Dedication

To Allah, who is the light of the skies and earth.
To my parents, who are the light of my eyes.

To everyone in my life who has been a light of guidance for me.
And everyone who created the drama in my life by being the exact contrast of light.

Thanks and Acknowledgement

At first, I would give thanks to my supervisor Mohammad Laadoui Benferhat, who has been patient on me all this long period, who guided me and inspired me every time, who did not hesitate responding to my questions evert time, and who did his job perfectly.

I would thank every person who believed in me in my worst cases, evert person who was a light for me in my darkest situations.

I would thank most Ms. Bechiekha who inspired and supported me in a passing position that that resonates in my memory every day

I would thank my amazing friends in Biskra with whom I shared all our bad and good situation and states during our university period, we've spent the best period of our lives together!

May Allah bless and reward everyone who has a helped me a day and I forgot.

Abstract

Daylight is absolutely a variable and changing source of light, which supplies lit spaces with multiple forms of light through sunshine hours, and across the seasons. The interesting atmospheres resulted from these changes of quantities and qualities of light provide spaces with perceptual effects that go far beyond the mere illumination of space. We are here trying to understand the dramatic light in architecture and define it inside an obvious range in the view of contrast in the history of art and architecture. Although dramatic effect is common in architectural works, the term '*Dramatic light'* is not very common, despite that it is common in parallel in different arts related to light. By a comparative and conclusive approach, we define and characterize the dramatic light. And according to scientific researches we classify its typologies.

Keywords:

Light, Darkness, Contrast, Visual Atmospheres, Comparison

ملخّص

مما لا شكَّ فيه أن الضوء الطبيعي مصدر متبدّل ومتغيّر للضّوء، يزوّد المجالات المضاءة بعدة أشكال للضوء خلال ساعات التشميس على مدى الفصول الأربعة. الأجواء المثيرة للاهتمام الناتجة عن تلك التغيرات في كميات و جودة الضوء تزود الفضاء بتأثيرات بصيرة تلعب دوراً كبيراً غير مجرد الإضاءة. نحن هنا بصدد فهم الإضاءة الدراميّة في العمارة وتحديدها داخل مدى واضح من التباين في تاريخ العمارة و الفن. بالرغم من أن الأثر الدرامي منتشر في الأعمال المعمارية، إلا أن المصطلح قليل الذكر وغير صريح التسمية، بالرغم أيضاً من انتشار المصطلح ووضوحه في مجالات أخرى من الفنون المتعلقة بالضوء. بمنهج مقارن ومستنتج نعرف هنا الضوء الدرامي ونحدد خصائصه، وفي ضوء دراسات علمية نصنّفُ أنماطه.

الكلمات المفتاحية:

الضوء، الظلمة، التباين، أجواء بصرية، مقارنة.

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Introductory Chapter

1. Introduction

Light is an essential natural element in life that we could not imagine life without it. In architecture, it is a pivot element that carries the different purposes of architectural thoughts and concepts. For the aesthetics it is the core of it, it is what make people appreciate the value of architectural works. The aesthetics comprehend different points of view of architecture, it comprehends the exterior as the interior. For the exterior, forms play the biggest role in making the identity of a buildings. And as said Le Corbusier *"Architecture is the masterly, correct and magnificent play of masses brought together in light."* As light go between forms and penetrate them it creates other forms of different dimension.

The relation between light and forms is never complete without shadows. It is what really defines the shapes and show the forms. Dramatic light effect is the relation between light and shadow in its most explicit form, also it is the most ambiguous relation between light and forms. That what attracted me to this subject, I do not know what it is exactly! The term '*Dramatic'* is common in fields close to aesthetic and it becomes more common when it gets closer to contrast. In many artistic fields it has an explicit definition, but in architecture it is rarely mentioned although the dramatic effect is widespread.

2. Problem problematic

Dramatic light is a concept that commonly describes luminous atmospheres in architecture interior design and lighting design, although it is more commonly repeated in art critics. Only few practitioners in architecture used the term and declared it in their conceptions and ideas, despite its wide application and common in famous projects and edifices, also in most common projects.

Problem questions:

What are the characteristics of light atmospheres that define the dramatic light effect and result it?

What are the main elements that make space dramatic?

3. Hypotheses

- The dramatic light effect can enhance the aesthetic values and qualities of space.
- Dramatic light could be achieved both daylight and artificial light.
- Dramatic light may have disturbing characteristics.
- Dramatic light is not the proper choice for all kinds of spaces.
- We could achieve dramatic light in schools of arts in public interior spaces.
- Dramatic light effect could be achieved whether by direct light or indirect.

4. Objectives

The purpose of this study is to give an explicit definition of dramatic light effect in architecture, define its characteristics and concepts that contribute achieving it in interior spaces, and discuss different strategies of daylighting that produce the effect.

Defining the previous elements will help us concluding different typologies of dramatic lighting, also will help giving recommendations for the use of dramatic lighting.

5. Research Methodology

This is an analytical research with an observative approach in different fields of science and art. The theme has been analyzed and more common concepts were deviated from it in order to find other closer throats to the theme and build the criteria of analyzing suspected and proposed examples. The materials of research included different examples such as paintings from different eras, contemporary art works and photographs of architectural projects.

6. Research Structure

The research has been carried consequently from the more general to the closer of research theme. In this chapter we define the research's scientific elements and ingredients. In the second chapter, we had a general review of what is light, how it contributes architecture, how does architects relate and links it to the architecture. The qualities of daylight especially were taken in consideration with more attention.

The third chapter is where the dramatic light is defined and characterized. In order to declare the word '*DRAMA',* linguistic and common definitions of the word were brought

to conclude a general understanding of the word. Related keywords were extracted from the definitions and later were explained in the different parts of this chapter in their proper situations. The theme has a strong connection to the art and the term ‘dramatic light’ is used explicitly by artists and critics, so it was essential to pass by the history of art to get to a clear and related definition of dramatic lighting in architecture.

In the fourth chapter, we reviewed five close scientific papers to the research theme that surround it by its different aspects. Those papers guided the way to understand the dramatic lighting and provided qualitative and quantitative approaches of studying the daylighting typologies and ambiances.

In the last chapter we presented the ‘*Fine Arts School’* project briefly and passed by essential analysis conclusions that formed our project. Then we presented the achieved dramatic light effect in the project by two typologies within digital renderings and diagrammatic schemes.

Chapter 2

Generalities: Light in Architecture

Defining and presenting different aspects of light in architecture

2. Generalities: Light in Architecture

2.1.Definitions of light

2.1.1. Light in Physics

Light : called luminous energy, radiant energy. electromagnetic radiation to which the organs of sight react, ranging in wavelength from about 400 to 700 nm and propagated

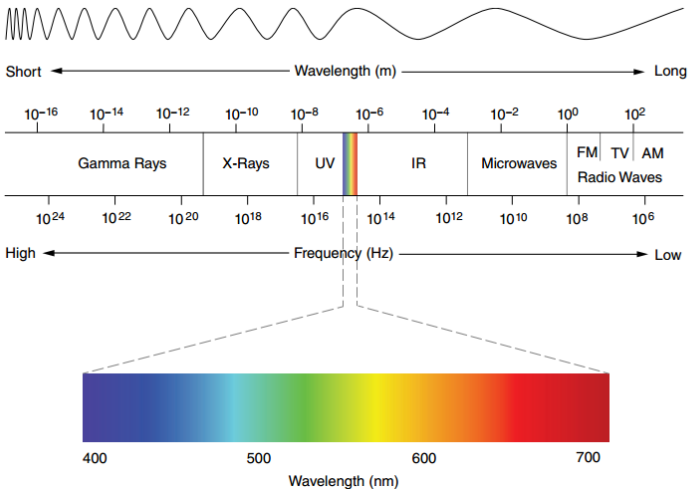


Figure 2-1 Electromagnetic Spectrum. (Livingston, 2014)

at a speed of 186,282 mi./sec (299,972 km/sec), considered variously as a wave, corpuscular, or quantum phenomenon.

2.1.2. Definition of Light in architecture

"Architecture is the masterly, correct and magnificent play of masses brought together in light." – Le Corbusier, 1930s.

So for Le Corbusier, light is the medium where masses take their role in the play, without light there is no architecture.

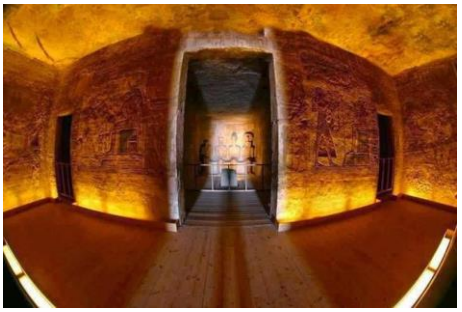
The purpose of light is to make us see things around us, light provides us safety and awareness. Without the light the use of spaces will be suspended and disabled, its absence might expose us to danger.

Guzowksi presumes that daylight is a ‘ephemeral’ essential material in architecture. Its dynamism in the movement of light and shadow embodies the dimension of time in the architecture and indicates the change of days and seasons. Also, she emphasizes the thought of Le Corbusier that light is an architectural medium. It expresses the mood of sky, interacts with materials and models forms (2018).

2.2. Generalities about daylight

“Daylighting has both ***quantitative*** and ***qualitative*** dimensions. On the one hand, light is tangible, measurable, and predictable. The apparent movement of the sun can be precisely determined, and luminous attributes can be measured using standardized metrics such as lux, foot-candles, daylight factors, and candelas per square meter. Yet, there is also a dimension of natural light that is unpredictable and immeasurable. There is a necessary element of intuition and experimentation required to discover the oftentimes unanticipated and emergent qualities of natural light as it interacts in time with changing site forces and sky conditions, architectural form, and material properties. The processes of discovery, experimentation, and serendipity are inherent to the art of daylighting design”. (Guzowski, 2018)

2.2.1. A Brief History of Daylight in Architecture



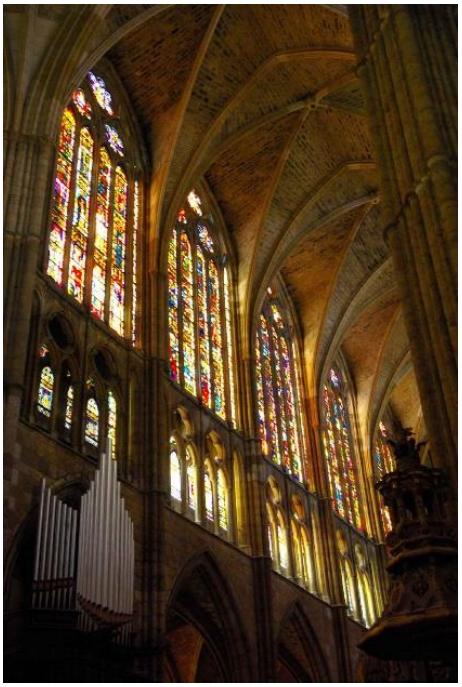
Picture 2-1 AbuSimble on light festival
(Viator, 2017)

Daylight had been integrated with the conception of buildings from the ancient times, it was used to express the spirituality. The temple of AbuSimble, dedicated to the gods of ancient Egypt, has a unique organization of its interior spaces, that allows sun rays reach the main space of statues of Gods of Darkness in the temple twice a year. The orientation of buildings to the East was not only in Egyptian Civilization, also Roman oriented their temples and cities with the East axis, allowing the sun to wash the cities' buildings and roads by the mornings. Unique employment of the light occurs in the Pantheon di Roma. The light comes from the zenith to the interior walls of the dome, every time it gives a unique oval projection in new spots illuminating hollow square panels of the dome.

Picture 2-2 Pantheon of Rome (10 FACTS ABOUT THE PANTHEON, 2013)

By the middle ages, new construction techniques such as vaulted arches allowed the architects to have new relationships with the light. The cathedrals were folded with daylight that comes from the sides and brighten the ceilings, to represent the clarity, illumination & transparence. Colors also were employed in the stained glass of windows, manipulating the light getting in.

The availability of new techniques and materials like glass & metal allowed new concepts to dominate the period of Industrial Revolution. The advantages of new techniques were taken to ameliorate the productivity. Whole buildings were built from glass and cast iron, like the Crystal Palace, which was built for the Great Exhibition of 1851, where goods inside were flooded in daylight. This technique provided an economic solution for urgent big projects, and brought to world the concept of detachable buildings.

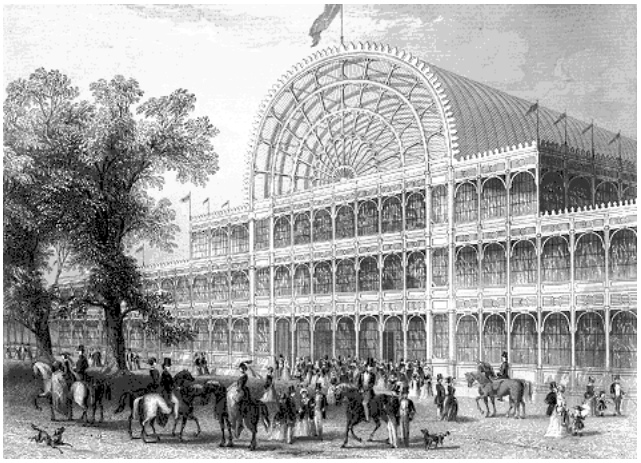


Picture 2-3 Leon Cathedral ©David Lyon

By the innovation of electricity and electric bulb and their abundance, the daylight didn't remain the main dependable source of light. The concepts had to change, also the standards. Driven by economic motives, the heights of floors and roofs had to be lowered. And by the dominance of artificial light, schools and factories were designed even without windows.

After this engineering-led approach in the beginning of 20th century, the daylight was the main tool of the Modernists to embody their concepts, such as the transparence. They fought to bring back the daylight, and succeeded achieving this using new economic construction techniques that allowed controlling the sizes of openings in all kinds of buildings and all sizes. Although, the artificial light stayed the more dominant while the natural lighting became a luxury.

The petrol crises in 1970s created new consciousness led by the environmentalists and ecologists, that aims to reduce the consumption of energy and the reliance on non-renewable energies. Increasing the reliance on daylight reduces the dependence on artificial light that contributes decreasing energy consumption. Concepts that mixes the natural and artificial light are efficient achieving such goals, using controlling technologies that manages buildings, like smart-house systems and others, these technologies work by sensors and algorithms based on standard and user preferences of daylight and brightness levels. (Bendekkiche, 2016), (Phillips, 2004) , (Merin, 2013) , (Chepchumba, 2014) , (Ander, 2016)



Picture 2-4 The Crystal Palace, 1851.

(wikiarquitectura.com)

Picture 2-5 Le Corbusier's Chapel at Rondchamp

2.2.2. The Unique Qualities of Daylight

Picture 2-6 (homeenergyheroes.com)

Change & Variety: First, we have the day & night, appearance of day light & its disappearance. And between the day & night, the daylight varies according to the angles of the sun, weather & seasons of the year. The amounts of light changes, but the human eye adapts these changes and keeps the perception possible.

Modeling: As the daylight changes, perception of things under light may change completely. The light models our understandings of space and objects.

Orientation: Spaces have to be ordered according to their activities and need of daylight. Good exploitation of daylight helps people find directions and not feeling lost, also grants them joy.

Sunlight: Sunlight inside the building increases the overall levels of light and ensure delight with other factors mentioned such as change and variety. But there are situations where the effect of sunlight would be unfavorable, like situations of great heat gain in hot climates, or where it produces considerable glare that prevents efficient vision.

Picture 2-7 Sunlight guiding direction and time inside Ando Museum © Yoshihiro Asada (laurenceking.com)

Color: Taking things to daylight shows their real colors, it's the color reference. The hue of daylight changes from morning to evening which indicates the change of time for the people inside the building. Color has three parameters, those are Hue, Chroma & Value. **(D. Phillips, 2004, 2000) (P. Tregenza & D. Loe , 1998)**

Picture 2-8 The variety of daylight form inside space through time (thedaylightsite.com)

Picture 2-9 The impact of light source on modeling of objects (Livingston, 2014)

2.3. The sources of daylight

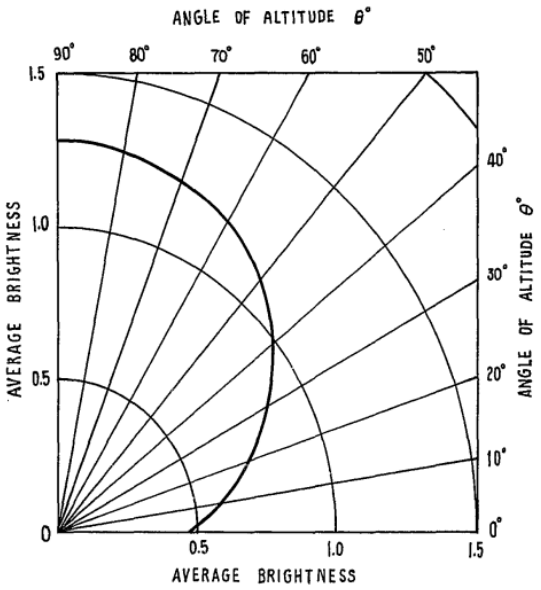


Figure 2-2 -The relation between the average brightness (luminance) and the angle of altitude. (Yip, 1972)

For designers of lighting, depending on natural light, there are two ways for light to come in: Direct daylight in form of sunlight beam, and indirect daylight. For the last, there are more than one form. Daylight may come from the sky as diffused light, or come as reflected light from the clouds or reflects from the surrounding built or natural environment to the interior of the buildings.

Reflecting daylight from a close white wall gives much more brightness than the blue clear sky, and so from the cumulus clouds. The reflected light is more dependable in hot climates and the Mediterranean, direct sunlight is not favorable for the overheat gain and excessive brilliance it causes. Even if not depending on the environmental light, there are many ways to defuse direct sunlight into the building. In Europe, North America and such northern countries, people cannot rely on the direct sunlight as their premier source of light, so they rely on the sky as a main light source. The sunlight is more preferred so windows could be large and skylight openings can exist.

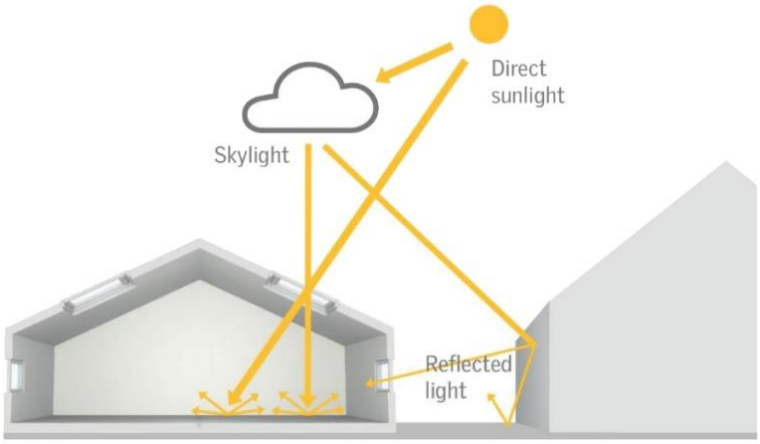


Figure 2-3 - Aspects of brightness – Velux.com

Whereas the sunlight is not dependable and the use of indirect daylight is not enough or the space is not well equipped with daylight capturing devices, people tend to mix the use of natural light with artificial light in order to meet the requirements of space for enough illuminance.

The sun is the original source of daylight. It shines directly and indirectly on both the exterior and interior of the building. The sun produces a strong and powerful flux of radiant energy. Part of this

light flux known as sunlight reaches the earth's surface after passing directly through the atmosphere. The rest of the radiant energy is diffused by multiple reflections as it passes through the atmosphere and produces a diffuse light. The quantity of daylight received by a given building along a specific period could be expected and calculated due to the sun's position.

There is a positive relationship between the position of the sun in the sky and the amount of brightness that earth gets from both sky and sun. As the sun is at the top of the sky, the overcast sky is the brightest at the zenith, while a blue sky is much brighter near the horizon.

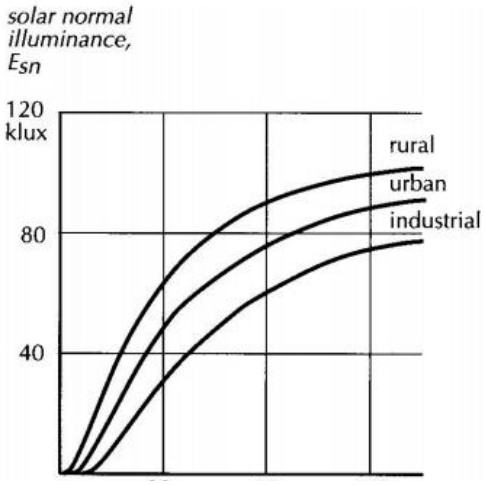


Figure 2-4 Illuminance on a surface facing direct sun light , for different environments
(Tregenza & Loe, 1998)

Thin clouds have greater reflectance ability than a blue clear sky, therefore they are much brighter. Shue-Fan assumes that the amount of light received from such a sky may be as much as 1/3 to 2/5 of the total light received from the sky and sun together when the sun is visible. When the sky is completely overcast with white clouds the light received from the clouds may equal that received from the sun. Light from a clear blue sky does not vary greatly in intensity during a considerable portion of the day. (Yip, 1972)

Sunlight is scattered as it passes through the atmosphere, even when the sky is cloudless. The lower the sun in the sky, the longer the atmospheric distance traversed by the beam and so the greater the attenuation.

The clarity of the atmosphere affects illuminance, because the scattering is caused partly by water droplets and airborne particles. The term turbidity is sometimes used to describe the actual degree of light attenuation, in comparison with that which would occur in a perfectly clean dry atmosphere. (Tregenza & Loe, 1998)

2.4. Interaction of light and materials

Brightness in a certain space is not only the amount of light that's in that space. Brightness is a combination of the intensity of the light and the reflecting, diffusing, transmitting, and absorbing properties of the surfaces in the room.

2.4.1. Reflection

Reflection is the recoil of light from surfaces. It has three general types, those are Specular, Semi-Specular and matte.

Specular Reflection: specular surfaces are very smooth and reflective and their reflection

is mirror-like. The angle of incidences equal and opposite to the angle of exitance or reflection.

Semi-Specular Reflection: Semi-specular surfaces partially scatter the reflected light. The angle of incidence is equal to the angle of reflection, but the reflection is not perfect and some of the light is partially spread and diffused.

Matte Reflection: also called diffused reflection. Matte surfaces diffuse light so that it is reflected in all directions. (Livingston, 2014)

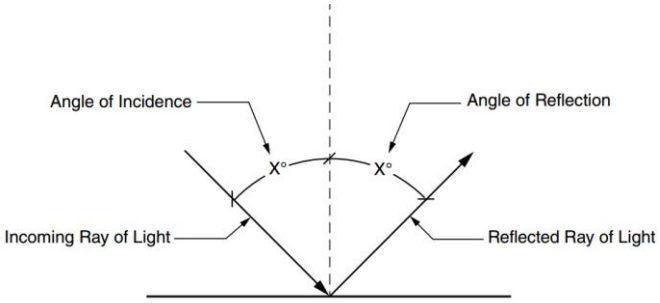


Figure 2-5 Specular Reflection (Livingston, 2014)

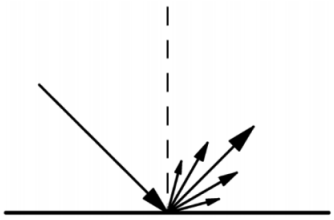


Figure 2-6 Semi-Specular Reflection (Livingston, 2014)

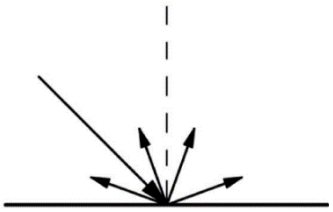


Figure 2-7 Matte Reflection (Livingston, 2014)

Reflectance Type	Material	Reflectance
Specular	Mirrored and optical coated glass	0.80-0.99
	Metalized and optical coated plastic	0.75-0.97
	Processed anodized and coated aluminum	0.75-0.95
	Stainless steel	0.60-0.65
Semi-Specular	Processed aluminum	0.70-0.80
	Porcelain enamel	0.65-0.90
	White glass	0.75-0.80
	Brushed aluminum	0.55-0.60
Matte	Matte white paint	0.75-0.90
	Limestone	0.35-0.65
	Acoustic ceiling tiles	0.72-0.90

Table 1 Reflectance of common interior materials (DiLaura & David, 2011)

For natural lighting, reflected light depends on materials on of exterior landscapes. So here are the reflectance coefficients of common ground surfaces:

Type of ground surface	Reflectance
Snow	0.70-0.80
Light color gypsum board	0.30-0.40
White sands	0.20-0.30
Smooth ground	0.07-0.30
Yellow sands	0.15-0.20
Asphalt	0.10-0.12
Green grass	0.06-0.10

Table 2 Reflectance of common ground surfaces (Yip, 1972)

2.4.2. Absorption

Livingston assumes that no material is a perfect reflector. When light strikes any surface some of it is absorbed. The amount of light absorbed depends on the material's surface and color. Materials with dark colors have greater absorption ability that ones with brighter colors. Material surface absorbs all color waves except ones with its own colors, they reflect from it. (2014)

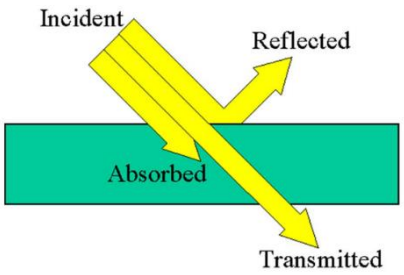


Figure 2-9 Light Absorption, reflection and transmitting.

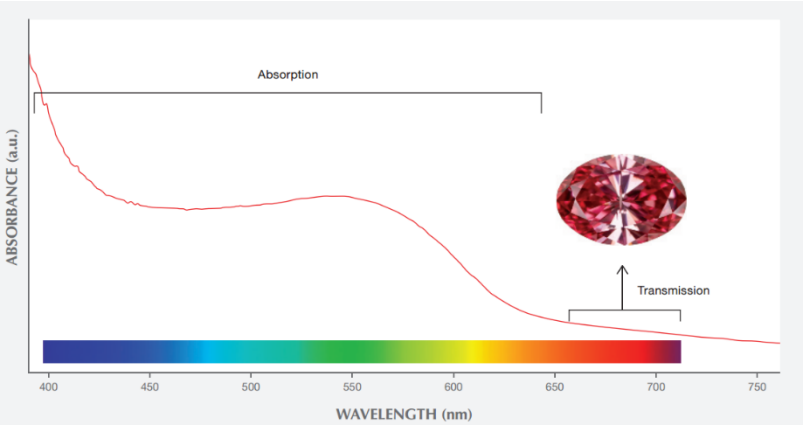


Figure 2-8 Diamond Light Absorption (Shigley & Breeding, 2015)

2.4.3. Refraction

Refraction is the bending of light as it passes between materials. When light passes from a medium where it is faster to a medium where it is slower, the light is bent

toward the line perpendicular to the boundary between the two. Light that is perpendicular to a surface isn't bent.

Index of refraction is the speed of light in a vacuum divided by the speed of light in the medium. (Livingston, 2014)

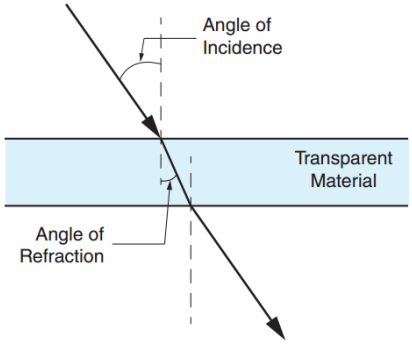


Figure 2-10 Refraction through glass (Livingston, 2014)

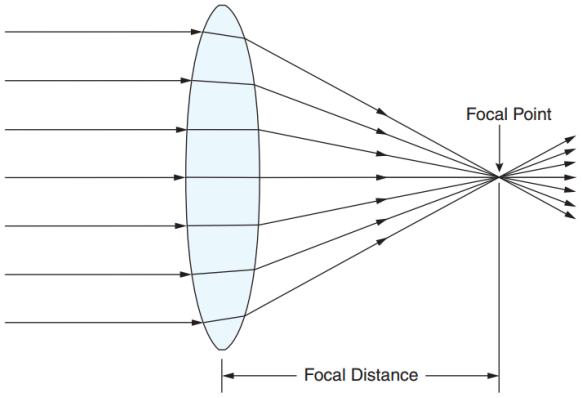


Figure 2-11 Refraction through Convex Lens (Livingston, 2014)

2.4.4. Diffusion

As light passes through a diffusing material, it is refracted, but not in a way that gives the light a specific direction or pattern. Diffusers use refraction to scatter light. Diffusers can be used to soften shadows by turning a point or linear light source into a planar light source.

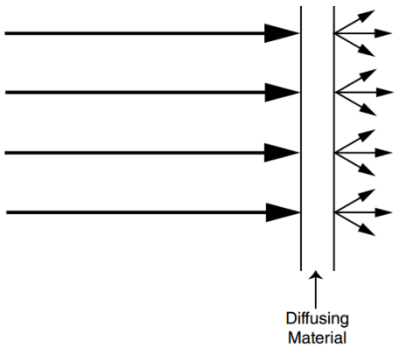


Figure 2-12 Diffusion of light (Livingston, 2014)

2.4.5. Transmission

Transmission refers to the passage of light through a material. Transmittance is expressed as a percentage of the light passing through the material. Materials are sorted according to transmission to Transparence materials, Translucent and Opaque.

Transparent: Virtually all light passes through. Objects can be clearly seen through the material. Example—Clear glass.

Translucent: Light passes through, but the material scatters some of the light, blurring the object seen through the material. Examples are frosted plastic or etched glass.

Opaque: No light passes through. Examples are wood and metal.

Material	Transmittance
Clear Glass	0.80-0.99
Sandblasted glass	0.75-0.85
White glass	0.15-0.40
Clear prismatic plastic lens	0.70-0.95

Table 3Transmittance of common materials (Livingston, 2014)

2.5.Photometric Indicators

LUMINOUS FLUX (lm) The total amount of light emitted in all directions by a light source. The unit of luminous flux is the lumen (lm).

Source	Luminous flux
Candle	12 lm
60W incandescent lamp	750 lm
1W LED	130 lm

Table 4 Typical Luminous Flux Values of some light sources (LEC Experts, 2015)

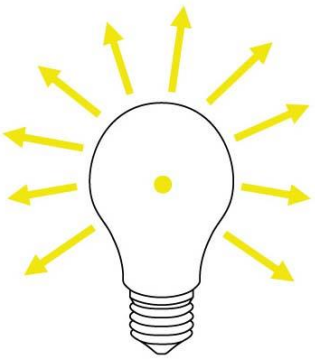


Figure 2-13 Luminous Flux (LEC Experts, 2015)

LUMINOUS INTENSITY (l or candela) In any given direction, the luminous intensity is the flux emitted by the entire light source, per unit solid angle. The unit is lumens per steradian, better known as the candela (cd).

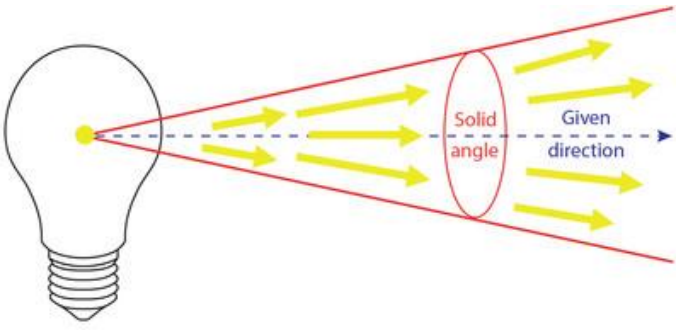


Figure 2-14 Luminous Intensity (LEC Experts, 2015)

LUMINANCE (candela per square meter)

In any given direction, luminance is the luminous intensity of the source per unit of visible surface. The unit is candela per square meter (cd/m2).

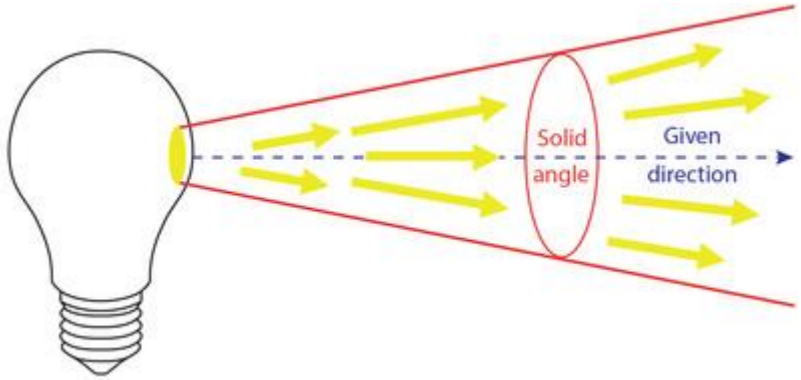


Figure 2-15 Luminance (LEC Experts, 2015)

ILLUMINATION (E) is the density of the luminous flux on a surface, hence it is flux divided by the area over which the flux is distributed. $E = \frac{dF}{dS}$. The illumination (E)at a point on a surface varies directly with the luminous intensity (I) of the source, and inversely as the square of the distance (d) between the source and the point. $E = \frac{I}{d^2}$. The unit of measurement for illumination is foot-candle (ft.c) or (Lux)in the metric system .

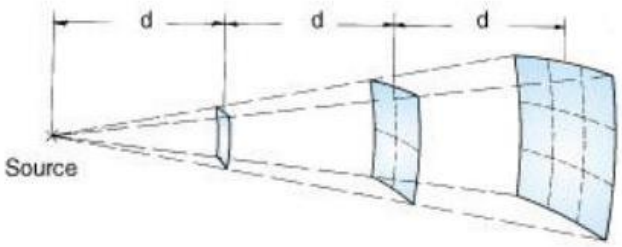


Figure 2-16 ***The inverse-square law*** *illustrating how the same quantity of light flux is distributed over a greater area, as the distance from source to surface is increased . (IESNA, 2000)*

Light Souce	Illuminance Value
Full-moon at night	0,5 lux
Outdoor Disability lighting	20 lux
Domestic lighting	100-200 lux
Office lighting	300-500 lux
Sunny day outdoors	100 000 lux

Table 5 Typical Illumination Values of some light sources (LEC Experts, 2015)

BRIGHTNESS (B) ls the luminous intensity of any surface in a given direction per unit of projected area of the surface as viewed from that direction. Our eyes are sensible to the amount of brightness. The unit of brightness is foot-lambert. It is a perfectly diffusing surface emitting or reflecting light at the rate of 1 lumen per square foot.

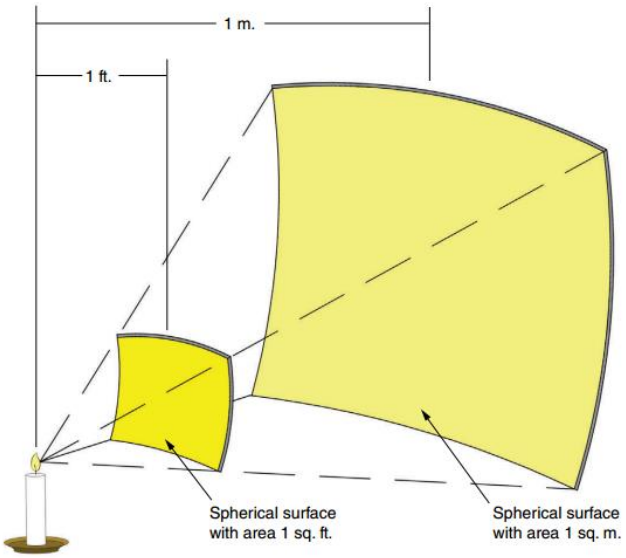


Figure 2-17The inverse-square law (LEC Experts, 2015)

2.6. Conclusion

Light with no doubt is one of the most essential elements in architecture, as much as in the life of human beings and most of other creatures. By the side of its necessity for the perception inside the buildings and for their exploitation, it models the forms of the buildings and contributes giving them the aesthetic qualities. Sun supplies earth with powerful flux of luminous energy which illuminates both the sky and the ground, and provides people with sufficient quantities of light for perception in the indoor and outdoor indeed. The daylight is a dynamic element that depends on many environmental and atmospheric factors, on contrast with the artificial light which is constant. Light is predictable and measurable in specific limits of time and space, although its qualities always change and vary through time.

People considered light seriously in their buildings from the beginning of the history. By the time they started building their shelters, they left openings that assumes entry of light and air. Later they involved light in their religious rituals and combined it in architecture. Although they couldn't calculate their needs of light, they sought for its sufficiency and for its qualities and aesthetics.

Chapter 3

Dramatic Light in Architecture

Defining the Drama, the Dramatic Light in Art and Architecture

3. Dramatic Light in Architecture

3.1. Approaching the meaning of DRAMA in architecture

The word "Drama"

- **Linguistic definition** *drama* (n.)
  1510s, "a composition presenting in dialogue a course of human action, the description of a story converted into the action of a play," from Late Latin drama "play, drama," from Greek drama (genitive dramatos) "action, deed; play, spectacle," from drāo "to do, make, act, perform" (especially some great deed, whether good or bad), which is of uncertain etymology. (Etymonline.com) https://www.etymonline.com/word/drama

- **Common Definition**
  - "a composition in prose or verse presenting in dialogue or pantomime a story involving ***conflict*** or ***contrast*** of character, especially one intended to be acted on the stage; a play."
  - "any situation or series of events having ***vivid***, emotional, ***conflicting***, or striking interest or results"
  (Dictionary.com) https://www.dictionary.com/browse/drama?s=t

Derivative and relative words for DRAMA

- **Dramatic**: (*adj.)* highly effective; ***striking***. / characteristic of or appropriate to the drama, especially in involving conflict or contrast; vivid; moving
- **Dramatically:** (*adv.)* in an exciting or impressive manner.
- **strikingly** (*adv.)* in a way that ***attracts attention*** by reason of being unusual, extreme, or ***prominent***.

(Dictionary.com) https://www.dictionary.com/browse/dramatic?s=t

Related Keywords

Contrast, Darkness, Conflict, Chiaroscuro, attraction, symbolism

3.2. Defining Essential Concepts

3.2.1. Contrast:

Figure 3-2Gradation and contrast (Livingston, 2014)

Livingston defines contrast as the relationship between the object being viewed and the simultaneously visible surroundings and assumes that a greater difference in illumination and/or reflection results in higher contrast, and its usually considered as a ratio. (Livingston, 2014)

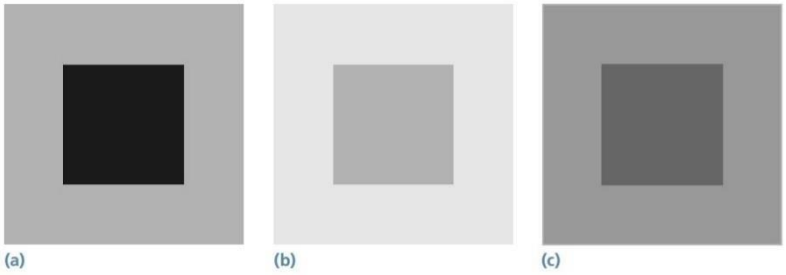


Figure 3-1 Different levels of contrast (a)3:1 Ratio , (b) 3:1 Ratio & (c)2:1 Ratio (Livingston, 2014)

Brightness and color perception are relative also, that can create illusions and make it harder to define colors, or to confirm the stability of brightness.

Contrast: The visual difference between the color or brightness of two surfaces when seen together. Too high a contrast can be the cause of glare. (Phillips, 2004)

Rockcastle negates that the average brightness or range of luminance values present within each image that create an impression of contrast, but what creates contrast is the composition of light and shadow. (Rockcastle & Andersen, Celebrating Contrast and Daylight Variability in Contemporary Architectural Design: A Typological Approach, 2013)

"It is generally recognized that vision is enhanced by good contrast, and that the natural colour of daylight increases contrast; it is argued that this permits lower illumination levels, whilst increasing visibility" (Tregenza & Loe, 1998)

3.2.2. Darkness and Shadow

When we talk about light and it comes to contrast, we must understand ***darkness*** and demonstrate its aspects and forms.

"Light is inseparable from the notion of form and space and so is shadow from light."

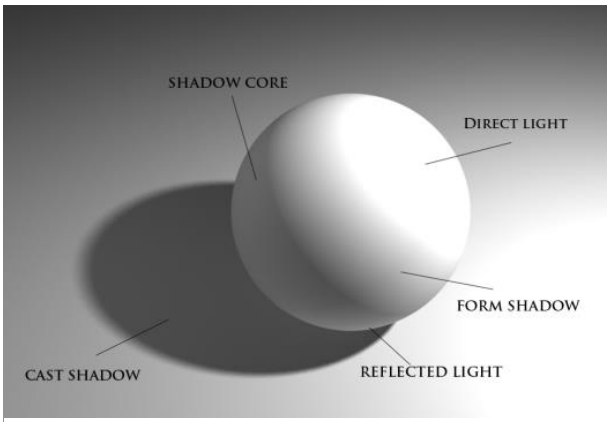


Figure 3-3 Shadows and light on objects (CLARA LIEU, 2013)

Darkness: (noun) the partial or total absence of light.

Shadow: (noun) a dark area or shape produced by a body coming between rays of light and a surface.

Shade: (noun) comparative darkness caused by shelter from direct sunlight.

Picture 3-1 El Jaleo" by John Singer Sargent (CLARA LIEU, 2013)

In arts and light anatomy, the term "*shade*" is usually replaced with more definitive concepts like *form shadow & shadow core.*

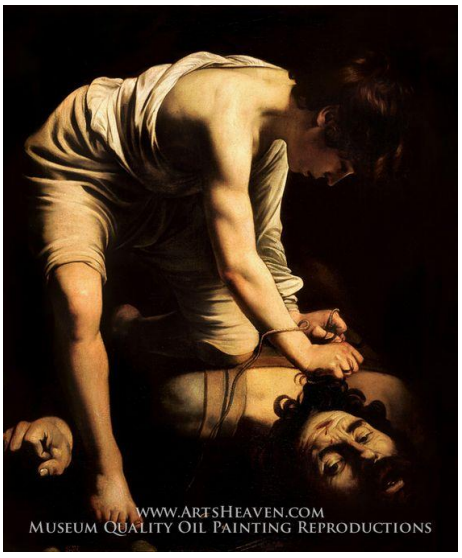
Lieu assumes that shadow core and form shadow give form to objects. And says that *Cast shadows* are everything that a form shadow is not. They are very harsh and graphic, with sharp edges. Cast shadows are very flat and do not show form at all. (2013)

Lieu explains how the cast shadow is very strong in the background in the oil painting of Sargent, that is being created by theatrical lighting casted from below on the flamenco dancer in the foreground. She points to the way that cast shadow cuts through the wall with its highly defined, graphic shape. (CLARA LIEU, 2013)

3.3.Dramatic Light in Art

3.3.1. Dramatic light in history of art

In art history, the terms ‘dramatic light’ or ‘dramatic illumination’ are linked commonly to ‘Tenebrism’ style of painting. The word has an Italian origin (*tenebroso* = murky) means dark or darkness. This style of painting is characterized by the deep and strong contrast between light and shadow, where most of the painting area is left black and some areas are lit by a single light source. (2010)



Picture 3-2 Tenebrism Painting David and Goliath 1599 by Caravaggio (ArtsHeaven.com)

This concept is usually confused with the concept of Chiaroscuro, which also has an Italian origin of a combination of two words mean ‘light and shadow’. Tenebrism is most often used in connection with works created during the Mannerism and Baroque eras, notably by Caravaggio (1571-1610), as well as other tenebristi in Naples, the Netherlands and Spain. (2010)


Picture 3-3 Chiaroscuro Painting 'The Calling of St. Matthew' by Caravaggio 1600 (mentalfloss.com)

Although **tenebrism** and **chiaroscuro** both depend on contrast to show the subjects of paintings and look very similar to each other, but there is a clear difference between the two techniques. The art of chiaroscuro means the control of contrast between light and shadow to manifest the three-dimensional effect in painting and drawing. While **tenebrism** only used to give the dramatic effect to the painting and may obliterate the background under the murky black shade. (2010)

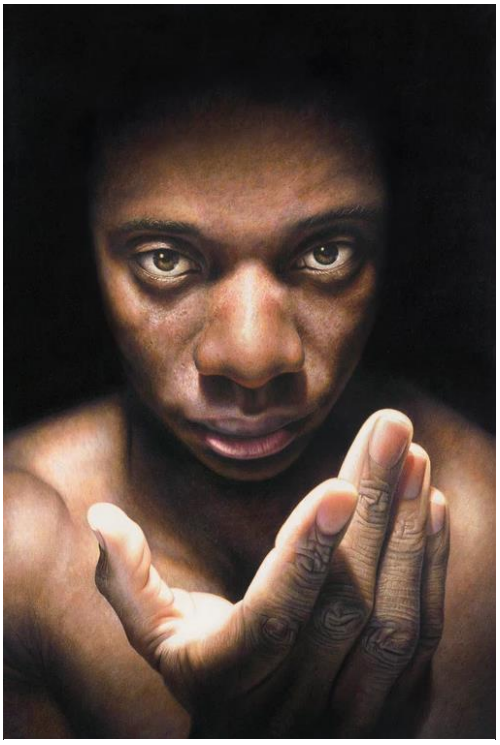
Moreover, they have common trunk, those two techniques shared the same eras, this caused that certain artists were classified as pioneers of both techniques. The most known ones are Caravaggio (1571-1610), Rembrandt (1606-1669), Francisco Ribalta (1565–1628), and Adam Elsheimer (1578-1610).

In those two paintings (Picture 3-2 and Picture 3-3) it's observable that the artist Caravaggio applied both techniques. At 'David and Goliath' painting an absolute strong dramatic effect is achieved by the dominant murky black areas surround figures and cover most of the canvas surface. There is only one subject 'the two men' and only a punctual invisible light source. In his other painting 'The Calling of St. Matthew', it was necessary to distribute light and control shadows, the solid light coming probably from a window spread through the space and illuminates the people and the walls. People look more three-dimensional than figures in 'David and Goliath' painting. The contrast between the two parts of the wall as the upper near light source is illuminated and the lower part is dark, boosts the presence of the two figures in the right and give them more attraction value. The dramatic effect in the second work is present but not as much as in the first. The thing that contributes on the drama by the side of light and darkness is the composition inside the scene.

3.3.2. Dramatic Light in Contemporary Art

The use of chiaroscuro never stopped after Caravaggio and his students, it has its presence in the modern and contemporary art. And by technology development and the diversity of art mediums artists manifested it in new creative ways. Datta states that '*the term chiaroscuro is frequently applied to a wide array of dramatic lighting effects and it is used as a technical word linked to many mediums and kinds of art'* (2014)

For Andrey, Jesse Lane is one of the best artists who mastered the technique of chiaroscuro and manifested the dramatic effect professionally in his artworks (2016).



Picture 3-4 Colored pencils drawing 'MANIFEST' by Jesse Lane (www.jesselaneart.com)

Jesse Lane stayed true to the principals of Caravaggio in his realistic portrayal paintings. All his works consist of a combination of light and darkness, and involve the

dramatic effects in their compositions of light and subjects. In his work ‘Manifest’ (Picture 3-4), he produced a dramatic effect by playing with light sources. The top light projected on the person casts shadows on the face and body, while the reflecting light from the hand is softening those shadows. There are contrast in three levels: between the murky background and the figure, between the bright hand and the shades on body, and between bright and dark surfaces on body.

Another creative contemporary painter Steven J. Levin. He states that the first thing he usually considers when composing a painting is the light. And that he is always attracted to very dramatic light effects, to the bright smash of light upon form that melts into a deep mysterious shadow. Also, he tends to emphasize the shadows in his work as a way of unifying the painting, paring things down to the essentials. (Levin, 2017)

Picture 3-5 Oil Painting 'Five O'clock Song' 2004 By Steven J. Levin (stevenjlevin.com)

The darkness in Steven’s works is reasonable and usual to the contemporary eye, not too exagerated nor dim. His lights tend to be cold and diffuse, they belong to his American cold environment.

3.3.3. Dramatic light in Photography and Cinematography

The chiaroscuro had its roots deep in the history of photography itself. The technique of Black and White imposed itself as the only available technique for photography in its early beginnings. The contrast in Black and White provided the proper conditions for the dramatic effect to dominate the era of black and white photography. Black and White technique is still being used nowadays by photographers and film makers with artistic tendencies. It's intentionally being used for its attractiveness and its ability to express emotions in photographs.

According to Andrey, it's also used in films. As many directors stated to him that the final products of their films depended on the technique of chiaroscuro (2016). In the 'Schindler's List' movie filmed at 1993, the director Steven Spielberg chose to manipulate the colors on the rhythm of chiaroscuro and turn them black and white. That's more appropriate for the historic context and dialogue of the film.

The dramatic effect is sought in many different photography subjects, mostly in portrait photography as well in still life, boudoir, and street photography.

Picture 3-6 Grand Central Station 1929 by Alfred Stieglitz (theatlantic.com)

Picture 3-7 Capture from 'Schindler's List' movie 1993 (sleeplessthought.com)

Picture 3-8 Silhouette photo 2015 by Marc Schenker (ramjaythingstopost.wordpress.com)

"Anything that's mysterious and gives off a sense of the evocative will add drama in an instant to your photography" Marc Schenker guides photographers to a simple technique to get the dramatic effect: making things mysterious. He cited the silhouette technique, where the subject tends to be dark and ambiguous. He mentioned the contrast of that, taking away the light: *"The more you take away the light, the more you get shadows, which add drama. Psychologically, it deprives the audience of as much as they'd like to see, making it a great technique to use."* (Schenker, 2018)

Picture 3-9 'Taking Away the Light' 2018 (contrastly.com)

Marc assumes that dramatic effects of light persuade audience and attract them to the photographs. Moreover, it makes them wonder and try to understand what's behind the mysteriousness. (Schenker, 2018)

3.1.1. Architectural Elements and Dramatic Effect in Art History

Artists in history and contemporary times, tended to produce the dramatic effect in different ways and forms. As previously shown, Caravaggio produced 'David and Goliath' in completely different way from the 'The calling of St. Matthew' (see Picture 3-2 and Picture 3-3). In 'David and Goliath', figures are completely abstracted from their spatial context, even the ground is flooded with darkness. While in 'The calling of St. Matthew' the spatial context is clear and contribute making the scene more dramatic. Nicole Shaub assumes and supports that the

Picture 3-10 ' A Philosopher' 1570 by Tintoretto (biblioklept.org)

figures in the painting are designedly laid down below a window in the church where it's painted. She states that *'the stark contrast between the dark and light areas in his work creates a charged, theatrical atmosphere.'* (Shaub, 2015)

Picture 3-11 'The Studio Party' 2002 By Steven J Levin (trianarts.com)

In the work of Tintoretto, the contrast created between the illuminated head of 'the philosopher' and the darkness of the cavity behind it generates a dramatic effect and attract the sight to that area. Here comes the role of architectural elements in contributing the dramatic light effect, such elements destined to place objects within their inner space were involving the theatrical effects in the early baroque era.

Other painters involved clearly the architectural elements in their works. In his works, Steven J. Levin captured the dramatic effects resulted from lateral sole window. The diffused light spread slightly in the space of the room create a dim ambiance of light, and project a strong dark shadow behind any object blocking its rays. By contrast, it creates a very bright patches on the surfaces facing it. We can notice in *Picture* 3-11 how the man by the window has both the values of darkness and brightness, and both are enforcing the contrast between each other. Also, we can notice the darkness on any figure's opposite face, Steven enforces the darkness to achieve the dramatic effect in his works. (2018)

3.2. Dramatic Light in Architecture

3.2.1. Defining Dramatic Light in Architecture

Dramatic Light:

Dramatic light is a luminous visual effect, in architecture it is spatial and atmospheric, so it is connected and concerned to interior or surrounded spaces. It is characterized by the contrast between darkness and light in space. If it is applied properly it will result an attractive effect.

Furuyama insists that geometry alone cannot arise our emotions, it needs the dynamism and conflict. He presumes that symbolic and embodied light can transform a pure space into a dramatic space. Form is concrete, until light and shadow impart the movement and make it a space. (1996)

Catherine D. Gomez emphasize the role of movement of light and shadow and their intensity in imparting drama to space. Also, she points to the importance of dynamic changing quality of daylight in producing different degrees and forms of an ambiance in a space, that enhances the dramatic effect. (Gomes, 2004)

Picture 3-12 Indian Institute of Management by Louis Kahn 1974 ©Laurian Ghinitoiu (Instagram.com)

Picture 3-13 ©Serge Najjar (purestyling.nl)

3.2.2. Concepts and Ingredients of Dramatic Light

- **Contrast:**

Contrast is a difference between two distant values of something, it is an effect resulting from two opposite things being together; Juxtaposed, adjacent. etc...

In architecture, many ways and configurations could result contrast. For example, different shapes; geometric and organic, different materials; raw and treated materials, different values of color; orange and blue, or different values of light, dark space and lit space.

For dramatic light, contrast is a core concept and essential element to achieve the dramatic effect. As without contrast between light and darkness, dramatic light could not be achieved.

Rockcastle doubts that the impression of contrast is resulting only from the difference in luminance or brightness. Instead, she insists that what creates contrast is the composition of light and shadow (Rockcastle & Andersen, Celebrating Contrast and Daylight Variability in Contemporary Architectural Design: A Typological Approach, 2013).

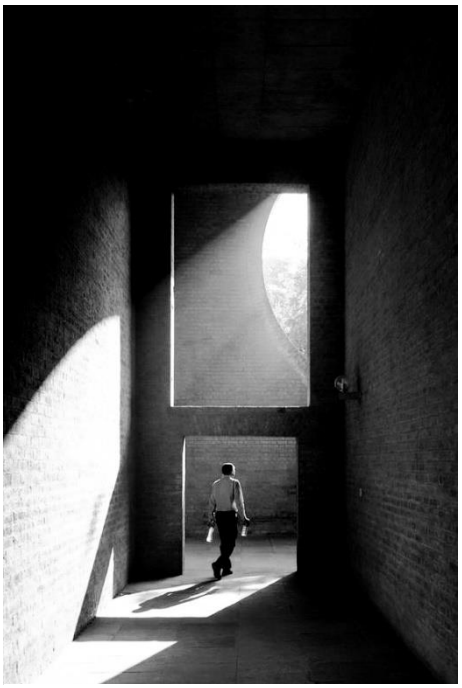
At Picture 3-12, we can see that Kahn applied contrast in the Institute of Management different levels. In level of form, he contrasted the rectangular portal opening with the other circular one in the outside. In level of illumination, sunlight patch inside the corridor has an obvious contrast with the shadow in ground and walls. Also, the level of illumination in the corridor is less than the outer space, that creates the contrast between surface of those two spaces. The contrast grabs the attention of the user and induces him to discover what is behind the portal opening.

Picture 3-14 Chapel of St. Ignatius by Steven Holl (moderni.co)

In the Chapel of St. Ignatius, Steven Holl produced contrast in a different way and level. The space of the chapel tends to be regular illuminated, but the high brightness around hidden openings creates attractive lit fields. Although the brightness in space is relatively high, the ambiguous bright light around openings make one wonders and thinks of brighter space. The dramatic effect here is achieved with no high contrast, just by the power of wondering and ambiguity.

Picture 3-15 Therme vasls switzerland by Peter Zumthor © Henry Plummer 2000

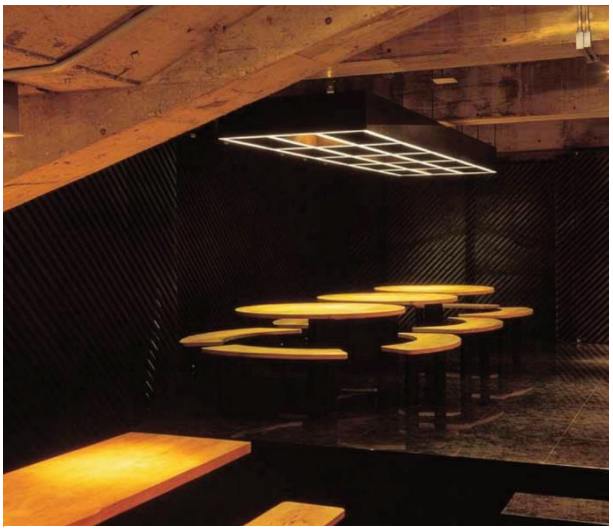
Contrast is a perceptual relative factor; its recognition is connected to the physiology of our eyes. Scientists emphasize that there is a relation between attention, contrast, and visual adaption. *"Adaptation optimizes performance by increasing contrast sensitivity for and neural response to changing stimuli while decreasing them for unchanging stimuli"* (Pestili, Viera, & Carrasco, 2007). Contrast is a catalyst that stimulates the attention of observer and attract it. I assume that high contrast between two adjacent surfaces make adaption takes longer time to bring the capable vision. That attracts attention and may make a state of discomfort.



Picture 3-16 Edited picture of Indian Institute of Management (Edition by author)

In photography, it is a bit different. A one-exposure photo cannot comprehend both the two values of contrasted scene; the high darkness and high brightness, especially with greater contrasted surfaces. What happens is that photographer will have to set camera capturing settings to correspond to one exposure value; if the bright one that makes the dark darker, and so. That what we can notice in the photographs of Serge Najjar. (See Picture 3-13).

Another factor playing a role in producing a more dramatic effect in a photo is the digital editing after capturing the scene. In Picture 3-16, I tended to make the shadows darker and maintain brightness in the same level. The level of contrast seems to have increased, and so the dramatic effect.



Picture 3-17 Maruhachi Bar – Tokyo by Takashi Sugimoto (Locher & Ando, 2006)

- **Darkness and shadow:**

Darkness is defined commonly as the partial or total absence of light. While shadow is defined as the dark area resulted from an object that is between light source and surface.

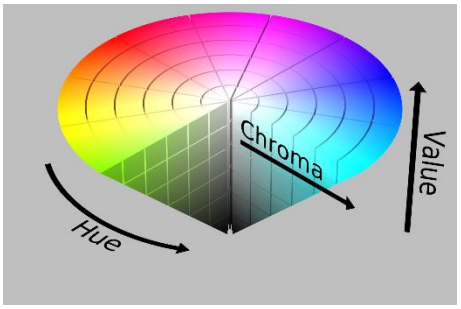
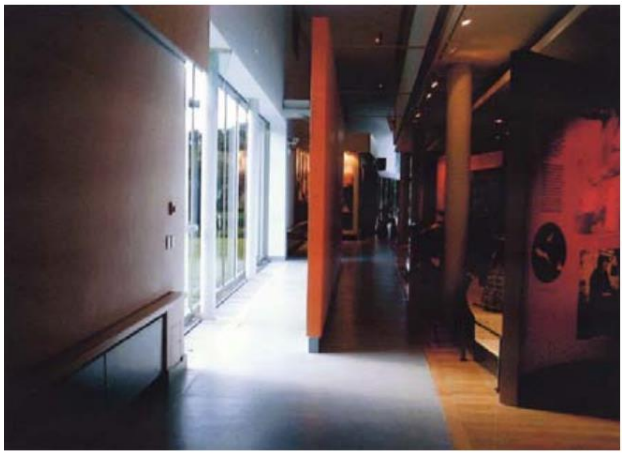


Figure 3-4 Color Theory (thegolfclub.info)

The word 'dark' is often called to colors with low '*value'* as they get closer to black. Dark colors reflect less light and give more depth to space. Therefore, they obstruct the propagation of light in space. This property contributes making dramatic effect easier and secure the darkness and contrast in space. At Maruhachi Bar in Tokyo, Sugimoto achieved the dramatic light effect by darkening surfaces around the wooden tables. The yellowish light above the tables increased the contrast between surfaces and make them evident and attractive. (Locher & Ando, 2006)

Pallasma pretends that deep shadows and darkness are essential, because they give the depth to the space, and make distance more ambiguous, they also balance the sharpness of vision. (Pallasmaa, 2005)

By the side of darkness lies the shadow, a smaller form of it. Shadow, where the sunlight is harmful, is a heaven. Sunlight or high daylight in some cases may cause harm to objects and users. For interior spaces, the cast shadows couldn't exist alone. It requires by its side a *light patch to exist*, definitively it's a close concept of cast shadow, it's cast light, it casts the pattern and form of the light device letting light in. In the case of Museum of Country Life, sensitive exhibited objects are protected by opaque screen parallel to the opening in the south wall. The screen split the circulation space to two contrasted parts. (Phillips, 2004) Here a dramatic effect is resulted from the meeting of shadow and light. The original intention was the protection of the exhibited objects.



Picture 3-18 Museum of Country Life – Ireland (Phillips, 2004)

- **Attraction:**

Attraction is an expected reaction of users to the dramatic effect. Visual contrast in different components of dramatic effect irritates the vision system, it grabs attention and activate visual adaption. Dramatic effect tends to has not a perfect comfort, attraction would not happen if the illumination inside space is distributed equally, and so the dramatic light would not exist.

- **Variation**

Picture 3-19 Wondering in Louvre Abu Dhabi by @iradonteovel (Instagram.com)

Luminance variability is one of the most important daylight characteristics. The dynamic qualities of daylight enhance the dramatic effect in a space (Gomes, 2004) and breaks regularity of form and geometry. However, dramatic light could comprehend both high and low luminance variability of daylight. That depends on where the daylight comes from, whether it is direct or indirect, solid or soft.

In the Louvre Abu Dhabi, the dramatic effect is achieved by the multiple envelope patterns that rain the spaces below with light patches and washes the people within. The resulted patterns keep changing through time and create that favorable atmosphere. The space could have not high contrast levels but it lies between the geometry of volumes and fluidity of light patches.

Chapter 4

State of the Art

Scientific Articles: Study and Analysis

4. State of the Art:

In order to make a methodologic experience in studying the dramatic light, we've chosen a collection of scientific articles that cover different aspects of light study. The articles included qualitative researches with comparative methods that relates to the dramatic light and its pioneers, experimental morphologic studies that compares different forms of windows and relates it to impact of size , typological and quantitative studies that categorizes spaces according to their contrast levels and seeks to build new measuring tools that fit the qualities of daylight

4.1. **Between the shadow and geometry of light – Hestnes Ferreira in continuity with Louis Kahn**

Alexandra Saraiva (2017)

4.1.1. Problem

How does the play of light and shadow manifests (shows, presents, models) the formal composition and perception of certain architectural spaces in view of works of Kahn and Ferreira?

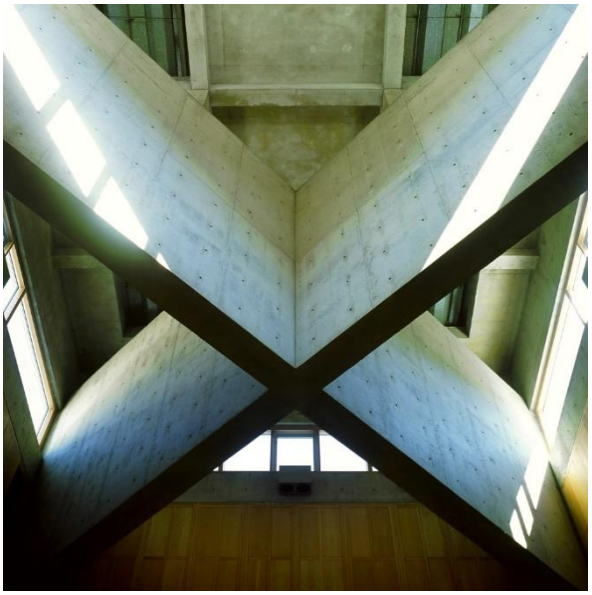
4.1.2. Objectives

- Understand light and shadow as decisive elements in the creation of architectural spaces.
- Introduce the concept of **Silence** as a decisive factor in the perception of these same spaces.
- Determine how Hestnes *Ferreira* designs in continuity with *Louis Kahn.*

4.1.3. Methodology

*This research is a **comparative typological case study** that analysis some works of Ferreira & Kahn. It studies the strategies of daylighting used by both architects. The material studied are **schemes of sections** over openings in their architectural works.*

Concerning Kahn's projects, the schemes are produced by Urs Büttiker from his research 'typology of light control'. Schemes of Ferreira's works are produced by the author due to their graphic documents.



Picture 4-1 Wall bays in Philip Exeter Academy Library by Louis Kahn

This research considered *two types of daylighting according to the direction of light inside the buildings: Vertical light,* Diagonal light.

The criteria of analyzing light includes: ***Direction of light source*** *(position of opening, Direct & Indirect),* ***Geometry*** *(of openings: size and positions),* ***Surfaces*** *(inside the space, surfaces of openings) & the* ***observer****.*

4.1.4. Discussion

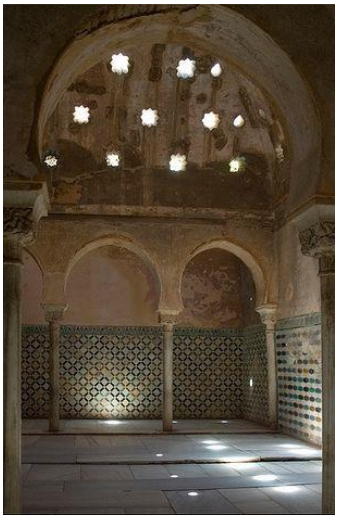
In order to understand daylight and its spatial effects, there are some considerations we have to know well, because daylight, like any natural element, isn't constant. Author emphasize that the understanding of light depends on: light source, the geometry, planes light focused on, and observer.

Picture 4-1 Atrium of Philip Exeter Academy Library by Louis Kahn

For light, its intensity, directional characteristics, and the colour are the most important things to consider. For planes, they work as a secondary source of light by reflecting it, also they filter it and change its colour. The geometry is the relation between light source and lit surfaces. The observer is what everything is made for. Both Kahn and Ferreira employed light in may symbolic and creative ways, the author categorized them into two categories:

Vertical light *and* ***Diagonal light.***

Vertical light *adds the interpretation and symbolism to the space by insuring indirect controlled reflections of light. Both architects applied it very multiple times in their project, but we can say that they applied it in two scales. In large-scale spaces, diffused light is achieved by* ***wall bays and white beams.*** *Those architectural elements adjacent to upper lateral openings prevent the space direct sunlight, and illuminate it with a* ***soft diffused light.***



Picture 4-2 Shiny light patches in Alhambra

Solid light *mostly achieved in smaller spaces using zenithal openings that allow sunrays getting in and intensify them in a point in the space creating shiny patches of light.* This strategy also has been used in religious buildings in the past. It gives an effect glorifying light and gives space a clear symbolism.

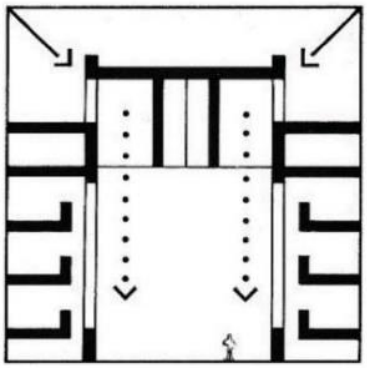


Figure 4-1 Philip Exeter Academy Library Section, illustration by Urs Büttiker

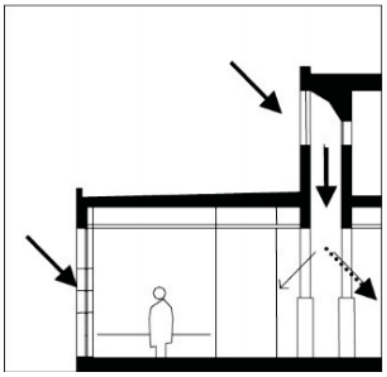


Figure 4-2 Caixa Geral de Depósitos, Branch , illustration by Saraiva

Diagonal light, *specially coming from the south, facilitates controlling the exposure and the intensity of light. This is achieved by the reachable lateral openings on façades and control elements.*

The two architects tended to employ this typology in both two procedures. The First, places and maintain the opening on the façade plane. The other, gives the opening a setback from the façade plane.

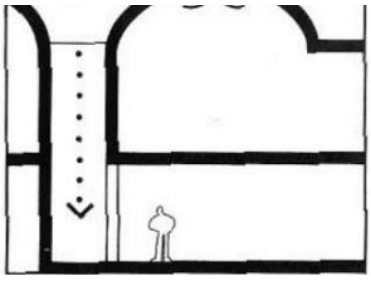


Figure 4-3 Kimbell Art Museum By Louis Kahn illustration by Urs Büttiker

The first procedure provides an abundant light that spread through the space with vast and clear light patches. Openings are controlled according to the functions and the size of space.

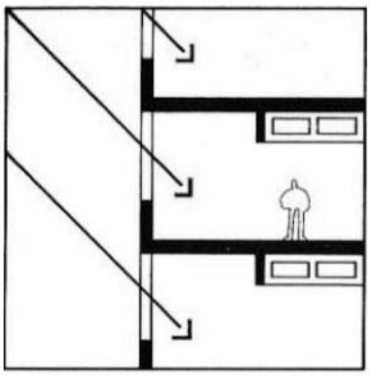


Figure 4-5 Salk Institute for biological studies By Louis khan

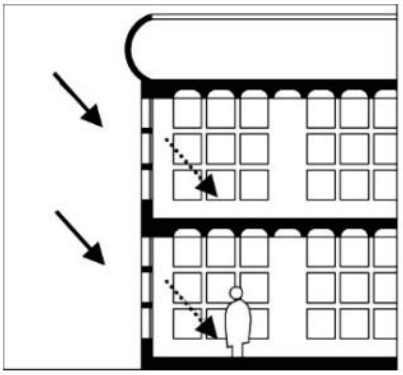


Figure 4-4 José Gomes Ferreira Secondary School

In these to projects, openings' size and height are limited to afford a controlled light intensity in spaces

Picture 4-3 José Gomes Ferreira Secondary School

A second case of multi-level spaces where openings are much bigger and provide another typologie of light inside the space. In the example of Phillip Exterer academy library, Kahn tended to rise the manin openings and create another small

The second type of diagonal light where openings take a setback from the façade plane the resulted effect inside the space is more diffused light than solid. Sometimes the setback takes another form, as Ferreira did in Ferreira Secondary School, he introduced trasnition space by the use of pergola and another forwarded elements resulting a 'contained opening'.

Picture 4-4 Phillip Exeter academy library Reading area

Silence and light

Silence in architecture allows users experience the slow, healing flow of time (Pallasmaa, 2005). Simple and clear shapes, absence of ornamentations, harmonious spaces are the main elements consisting silence. ‘Silence represents what does not exist and light represents what does.’ Silence is a catalyst of imagination.

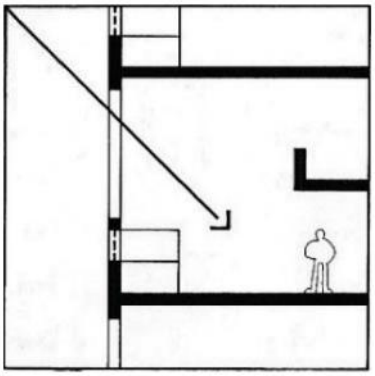


Figure 4-6 Phillip Exeter academy library - Section over openings.

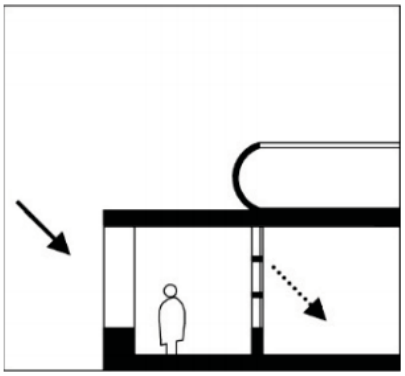


Figure 4-7 Contained openings of José Gomes Ferreira Secondary School – Section over openings

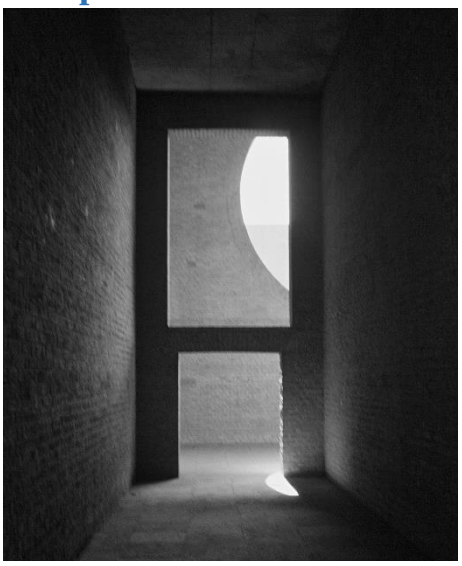
Membrane walls, light, simple shapes, scale, and materials. The blend of these design strategies may determine a space of silence.

What the author didn’t mention is relation between silence and darkness. Darkness is an equivalent to silence and enhances it with ambiguity and mysteriousness.

Picture 4-5 Contained openings of José Gomes Ferreira Secondary School (cm-lisboa.pt)

4.2. The Impact of Window Form on the Size Impression of the Room

Barbara Matusiak (2006)



Picture 4-6 Indian Institute of Management by Louis Kahn (©Alessandro Vassela, archdaily.com)

4.2.1. Problem

In which way does the window's form influence the size impression of the room?
Does the impression of the room size depend on the form of the window, daylight falling through it, or both?

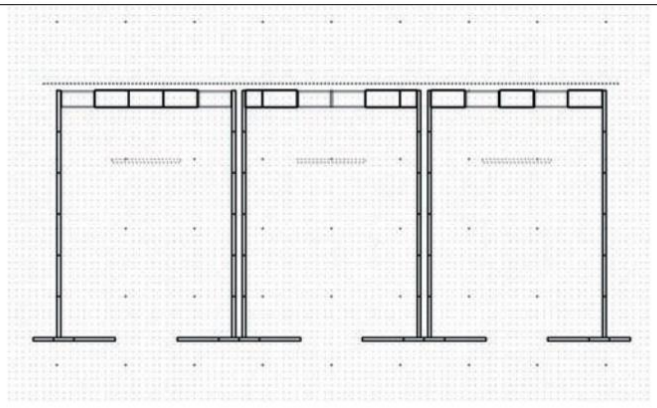
4.2.2. Objectives

The research seeks to find the relation between window's geometric patterns and the image of the room & its influence on the feeling of the size.
Also, how do the position & form of the window affect the daylighting quality of the room?

4.2.3. Methodology

The method used in this research project is based on relative and simultaneous comparison of two or three neighboring rooms.

The three rooms have matched dimensions, materials of walls, ceiling and ground. All the materials have a strong reflectance.



Reflection factors:

White walls:	0,69
Plywood walls:	0,51
Black walls:	0,10
Floor:	0,38
Ceiling:	0,55
White boxes in window wall:	0,80
Beige boxes in window wall:	0,45

Figure 4-8 Rooms plans & reflectance factors of each surface

In order to take only the impact of windows form on the size impression, windows background was covered with white curtains, which block the outside view and cancel its contribution on the impression. Also, the transparent boxes used are translucent to give a regular level of light.

The only two variables are the composition of windows' patterns, and the permeability of light of windows. Each experiment is carried two times. The first with transparent window boxes allowing daylight illuminating the rooms, and white boxes as wall elements. In the other experiment white wall elements are replaced with beige (dark beige) boxes, and transparent boxes are replaced with white boxes. In this case, rooms are illuminated with wash light projected on side walls.

In each experiment, the areas of window compositions in the three room are equal. The evaluation of experiments is done by over 20 volunteers from nearly all age categories. Everyone was allowed to enter each room many to make sure of what they see. Also, no time restrict is put.

Evaluation included depth, width, height, and general size impression. It's determined on a relative scale contains: very small, small, mean, large, and very large. Each dimension is evaluated on a separate scale.

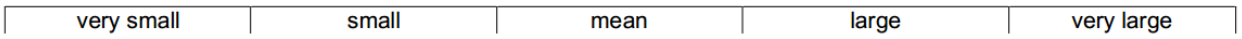


Figure 4-9 Evaluation scale

4.2.4. Discussion and recommendations

Resulted effects could be categorized as the following: Linear enlarging (on width or on height), Size or surface enlarging (both width and height, may include depth), deepening effect.

Linear Enlarging effects result from linear shapes. In general, horizontal linear windows make space looks wider, as vertical linear windows make space looks higher.

Size enlarging effect results from the spread of openings on the wall. The more spread of the pattern, the more illuminated room will be, the bigger room will seem.

Less illumination of ground and ceiling, especially on their midst, will make space looks **deeper**.

In each experiment, the resulted impression is a combination of those three illusion effects. There are many considerations that determine which is the most dominant effect.

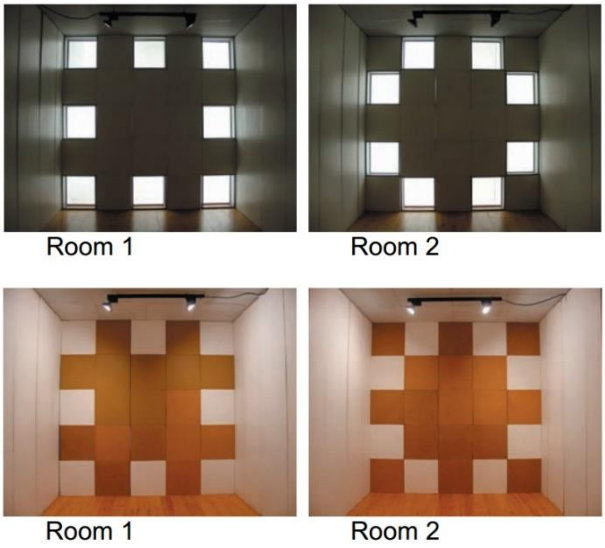
Experiment A

Figure 4-11 Two different experiments of the horizontal narrow windows.

The main indicator playing a role in this is the clearness of surfaces' boundaries. What mainly determines this is the contrast.

According to the impressions of experiment A, Room 2 seems to people deeper than Room 1. That's because window elements illuminate the ground and make it clear for the observer, although it reflects the light and creates extension-seem of the window, users could define the boarders. Room 1 seems higher and wider than Room2, according to the impressions of people.

Experiment B



B *A*

Figure 4-10 Corners impact on size impression

In experiment B, Room 2 also seems deeper. But in contrast with experiment A, Room 2 seems wider and higher than room one. That's due to the proximity and compactness of window elements in Room 2 the mass of white boxes makes them look bigger.

Another experiment studying the role of lighting corners showed that, in the case of daylight permeability, when window elements are adjacent to corners room looks bigger

(A). While impressions are close to each other in case of artificial light (B).Figure 4-10 Corners impact on size impression.

An experiment targeted the frame form of window elements, gave an impression of a bigger room than an ordinary square window in the center of the wall. The last makes room looks deeper than the framing window. Figure 4-12 Impact of adjacency of window to sidewalls.

Figure 4-12 Impact of adjacency of window to sidewalls

4.3. THE CREATIVE AND SYMBOLIC FUNCTIONS OF DAYLIGHT IN THE ART MUSEUM BUILDINGS OF THE 21st CENTURY

Dr. Malgorzata Roginska-Niesluchowska (2016)

4.3.1. Problem

How does the Museums of the 21st century employ the natural light to attain aesthetic values and acquire attraction?

"Analysis of the role of light showed that it was used in galleries in various ways, and its functions in exhibition spaces was often limited on ambient light. On the other hand, it was observed that attractive arrangements of daylight in representative spaces, like entrance halls and spaces of circulation, as well as rest and recreation areas such as cafes, restaurants, play areas for children, were often applied." (Roginska-Niesluchowska, 2016)

4.3.2. Objectives

The aim of this paper is to answer the question concerning the extent to which art museums of the beginning of 21st century, being the most demanding structures with regard to lighting quality and the aesthetic values of architecture. The author focuses mainly on the possibilities of the use of visual and aesthetic terms.

4.3.3. Methodology

This search is a case study. Critical analysis is the main method of this study. The criteria for the analysis cover the *use* and *role* of daylight in solving problems of function and aesthetics.

The criteria of study include the following:
Utility functions and Visual effects of light in exhibition spaces and other spaces,
Provision of meaning and symbolism in each of interior and exterior of the building,
Technical engineering solutions like glazing and daylighting strategies.

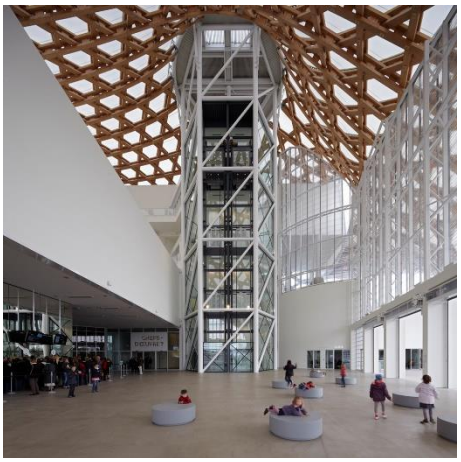
The material of study: the analyses are applied on art museums of USA and Europe in the first decade of 21st century present by Ronnie Self in his book ***(The Architecture of Art Museums: A Decade of Design: 2000 – 2010, published on 2014)***. Selection of works is based on the advanced building technologies applied on those projects.
Centre Pompidou in Metz by Shigeru Ban and Jean de Gastine
Museum of the Arts of XXI Century in Rome by Zaha Hadid Architects
Nelson-Atkins Museum Extension -Art Bloch Building in Kansas City by Steven Holl Architects

4.3.4. Discussion and recommendations

Centre Pompidou in Metz by Shigeru Ban and Jean de Gastine

One can feel the high level of illumination inside the spaces of this project, the light is very smooth that you can't hold it or find a single patch of light on interior surfaces.

The unique semi-translucent roof of this project, made of PTFE (Poly-Tetra-Fluoro-Ethylene) fiber glass membrane of half-millimeter reduces solar energy transmission and provide users with enough diffused light.



Picture 4-7 Centre Pompidou in Metz – interior of public space. (©Didier Boy de la Tour, archdaily.com)

The exhibition spaces also depend on diffuse light that doesn't harm objects and offer fair light. Lateral telescopic screen openings, which prevent direct light, supply spaces with light, while the very clear and reflective surface spread it through the exhibition space. The "gallery tubes" interact with their environment by offering views capturing city monuments.

"The night view seems to better correspond to the architects' vision."

Picture 4-8 Centre Pompidou in Metz – Exterior. (©Didier Boy de la Tour, archdaily.com)

Picture 4-9 Centre Pompidou in Metz - View from exhibition gallery (© Roland Halbe, theguardian.com)

Picture 4-10 Centre Pompidou in Metz - Exhibition gallery (© Kimsooja , e-flux.com)

Museum of the Arts of XXI Century in Rome by Zaha Hadid Architects

The light in the galleries is a combination of artificial and natural light. Daylight coming from the top of galleries passing through glass behind the louvers. Louvers diffuse light in space, and make you forget the sun totally. That's works well with artificial light, nearly no difference is noticed, contrast is totally eradicated.

Picture 4-11 Interior of MAXXI Museum (©Iwan Baan, archtalent.com)

Although, the atrium provides circulation spaces with zenithal daylight, circulation paths are enforced with decorative artificial light.

From a point of view, the project misses the natural orienting light, architects tended to replace it with suspended artificial illuminants that speculate the way in front of visitors.

Picture 4-12 Model of MAXXI Museum (archtalent.com)

Shadow does not exist in this place. Black railing walls of stairs and bridges balancing the values of light and grayscale of interior.

Not only the parallel louvers diffuse light, two layers of glazing above it are reflecting the UV-rays in order to protect artworks, and spread the light.

Picture 4-13 Circulation paths inside MAXXI Museum (©Iwan Baan, archtalent.com)

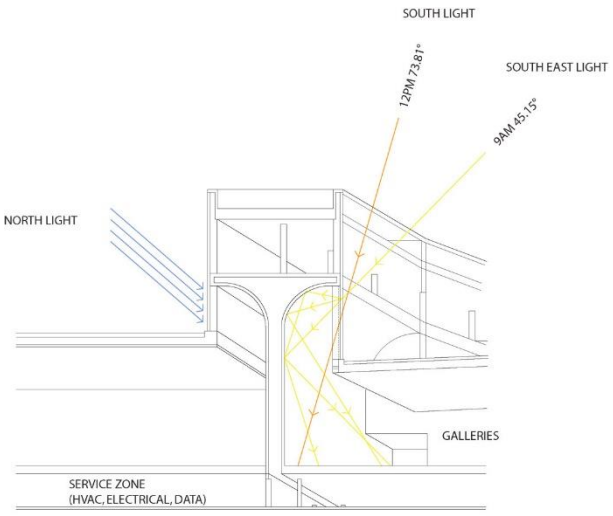
Nelson-Atkins Museum Extension -Art Bloch Building in Kansas City by Steven Holl Architects

This project shows a diversity in used daylighting strategies as well as artificial light during the night. Exhibition spaces mainly depend on natural light during the day. Light in exhibition spaces shows a variability of effects, this is due to the many techniques and materials used. Clear glass and translucent planks provide lukewarm light, with slippery reflections on floors.

Steven Holl plays well with light and shadow. Top-light passing through ‘lanterns’ and reflecting from the ‘breathing T’ give space an impression of warm light. Picture 4-16 The 'Breathing T' Nelson-Atkins Museum Extension (©Andy Ryan, archdaily.com)

Picture 4-14 Nelson-Atkins Museum Extension (©Andy Ryan, archdaiyl.com)

Picture 4-15 Exhibition space of Nelson-Atkins Museum Extension (©Andy Ryan, archdaily.com)



Picture 4-16Section over the 'Breathing T'

Picture 4-17 The 'Breathing T' Nelson-Atkins Museum Extension (©Andy Ryan, archdaily.com)

Diversity in geometry and surfaces directions generates contrast between surfaces, due to the different amounts of received light in each plane. This creates the sensation of dramatic light inside the space.

The grand reflecting pond also plays a role in illuminating the façade with a dynamic illusion and enforces the lateral light through south openings.

Picture 4-18 Reflection pond at Nelson-Atkins Museum Extension (©Andy Ryan, archdaily.com)

4.4. Celebrating Contrast and Daylight Variability in Contemporary Architectural Design: A Typological Approach

Siobhan Rockcastle, Marilyne Andersen (2013)

4.4.1. Problem

There is an insufficiency in traditional (ephemeral) metrics in dealing with perceptual effects of daylight. Also, daylighting strategies of contemporary architecture are very broad.

How does the classification of daylighting strategies according to contrast and variability help understanding and quantifying these qualities?

4.4.2. Objectives

This work seeks to develop a more effective vocabulary about contrast and variability under daylight conditions in order to expand the understanding of contrast-driven visual effects and their dynamic impacts on daylit architecture.

The resulted matrix help categorizing spatial visual effects and give intuitive scales. The simplified spatial models allow getting rendered images to be used in further researches determining the annual contrast and variability and predict their impacts on space.

4.4.3. Methodology

This is a typological study of architectural openings and their resulted spatial visual effects. The research is carried over projects of contemporary architecture from around the world. Projects' photographs are put into 10 categories of a linear gradient represent the degree of contrast and temporal variability according to the authors' 'trained intuition'. A simplified spatial model of each typology in the matrix is made to represent the typologies of daylight strategies resulting contrast.

4.4.4. Discussion and recommendations

The typologies of light in the architectural contrast matrix and strategies used

	Typologies Label	**Strategies**
1	**Direct and exaggerated**	Highly variable top lit spaces
2	**Direct and dramatic**	Side lit spaces with large light patches
3	**Direct and screened**	Perforated walls or ceilings emit small and frequent light patches
4	**Partially direct**	Side lit spaces with louvers and repetitive façade elements
5	**Direct**	Side lit spaces with no obstructions
6	**Selectively direct**	Spaces with sunlight in discrete instances – separated narrow openings.
7	**Direct and indirect**	Sunlight lit through thickened openings.
8	**Spatial indirect**	Light is emitted from interior surfaces
9	**Indirect**	Light coming form north facing openings on walls or roofs
10	**Indirect and diffuse**	Use of diffusing surfaces and elements

Table 6 typologies of light in the architectural contrast matrix

Direct sunlight in Kogod courtyard (by Foster) passing through glazing roof structure and draws a 'fishnet' pattern of light and shadow on courtyard's walls and floor. Such spaces of people gathering don't need tightly controlled light. The

Picture 4-19 Kogod courtyard by Norman Foster (©Leo Boudreau, flickr.com)

authors categorized this space under the Direct and Exaggerated typology.

In the Chapel of St. Ignatius, according to the architect Steven Holl this space transforms sunlight through a series of soft and indirect luminous forms. (Holl,1999)
The space of the chapel has a dramatic play of light and geometry.

Picture 4-20 Chapel of St. Ignatius by Steven Holl (©Scot Larsen, Flickr.com)

The exhibition space of Chicago Arts Institute has low and constant contrast level due to the diffuse light resulted from the two layers ceiling. The curved louvers block direct sunlight, and the translucent glass diffuse it.

One simplified model is produced for each typology. Those models are arranged at the same linear gradient of typologies of the intuitive matrix. Models make an easier understanding of each visual effect.


Picture 4-21 Chicago Art Institute The Modern Wing By Renzo Piano (bluffon.edu)

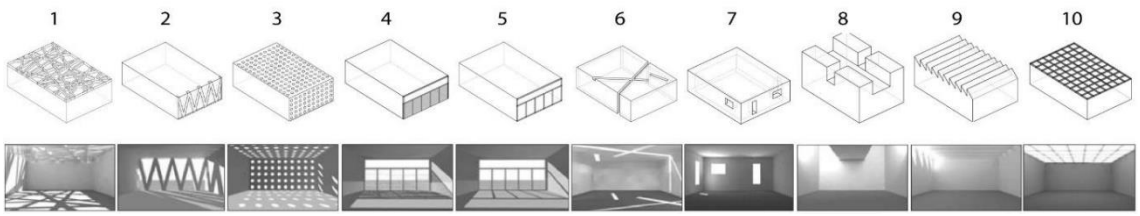


Figure 4-13 Typological Matrix of contrast and daylight variability.

4.5. Measuring the dynamics of contrast & daylight variability in architecture: A proof-of-concept methodology

Siobhan Rockcastle, Marilyne Andersen (2014)

4.5.1. Problem

Contrast & luminance variability are traditionally considered as qualitative design factors. Metric systems like task-based illuminance & visual comfort metrics also don't study contrast & temporal variability of daylight. Quantitative methods to explore their impacts & relevance are limited.

Here comes the need for developing new methodologic metrics that allow measuring and evaluating these qualitative factors.

4.5.2. Objectives

The authors propose new class of metrics that quantifies the dynamic perceptual effects overtime. They introduce two metrics: Annual spatial contrast & Annual luminance variability.

Using case studies of 3d models, this paper establishes a methodology for comparing spatial contrast and luminance variability between two spaces that are similar in size and orientation.

4.5.3. Methodology

The method used in this research is proof-of-concept with an experimental approach. The material of the experiments is the digital rendering images of the 3D models resulted from one of authors' previous researches (Rockcastle & Andersen, Celebrating Contrast and Daylight Variability in Contemporary Architectural Design: A Typological Approach, 2013).

In order to get an annual reading of spaces' contrast and luminance variability, the year is divided to 56 equal portions (8 days of each year are taken, and each day is divided to 7 instances) renders are taken at each instance. The 56-renders are converted to High Dynamic Range photo (HDR). Rhino was used for making the 3D models of lighting typologies, a plugin for Rhino (DIVA toolbar) which exports the renderings to Radiance where simulation and measuring of contrast and luminance are carried. To get the annual graphs of contrast and luminance authors used MATLAB.

Rendering virtual cameras positioned at the middle of the models are facing the south direction. For most of the typological models, openings are in the south wall.

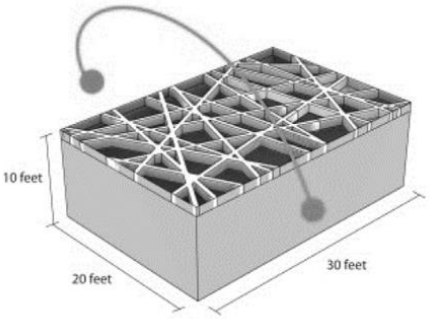


Figure 4-14 Dimensions of Typological Mode (Rockcastle & Anderson, 2014)

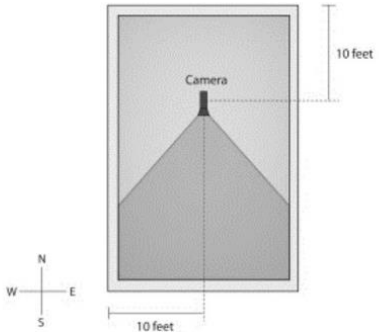


Figure 4-16 Position of Rendering Camera (Rockcastle & Anderson, 2014)

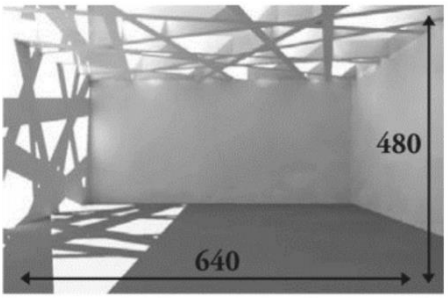


Figure 4-15 Dimensions of Rendering Image output (Rockcastle & Anderson, 2014)

4.5.4. Discussion and recommendations

The results of experiments are on five forms a) 56 annual renderings b) temporal maps of dynamic results for spatial contrast c) spatial map of cumulative annual spatial contrast d) temporal maps of dynamic results for luminance variability e) spatial map of cumulative annual luminance variability.

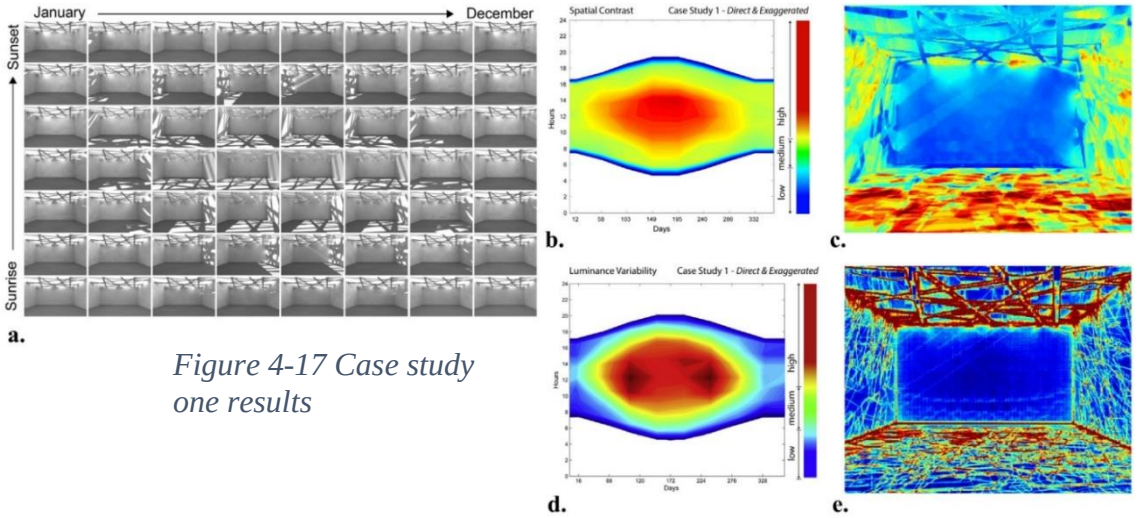


Figure 4-17 Case study one results

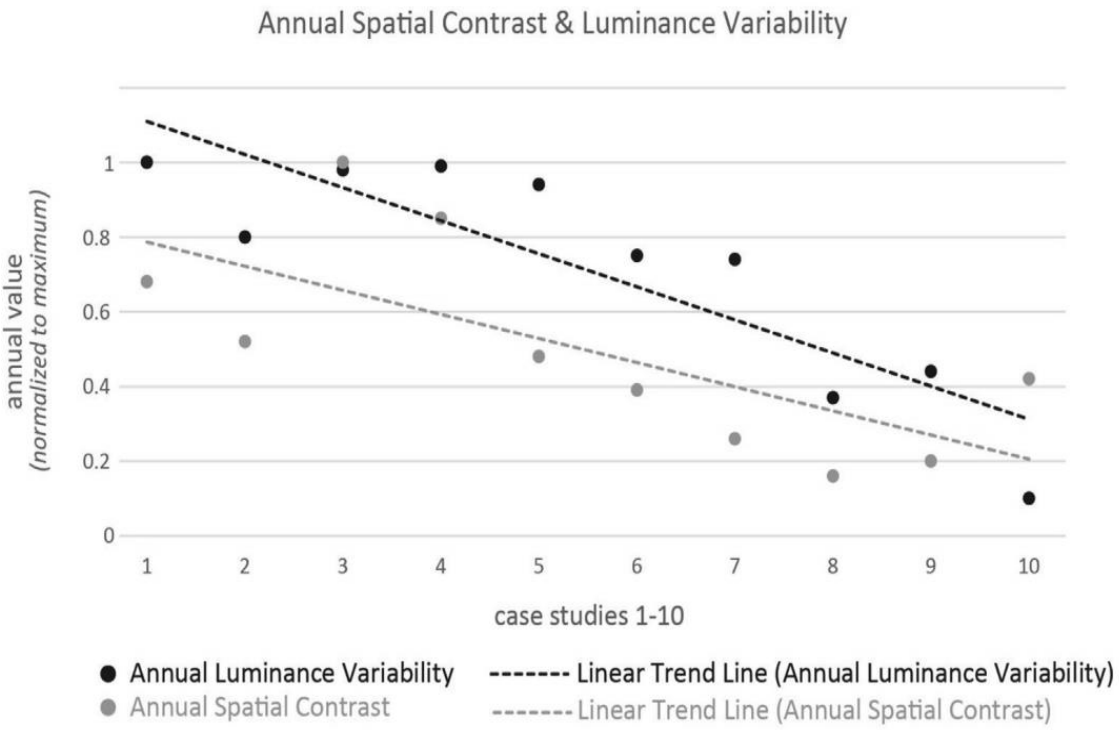


Figure 4-18 Case study result for annual luminance variability and annual spatial contrast for all 10 case studies. All values are normalized from 0 to the maximum cumulative value across all spaces.

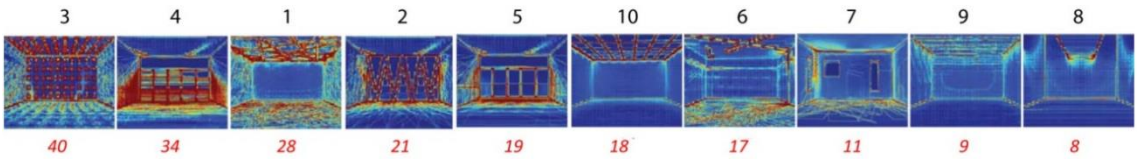


Figure 4-19 Quantitative order of typological according to contrast levels

The results of experiments carried on the 10 typological models shows an evaluation of both contrast and luminance variability. Results show that we can put another order for the models according to contrast and luminance values. The order is different from the authors' intuitive order.

4.6. Conclusion

These researches shown a vast range of luminous ambiances in different architectural projects, but one of the categories could be standardized to classify the others. Saraiva has divided light according to its resulting effects to solid light and diffused light (Saraiva, 2017) . We can say in general that most daylighting typologies tolerate to be within those two typologies. Diffused light could include most of indirect light typologies, and it's commonly employed within spaces with sensitive needs of light like exhibition spaces.

The analysis carried by Roginska of art museums of the 21st century showed that diffused light is the most adapted in their exhibition spaces (Roginska-Niesluchowska, 2016). Also diffused light is used in other spaces where direct light and strong light patches are harmful or inappropriate. It's important to mention that diffuse light is used to achieve dramatic effects by employing it in such spaces where there no special light requirements, as the darkness could not adversely affect the functions in the space.

In the other hand, solid light could include direct daylight typologies that supply spaces with clear sunlight patches and patterns. Those typologies could comprise the dramatic and exaggerated patterns categorized by Rockcastle and other high-contrast typologies (2013). Solid light is commonly used in spaces with no sensitive requirements for light levels, such as circulation and gathering spaces. For example, it's exploited in museums' public space such as in the Louvre Abu Dhabi, where sunlight patterns incident on ground create favorable and interesting luminous atmospheres. Solid light also could

correspond to the dramatic effect, it creates more explicit contrasted and audacious light patterns than diffuse light.

Chapter 5

State of the Art

Scientific Articles: Study and Analysis

5. Project and Application

5.1. Analysis

5.1.1. Site Analysis Conclusion

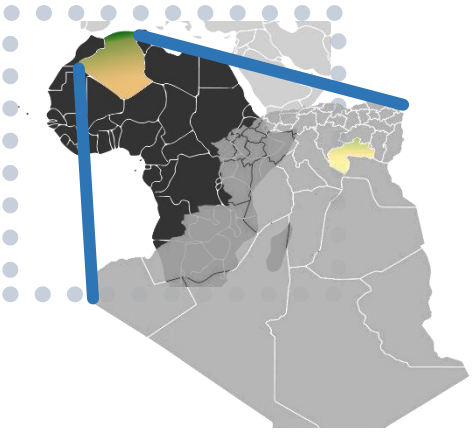


Figure 4-1 Situation to Algeria (by Author,2018)

The terrain is situated in the Wilaya of Biskra – city of Biskra, Algeria. It is located in the touristic area near AlMojahideen Neighborhood. It is located by the national route N3. Route N3 splits the neighborhood into a domestic part, another part is Almojahideen touristic complex.

Picture 5-2 Site Boundaries and Entourage (maps.google.com, 2008)

The plot has an area of nearly 4000 sqm of a nearly rectangular shape of 68m by 58m. It is accessible by the four directions from principal and secondary streets, but the main considerable façade is the western facing the route N3. The site in the urban area has no one special views from it, but it could have many especial views from different points: from different hotels in the area, and from the street that draws an arc around the terrain. The site has no vegetation inside, but some trees and bushes are planted by the main street. Cold winds come from the NE in winter, and hot dry winds come from the SW in summer. Temperatures generally higher than 35 c in summer, and do not go lower than 5 c in winter. Analysis methodology is retrieved from EDWARD T. WHITE's book (Site Analysis Diagramming For Architectural Design , 1983).

Picture 5-1 Panorama of the site (by Author, 20018)

(See Annexes for full Diagrams Poster)

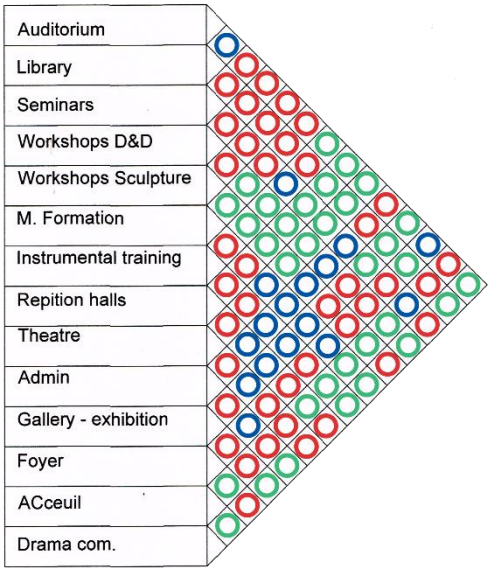
5.1.2. Example Projects Analysis Conclusions

Three bibliographic examples have been analyzed plus one local project. For sites, for all the schools of art have been analyzed, are situated in urban areas in partial or full built contexts. The contexts in most cases are mixed-use of cultural and domestic use. Most analyzed projects have explicit forms that attracts the attention and make a contrast of their sites. Also, they have obvious pedestrian and mechanic accesses. Entrance are usually guided by paths with unique surfaces or marked by hollow or salient elements.

Foreign projects have a unique visual identity that distinguishes them form their surroundings and guide the public to the function of the buildings. While the local project lacks for this feature while it's very regular building. Colors are usually bright with modern materials in most cases.

We can conclude principal activities happen in Fine Arts School:

-Educating/Learning
-Practicing/Training
-Performing/Showing
-Managing
-Meeting/Communicating



Picture 5-3 Functional Relationships between spaces

5.2. Programming

5.2.1. Project

School of Fine Arts

Schools of Fine Arts are cultural and educational projects that contribute forming artists in different fields of art. School of arts may include different arts such as visual arts (drawing, painting, designing, graphics, etc..), performative arts (drama and theatre, dancing, music, etc.…) and crafts (sculpture, pottery making, minimats, etc.. .).

School of arts are essential in communities; art gives aesthetic and beauty to everything. One may define art is making things beautiful, or making beautiful things. Art is an elementary object in very many professions that wouldn't work without. So, it is important to teach art and to have an art school in city.

5.2.2. Programing

After analyzing different examples of art schools with different functionalities and capacities, certain specialties have been chosen to contain in our project according to relevance to the culture and needs of Biskra city. Our school of art will bear teaching *fine arts, sculpture and crafts, music and drama. Its programmed capacity is from 100 to 200 students, 10 to 20 teacher and tutor, and up to 200 visitor*

For the activities of users we can sort them into the following: *Learning, Practicing, Performing, Exposing, Managing, Communication and* Resting. Some of those activities need private spaces such as sculpture workshops. Other activities need common spaces between different fields such as spaces of theories learning- Auditoriums, and spaces of exposing art works: exhibition spaces, or performing art pieces: theatre. Other spaces could be common between all kinds of users (Tutors, students, employees, and visitors) like cafeterias, which also could be separated.

For areas estimation and calculation, first, the number of users is a base element that determines how much space wee need. Second, standards and comparison between different previous project could help determining areas needed for each space.

SPACES	AREA (sqm)
Reciption	50
Auditorium	100
Library	150+50
Exhibition	250+50
Manager	25
Secretary	20
Archive	10
Teachers Hall	75
Meetings Hall	75
Teachers Service Room	12
Teacers WC	10
Metal Workshop	150
Wood Workshop	150
Ceramic Workshop	150+50
Workshops Stockage	50
Rehearsal	140
Loges	3x10
Cloalroom	2x10
Make Up	2x10
Drama Stockage	15
Maintainance Workshop	
Students WC	40x3
Drawing & Design Atelier	2x150
Advanced Painting	2x150
Students Exhibition Hall	200
Musical Formation	2x50
Instrumental Training	4x20
Individual Training	4x10
Theatre + Stage	250
Visitors WC	14
Exterior Workshops and seminars Hall	200

Table 7 Project's spatial program

Thirdly, the nature of activities is another elementary factor in determining space area. Here are the resulted planned spatial program and other compared programs:

Carcassonne Ecoles des Arts		Music	
Dance		Choral Theatre Hall	300
Studio with public acces	260	Musical Formation x8	40
Foyer	35	Keyboard ins // 3	70
CloakRoom x4	18	Training Studio x6	15
Arrangement x2	12	Wind ins x5	20
Studio x3	120	Choral x2	50
Drama		Choral Rehearsal	90
Stage with public access	220	Record Studio x2	10
Loge X2	10	Percussion Performance Hall	120
Arrangement	30	Chords Ins X5	20
Stage -trainging	110	Plastic Art	
Cloakroom - WC	3.5	Painting	160
Repeating Hall	15	Sculpture	100
Open Air Stage	130	Works hall	40
Open Air Auditorium	260	Arrangements x2	20
Library		Managment	
internal reading x2	30	Teacher room	35
Mediatique	70	Meetings room	45
Registration	15	Archives	22
Discussion	20	Reserve ins	22
Reception		Offices	17
Entrance Hall	50	Services	25
Waiting Room	75		
Cloakroom	20		
Reception Office	20		

Table 9 Caracassone Art School- Spaces Areas (Calculated by Author)

Glassel Art School	
Spaces	Area (Sqm)
F1	
Exhibition	250
Jewelery	144
Metal	125
Ceramic	195
Wood	125
Jr Ceramic	88
Jr Fashion	80
Jr Studio	80
JR Drawing & Design X2	80
Offices	120
Auditorium	150
F2	
Gallary	160
Drawing & Design X6	90
MultiMedia Studio	150
Digital Studio	70
PrintMaking	175
Printing	70
Faculty Lounge	90
F3	
Photography	140
Advanced Painting	160
Drawing& Design Studio	90
Offices	215
Core Studio	50
Core Seminar	80

Table 8 Glassel Art School - Spaces area (Calculated by Author)

5.3. Applications of Dramatic Lighting

After defining the dramatic light and building an idea about its typologies, here we will show our attempts achieving it in the school of art. To get renders of dramatic light effect in the interiors of our project considering only daylight, we used *V-Ray Next* render engine *(https://www.chaosgroup.com)* version 4.04.3 to get the naturalistic light distribution and realistic interaction with materials. Digital models were made using *Rhinoceros 3D* version 5 *(https://www.rhino3d.com).*

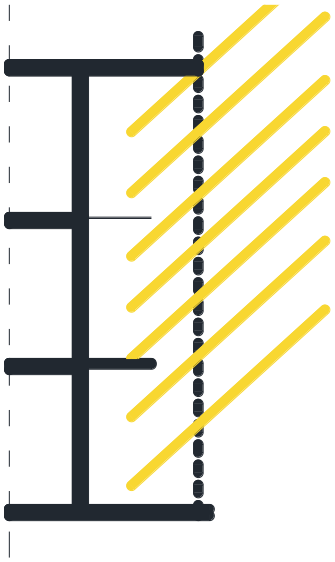
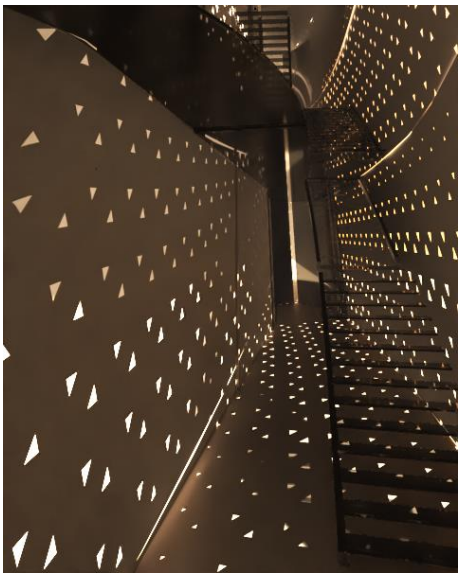


Figure 5-2 Section over Perforated Panel – Case 1

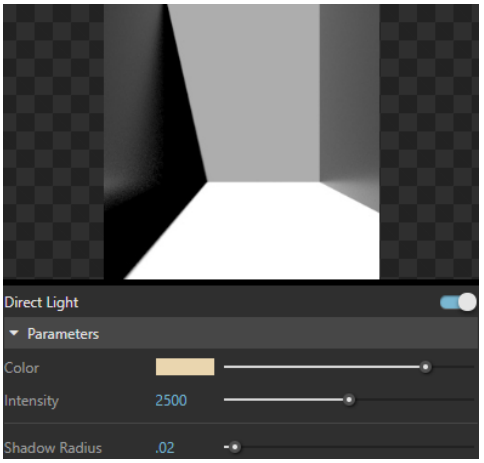
The first typology of lighting is the direct-solid light from south coming inside space through small openings (5cm to 30cm wide) in a metal panel with tiny thickness (5mm). In our case the light patches fall in a solid dark concrete wall that is 3 meters away from the exterior metal panel. This space is a circulation space with vertical and horizontal continuity. The continuity of vertical space is obstructed by hanged passages in upper floors, in order to not obstruct the effect, those passages will be transparent; using glass and metal. This will not only guarantee the continuity of rays in space, but also will give an extraordinary experience of walking in void, and will enhance the dramatic effect felt by users.



Picture 5-4 Perforated Panel - First render Case 1

The light source set in this attempt is a directional light source from the south direction (in some attempts from SE, in others from SW). In the first render try shadow scale was set to zero, that created very unrealistic sharp patches of light. In other attempts shadow scale was elevated to 0.02 to get more soft light patches that will look more real.

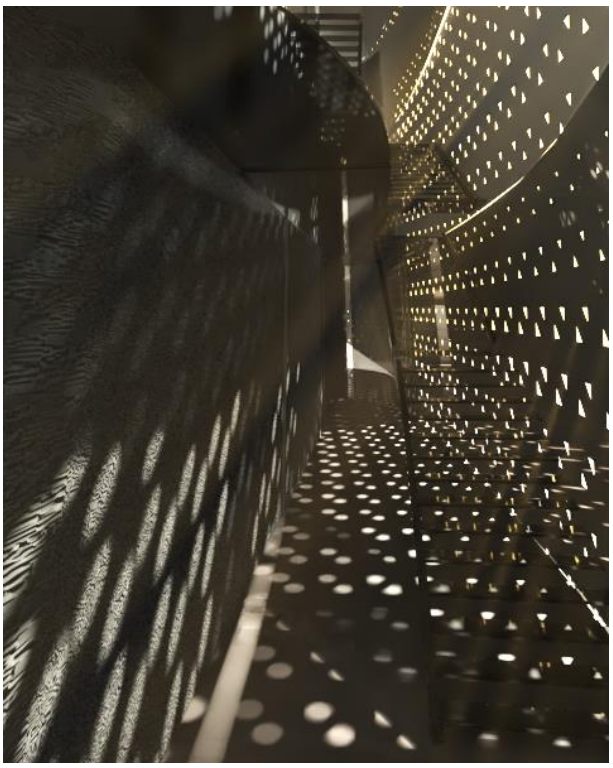
In the second render (see Picture 5-5) with shadow scale of 0.02 and environmental volumetric fog, the dramatic effect is more explicit. We added fog due to the sculpture workshops by the side of circulation space, to add more realistic effect and express the nature of this area in project.



Picture 5-5 Direct light settings - Case 1

Walking through such space would be emotional and fanciful. The embodied light and sunrays transform space's characteristics and turn it into something else with imaginary capacities.

Rockcastle found in her researches that this typology of lighting has great contrast and luminance variability. Her calculations proved that in her research paper (Measuring the dynamics of contrast&daylight variability in architecture: A proof-of-concept methodology, 2014). The pattern will keep changing by the movement of the sun through day. (see Figure 5-3 and Figure 5-4)



Picture 5-6 - Perforated Panel Second Render Case 1

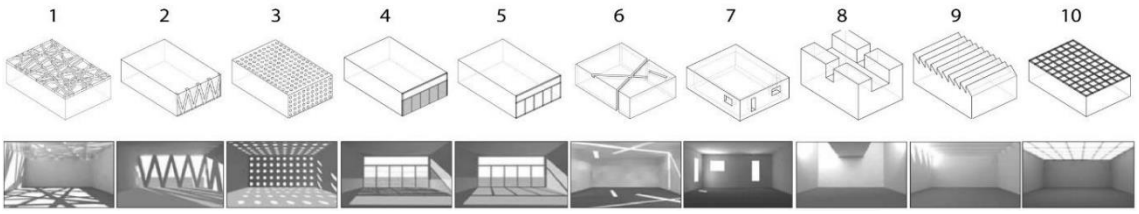


Figure 5-4 Rockcastle's Intuitive Typological Matrix of contrast and daylight variability. (Rockcastle & Anderson, 2014)

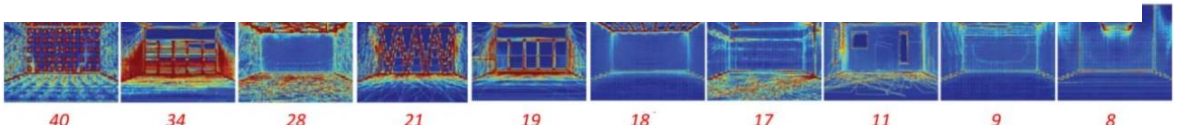


Figure 5-3 Quantitative order of typological according to contrast levels (Rockcastle & Anderson, Measuring the dynamics of contrast&daylight variability in architecture: A proof-of-concept methodology, 2014)

The second typology of lighting is the indirect-diffuse light, it is achieved by a series of daylight reflections on multiple elements. The diffuse light will provide a constant level of luminance and low variability and contrast. This strategy may match *typology number 8* in Rockcastle's *matrix* (see Figure 5-3). Her calculations show that this typology has the lowest level of contrast and luminance variability. However, we achieved dramatic light using this technique. By letting the diffuse light go down from a narrow void between

Picture 5-7 Dramatic Light Effect in corridor - Case 2

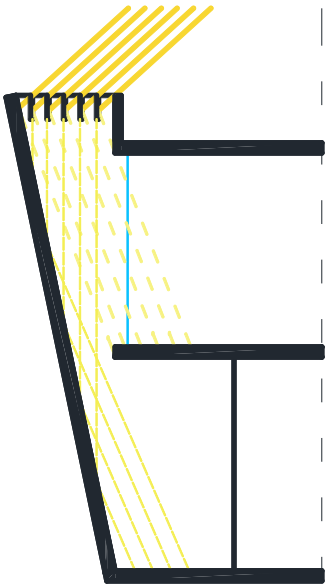
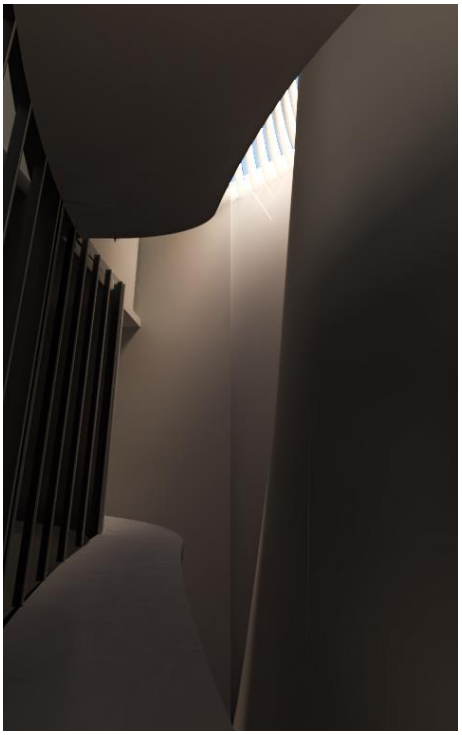


Figure 5-5 Section on Lateral Light Diffuser and Corridor– Case2

the slap and inclined wall, and by closing the targeted corridor and not allowing else light entering it. Using these procedures guarantees the darkness of surfaces but the ones that diffuse light fall on. This will produce contrast and therefore the dramatic light effect.

The same typology is used to illuminate northern circulation space around workshops, and contribute providing them with natural light. Here the purpose is not the dramatic light effect itself, but it could be achieved by darkening faces that light do not fall on and keeping the wall receiving sunlight bright. This will guarantee the illumination of workshops.



Picture 5-8 Diffuse Light in workshops corridor - Case 3

One last case that is not dramatic also, vertical diffuse light as a strategy for the illumination in last floor workshops. This typology may be close to *typology number 9* in Rockcastle's *matrix* (see Figure 5-3). The strategy used here is inverted light canals, as glass openings are oriented to north, and they are receiving light from surfaces facing south. This strategy provides a will distributed light in advanced painting workshops and student's exhibition space.

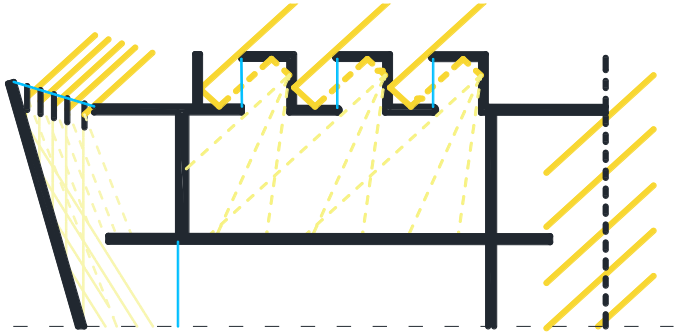
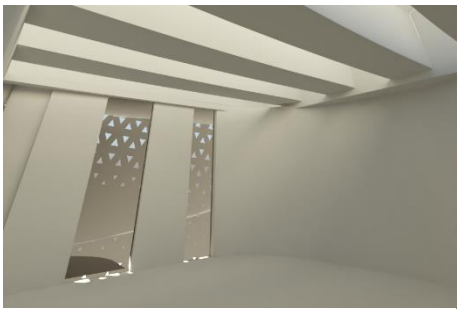


Figure 5-6 Section over Inverted Light Canals - Case 3 and 4



Picture 5-9 Diffuse Light in advanced painting workshop - Case 4

General Conclusion

The light has impressive abilities in changing space properties, natural light has unique qualities of changing quantities, colors, form and intensity. Through the time of day, a space illuminated within daylight could have multiple luminous ambiances. Contrast is one of factor the describes the relationship between light and shadow, it is a decisive element in categorizing spaces according to their lighting typologies.

However, dramatic light effect requires a certain degree of contrast and variability in space to be achieved. That depends on the level of darkness in space and the type of light entering it. Dramatic lighting could comprehend both direct and indirect light if the contrast is guaranteed. The dramatic effect provides attraction to space. Photographs of such spaces are mostly strikingly attractive due to the black and white effect and manipulated contrast levels. This may open another door for forward researches comparing architectural spaces with media such as photographs, digital images or further more *virtual reality* contents. Relating the reactions to such media and comparing it to reality is an interesting subject.

Achieving the dramatic effect in such media like digital models need a certain Precision

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Annexe