

# Lighting artworks in art exhibitions

Francesco Murano | Politecnico di Milano





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## AFTER INCANDESCENT LIGHTING

Clino Castelli

With the novelty of the additive synthesis, in the early 1980s, there has been a moment when it seemed that everything that could have happened in the lighting field had already happened. When I had the luck of catching the first signs of that phenomenon, I myself considered them as a form of light synthesis further than chromatic. This was the idea of a new ambient lighting, which would have changed the destinies of the plastic perception of space, preferring the penumbra as backdrop for new colors.

In those years, we believed in fact that this revolutionary way of lighting, although epochal, would simply be added as a complementary mode to the incandescent and fluorescent light. Remaining a curiosity to be ruled by known physical laws however not much applied. So we come to 1983, the Domus Academy's year of foundation, in broad advent of the color-light which had already absorbed on its own, with the creation of the IVI Colorterminal, other five years of my work on the Primary Design.

This former one, would become the subject of my masters course at the Domus Academy, together with the other two held by Ettore Sottsass and Mario Bellini. The Primary Design class, held in a typically meta-design way, could appear quite cryptic for foreign students, who knew only the Product Design, but not at all for the young Italian architects-designers such as Francesco Murano.

However, I considered the students as my peers, being in my turn, the youngest among the teachers of the time: Francesco, in particular, had just turned thirty years old while I would have been so not for much longer.

His thesis project, which even then had an expository intention, regarded the large areas of the Lingotto in Turin and how to illuminate its cars. Very shiny objects to be

presented in an ideal Automobile Show.

It was a difficult topic and he carried it out through the idea of the "arts of reflections". Therefore, working on the light sources' imprints and on their random distribution, completely unrelated to the architectural structures' texture.

Basically, all students of the Primary Design class would have worked on qualitative issues, far away from the traditional quantitative concerns of the modernist language, prevailing in the lighting design of that time. For example, it stood out among the new primary qualities: the management of the lighting sources' color temperature, the color rendering index and the resulting metameric aberrations – creatively used – including any acoustic, tactile or olfactory synesthesia. Each topic projected the sense of a renewed design awareness and a different way of working.

Only twenty years later, we would have realized that all that conceptual workings had taken place in the absence of a light medium suitable to the expectations of the time.

The electroluminescence of the LEDs, at that time still unable to transform their selves into the new light sources of the future, would be at the origin of the RGB light and of the new qualitative ways of lighting. Today, not surprisingly, I have noticed that Francesco illuminates the most beautiful works of art magically mixing LED sources with subtly different color temperatures.

## EMOTIONAL AND EMPATHETIC COMMUNICATION MANUAL OF THE ARTWORKS

Jacqueline Ceresoli

Lighting design involves a complex system of rules, innovative tools to artfully experiment, applicable in different environments. This is taught by Francesco Murano, esteemed lighting design professor at various prestigious national and foreign universities, among the most popular Italian lighting designers at the service of art exhibits held in public and private spaces.

After years of field experience, Francesco Murano collects in this practical manual, interesting case studies about "lighting solutions", adaptable to other contexts.

His book answers to the lack of an updated literature around some variable and at the same time paradigmatic models, that enhance the expressive potential of light, within the design of unexpected spatial depths, through the lighting of ancient, modern and contemporary artworks, guided by concepts that focus on the artworks and their formal, compositional and chromatic peculiarities. Murano starts from what one must not do. He shows how even wrong logistics or architectural errors may sometimes turn into a design opportunity to invent "hic et nuc" new appropriate lighting solutions, making the most of natural and artificial light sources. Murano applies the rules of perspective to the lighting design. He focuses on the camouflage of innovative systems, taking advantage of the surrounding space and works on the perception and visual communication by subtraction. Because the protagonist is, in any case, the exhibited artwork that lives in the eye of the viewer. But light still acts on our perception of the objects, spaces and in particular of the artworks. By acting on our subjective capabilities, amplifying feelings, imaginations and highlighting underlying meanings, compositional details and tonal shades of the paintings as well as the sculptures, perfused by light beams or never invasive light trajectories. This handbook about visual languages, conceptual and practical rethinking of lighting, is essential

to understand that the issuer, the channel, the lighting system, does not depend on the message but on who looks at the artwork: the star of the show. This kind of lighting brings the focus to the perceptive potential, by suggesting the viewer an internalization of the visual experience. Moreover, when the artwork is illuminated by imperceptible sources, to the point that it seems to float in the darkened space, then our cognitive and retinal approach empathically relates with it. His seemingly simple and functional projects, trigger a dynamic of complex phenomena in which light becomes sign, sense and communication of the representation of the vision itself.

For Murano, the unexpected opens to imaginative solutions which then become decisive modes, applicable to different environments, conditions and spaces, as shown in this sampling invisible structures of the vision's perception. In other words, his lighting enhances the luminescence inherent in the paintings as well as the plasticity of the sculptures. It plays with perception and reflection effects, extension and extroversion, dialogue and communication of the artwork, into the museum's surrounding space, focusing on the outlines of the figures and on the shadows. All of this, to invite the viewer to a further, philological, reading of the exhibits. The goal is to transform the image into a totalizing perceptual experience, in which the artwork becomes agent of vision, allowing also the careless viewer to receive retinal sensations and lead him to further reflections, through the incidence of quantity and quality of more or less intense light beams. Murano iconify the visible effects of ever changing lighting systems. He presents variable points of view on the basis of a perceptual recognition. Because the artfully lit artwork is remembered over time, it gets stuck in our memory and transforms light into an essential element for the communication of emotions.





## WHY I WROTE THIS BOOK

*I have been working light and lighting design for several years now, after graduating in Architectural Composition in Rome I have attended a Master of the Domus Academy where I was taught by Masters such as Ettore Sottsass, Mario Bellini, Alessandro Mendini, Gianfranco Ferrè, naming the most famous ones.*

*Having as rapporteur Clino Trini Castelli, I approached to the Design Primario and to the design of immaterial elements such as sound, scents, textures, flavors and of course light. These teachings have left a trace in all my works, from the luminaires' design, to light art projects, to the artworks' lighting.*

*My designer activity has poured into the Politecnico di Milano as lecturer both in ordinary courses of the Scuola del Design and in specific modules planned in various Master classes by the Polidesign or other cultural institutions in Italy and abroad.*

*During the course of my lectures,*

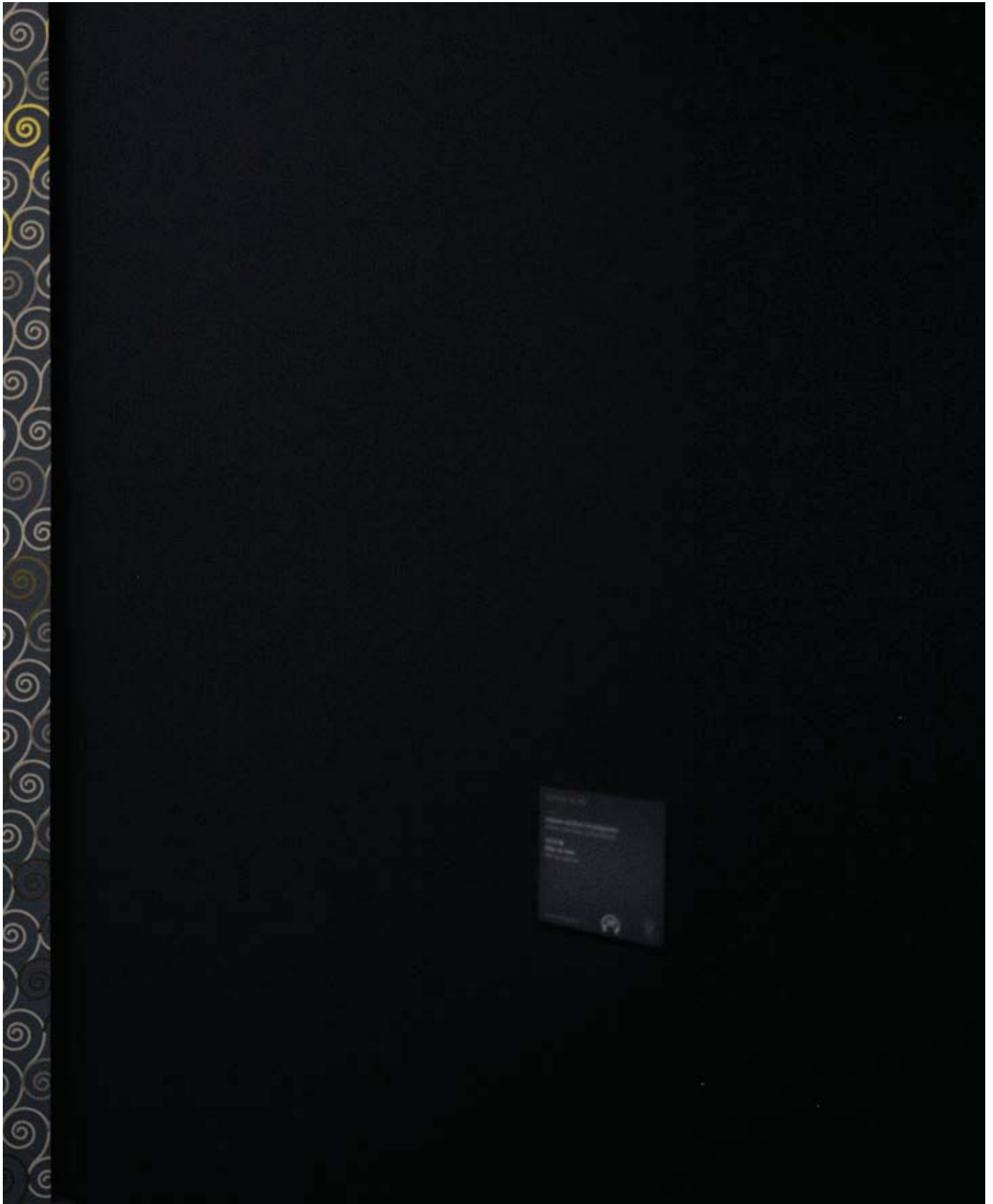
*I have realized how difficult it becomes for a student or an interior designer to approach a lighting design project through the reading of textbooks and manuals which are basically optical physics' essays with the capacity of discouraging more than attracting the inexperienced ones.*

*This is the reason why I chose to write this brief treatise aiming to sort out and systematize what one should know about when lighting a painting by Raphael, a drawing by Leonardo, an artwork by Warhol or Damien Hirst's skull.*

*I do not know if I will succeed in giving all the necessary explanations concealing a practice built up over years of experience; but it would make me happy to know that reading my text has been a pleasant experience and nobody decided to leave it half way to do other.*

*Francesco Murano*





> Klimt: At the origins of the myth – Milano 2014 – Palazzo Reale

> Giorgione and Gio Ponti – Venezia 2010 – Galleria Giorgio Franchetti alla Ca' d'Oro





## Lighting artworks

In Italy plenty of art exhibitions take place each year exposing thousands of artworks, hosting millions of visitors aiming to broaden their culture through the direct observation of paintings, drawings, sculptures, lit by artificial or natural light.

Light for art exhibits is mainly used to lit artifacts but it also absolves other functions, as to provide optimal visual conditions for security, way finding, captions' and introductive graphics' reading, accentuate entrance banners, bookshops, ticket offices and so on.

All of these functions merit more specific detail which for reasons of brevity I have decided to postpone choosing to focus this text specifically on how to light artworks. However, I would like to underline that first and most important requirement of all in order to develop and implement all the mentioned functions, is to ensure that the lighting itself does not disrupt the view of the artworks. This may appear trivial but it is often ignored in exhibitions where masterpieces are not enjoyable because of uneven casts of light, glare, shadows, patches of brightness on the walls.

Among the many flaws found when visiting an exhibition, there are also those caused by the desire to prevaricate the work of art with a violent, hard lighting, chosen to intentionally enhance the lighting fixture's author or the exhibition design more than the artworks' author. I personally do not support this type of approach while I prefer a discreet but perfect lighting to one exaggerated and not focused on the artifacts. Artwork's lighting should have the same effect of the face powder on a beautiful woman's face, that is to say it shall correct some minor imperfections and glorify its natural beauty.

## – Preliminary actions

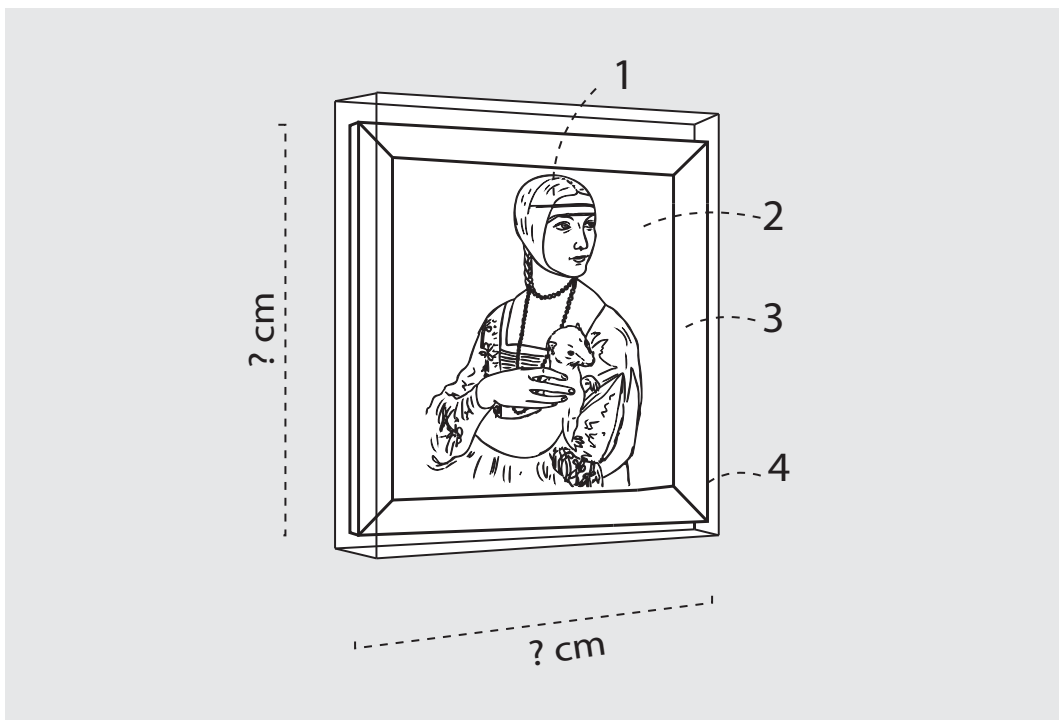
The lighting design of an art exhibition supposes certain preliminary actions.

These will provide an overall framework of the intervention and relate to:

1. analysis of the exhibited works of art;
2. understanding of the curator's exhibition concept;
3. inspection or better sharing of the exhibition project.

## – Analysis of the exhibits

The analysis of the exhibited artworks regards first of all the detection of a number of factors which can result in inconveniences or difficulties.



This means verifying:

1. materials the artwork is made of (acrylic colors, tempera, oil-based, pencil, crayons, marble, stone, wood, else);
2. materials of the surface on which the artwork lays on (canvas, wood, paper);
3. materials within which the artwork is contained (frame, passepartout, glass, else);
4. materials in which the artwork is displayed (plastic/glass cabinets, else).

Main problems occur with:

1. direct glare;
2. reflections of dark paintings executed oil on board;
3. reflections of non polarized glasses placed to protect the artifacts;
4. reflections of display cases made of plastic or glass;
5. shadows cast by the edges of the showcases on the artworks;
6. shadows cast by sizable frames on the artworks;
7. shadows cast by the frames on the walls;
8. paintings and a drawings placed very close together.

Each of these problems and respective solutions will be discussed next.

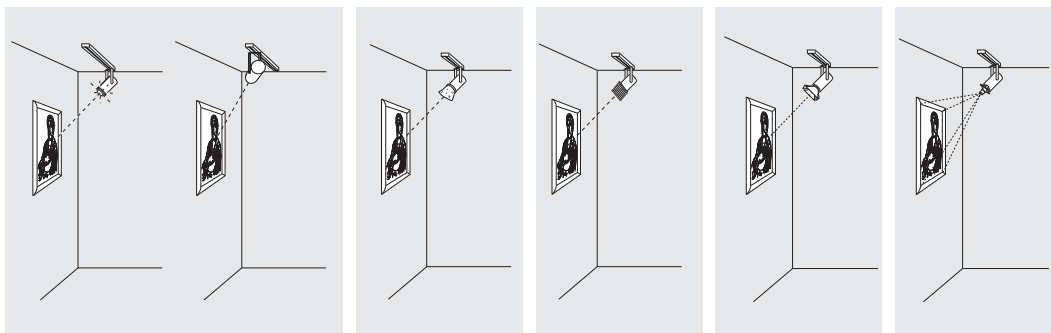
## – Direct glare

Direct glare occurs when the light rays emitted from the luminaire travel directly into our eyes causing partial or total hindrance to the vision of the environment or the artwork.

In order to prevent this, the first thing to do is to ensure that on his way through the exhibition the observer sees, as far as possible, only of the rear part of the luminaire and never its “mouth”. Therefore, always recall the routes of the exhibition and consequently adapt the luminaires’ position and orientation.

If it is impossible to direct the luminaire to avoiding glare, we must attach accessories such as honeycomb screens or barn doors.

If neither these are available, it is always possible to use a matte black aluminum foil called cinefoil or black-foil, which are resistant to all temperatures because made of aluminum. There is also a self-adhesive version but it is usually fixed on the luminaires with some high heat resistant tape called Gaffa, in jargon, or metal paper clips.



> Direct light

> Cinefoil

> Honeycomb

> Barn doors

> Frame

## – Indirect glare

As stated previously the observation of an artwork should be perfected and not hindered by light.

If direct glare directly affects our eyes, the reflected one falls firstly on a surface and then bounces toward us, creating marks of light that obscure the view of the artworks.

## – Reflections of dark paintings

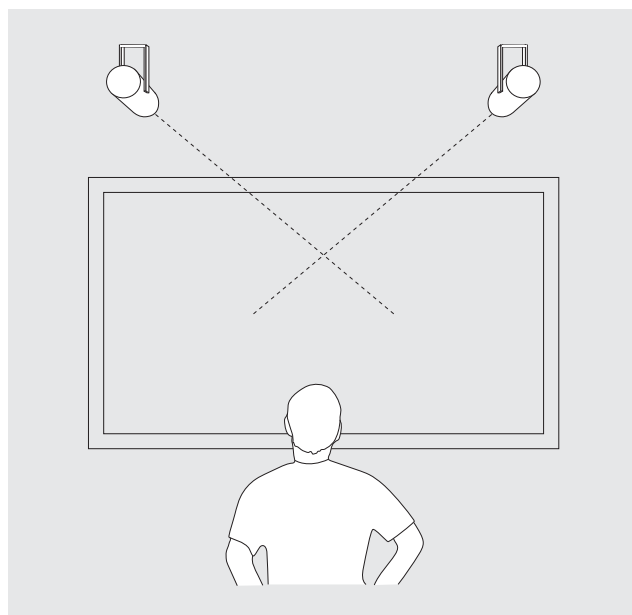
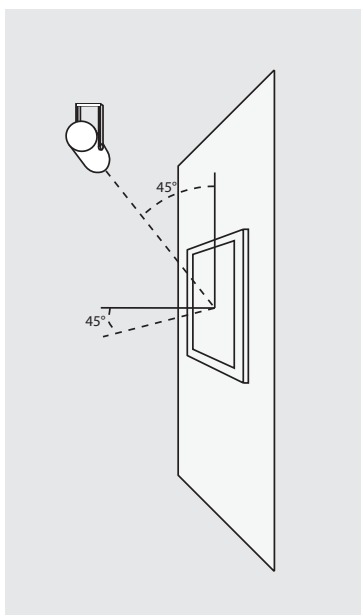
The reflections are typically caused by the material with which the artwork is realized, disturbing reflections particularly occur with oil on board paintings and especially in their dark or black parts.

To eliminate these reflections different kinds of actions can be made.

The first consists in properly directing each single luminaire on the artwork.

The experience led me to verify that the best arrangement consists in placing these on the existing track at 45 degrees relative to the center of the painting.

If the painting is very large it will be necessary to place two fixtures, one to the right side and one to the left side of the painting, at 45 degrees starting from the edges of the painting itself. In this case the light beams are crossed, meaning that the beam on the left illuminates the right part of the artwork and the right one the left side.





## – Reflections of non-polarized glasses

As previously said, while direct glare directly affects our eyes, the reflected one falls firstly on a surface and then bounces toward us, creating patches of brightness that obscure the view of the artworks.

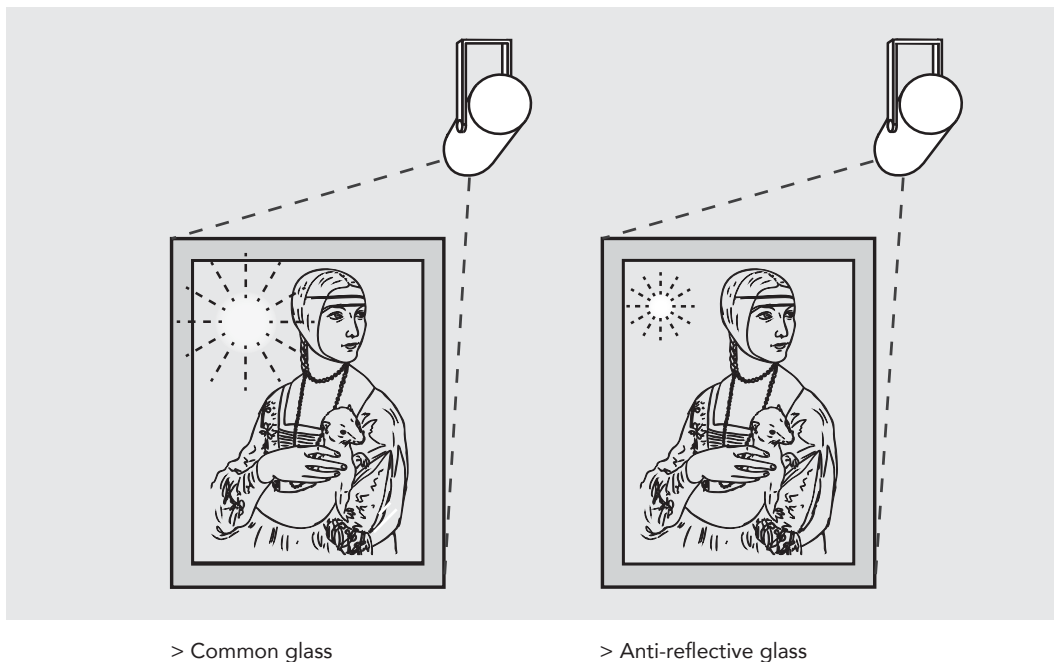
Then we must consider the glasses with which the paintings are often protected, it is easy to check whether or not the glass is anti-reflective; in the anti-reflective glasses the lights appear slightly and are bluish, in the common glass the lights appear very obvious and not bluish.

Reflected lights do not come only from the luminaires used to illuminate the artwork, but usually from all the ones intercepted by the glass even if they are lighting different artworks from the one we are observing. For example, those used to illuminate the environment.

In this case it is necessary to rearrange the luminaires, redirecting them or otherwise shielding them so that the light reflected from the glass turns almost invisible.

Many luminaires can then be supplied with anti-glare shielding accessories as honeycomb screens or barn doors, these accessories, along with the Cinefoil may help reducing direct as well as reflected glare.

The real function of flag-mounts, however, is to modify the shape of the light directed on the artwork, reducing the spill light around the paintings or drawings.



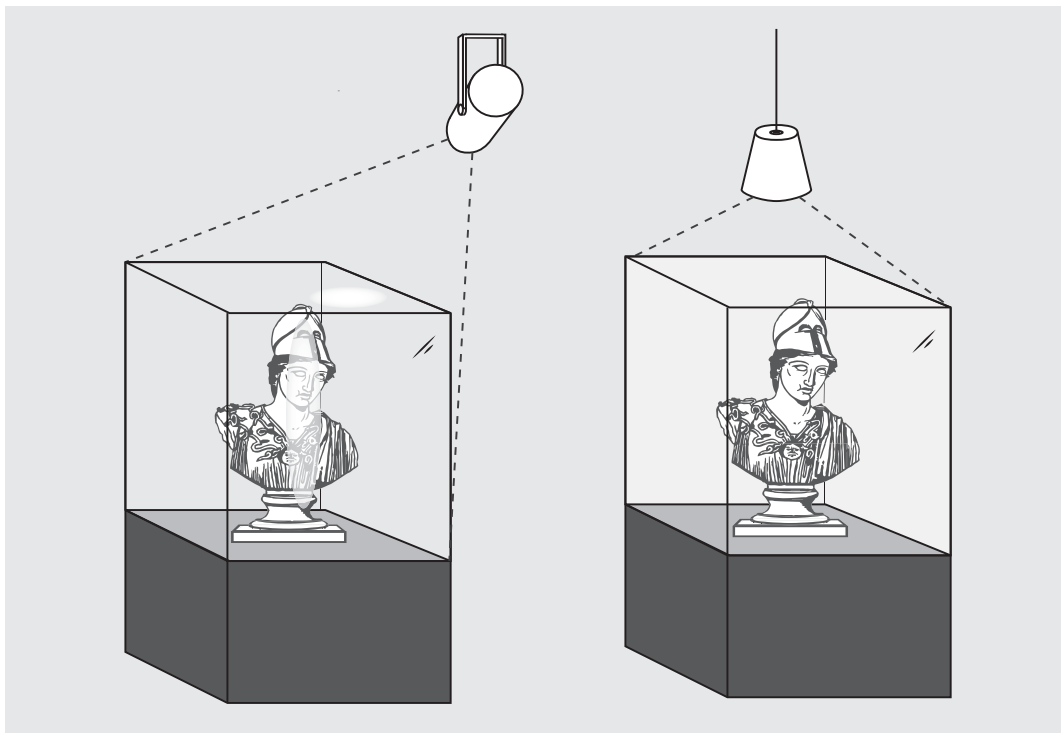
## – Reflections of display cabinets

Often some of the artworks are protected by display cases made of glass or methacrylate, these serve to protect them and to ensure the right level of humidity.

The display cases are almost never made of anti-reflective glass and therefore they represent an almost certain source of inconvenient glare.

The reflections of the methacrylate showcases (commonly called plexiglass) are more noticeable than those made of glass because they are never perfectly planar and present some undulations which tend to intercept the lights, also the plexiglass tends to be scratched and the scratches are emphasized by the light illuminating the artworks contained in the showcases. In all these situations, move or shield the lights and find ways not so much to avoid reflections, but merely to ensure that those who prevent a good visibility are limited or invisible to whom stands in front of the artwork and observes it from a distance of about 80 cm while its eyes are placed at 160 cm from the ground. This proportion usually corresponds to the center of a painting placed on the display wall.

Better yet would be to illuminate the artifacts from the inside of the case or with luminaires placed just above them, in this case of course there would be no reflections. Still, often the lights can not be placed in the display case because they affect the microclimate, which might theoretically damage the works.



### – **Shadows cast by the edges of the showcases**

Glass or methacrylate display cases can generate other problems because the edges of the cabinets generate shadows that manifest themselves as dark lines.

We need to ensure that these dark lines do not fall onto the works of art and this is easily accomplished by moving the luminaire to another track or moving the artwork inside the display case.

The lighting fixture must be moved to another track. Moving it on the same track is useless because the line of shadow, usually generated by the upper edge, remains identical since the tracks are generally parallel to the walls on which the paintings are placed. Sometimes the artwork can be moved in the display case, but it is not always possible to move it forward or backward, so that the dark line does not capture it.

### – **Shadows cast by the frames on the artworks**

Other bothering shadows are those produced on the paintings by their frames.

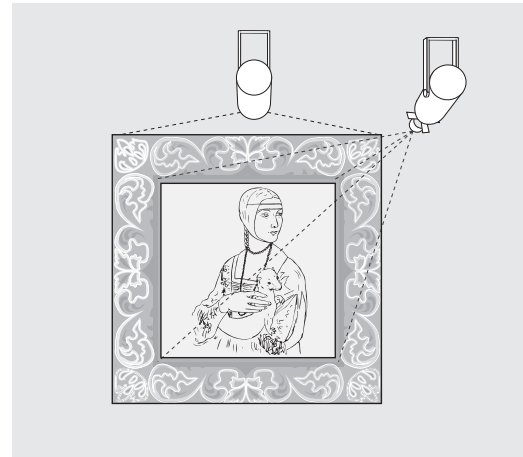
These shadows can have a linear profile but can also be “lacy” depending on the shape of the frame that causes them.

To eliminate these shadows, move the luminaire that causes them making sure that the light that reaches the painting is less angled. Although one must pay attention because this often generates inconvenient reflections from the paintings.



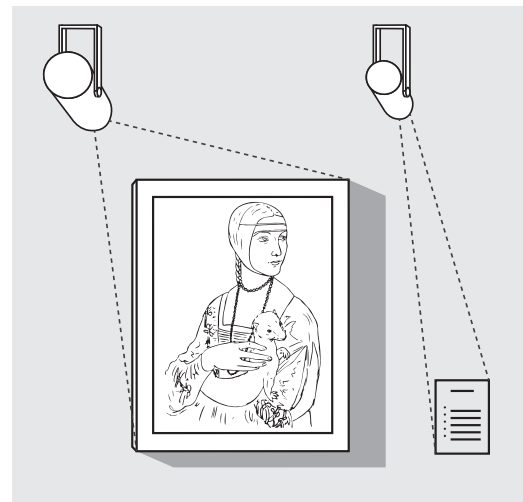
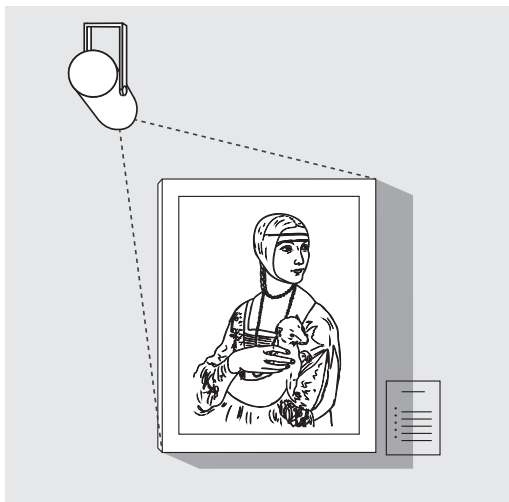
If it is impossible to move the luminaire there are other solutions, such as using a profiler to create a bright area that will overlap the shadow area produced by the frame.

## — Shadows cast by the frames on the walls



All paintings create shadows on the walls, caused by the arrangement of the luminaires and the distance that exists between the protrusion of the painting's frame and the wall on which the painting itself is placed.

I generally place the luminaires to the left of the paintings and light the artworks at 45 degrees. This makes the shadows to be projected at 45° to the right side of the paintings, this position is also useful to illuminate the captions which are as well placed to the right of the artworks. The arrangement of the captions should, however, be discussed with the curator and the exhibition designer, in order to avoid that these get placed too close to the paintings, otherwise they could be covered



by the shadow of the frame. The captions should be placed neither too far apart because otherwise it will be necessary to add another light just to illuminate them.

### – A painting and a drawing placed very close to each other

Other difficulties may be encountered when illuminating a drawing and a painting which are placed very close to each other.

The difficulty comes from the fact that it is allowed to illuminate a painting on canvas with 200 lux while for a drawing we can reach a maximum of 50 lux.

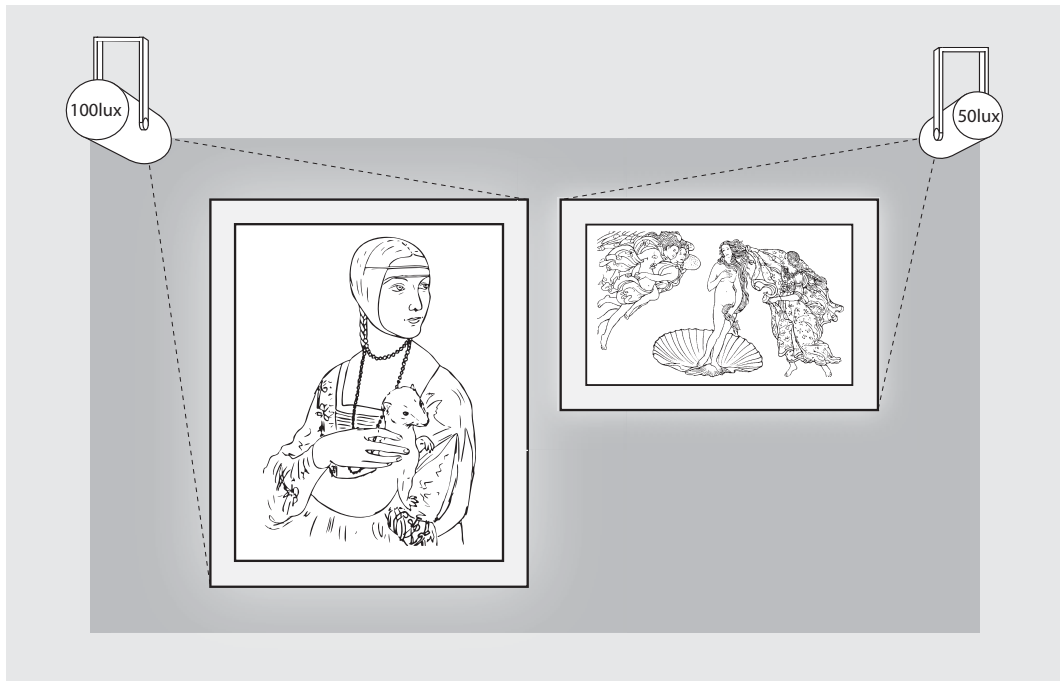
This involves the fact that the picture will appear very bright and the design very dampen.

The only solution will be to lower the light on the painting in order to reduce the contrast between the two lights.

But the best thing is to discuss with the curator or the exhibition designer before, because it would be better to collect drawings and artworks for which it is permitted to use a maximum of 50 lux, together in one section.

This would allow the whole section to be lit with a low light and avoids conflicts dictated by the difference in lighting that makes the lights on the drawings appear even more dim.





## – Understanding the curator’s exhibition concept

Another important factor regarding the lighting design strategies concerns understanding the curator’s concept for the exhibition and his requirements. That means interpret with which visual experience he wants the message, topic, to be delivered. In a particular way it needs to be understood if the curator (whom is the critic in charge of selecting and dividing by groups the works of art and decides one by one in which succession these must be displayed), thinks to lighting the artworks by group or individually; if he has a specific need regarding the hue and shape of the light that will hit these; if he wishes to emphasize the environment or prefers an accent lighting on the individual artifacts. All of this will give birth to diverse lightscares.

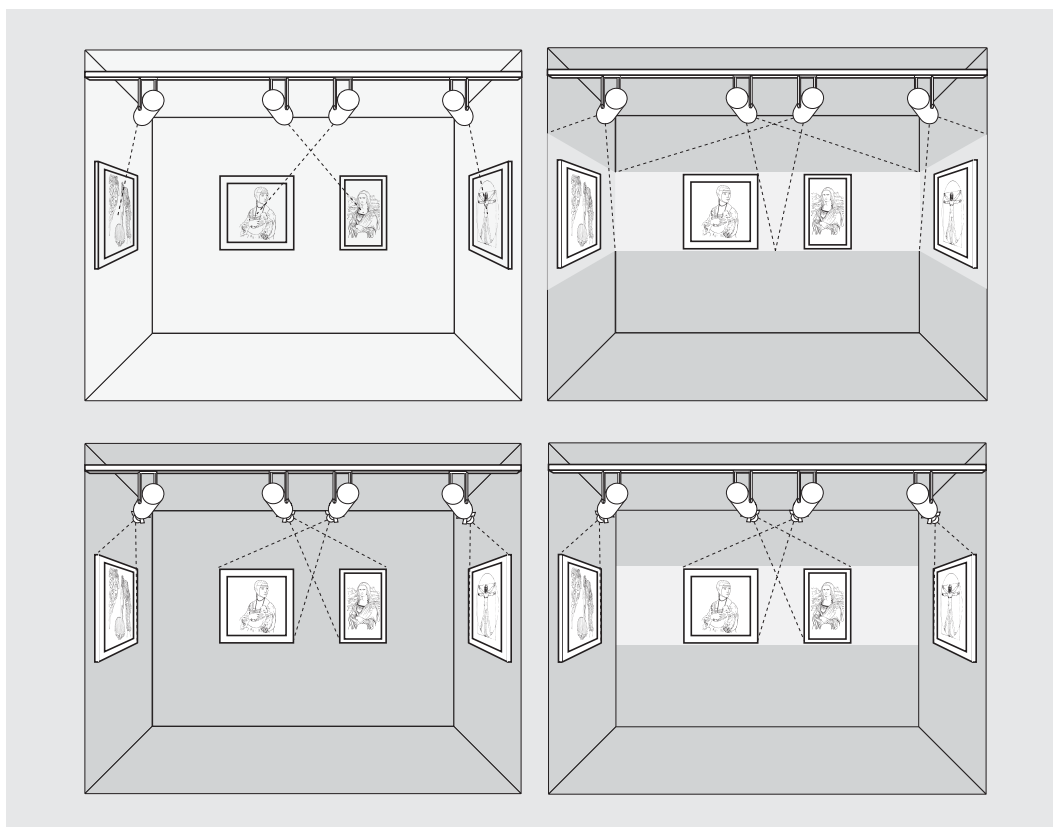
## – Lightscape

It must be considered whether the works of art are to be contemplated as a whole or as individual exhibits. In the first case we can illuminate or the entire exhibition room or groups of paintings, in the latter, the light will have to focus on one artwork at a time.

If multiple paintings are illuminated together we can perform the following lightscares:

1. uniform lighting of the whole environment, largely used in contemporary art galleries, achievable with diffusors or skylights;
2. uniform lighting of one or more walls, achievable with wall-washers, profilers or with a set of luminaires with wide beam angle;

3. collective uniform lighting of the individual paintings, achievable with profilers, sets of luminaires with medium beam angle or, in special cases and especially for drawings, with a single fixture whose light beam can be shaped with framing attachments or beam shapers, for a yet more clearly defined framing;
4. lighting over a single artwork realized with one or more luminaires with an appropriate light beam angle the size of the exhibit, eventually equipped with wings for framing the light beam to the precise size of the artwork or profilers for a more accentuated framing;
5. mixed lighting, when different types of lighting are adopted depending on the exhibited works on each individual wall.



## – Sharing of the exhibition project

Another basic element for the lighting project is sharing the exhibition design and setup. In fact we are often asked to light not only the works of art but also the display units and presentation surfaces especially, for example, the traffic zones such as the paths between the exhibition halls more than the architecture's details.

By simplifying, the scope of options ranges between two extremes which are:

1. design for simple displaying;
2. design as scenography.

In the first case the interior design is minimized for maximizing the artworks' impact and fruition.

In the second case the design is more complex and the artworks are contextualized within spaces that together with them create a one-piece display structure.

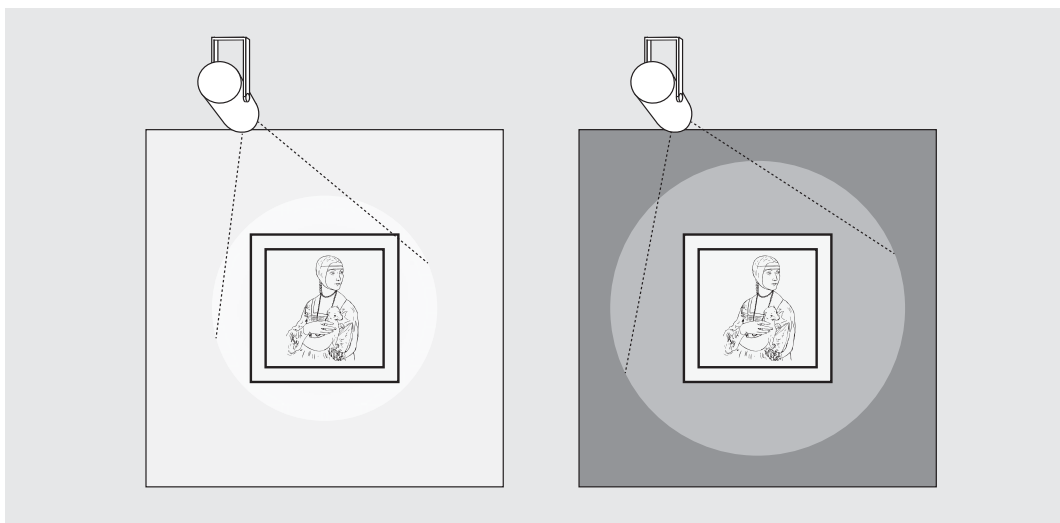
In the first case lighting the artworks would be enough, considering the neutrality of the scenic design, in the second case we must properly light also the various structures or the entire exhibition hall which does not present a scenic character.

But beyond these general observations it will be necessary to dialogue with the exhibit designer in order to avoid or at least limit the difficulties inherent to the design.

Major problems occur when:

1. the walls on which the artworks are displayed are light-colored;
2. the walls on which the artworks are displayed have a glossy topcoat;
3. the light that illuminates the artworks creates shadows caused by the exhibition room's furnishing;
4. the exhibition setup occludes the tracks where the devices should be placed;
5. there are no lighting fixtures;
6. the tracks are not placed where they should be;
7. no lighting fixture can be mounted in the room.

Each task will be examined in depth next.





### — The walls on which the artworks are displayed are light-colored

Bright walls on which the works are placed are not recommended because in these conditions the light that illuminates the surrounding area of the painting will appear very obvious.

In the case of light-colored walls it will be necessary, as far as possible, to size the light into the area of the painting. This is obtained by lighting sources with a very narrow beam angle, shaping the beam with barn doors and framing attachments, using profilers.

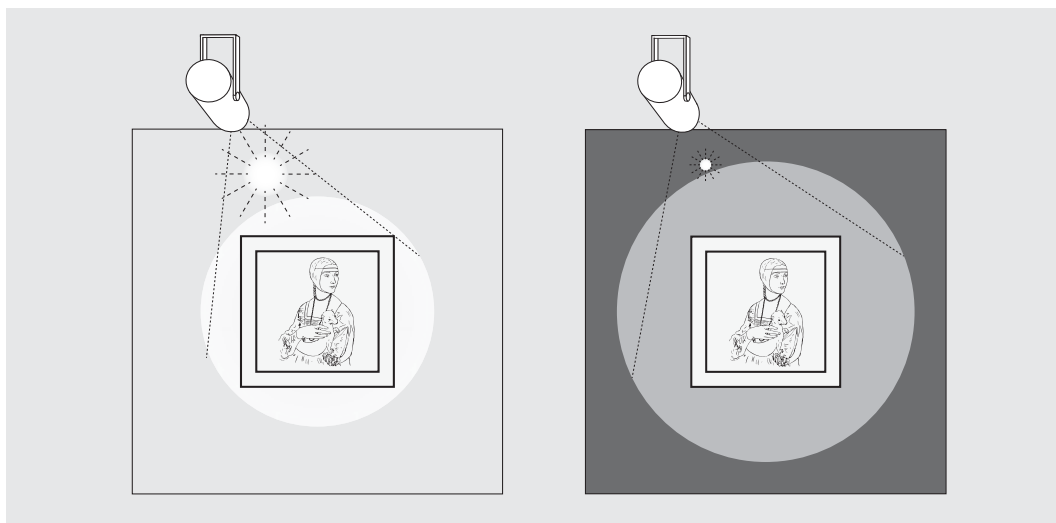
Again it would be better to discuss this before with the curator or the exhibit designer, in order to choose a less bright color.

### — The walls on which the artworks are displayed have a glossy topcoat

Another problem is with the glossy finishing of the walls.

When the light falls onto shiny walls of any color it creates reflections that end up being obvious, disturbing the view of the artworks placed on them.

In this unfortunate case, it is possible to move the fixtures so that the reflections facing the observer are at most avoided, also it is always useful to keep the light as much as possible within the confines of the frame with narrow angles, flag-mounts and profilers. It would be even better, as always, to discuss this with the exhibit designer to find a better solution. As for the finishes generally the coatings are preferred, preferably in matte cloth and even better not polished black velvet, the best of all because it absorbs all the spill light outside the painting.



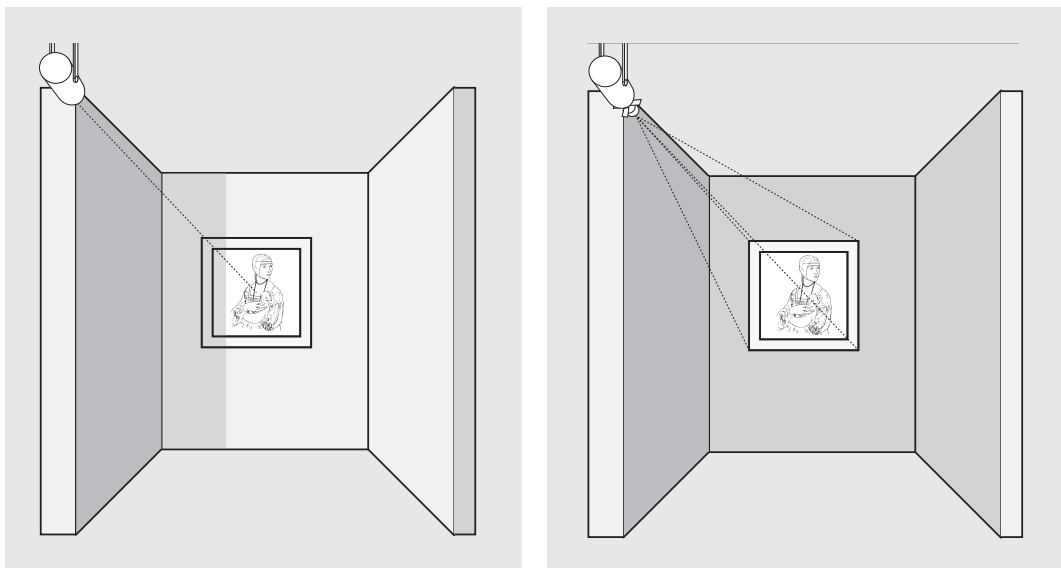
## — The light creates shadows caused by the exhibition setup

Sometimes the disposition of the display structures is not parallel to the arrangement of the tracks and follow their own pattern, this situation occurs for various reasons, it may be such that the display units are more numerous than the number of rooms available and it becomes necessary to split the spaces adding vertical walls.

Sometimes however, the exhibition designer imagines different spaces and at all coincident with the original ones in the exhibit. Obviously in these cases the best solution would be to adapt the lighting system to the exhibition project, but this is not always possible due to the available budget, or for reasons of time or for other reasons, which include for example the prohibition for legal reasons to modify the existing system.

In all these cases we must ensure that the light illuminating the paintings does not create unwanted shadows caused by the new structures, and we need to find the best arrangement for our fixtures.

Furthermore, the use of barn doors and profilers often solves the problem by eliminating the light that would affect the structures, but the best solution is always to predict these errors by discussing with the exhibition designer to determine where and how to place both the structures and the paintings.

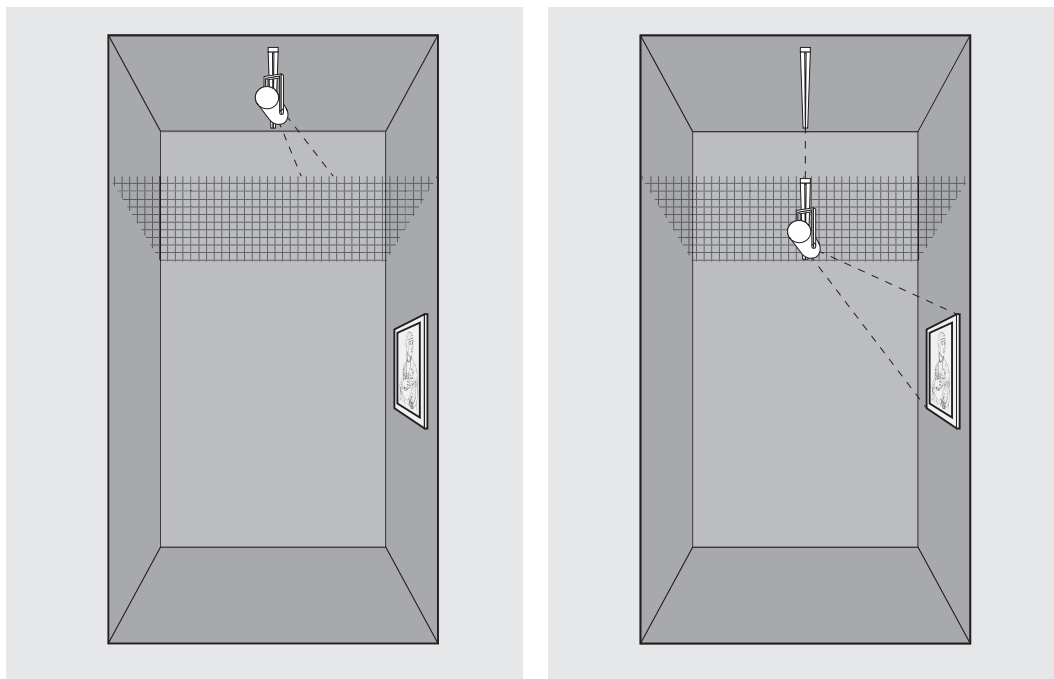


## — The exhibition setup occludes the tracks

It can also occur that the exhibition setup furnishings are placed under the tracks that should power the fixtures as often happens for the fabric membranes that can roof in whole or in part the exhibition spaces.

In this case we certainly prearrange new tracks to be placed under the fake ceiling or it

would be impossible to illuminate the paintings. But it may happen to mount the tracks just above the fake ceiling, in this case the solution is to tear apart the membrane just enough to let the adapter, that mechanically and electrically connects the device to the track, pass.



### — The tracks are not where they are supposed to be

It can also happen that the tracks are not in a suitable position for the proper illumination of the painting. In this case, if possible, add new ones to place the luminaires. Or in any case supplying power to luminaires, perhaps directly fixed with brackets on the display structures.

In other cases, mirrors can be used to reflect the light even better.

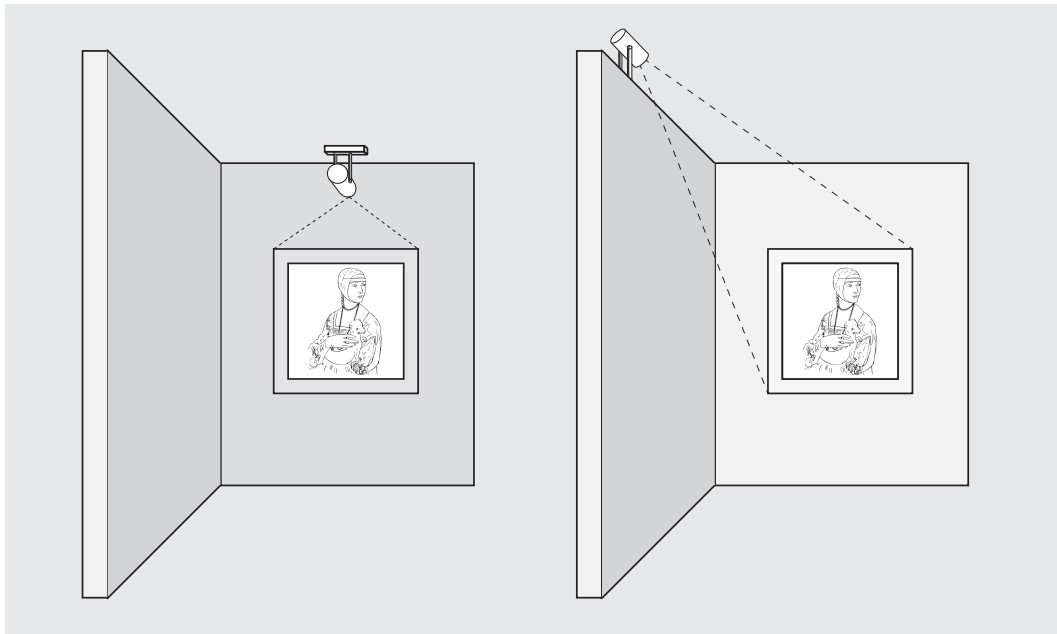
### — There are no lighting systems

Artworks may be illuminated by special stands in case no dedicated lighting fixtures such as recessed or pendant tracks are provided.

These stands are made of vertical physical structures consisting of more or less two meters high poles that branch off from heavy bases placed on the ground.

The vertical structures usually end up with horizontal bars long less than a meter to which one can directly fix the luminaires or parts of track on which the luminaires are inserted.

When using these stands be very careful with the safety of people and artworks. Therefore it is good to place the stands very close to the walls, binding them so they do not knock over and make sure that the electrical cables that connect them to the

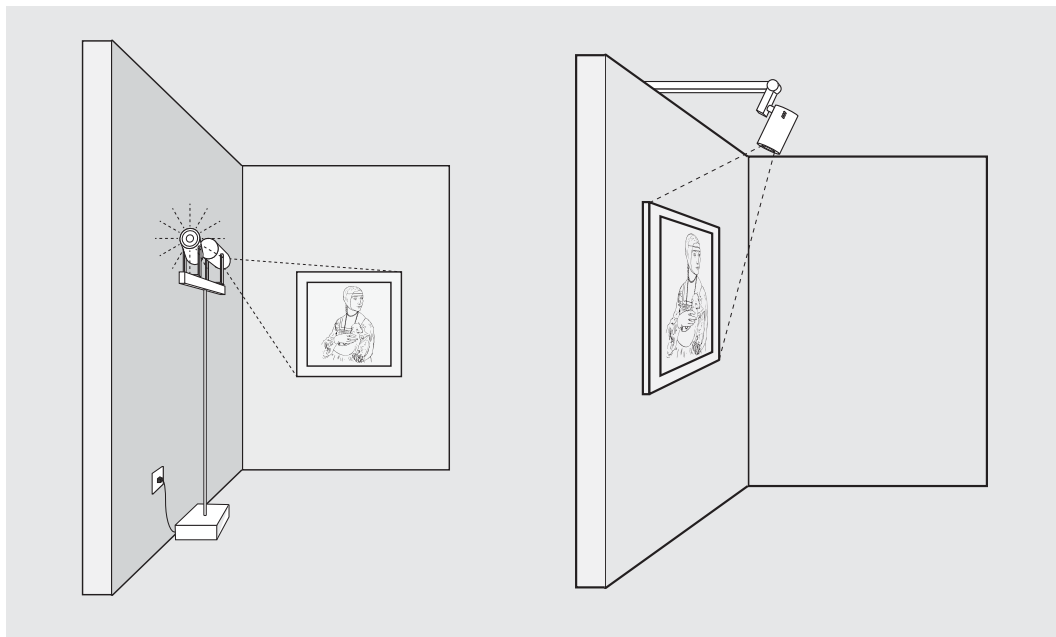


> For the Love of God – Firenze 2010 – Palazzo Vecchio – Lighting made with profilers and mirrors

socket are not element of disruption for the visitors passing by, in case of crossings it will be necessary to protect the cables with walkable cable ducts.

Another type of lighting that can be used in absence of a dedicated lighting system, is constituted by linear arms which branch off from the display structures and sustain the tracks to which the luminaires are anchored.

These arms are never too long for structural reasons, thus the units are too close to the structures and often the light illuminating the paintings causes bothering reflections on the artworks themselves, therefore, unless there are no other solutions, it is not recommended to use this type of lighting system.

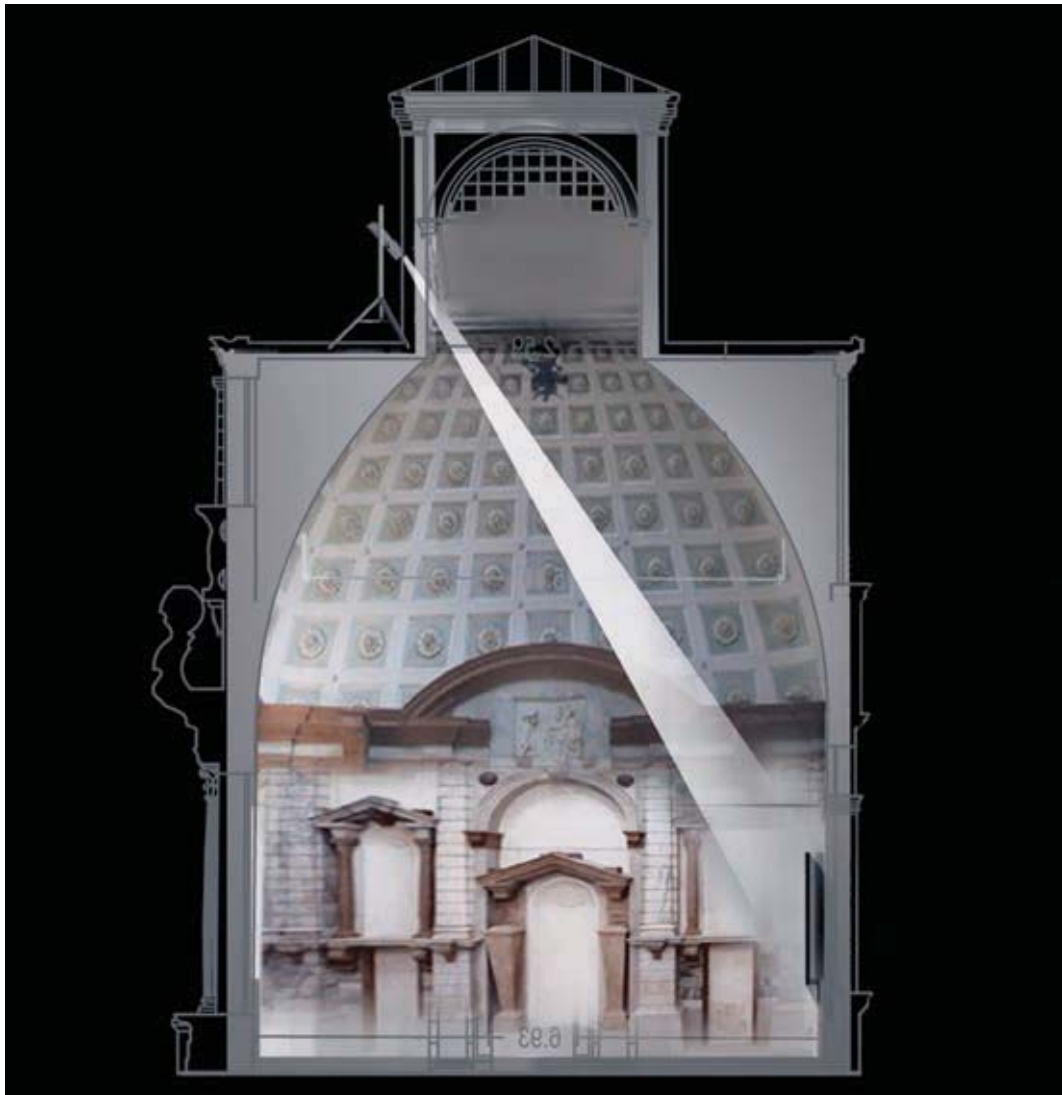


## — No lighting system can be mounted

The extreme case to encounter is when inside the exhibition hall it is not possible to install any lighting system because there is no electrical power plant. Also in this case, it must be ensured if it is possible to illuminate the artworks from an adjacent room through the entrance or even through a window or a skylight, placing the devices on the outside of the exhibition's building. Sealed lighting fixtures must be used to prevent the entrance of rainwater. Using technical terms, their protection index must be higher or equal to IP65.

If these devices are not usable, adequate provisional coverages must be used to protect them from water infiltration.

> Lighting design plan of La Tempesta – Venezia 2010 – Palazzo Grimani



— Project's data acquisition

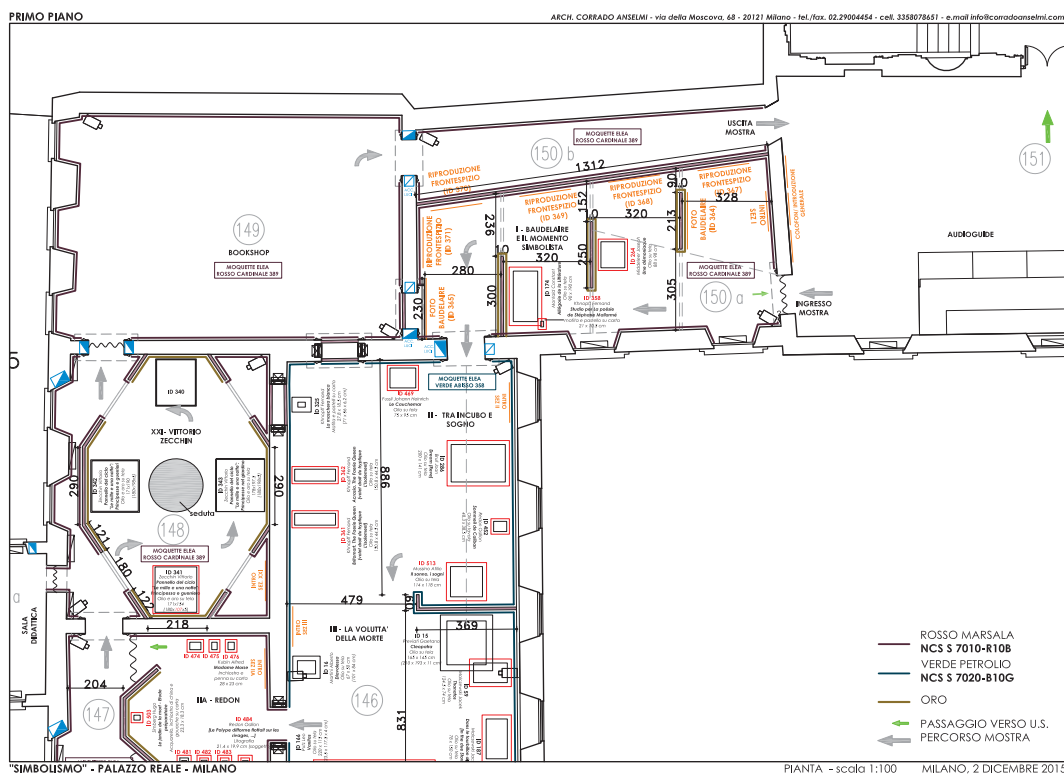
Several problems may be avoided by:

1. the knowledge of the achievable lighting levels;
2. an overview of the luminaires and lighting systems at your disposal in the exhibition room;
3. a site survey referring to the positioning of the lighting fixtures and tracks;
4. the disposition, size and typology of the single artworks as shown on the register provided by the curator and the plans made by the exhibition designer.

## Simbolismo - Palazzo Reale, Milano - 3 febbraio / 5 giugno 2016

### 1. Baudelaire, i fiori del male: alle origini del simbolismo

Artista Montald Constant  
 Titolo Allégorie de la Littérature  
 Serie  
 Anno 1899  
 Tecnica Olio su tela  
 Dim SC 90 x 190 cm  
 Dim CC 101,1 x L : 1 96,5 x 4 cm  
 Prestatore Bruxelles, Musée d'Ixelles



> **Symbolism - Milano 2016 – List of artworks and exhibition plan.**

Courtesy of architecture firm Corrado Anselmi

## Knowledge of the achievable lighting levels

Both the artificial and natural light can damage the artworks depending on the material from which they have been realized.

For this reason, recommendations have been formulated to establish the maximum amount of light that the surface of exhibited objects can support during a temporary exhibition or within an year.

The amount of luminous flux emitted from a light source and hitting the artwork is called illuminance and it is measured in lux.

The lux are shown on a tool called luxmeter which can be bought for few euros on the web. I own an expensive one, but I usually use a cheap one that works just fine.

When measuring the lux, bring the luxmeter close to the artwork (without touching it) with the sensor facing towards whom will stand in front of it.

Be careful not to measure the lux with the sensor facing the light, otherwise the values will be distorted.

Below are listed the maximum light levels that are usually asked:

- A. 40-50 LUX: extremely sensitive materials  
Silk, extremely sensitive dyes, newspapers.
- B. 40-50 LUX: very sensitive materials  
Fabrics, cotton, natural fabrics, very sensitive colorings, furs, silk, costumes, inks, prints and drawings, watercolor paintings, lacquers, wool, some minerals, tapestry, manuscripts, miniatures, wallpapers, paintings with diluted paint, gouache, dyed leather, feathers, plants, books, marker-pen drawings.
- C. 150-200 LUX: medium sensitive materials  
Fabrics with fixed colors, oil-based colors, wood panels, tempera paintings frescoes, non-painted leather and wood, ivory, bone, lacquer, some plastic materials.
- D. Over 200 LUX: slightly or non-sensitive materials  
Metals, stones, glasses, ceramics, glazes, most minerals.

## — Lux meters

I will not provide you the definition of lux, which I refer to other reports, for now. Just learn to not exceed the recommended values to avoid incurring the wrath of the museum directors or lenders that lend their artworks to temporary exhibitions.

It can happen that a lender or director decides that the lighting values for their artworks must not be lower or higher than those recommended by the recommendations in this case, once verified that he has sufficient knowledge of the standards himself, do what you are asked for, the artwork is "his".

## — The lighting equipment at your disposal

It is always necessary to check the spaces where the exhibition will take place to verify the existence of a suitable lighting system for the exhibition's design.

The lighting system usually includes electrified tracks and the available luminaires.

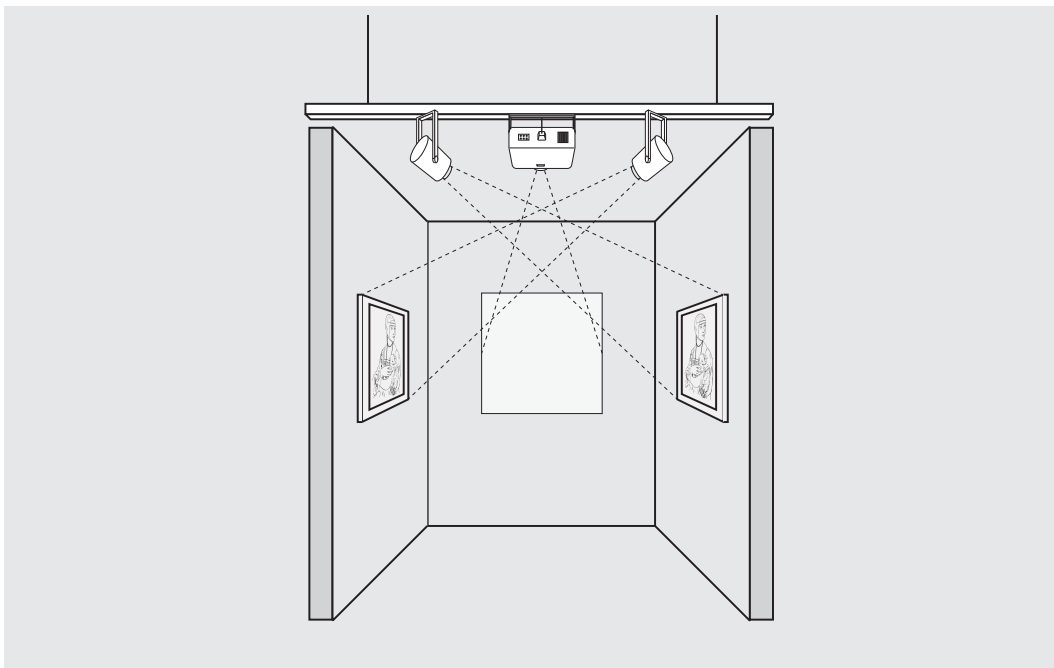
If there are tracks it is necessary to make sure they work, if they are not it is necessary to understand who is in charge of buying, installing and connecting them to the main power line. Typically the tracks are a standardized type, as 3-phase lighting track Eutrac,



meaning that within them they have three power supplies useful to distribute the loads electricity of the equipment.

The tracks can be recessed, hung or attached to the overhang (side-entry) over the walls or the exhibition structures.

The tracks suspended with cables (rod) to the ceiling are the most practical ones because just in case they can be moved and can support heavy luminaires with the brackets placed in between. Instead the recessed ones or the ones screwed to the structures are immovable.



## – The lighting equipment included in the exhibition

If the luminaires are already in the exhibition site it will be necessary to verify their operation and make a list including the number, make, model, power, lamps and available optics.

If the luminaires are equipped with incandescent bulbs, halogen or discharge lamps it will be needed to get new ones in order to minimize the maintenance due to the fact that the lamps “blow out”.

If the lamps have an incorporated reflector as the halogen dichroic MR16, it is possible to provide for its replacement with those who have the power and beam angle suitable to the requirements.

Further on we will see how to calculate these two factors.

If there is enough budget it is worthwhile to replace wherever possible the incandescent bulbs with LEDs like (retrofitting), the LED lamps last for years.

Therefore the devices do not require any maintenance, but be careful because LED lamps do not always run on old equipment and one should always perform a test before purchasing.

If the devices are equipped with non-replaceable LED sources it is necessary to determine whether at least the lenses, which allow to change the beam angle, are replaceable.

If the lenses are replaceable check which are those mounted on the devices and whether there are other ones in the storage of the site, at this point, check the plan and see if it is necessary to integrate the devices and/ or lenses, ensure also if for reasons of budget or time it is possible to buy or rent what is missing.

If the devices have fixed lenses and can not be integrated or replaced with suitable ones, immediately point it out to the organizers of the exhibition, so they will know about the problem.

Remind that this is a last resort because usually we arrange with what is found there and the more one is good with this practice the more the goals become achievable with little (or with nothing).

Furthermore, it is necessary to verify that the devices are dimmable, meaning if it is possible to reduce the luminous flux of the source .

If they are dimmable and the dimmer is integrated in then luminaire (dimmer on board) there is a wheel or a ferrule that you can spin to adjust the luminous flux.

If the devices are not dimmable then we must intervene with ND (neutral density) filters to reduce the light output of the source.

## — Dali system

DALI luminaires and tracks can be a problem because after addressing the devices, these must be dimmed from the central control zone one by one.

Usually the control zone is located in a different room and it becomes difficult to communicate with the programmer.

When you happen to work with DALI systems it would be better to disconnect them and treat the devices as standard not dimmable luminaires.

## — Relief of the exhibition rooms

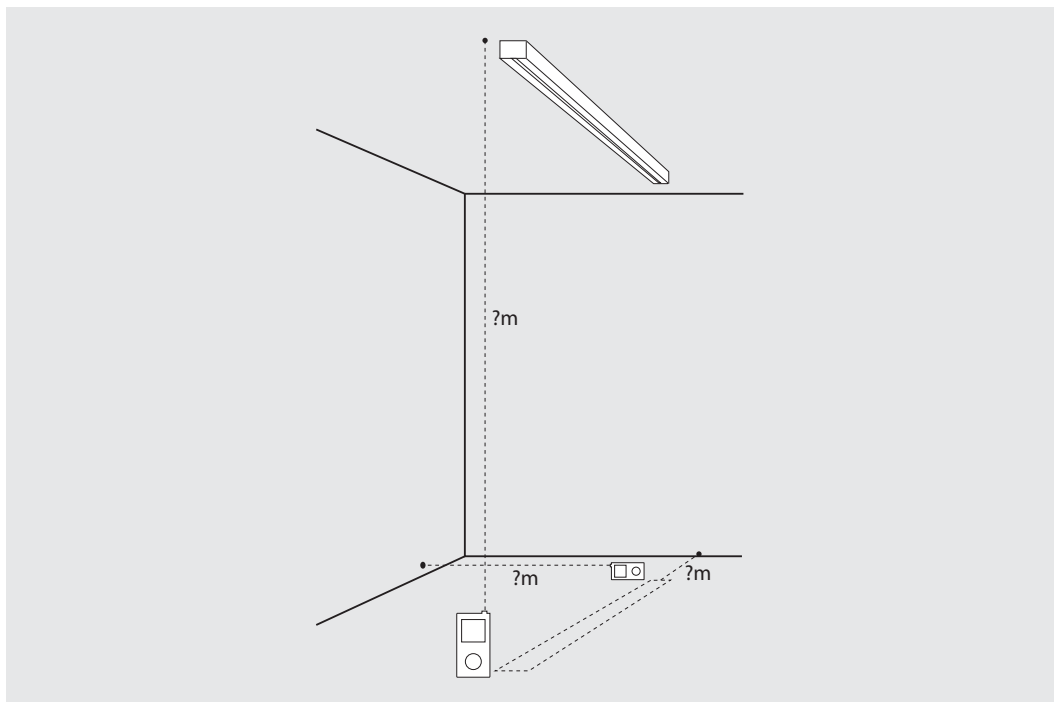
Once the system has been tested, secondly comes the relief of the existing electrified tracks in reference to the original space arrangement, regardless of the exhibition's design.

The relief will be done by measuring the length of each section of track and its distance from the ground and from the walls.

Use a laser distance measurer to measure the distance from the ground, to measure its length, with the same distance measurer, mark on the floor the projection of the beginning of the track, repeat the same operation with the end of the track, measure the distance between the two signs left on the floor.

To measure the distance from the walls it will be enough to direct the distance measurer from the signs drawn on the floor to the walls. To make sure that the distance is being measured orthogonal to the wall, repeat the process several times and report the minimum distance.

Once the positions in every room are signed and the individual rooms numbered, these will be reported on a small scale plan that will outline the entire exhibition site. The relief of the position of the individual devices is not necessary, the list described in the previous point will be sufficient. As the position of the individual devices will vary from time to time. Unless the luminaires themselves are fixed. In this situation it will be necessary to mark them on the plans of each single room.





LANDSCAPE  
19th century  
oil on canvas



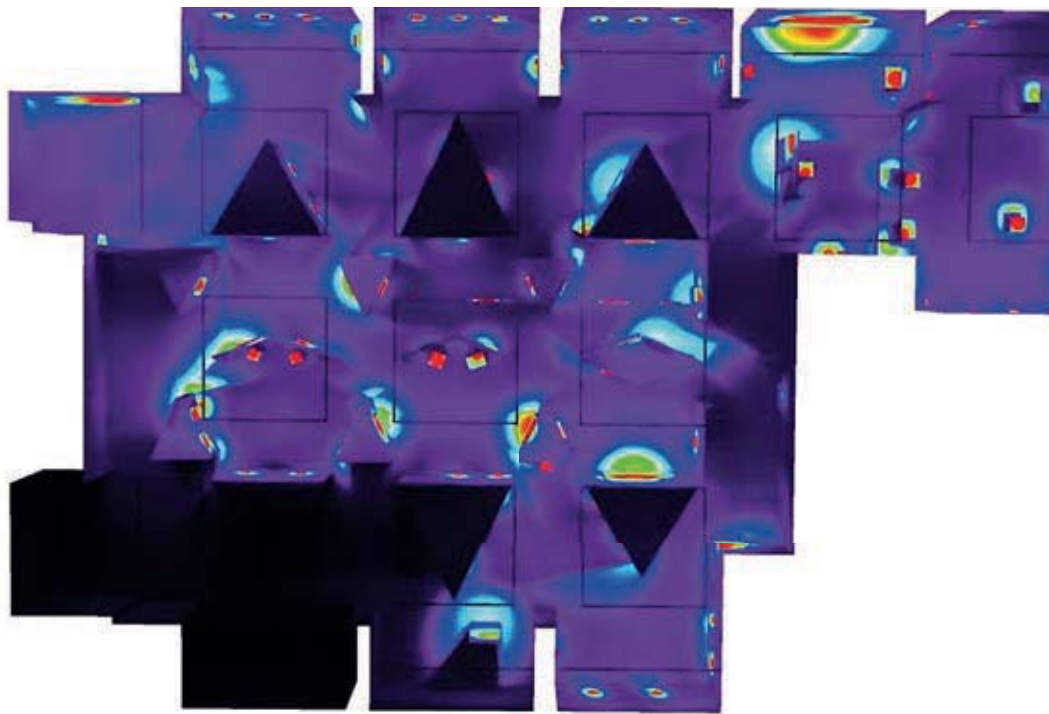
LANDSCAPE  
19th century  
oil on canvas



> Escher – Treviso 2015 – Museo S. Caterina – disabled DALI System

## – Position, size and typology of the single artworks

The plans provided by the exhibition designer contain indications about the position and size of the individual exhibited artworks in the individual rooms, also typically the companies in charge of planning the exhibitions provide a detailed list of the artworks with descriptions regarding the techniques, the size, the encumbrance of the frames, the authors, the year of realization etc, all important informations for the lighting calculation output that may be finalized for each and every point or in reference to the entire environment, in this case a software for automatic calculation is used, I use Dialux for example.



> Modigliani and the Paris Bohème– Torino 2015 – GAM – Dialux rendering of the general plan

The lighting calculation allows you to know the exact location and type of luminaire, lighting source, power and necessary beam angles to ensure the lighting levels on each of the exhibits.

The lighting calculation provides the required amount of light (but not the quality of the light) and it is essential for the graphic documentation of the project.

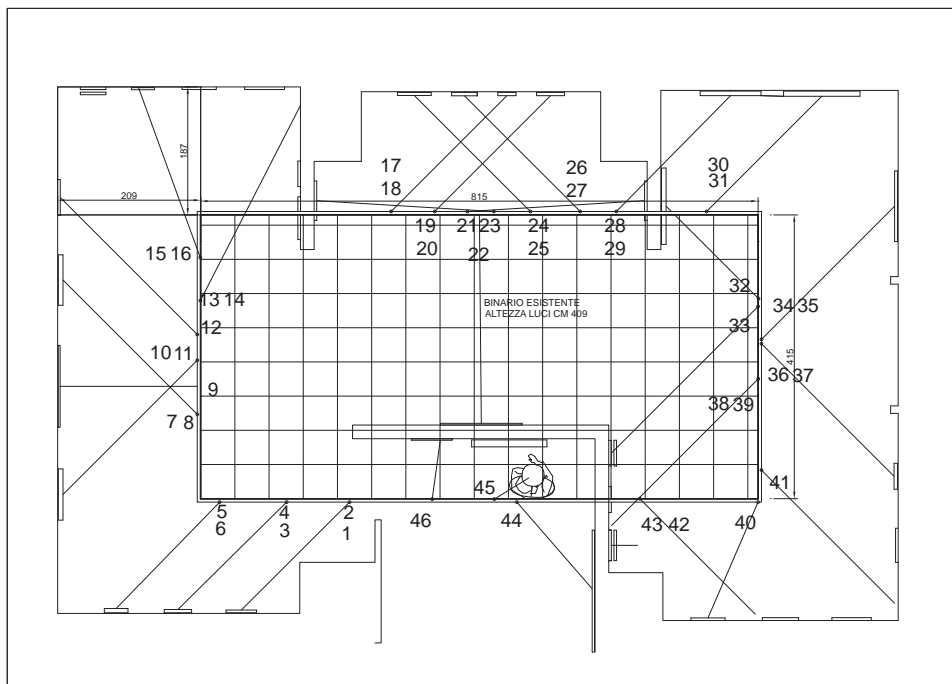
## – Graphic documentation

The graphic documentation to be delivered at the persons in charge of the exhibition; the exhibition designer, the lighting technicians whom will direction the lights, are made from printed documents obtained by the automatic calculation program accompanied by the lighting plan that derives from them.

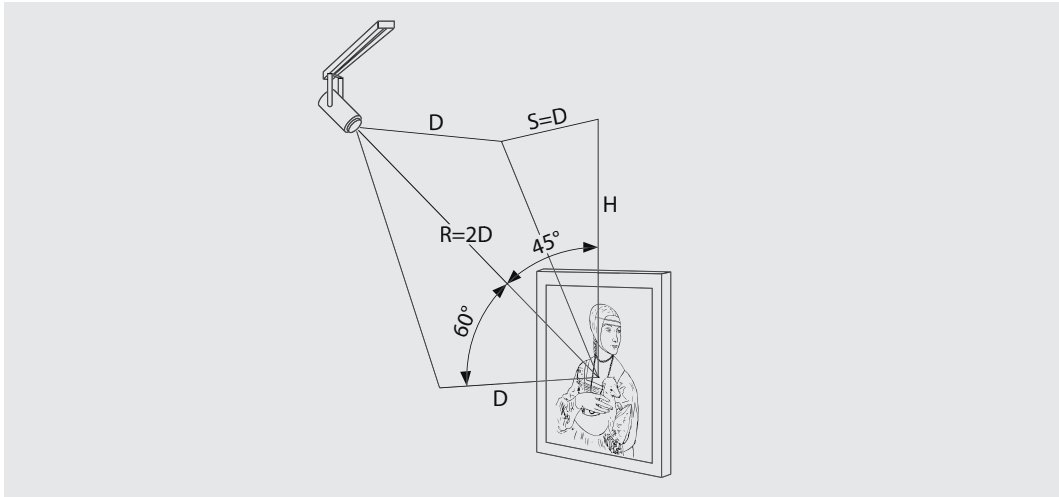
The documents supplied in output from the calculation software are typically made of data referring to the sources, the devices, their location, the lighting levels of the rooms and/ or paintings with the technique of false colors and with the technique of the isolux curves.

The lighting plan consists of a simplified graphic. This shows in plan, for each single room numbered in progression: the exhibits, tracks, location of the luminaires and selected sources.

The set of plans related to the individual rooms is preceded by a general plan of the exhibition. Here are shown all the rooms in the center of which is placed the reference number followed by a summary table indicating the luminaires, sources and filters used. These simplified graphics will serve to place the devices in the position identified by the designer, in this regard it is worth remembering that it is more practical to have the plans of the lights divided by the individual numbered rooms, each one printed on an A4 sheet of paper, easy to handle and to photocopy.



## – The tracks' arrangement



Usually exhibition sites present two cases:

- they have tracks;
- they do not have tracks.

In the first case there is also the possibility that the tracks can be moved and the case therefore falls within the issues of the second case, if instead they can not be moved, be sure that other tracks can be added, if they can not be added we have to make a deal with the existing lighting system.

If the arrangement of the tracks can be decided, it is better to place them as much as possible at the same distance thought-out from the walls, and so as to realize rectangular rings that are concentric to the said walls. These rectangles must take into account the size of the tracks which are one-meter modules. Therefore, the real distance is not always corresponding to the theoretical one.

Of course another option is to cut the tracks, but this operation is often useless, because it does not significantly change the final result. To calculate the distance of the track from the wall on which the paintings are placed we start from one simple question: which is the optimal position to place an ideal luminaire for an ideal painting?

In many manuals this point is located in the upper edge of the picture at a distance such that the line between this point and the center of the painting forms a 30 degree angle with the vertical line passing through the same center.

Instead I prefer locating the luminaires in a position so that the line between this one and the center of the painting creates a  $45^\circ$  angle with the vertical line passing through the same center, and that this line is inclined of  $45^\circ$  to the left of the painting



from the observer's line of viewing.

The reasons of this choice are:

1. there is less danger of reflections since the light proceeds diagonally;
2. the shadows are less noticeable over large frames;
3. the light emitted 45 degrees to the left is typical of architectural drawings (after all I am an architect ...).

The line that branches off from the center of the painting and travels to the left of the painting itself will eventually meet the plane on which the tracks are located.

The plane may be real as in the case of recessed tracks, or theoretical as the case of pendant tracks, in each case the parallel to the wall of the exhibition room will pass to the intersection point of the line with the plane. This line has a distance from the wall equal to the distance from the center of the painting to the real or theoretical horizontal plane on which the track is placed (minus the size of the luminaire) times 0.707. For example, if the horizontal plane of the track is at 2 meters from the middle of the painting, the distance of the track from the wall is:  $D = m (2.0 - 0.30) \times 0,707 = 1,19 \text{ m}$ . Now that the distance of the track from the wall is determined it is possible to determine the displacement of the luminaire from the vertical plane orthogonal to the wall itself and passing through the center of the painting. This distance will as well match, in the given example, 1.19 m.

H	D = H x 0,707	S = D	R = 2D	DIAM 50W36°	BRIL 50 24	BRIL 35 10	BRIL 20 10	BRIL 20 24	BRIL 35 36	BRIL 50 36	BRIL 35 24
				cd	cd	cd	cd	cd	cd	cd	cd
				4100,000	4400,000	13000,000	2200,000	1300,000	1500,000	2200,000	3100,000
meter	meter	meter	meter	lux	lux	lux	lux	lux	lux	lux	lux
'0"	0,495	0,495	0,990	2092,469	2245,576	6634,657	1122,788	663,466	765,537	1122,788	1582,110
'1"	0,566	0,566	1,131	1726,077	1719,269	5079,659	859,635	507,966	586,115	859,635	1211,303
'2"	0,636	0,636	1,273	1448,125	1358,435	4013,558	679,217	401,356	463,103	679,217	957,079
"	0,707	0,707	1,414	1232,279	1100,332	3250,982	550,166	325,098	375,113	550,166	775,234
"	0,778	0,778	1,555	1061,327	909,366	2686,762	454,683	268,676	310,011	454,683	640,689
"	0,848	0,848	1,697	923,630	764,120	2257,626	382,060	225,763	260,495	382,060	538,357
,"	0,919	0,919	1,838	811,090	651,084		325,542	192,366	221,961	325,542	458,718
"	0,990	0,990	1,980	717,932	561,394	1658,664	280,697	165,866	191,384	280,697	395,528
"	1,061	1,061	2,121	639,948	489,037	1444,881	244,518	144,488	166,717	244,518	344,548
,"	1,131	1,131	2,262	574,014	429,817	1269,915	214,909	126,991	146,529	214,909	302,826
0"	1,202	1,202	2,404	517,768	380,738	1124,907	190,369	112,491	129,797	190,369	268,247
1"	1,273	1,273	2,545	469,401	339,609	1003,389	169,804	100,339	115,776	169,804	239,270
2"	1,343	1,343	2,687	427,509	304,801	900,549	152,401	90,055	103,909	152,401	214,746
"	1,414	1,414	2,828	390,984	275,083	812,745	137,542	81,275	93,778	137,542	193,809
"	1,485	1,485	2,969	358,947	249,508	737,184	124,754	73,718	85,060	124,754	175,790
"	1,555	1,555	3,111	330,693	227,341	671,690	113,671	67,169	77,503	113,671	160,172
,"	1,626	1,626	3,252	305,648	208,002	614,552	104,001	61,455	70,910	104,001	146,547

> Sources' selection comparison chart

## — Luminous intensity

Now we can determine the radius between the spotlight and the center of the painting. This distance is equal to twice the displacement. That is, for the former example 2.48 m as it is easily verifiable by applying the Pythagorean theorem to the set of triangles that emerge. Now it is possible to calculate the light intensity in candelas (CD) which will allow us to have the desired lighting levels on the artwork, taking as values:

- $E_{\text{max}}$  on the paintings = 170 lux
- $E_{\text{max}}$  on the incisions = 100 lux
- $E_{\text{max}}$  on watercolors and pastels = 40 lux.



The cosine law tells us that the illuminance E in Lux detectable on a point placed at the center of the artwork and that is emitted from the source is equal to

$$E \text{ (lux)} = I \text{ (cd)} \times 0,5 / (2D)^2$$

where 0,5 =  $\cos 60^\circ$  and is the angle that the optical axis D forms in the point with the perpendicular to the wall on which the light source is placed.

To obtain the value in candelas, apply the inverse formula. Therefore:

$$I \text{ (cd)} = E \text{ (lux)} \times (2D)^2 / 0,5$$

this will allow us to select a source with luminous intensity closest to the established one.



## – Beam angle

Regarding how to calculate the luminaire's opening angle, in general and in practice, the selected beam angle is the one that allows the artwork to be fully illuminated.

Most commonly used projectors, emit a symmetrical and conical beam but, given the inclination, this beam will trace on the wall the area of a bright ellipse.

To calculate the right beam angle, start from verifying the available ones from the product's data sheet; the data sheet also includes: type of source, the power in watts and the luminous intensity expressed in candelas.

The beam angle will be chosen so that the artwork can be inscribed in the ellipse projected on the wall and the luminous center will not be found in the middle of the ellipse but it will be shifted to the upper right or left depending on the direction of the light emission's origin.

Also for this reason the measurement tasks and illuminance control are essential on site and the position of the maximum illuminance on the painting depends on the critical assessment of the lighting designer.

Typically the devices have three types of beam angles that correspond to the narrow,



> The primacy of drawing – Milano 2015 – Pinacoteca di Brera

medium and wide angles. Several devices, also LED, present beam angles of 10, 24, 36 and 60 degrees. The 60° one is rarely used and I tend to use sources with very narrow beam angles, in the case of very large paintings there can be used more luminaires to lit the entire surface of the painting.

## — Usable sources

Now we define the selection criteria in reference to the usable sources.

Generally, in museums and exhibit halls adopt triple-phase tracks, that means equipped with three supply lines.

Devices that support halogen, discharge and LED sources can be mounted on these tracks. Discharge lamps are not recommended because once switched off they do not switch on quickly and that's a problem because although the rooms are lit by emergency lighting systems, the right visual experience of the works is compromised for some time. This leaves halogen sources and LED bulbs.

Devices that support halogen lamps are:

- halogen reflector-less lamps
- halogen lamps with integrated reflector.

The reflector-less halogen lamps are typically halogen capsules operating at 12 Volts with GU 5.3 base and typically have a power of 20, 35 or 50 Watts.

Around these sources are placed reflectors that allow the light to be emitted with beam angles typically of 10, 24, 36, 60 degrees. It is often possible to change the type of reflector using the same luminaire and the same type of source in different situations.

The sources with integrated reflector most commonly used for lighting art are the dichroic with GU 5.3 base. These also operate at 12 Volts and have an output of 20, 35 or 50 Watts and beam angles of 10, 24, 36, 60 degrees.

These are essentially the same sources described before around which, during the production, is connected a dichroic glass reflector.

Other usable halogen sources are the AR111 with GU 5.3 base, also 12 Volts, with a power that ranges from 30 to 100 Watts and with beam angles of 4, 8, 24, 45 degrees. AR111 lamps allow to direct large amounts of light in very tight corners and are therefore essential in situations where the requirement is to illuminate small paintings at a great distance.

Nowadays, both the dichroic and AR111 lamps can be replaced by LED lamps that have the same size (retrofitting).

There are also many other reflector-less LED luminaires, in such devices, the beam angle can be adjusted by lenses, masks, fixed or interchangeable reflectors.

This to allow different beam angles without completely replacing the devices.

There are also “zoom” equipped devices, meaning that in order to change the beam angle it is simply needed to spin a ferrule. I personally prefer this solution because it is more practical than reflectors and interchangeable masks.

## — Color temperature

The analysis of the artist’s artwork gives us guidance in the selection of the type of lighting to be implemented and first of all the color temperature or better the tone of white light. This ranges from a warm white to a cool white, these shades of white color are technically called color temperature. Generally for paintings are preferably used a warm white lighting at 3000K or cool 4000K.

K stands for Kelvin, and contrary to what happens for the temperature measured in Centigrade degrees, high values stand for cool brightness.

If lighting up old paintings, till the impressionism, warm tones are preferred.

Cool tones instead are better used for recent ones.

But there is also the possibility to lit an artwork with mixed warm and cool white, which enhances all the colors in a painting. I suggested this technique in several exhibitions always achieving good results.

The only drawback is constituted by the fact that this takes a double amount of lighting fixtures. While the double shadow generated by the painting is minimal and does not bother. To calculate the exact mixture of warm white 3.000 K and cool white 4000 K, the cool shall produce about 30 lux and the warm around 140 lux, amounts that together will produce the overall 170 lux desired.

## — Project choices

Once all of the necessary informations are acquired and the plans and requirements’ list useful for the exhibit designer and the electricians are set up, the light directioning phase can take place.





> Edward Hopper – Roma 2010 – Palazzo Cipolla – Lighting made with mixed light

All these actions must be carried out on site because:

1. none of the artworks will ever be placed in the exact location as shown in the project;
2. curators can at any time choose a different location;
3. the relief in our possession may not be accurate;
4. tracks may be in a different position from the indicated one;
5. the light sources can present light intensities different from those contained in the catalogs (for age or manufacturing defects);
6. luminaires can have different performances from the expected ones;
7. the light on the artwork does not "satisfy the eye".

Obviously this does not mean that the eye is the only reference, because the lighting levels should not be exceeded, or risking the curator's/ lender's fury, to avoid serious damages to the artworks.

But we must always remember that the purpose of a good lighting is the enjoyment of the exhibits and that the respect of the amount of light is useful to the preservation but tells us nothing about the quality of lighting.

## – Blur

Whether the calculation is made by applying the cosine law point by point or is carried out automatically with a software and extended to the whole room, nothing will tell us about this borderline that is in my opinion the most important and useful to achieve a good lighting.

The line that delimits this zone should be invisible from my point of view.

The light must fade into the shadow with an effect that in editing programs is called “blur”.

This does not mean that the light should not be focused on the artwork, but there should be a balanced soft-edged shadowing. From the area of maximum intensity it should move to the less bright one without there being an obvious and net jump.

This effect is always possible to achieve using very narrow beam angles and diffusion filters. But the best way to illuminate a painting is to employ a profiler and smooth



> **Modigliani and Paris Bohème – Torino 2015 – GAM**

*Blur effect obtained with MR16 dichroic lenses and diffusion filters*

the light on the frame with a filter diffuser.

In this way, the painting will appear completely and perfectly illuminated but without the profiler creating what is called a slide effect.

That is, without the light being a bright shape in a dark field.



Besides, this way of lighting avoids to clearly shaping the light on a painting. Furthermore, it also avoids black lines to form at the upper part of the painting and straylights on the bottom of the frame or on the wall, as time passes by and the position of the luminaire unavoidably lowers down.

## — Light directing

The phase of directing the light on the paintings is the most important and delicate stage of lighting art. Once the device is placed on the track as indicated by the lighting plan, it will be necessary of course to turn it on and position it towards the painting.

This operation will be done giving precise indications to the technician in charge, whom generally stands on a ladder or better a scaffolding to move the device following our instructions. I always use a laser pointer to indicate the correct position of the device on



**> Seurat – Van Gogh – Mondrian – Post Impressionism in Europe – Verona 2015 – Gran Guardia**

*Light directioning made with profilers and blur effect on paintings with oversized frames*

the track, addressing the light upper or lower, left-most or right-most because the voice commands can be misunderstood. This stage of directing is to be carried out in all light, that is, not dimming or filtering the emitted light. However, it is not said that the optimal positioning is the one that illuminates uniformly the painting. For example, whether the

painting portrays a face or a group, which is the subject of the picture, sometimes it is better to direct the light towards this. If there are clear reflections or unwanted shadows, it is better to move the luminaire immediately and find a better position. This often requires much time and patience.

### — The light beam is too narrow

If the positioning is right, but the light that invests the painting is too narrow, it will be necessary to replace the luminaire, the light bulb, the reflector or the lens.

Furthermore, more devices can be directed on the same artwork in order to hatch the entire painting with light. If substitutions or additions are not possible, it is possible to widen the beam angle with a filter diffuser in film.



> Tamara de Lempicka – Verona 2015 – Palazzo Forti – Brushed Silk Filter

A "Silk" filter can also be used to widen or lengthen the beam in one direction. This is useful to illuminate a number of paintings close together, a particularly wide or long painting or a sculpture. To change the orientation of the light from portrait to landscape simply rotate the filter on the luminaire. To fix the filter, in absence of filter cassettes or different accessories; high-temperature resistant adhesive tape as well as metal paper clips, as those used in stationery, can be successfully used.

## – The light beam is too wide

If the light beam appears too wide and also in this case it is not possible or convenient replacing the luminaire, the bulb, the reflector or the lenses, barn doors shall be added to eliminate the spill light.

For example, I do not particularly enjoy the area of light that hits the part above the painting, therefore I use barn doors to reduce it or eliminate it.

Unfortunately with the Multi-LED devices barn doors do not work and it is practically impossible to reduce the beam without changing the transparent micro-prism mask that acts as a lens. In addition to barn doors it is possible to use the Cinefoil which is made of a thin film of black aluminum sold in rolls or strips to be connected to the luminaire as usual with tape for high temperatures or with metal paper clips.



> Bosch – Venezia 2010 – Palazzo Grimani – Profiler with White Diffusion filter

Profilers eliminate all problems and define the precise area of light on the painting. To avoid the slide effect it will always be better, as already said, to place on the profiler a light diffuser filter.

Furthermore, the same type of filter can be placed on regular projectors to realize a faded light on the walls surrounding the painting.



> Tamara de Lempicka – Torino 2015 – Palazzo Chiabrese – Profilers with diffusion filters and ND

## – Artworks are overly bright

Once the light is defined, it will be necessary to measure the illuminance on the painting. In general, as already mentioned, it would be better if this goes around 150-170 lux for the paintings on canvas or on board and 40 lux for artworks on paper.

The illuminance will be measured with a light meter with the sensor parallel to the wall and facing the observer, preferably calibrated with the exhibition managers to avoid disagreements.

If the illuminance is higher than the expected it will be needed to reduce the light emitted from the luminaire. This may be achieved in various ways.

The first and more convenient consists in working on the dimmer's ferrule.

This operation will be performed by the lighting technician, while the lighting designer will check on the lux meter the achieved illuminance levels.

If the device is not dimmable, the emitted amount of light can be reduced with ND filters, which stands for neutral density, because in theory they reduce the light intensity without altering the color of the light (but actually the color becomes a bit green). ND filters can be found in three shades corresponding to the numbers 209, 210 and 211. One or more filters must be placed in front of the luminaire until the desired value is reached; once that value is established, the filters may be inserted in the additional filter holder or connected to the luminaire with the usual high temperature resistant



> From Raphael to Schiele – Milano 2015 – Palazzo Reale – 5000K Sources with conversion filter

tape or metal paper clips.

It is also possible to reduce the brightness with diffusion filters since also these absorb light. But in such way light will be softer and less bright.

As a last resort it is possible to further tighten the barn door wings. But this will also tighten the light reaching the artwork. This last action is recommended only when it is required to reduce the illuminance of a few lux.

## – The light that hits the artwork appears too warm or too cool

It may also happen that the tone of white is too warm or too cool for a given artwork.

As noticed above, warm lights are generally used for old artworks instead cool ones are mostly used for contemporaries.

In technical terms we can say that 3000K sources can be used for warm lights and 4000K for cool lights where K stands for Kelvin.

If the exhibition is provided with warm white light sources while the requirements are to illuminate the paintings with a cool white light source, there are several ways to intervene.

First of all it must be verified if the sources can be changed; if the light bulbs are dichroic MR16 with GU 5.3 base, a dichroic cool light as Osram's Cool Blue Decostar that generate 4100K light can be used. Unfortunately these light bulbs are made only





> Caravaggio "The nativity" (clone) – Palermo 2015 – Oratorio di S. Lorenzo

with a 36 degrees angle, too wide for small size paintings.

No problem occurs if instead there are cool light bulbs to be replaced by warm ones. In this case we can use the excellent Philips Brilliant Line, that are produced with different powers and beam angles. Same for the MR16 LED because it will always be possible to find a corresponding 4000K source.

In the case of luminaires with irreplaceable bulbs, it is possible to intervene with conversion filters. To switch from warm to cool it occurs a 202 filter always LEE Filter to switch from a cool to a warm a 205. On LEE Filter website there is a useful Color Temp Calculator with which, given an initial color temperature and a desired one, it is always possible to find an appropriate conversion filter.



> Giorgione – Venezia 2010 – Palazzo Grimani

## — Aesthetic fulfillment

After the luminaires' positioning, filtering and verification of lighting levels phases, we have to control that the lighting of the painting convinces us.

If we are not satisfied we will have to ask the lights technician to slightly move the luminaire, just a few millimeters shift to find the right light and it takes passion and patience both from us and from the technician on the ladder.

What is then the right light is hard to say and it depends on our sensibility. But there is a time in which the painting communicates with us and appears to us in all its beauty. At the end, find this time that corresponds to one single position of the luminaire and to one single direction of the light and fix it for the whole duration of the exhibition.



## – Lighting for the environment

Ambient lighting is a minor point in the illumination of paintings.

I do not prefer to light the environment where the artworks are exhibited.

Instead, I believe it is better to focus the light on the artworks, ensuring that the ambient “lives of reflected light”.

This position is often at odds with the exhibit designer whom naturally wants the exhibition design, the technical solutions adopted and the colors to emerge.

By the way, it is possible to find an intermediate solution that, while not imposing the structures on the exhibited works, constellates the room of light making it visible.

At least that much to prevent visitors from falling or getting lost in the dark.



> Sculptures from Santarelli and Zeri's collection – Roma 2014 – Palazzo Sciarra



It is possible, for example, to illuminate the floor at the entrance of each single room. This will help to realize a light path. At the same time it is possible to illuminate the ceilings with a mild light or illuminate the walls on which there are no exhibits or sittings which are often placed in the environment for the visitors to rest.

All these solutions are obviously taken in the case of an accent lighting on the artworks.

It would make no sense in the case of a uniform illumination of walls and rooms.

Even in these cases, however, it may be better to opt for an accent light on the artworks in order to facilitate a visual hierarchy.

## — Lighting for the sculptures

An exception is made for the sculptures' lighting that often are part of the exhibition. Although the rules of a good theatrical lighting prescribe three lights for the figures: a key light, a filling light and a backlight. Sculptures in an exhibition will instead be lit with one single light because more of them would produce a bothersome double shadow on the walls.

Still, it is fine to illuminate a sculpture with more lights if this is placed far away from the walls and if the lights do not cause unsuitable shadows.

Therefore, it turns useful to have on the luminaires a sculpture filter or a Silk filter to "verticalize" the light beam.

Sculptures, even more than with the paintings, tend to dialogue with the observer.

In fact, there is a specific position for directing the lights so that this is reflected by the artworks towards us. The right light happens to be when the sculpture shines.

## — Lighting for the graphics

The term graphics is intended as all the display panels with written informations and drawings that guide the visitor throughout the various sections of the exhibition.

These panels will be uniformly illuminated with 20 or 30 lux, this is not a prescribed value but it is useful to read the content of the panels without the light to be disrupting or goes beyond the one used for the artworks.

It happens sometimes that the graphics are backlit and appear as boxes in which lighting fixtures are placed, usually fluorescent lamps and lately LED light panels lit from the side. With the graphics this work about the issues related to the lighting of artworks ends for now. Tasks as lighting for bookshops, or the cafeteria, as well as the reception and ticket office are not treated because these present distinct environments with different characters and different problems relatively to the ones of the exhibited artworks, which were specifically treated in this text.

# Pieter Brueghel il Vecchio

(1525/30 – 1569)

Capostipite della più celebre dinastia di pittori fiamminghi, si interroga sul mondo attraverso una critica graffiante dei vizi e delle follie umane. Narratore attento degli aspetti grotteschi e quotidiani della realtà, crea un'opera ricca di contenuti morali. La sua pittura spazia dalla raffinatezza intellettuale all'espressione dei proverbi popolari.

Head of the most celebrated dynasty of Flemish painters, Brueghel investigates the world through an insightful criticism of the vices and follies of mankind. A meticulous narrator of the grotesque aspects of daily life he created works of intense moral content. His paintings range from intellectual elegance to an expression of popular proverbs.





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### **Francesco Murano**

He illuminated the most important exhibitions held in Italy from Raphael to Klimt from Bosch to Basquiat.

Architect, obtained a master at the Domus Academy and a PhD in Industrial Design at the Politecnico of Milan with a degree thesis entitled "Le figure della Luce" .

He carried out academic, scientific, research programs and design activity for important Italian and foreign industries as well as national and international Cultural entities and Institutes. His projects and products have been published by several interior design national and international magazines.

He has been a member of the research staff of both the Domus Academy and the Tapey Design Centre and Coordinator of the Master in Lighting Design at the Istituto Europeo di Design of Milan. He is currently Assistant Professor at the Scuola di Design and member of the Lab "Luce e Colore" of the Politecnico di Milano.

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Arch. Guido Jaccarino

Archiroom Architetti Associati

Associazione Italiana Exhibition Designers

Keycommunication

Panstudio Architetti Associati

Studio Premoli Silva

List of artworks from the Exhibition "Boudelaire,  
i fiori del male alle origini del simbolismo"  
kindly lent by Sole 24ore cultura.

Plans of the Exhibition "Boudelaire,  
i fiori del male alle origini del simbolismo"  
by Studio Architetto Corrado Anselmi.

Dialux project of the Exhibition  
"Modigliani e la Bohème",  
realized by Architect Stefania Mittiga.

Pictures of the Exhibitions Bosh and Giorgione  
at Palazzo Grimani followed by Giorgione and Giò Polti  
at Ca' d'oro, Venice, by Architect Barbara Nodolo.

All other pictures are kindly lent  
by Società Arthemisia Group, photographers:  
Fabrizio Stipari, Danilo Alessandro, Pierluigi Siena.









*Quick and complete manual for the lighting of paintings,  
sculptures and spaces within art exhibitions.*

*In Italy plenty of art exhibitions take place each year exposing thousands of artworks, hosting millions of visitors aiming to broaden their culture through the direct observation of paintings, drawings, sculptures, lit by artificial or natural light. Light for art exhibits is mainly used to lit artifacts but it also absolves other functions, as to provide optimal visual conditions for security, way finding, captions' and introductive graphics' reading, accentuate entrance banners, bookshops, ticket offices and so on.*

*During the course of my lectures, I have realized how difficult it becomes for a student or an interior designer to approach a lighting design project through the reading of textbooks and manuals which are basically optical physics' essays with the capacity of discouraging more then attracting the inexperienced ones.*

*This is the reason why I chose to write this brief treatise aiming to sort out and systematize what one should know about when lighting a painting by Raphael, a drawing by Leonardo, an artwork by Warhol or Damien Hirst's skull.*

