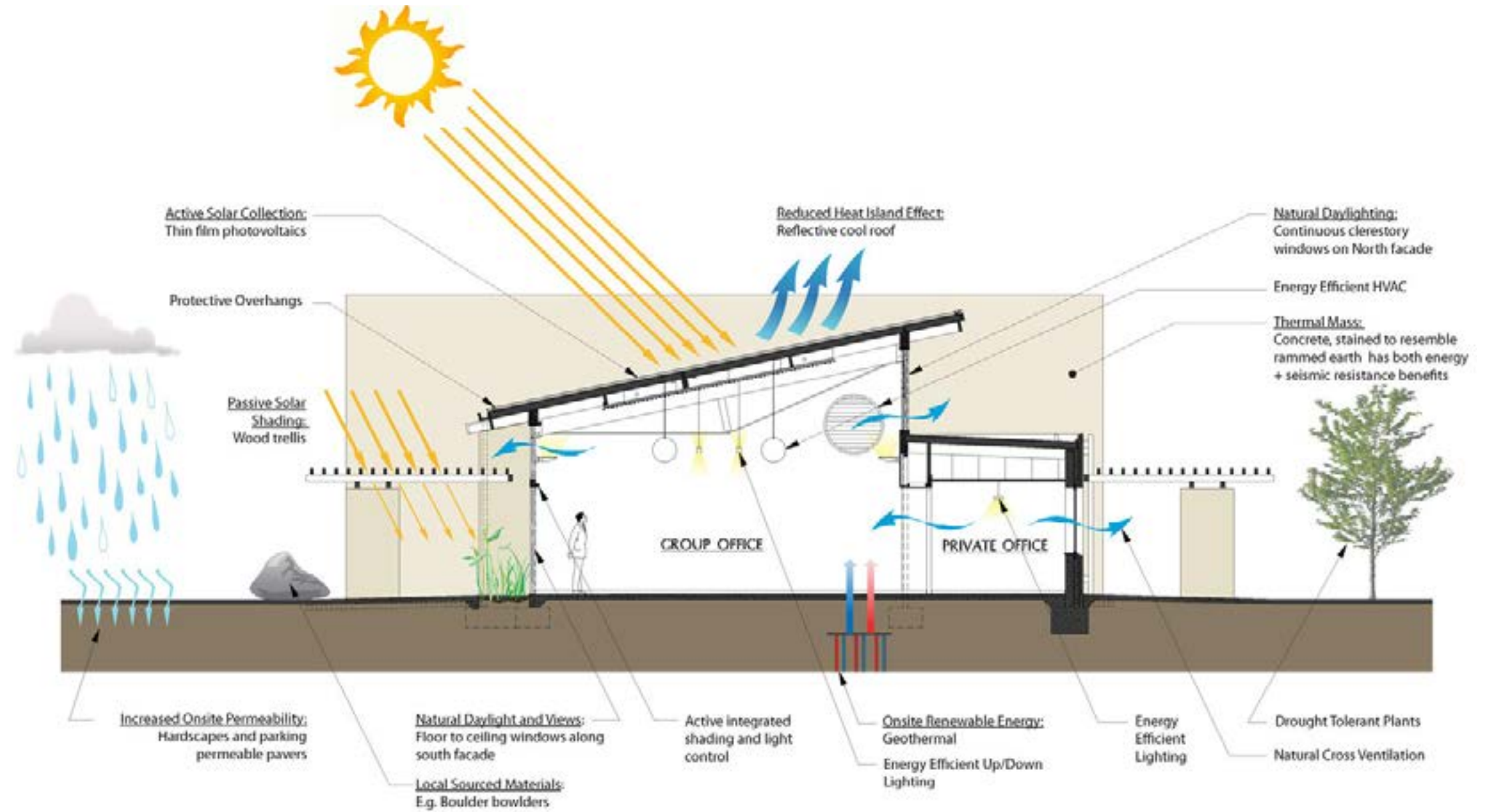
3



ALD AND SUSTAINABILITY

Sustainable Design Principles

- Optimize site potential
- Minimize non-renewable energy usage
- Use environmentally preferable products
- Protect and conserve water
- Enhance indoor environmental quality
- Optimize operational and maintenance practices



Mojave Rivers Ranger Station - Section Looking West
Sustainability Features



LIVING BIG IN A TINY HOUSE

Sustainable Housing - Bryce Langston

The housing market has dictated who can and cannot own a house, or even rent.

All the facts and data that the World Green Building Council states, the inhabitants of tiny houses have confirmed it all.

From the cost of building, to monthly utilities, flexibility of the structure (e.g. mobile homes), practicality in maintenance and the value of the property, living in a sustainable property has made a great difference in their lives.

These are the places where sustainable lighting design thrives.

All houses built from a sustainability standpoint, the use of daylight is optimized.

Heating, cooling and ventilation are naturally controlled via insulation, strategic placement of the windows and solar panels becomes crucial.



SUSTAINABLE HOUSE OFF THE GRID



SUSTAINABLE HOUSE OFF THE GRID

DAYLIGHT - COST EFFECTIVE MEAN

7 Ways It Can Be Cost-Effective - Thomas Schielke

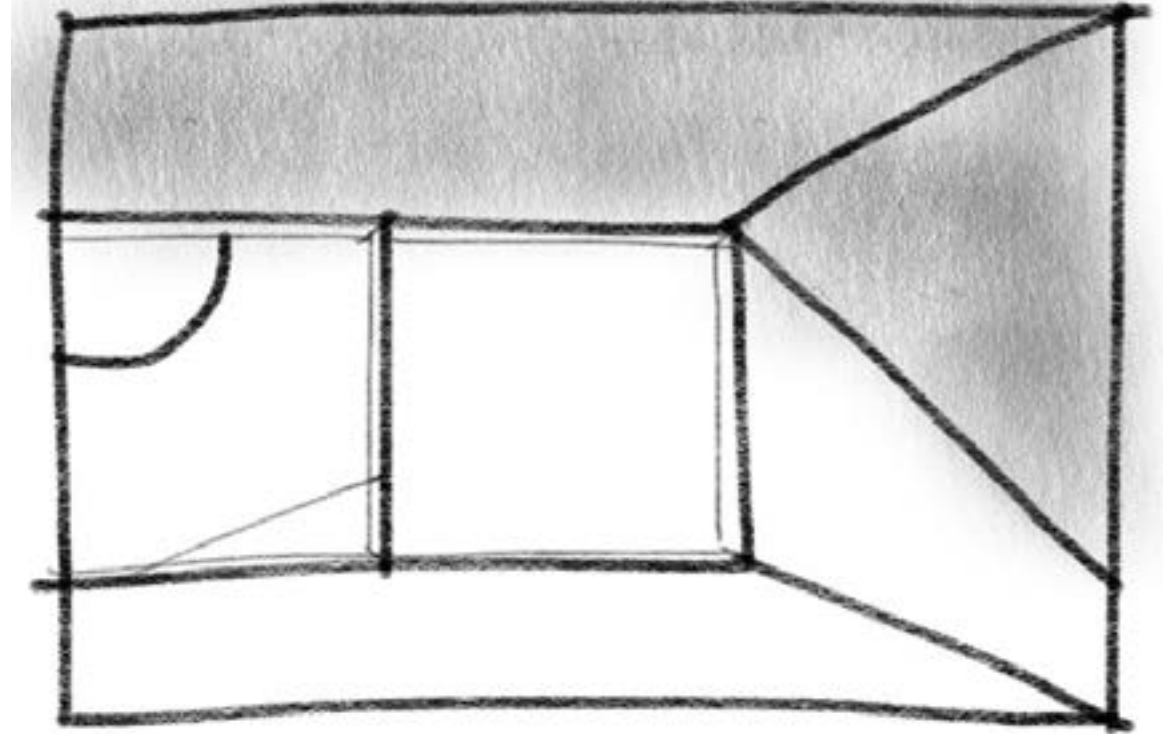
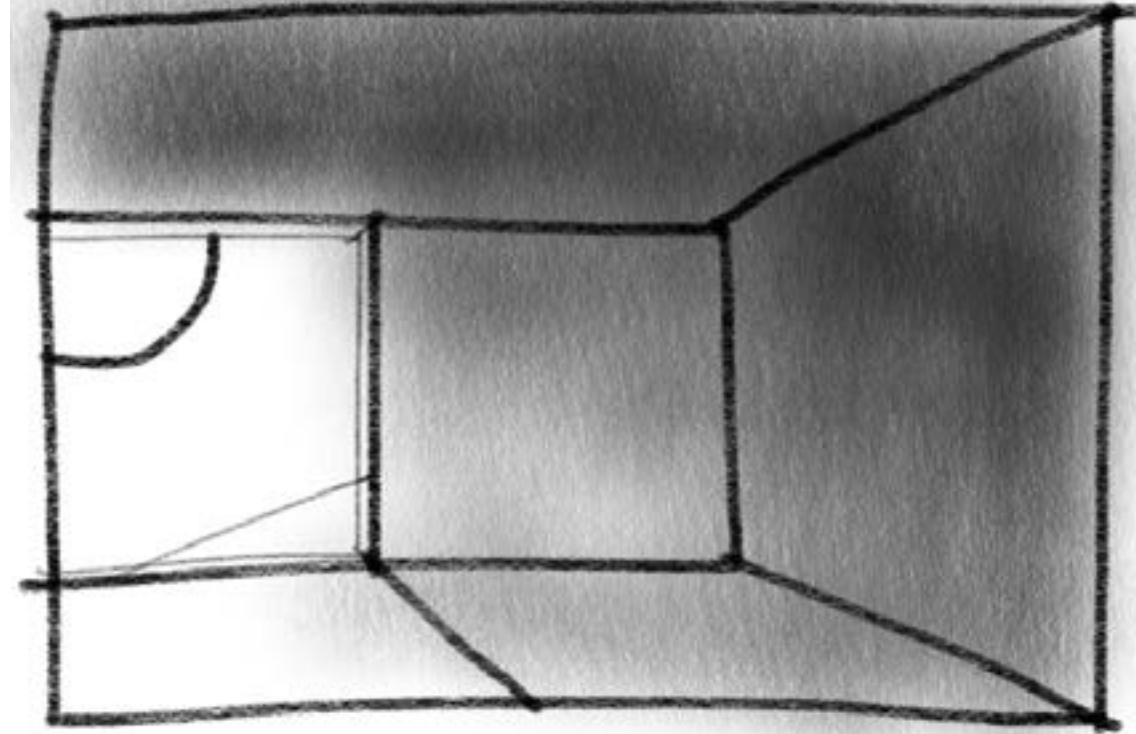


1. Optimize urban design and building orientation.

- Orientation of architecture to maximize exposure
- Enlarge as much as possible the perimeter footprint in order to maximize the daylight for interior spaces
- For harvesting daylight, long and narrow building forms work better; atriums offer additional possibilities.

DAYLIGHT - COST EFFECTIVE MEAN

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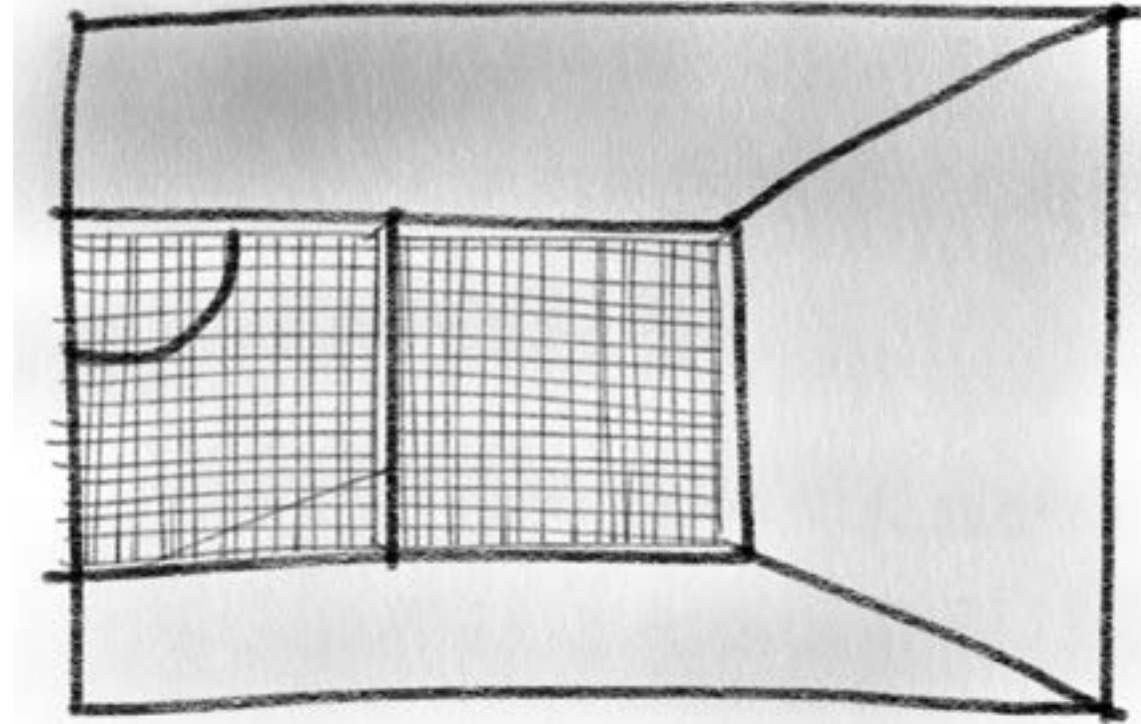


2. The perfect size, form and glazing treatment for windows

- Analyze your climate regarding the four forms of daylight for each façade
- Differentiate between daylight and the view to optimize the functions individually
- Ensure that the thermal break of the window frame construction is effective.

DAYLIGHT - COST EFFECTIVE MEAN

7 Ways It Can Be Cost-Effective - Thomas Schielke

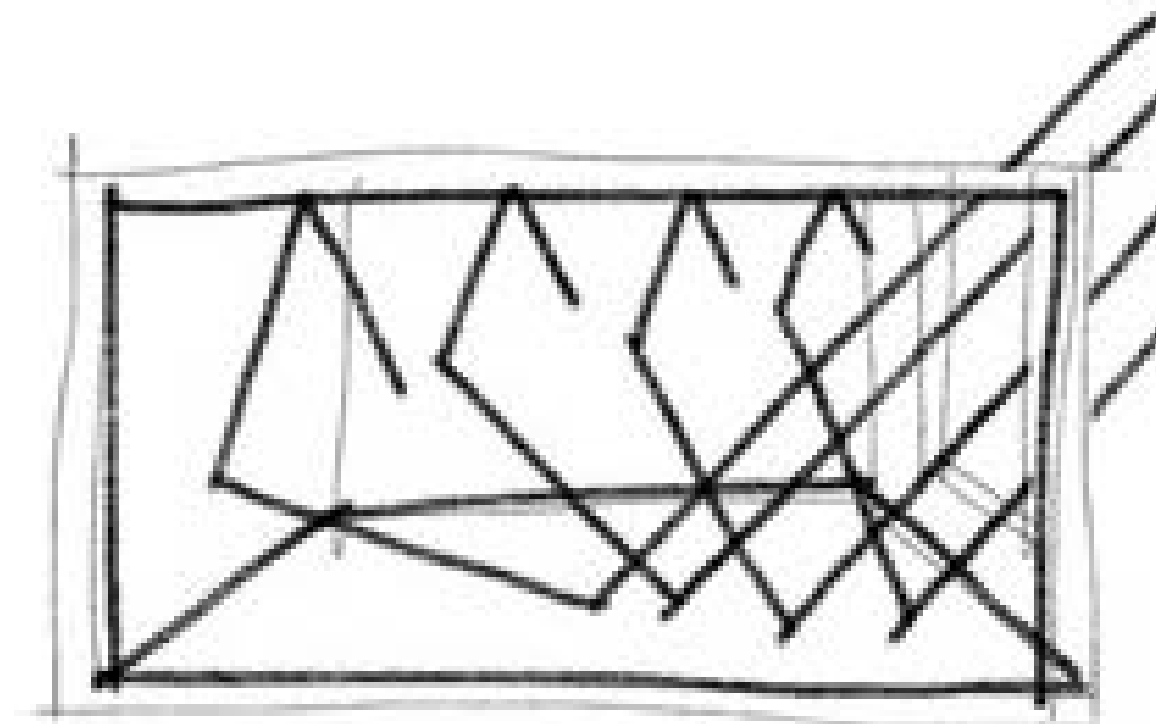
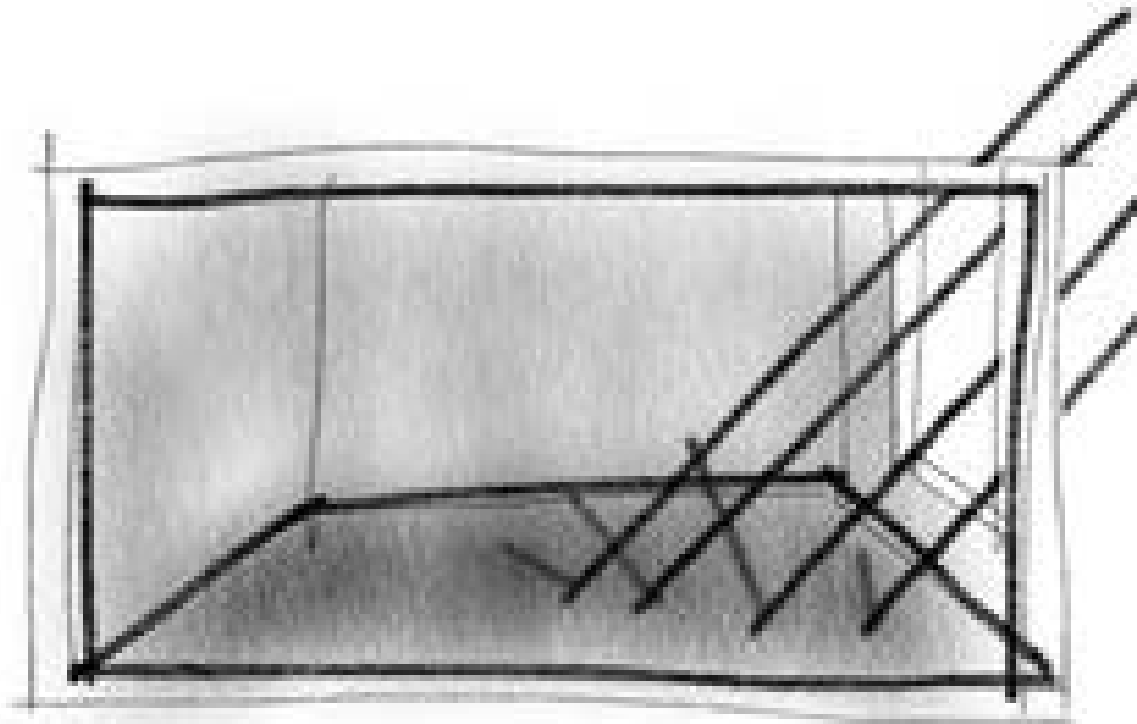


3. Shading for visual comfort and cooling

- Block the direct sunlight for workplaces
- Provide screens for glaring sources like neighbouring glass facades
- For technical solutions, prefer exterior shading elements, which are much more effective than interior, because they keep the heat directly out of the building.
- Plan movable shading elements for the daily and seasonal changes and let sensors and control systems help you optimize shading for visual comfort and cooling.

DAYLIGHT - COST EFFECTIVE MEAN

7 Ways It Can Be Cost-Effective - Thomas Schielke

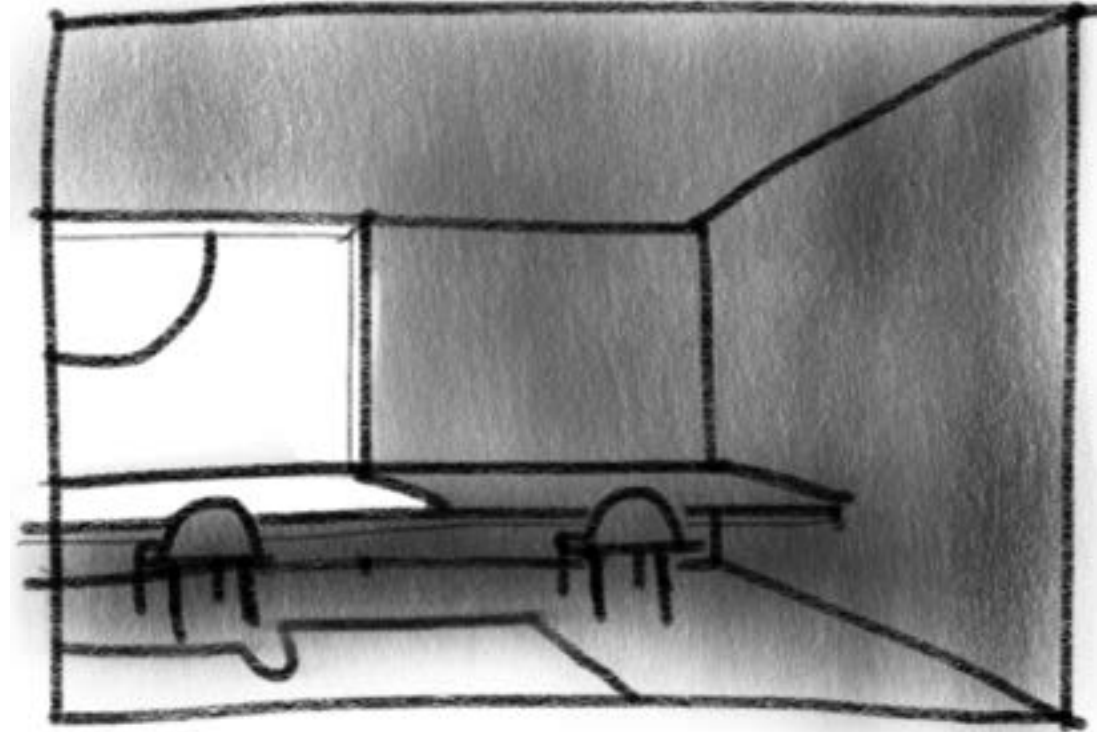


4. Work with bright interior surfaces

- Design interior surfaces with high reflectance to increase the daylight level in the depth of the space.
- Use matte light colours to improve the visual comfort.
- For a bright room impression, keep away from dark surfaces, especially on the back wall.

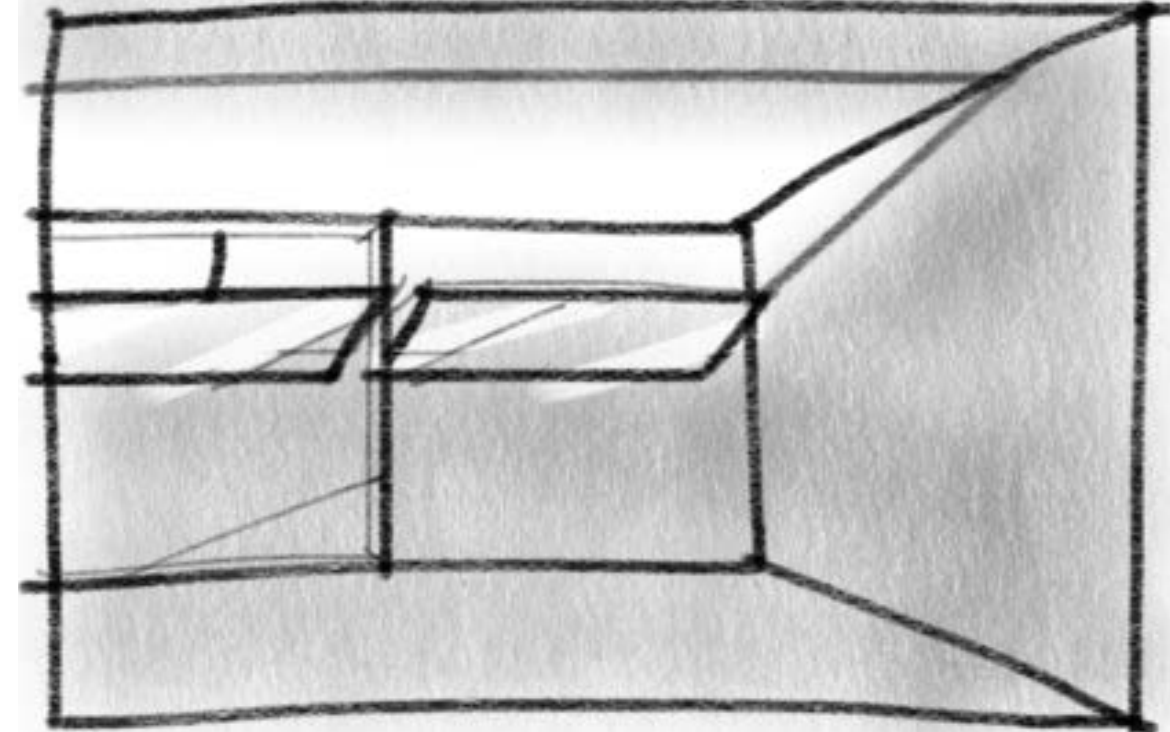
DAYLIGHT - COST EFFECTIVE MEAN

7 Ways It Can Be Cost-Effective - Thomas Schielke



5. Move task areas close to windows

- Offer workplaces access to daylight
- Keep service rooms in the core of the building.
- Make sure that furniture does not block the daylight.
- You could provide daylight to corridors by using translucent partition walls.

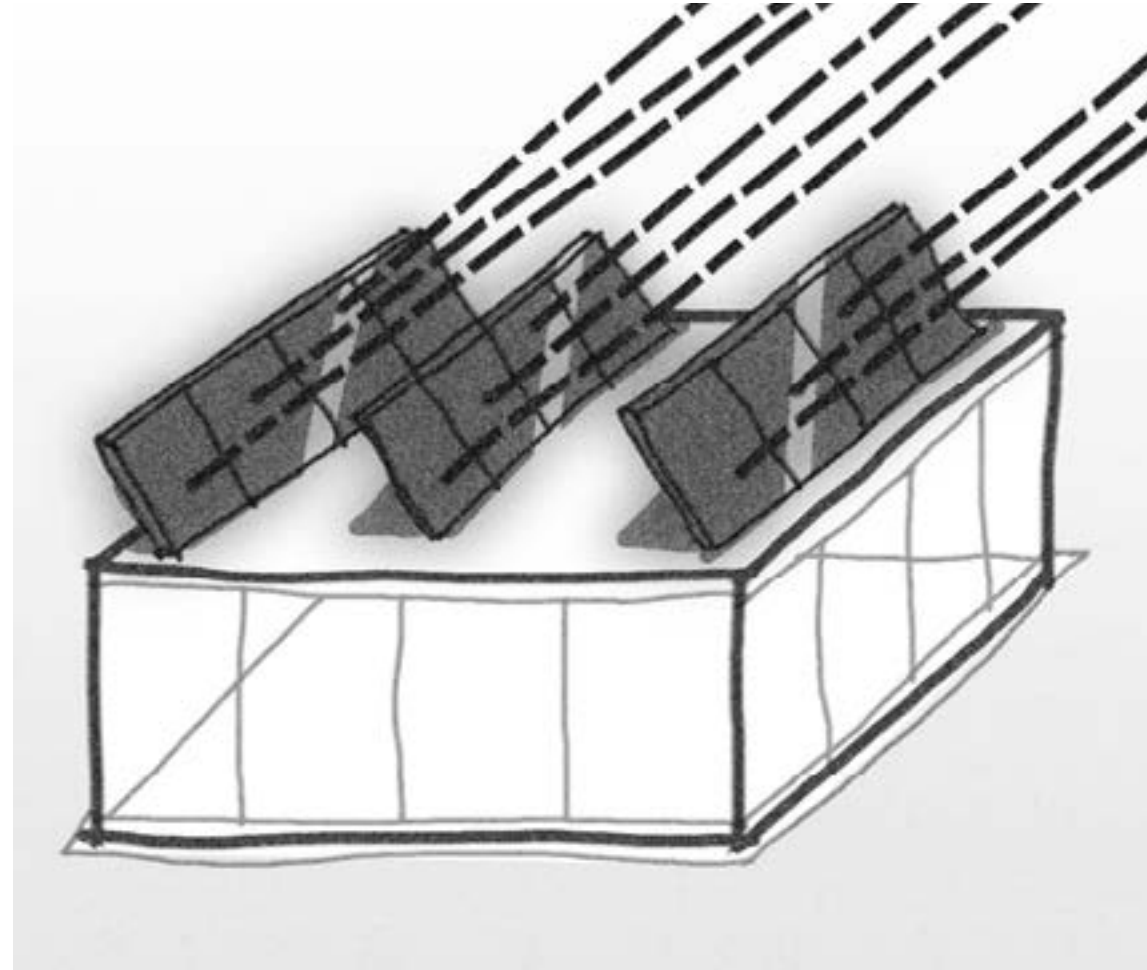


6. Consider daylight reflector systems

- Use light surface colours for the reflecting surface and the ceiling.
- Increase the reflectance in front of the window to make it more effective.
- Locate the reflector system above eye-level to better avoid glare.

DAYLIGHT - COST EFFECTIVE MEAN

7 Ways It Can Be Cost-Effective - Thomas Schielke



7. Energize your building with solar radiation

- Use the power of the sun for solar water heating
- Install photovoltaic systems for electric devices.
- The sun is a cost-free medium to cut down your carbon footprint.



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