STUDIES AND ANALYSIS OF MODERN LIGHTING DESIGN THROUGH SOME PRACTICAL PROJECTS

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CERTIFICATE OF RECOMMENDATION

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This foregoing thesis is hereby approved as a credible study of an engineering subject carried out and presented in a manner satisfactorily to warranty its acceptance as a prerequisite to the degree for which it has been submitted. It is understood that by this approval the undersigned do not endorse or approve any statement made or opinion expressed or conclusion drawn therein but approve the thesis only for purpose for which it has been submitted.

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CHAPTER : 1

1. INTRODUCTION

Light plays an essential role in our ability to perceive the world around us. It plays vital role in our daily life. At the day time light of the sun illuminate the world and at night, with the modern creation, artificial luminaries are helps to illuminate the world. Light create an attractive medium and make the positive impression to everyone. With the good illumination techniques by the designers brings satisfaction, comfort and safety to the world. The lighting needs of a space must be design to optimize with proper allocation and management of energy. Lighting needs may range from simple orientation to complex visual tasks.

1.1 :Façade Lighting :

In the past, halogen lights were the norm. People use it to light up the facade of buildings or homes. Since halogen lights aren't energy efficient, only significant buildings can use them for artistic purposes. But with the growing popularity and preference for LED lights, more people and structures can now take advantage of the aesthetic benefits of facade lighting. LED lights provide energy efficiency, reliability, and durability. It is easier to apply the lights artistically. LED lights come in different colors and emit a more intense beam of light to allow a more explicit focus. This means it's easier to make a building the main attraction.

According to experts, gracefully lit buildings stand out and enhance the surroundings as well. Appropriate facade lighting creates a great first impression of the building that attracts the employees and customers.

Different objectives can be achieved with façade lighting. Some of these are :

- **Promotion of the Economy and Tourism**

In today's architectural landscape, facade lighting is not simply a functional necessity . By exploring different types of facade lighting, ranging from the nuanced elegance of accent lighting to the mesmerizing drama of shadow play, readers will gain insight into how each technique contributes to the aesthetics, identity, and purpose of a building.

- **Security Aspects**

Façades that are illuminated make people feel safer as they navigate through the night. It can create a more inviting space that's visible from a distance. By implementing lighting techniques such as horizontal and vertical lighting, façade lighting can increase the sense of safety for everyone. Whereas in residential areas consideration should be given to light levels. Well planned façade lighting that considers the surrounding areas, zones, architectural elements of the buildings will provide a safe and pleasant space for all.

- **Emphasize Architecture & Structure**

  Well designed façade lighting can accentuate the architectural characteristics and provide a remarkable first impression of the building. With façade lighting, a building that looks normal during the day can alter into a piece of art during the night. The interplay of light and shade can emphasize the distinctive architectural details and create a dramatic look to bring life to your outdoor space. Personality can be created through the combination of color and lighting techniques to convey a building's identity .

- **Attracting Attentions**

  Well Design façade light make a building looks different at night . Static and dynamic Lighting scenarios using colors replace traditional accent lighting. One the other hand creative lighting pattern can enhance the texture of the wall, which help to make an emotional connection to the building

1.2: Indoor lighting

Indoor lighting plays a crucial role in our everyday lives, influencing not only the functionality of spaces but also our mood and well-being. Effective indoor lighting enhances the aesthetic appeal of interiors, ensures adequate visibility for daily tasks, and contributes to the overall ambiance of a room.

Different types of indoor lighting serve various purposes. Ambient lighting provides general illumination, making it possible to move around safely and comfortably. Task lighting focuses on specific areas where activities such as reading, cooking, or working are performed, ensuring sufficient brightness for these tasks. Accent lighting is used to highlight particular features or objects within a space, such as artwork or architectural details, adding depth and interest to the room.

Modern indoor lighting solutions incorporate energy-efficient technologies, such as LED bulbs, which offer long-lasting performance and reduced energy consumption compared to traditional incandescent bulbs. Additionally, smart lighting systems allow for greater control and customization, enabling users to adjust brightness levels and color temperatures to suit different times of the day or specific activities.

The design of indoor lighting also takes into consideration the psychological effects of light on humans. Proper lighting can improve mood, enhance productivity, and create a sense of comfort and relaxation. Conversely, poor lighting can lead to eye strain, headaches, and a general sense of discomfort

1.3 : Aims

In this Thesis work, basic aim of good lighting design is to create a lighting installation that provide both good task visibility and satisfactory visual environment. For achieving modern lighting design, It has several goals. These are :

- Enhancing functionality
- Creating Ambiance
- Improving energy efficiency
- Emphasizing architectural features
- Promoting Well-being
- Reducing environmental impact.

For this work, basic aim of the outdoor lighting is to illuminate the area, to maintain or to improve visual performance of the persons conducting human activities. The basic principle of facade lighting design is to consider the building's unique architectural features, whether it is a historic landmark or a modern office building. The primary goal is to bring out the architectural beauty of a structure after the sun sets. Other than , it can also increase security or appeal to the local community. These lights can increase the visibility and safety of an area for your employees and guests.

1.4 : Objectives

Lighting design can have many different objectives. In this Thesis work main objectives are to enhance the architectural aesthetics and visibility of the building during nighttime, while sunlight is not present for the façade lighting and to provide optimal illumination for various activities and tasks within the space, while prioritizing visual comfort and the enhancement of that indoor space environment, ambiance and functionality for indoor lighting. A holistic strategy for lighting design is necessary because without it important benefits will be lost and money and human efforts will be wasted.

CHAPTER : 2

1 Definition and Description of different Terminologies

2.1 : Façade Lighting :

2.1.1 : Introduction

Façade lighting is a lighting technique and design to expose the beauty of the facade of a building, house or structure. The facade itself comes from French language, ***façade***, which means “frontage” or “face”. So that the essential meaning of the facade is the principal front or the exterior side of the building that is facing front.

Facades are typically known as the principle front or the front facing exterior sides of the building. In architectural terms, they are one of the most important exterior design elements as they largely determine the overall feel of the structure. It play a crucial role in terms of light transmittance, acoustic performance and energy efficiency of a building. Facades exert influence on achieving superior aesthetics, and this is where facade lighting comes into play. Illuminating facades with lights can transform a boring building into a real eye-catcher as it highlights the architecture and puts emphasis on key building features.

2.1.2. : Type of Façades :

Today, most of the buildings with modern architecture are furnished with different types of facade designs. The facade lighting may have a different shape or design when it is illuminated by natural or artificial lighting at night. More so, its appearance changes throughout the day as the natural light shifts. The common and most suggested facade lighting[13] includes:

2.1.2.1: Solid facades:

A solid facade is referred to a smooth wall surface with no texture. These facades are primarily influenced by natural lighting conditions (sunlight). However, large and uniform surfaces can be provided with a definite structure and patterns of light, shown in fig .1(a). the fixtures are mounted on the ground opposite the façade is illuminate the wall .

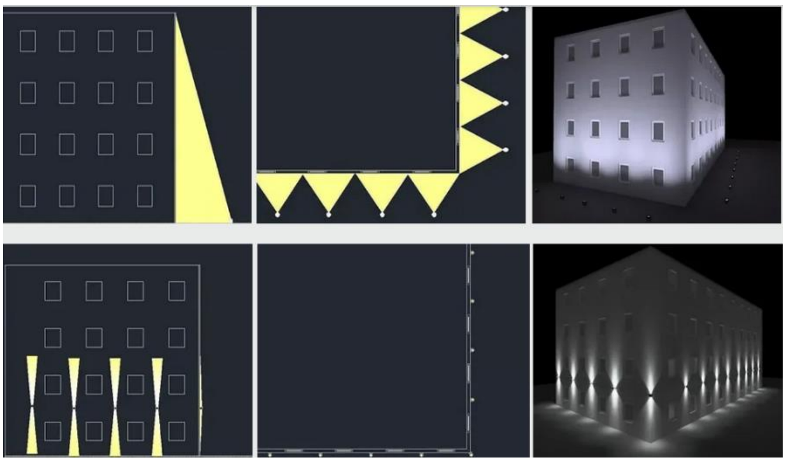


Fig 1 (a) : Solid façade lighting[14]

2.1.2.2 : Vertically divided facades:

Developers can use narrow beams of light to intensify the vertical division. They can also consider a combination of up-lights and downlights for augmenting the façade, shown in fig. 1(b)

Fig : 1(b)

2.1.2.3 : Horizontally divided facades:

Horizontal divisions can cast long and heavy shadows in the building's facade. However, this can be reduced by increasing the offset of the luminaire from the façade, Shown in fig. 1(a)

2.1.2.4 : Perforated facades:

A facade based on innovation that allows creative use of multiple lighting techniques. A building with a perforated facade allows a creative innovation of several lighting techniques. This structure uses perforated wells to allow natural light into the building. But at the same time, it can also project light from the building.

With Vertical Divisions : When a building's facade features vertical divisions, emphasizing them can be achieved using narrow ground-based beams, such as spotlights or floodlights. A combination of up light and downlights can create a dramatic effect, especially if there are captivating architectural elements on the ceiling or roof top.

With Horizontal Divisions : To enhance a structure with distinct horizontal divisions, use shadows effectively—place lights at the structure's base to create pronounced shades that enhance its aesthetics. The interaction between light and shadow brings life to the facade and improves its texture. Position lights closer to the system to achieve longer shadows or place them further away for a better overall effect.

With Recessed or Protruding Sections : Recessed or protruding sections in building structures benefit from pronounced shadows to emphasize distinct areas of the facade. A combination of various facade lights can be employed. Up lights work well for recessed sections, highlighting corners. Contrasting light colors can further magnify the differences, but the precise alignment of light beams with each unit is essential.

2.1.3 Different ways to illuminate the facade of a building.:

There are three different ways to illuminate the facade of a building.

2.1.3.1 : From the Floor :

This type of facade lighting means the light fixtures are on the floor. It illuminates the facade of the building from the ground up. This results in a stronger light at the bottom, where the beam gets wider as it gets higher. The intensity of the light also gets softer as it reaches the middle of the structure.

2.1.3.2 : From the Ceiling :

For this type of facade lighting, the light fixtures come from the top. For residential houses, the fixtures use the roof gutters as the base for the facade lights. For buildings, the luminaire can position it at the rooftop ledge so you can point the lights downwards. In this application, the lights at the top are given more attention. If the structure has a great ceiling, this is the option that can highlight it. The downward direction of the lights can create shadows and accentuate the silhouettes of the architecture.

2.1.3.3 : From the Wall :

This type of facade lighting refers to the light fixtures that are on the wall. This is great for creating a shadow effect on the facade of the building. When using this technique, there's more freedom to choose where to position the light fixture. This includes windows, columns, or other vital structures that can help create the right shadow and mood. With the correct positioning of the lights, it's easier to create the right accents and elements in the building.

2.1.3.4 : Mix different facade lighting types :

When it comes to lighting up the facade of a structure, there's no one formula on how to do it. So feel free to mix and match the three different types of facade lighting. If the structure is big enough, we can even use all three. It just make sure we take into consideration the beam angles, color, intensity, and other factors that could affect the overall look .

2.1.4: Type of facade Lighting Techniques

2.1.4.1 : General Floodlight :

Flood lighting[13] is characterized by the installation of lights at a certain distance from the illuminated objects they are often mounted on poles. But we must keep in mind that the light aimed at the building will pass through the window, so this kind of lighting is undesirable for use in buildings that will be full of people at night (houses, malls, hotels) . Fig: 1 is an court building . The front sideof the building illumation is an example of genaral flood lighting technique.

Fig : 2(a) Lincoln Memorial[14]

2.1.4.2: Local Lighting :

Focus Attention to interface elements (window frames, arches, cornices, columns, balconies). In order for the composition to be harmonious, all items must be luminous and skillfully connected to one composition. In this incarnation, architectural lighting used medium, low- power lamps and linear shape lighting on the basis of light-emitting diodes. In Fig: 2 ,The front side of the building illumation is an example of local lighting[13] technique.

Fig : 2 (b) Cairo Haritage Building

2.1.4.3 : Background Lighting (silhouette):

It is a kind of artistic effect, allowing to achieve the shape of the image outline of the object, but without any details. That is, the silhouette of the object shows the creation of a luminous, black or dark background (the essence of the effect). This creates a clear image and powerful graphics, and applies a similar effect to highlight the palaces with columns and theaters . The Side image is an example of backgraound lighting[13] technique, by wich we can se an out line of an object or person and create a silhouette effect.

2.1.4.4 : Light Facade Lighting :

Suitable for lighting Modern buildings with fully glazed(shopping and entertainment centers, office buildings) .The lighting equipment is installed indoors and draws on the glass-produce a variety of lighting effects weather it is fixed or variable.

2.1.4.5 : Contour Lighting (use of Strip light) :

A relatively new technique[13] when the perimeter of the building stands out with the help of linear lighting. This collective implementation of contour lighting was made possible by the advent of inexpensive light sources (flexible neon and LED bars). They are installed on the front of hundreds of meters, for example, in fig : 3, illuminate the corners of the gate is create an 3D effect.

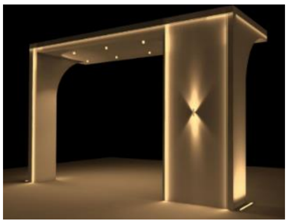


Fig : 3 OUTR Bhuwaneswar

2.1.5 : Factors That Influencing Facade Lighting Choices[11]

Facade lighting is a critical element in architectural design, impacting aesthetics, functionality, and sustainability. Facade lighting decisions are shaped by an intricate interplay of factors, encompassing everything from artistic vision to technical assessments.

2.1.5.1: Architectural Style and Intent :

Architectural style[10] and intent are pivotal in shaping the decisions surrounding facade lighting. This factor encompasses a broad spectrum of considerations, ranging from the overarching design aesthetic to preserving historical and cultural significance.

Design Aesthetic: A building's visual language mirrors its architectural style, guiding choices in lighting techniques, fixtures, and placements to complement its design

Cultural Significance: Buildings often carry cultural and historical significance, and facade lighting takes on a profound responsibility in honoring and showcasing this heritage

2.1.5.2: Building Function and Use

2.1.5.2.1 : Commercial vs. Residential:
The facade lighting of commercial buildings serves multifaceted purposes, often dictated by branding, marketing, and operational demands. In these settings, lighting is a powerful tool for making a memorable first impression, promoting products or services, and establishing a strong brand identity. High-impact lighting strategies are commonly employed, including:

- **Attention-Grabbing Displays:** Dynamic, eye-catching lighting displays that draw the attention of passersby, creating a distinct visual identity for the business.
- **Signage Illumination:** Lighting integrated into signage, such as illuminated logos or company names, to enhance visibility and reinforce brand recognition.
- **Architectural Accents:** Strategic lighting to highlight architectural features, adding depth and sophistication to the building’s appearance.

For example, a flagship fashion store may use vibrant, color-changing LEDs to create a visually stimulating facade that attracts customers and reinforces the brand’s identity as a cutting-edge fashion destination.

2.1.5.2.2 : Residential Buildings:
In contrast, facade lighting for residential buildings prioritizes subtlety, functionality and creating a welcoming atmosphere. The objectives are to ensure safety, enhance the property’s aesthetics, and provide comfort for residents and guests. Common residential lighting choices include:

- **Warm and Inviting Illumination:** Soft, warm lighting fixtures like porch lights, wall sconces, or garden lights that offer a gentle, inviting glow.
- **Architectural Emphasis:** Lighting strategically placed to accentuate architectural elements such as columns, balconies, or landscaping features.
- **Security and Pathway Lighting:** Well-placed lighting that ensures visibility along walkways, driveways, and entrances, enhancing safety.

For a residential context, imagine a cozy suburban home with gentle porch lighting that creates a warm and inviting ambiance, welcoming residents and visitors alike.

2.1.5.2.3 : Public Spaces:
Public spaces, including museums, galleries, educational institutions, and cultural landmarks, require facade lighting beyond aesthetics.

- **Museums and Galleries:** Lighting in these settings is carefully designed to enhance the viewing experience of exhibits and artworks. Specialized fixtures with precise control are utilized to achieve optimal color rendering and minimize the risk of damage to sensitive artworks.
- **Educational and Cultural Institutions:** Facade lighting in these settings often plays a communicative role, celebrating achievements, marking significant events, and fostering a sense of community pride. For instance, a university's administration building may be illuminated in the institution's colors during graduation ceremonies, symbolizing a collective achievement.

2.1.5.3 : Environmental Considerations

Environmental considerations[10] are becoming increasingly central to the decision-making process in facade lighting. As society's awareness of sustainability and energy efficiency grows, architects and lighting designers are incorporating eco-conscious solutions into their projects.

- **Energy Efficiency:**

Energy efficiency is at the forefront of modern facade lighting design. The aim is to minimize energy consumption while providing effective illumination. This reduces operational costs and decreases the environmental footprint associated with energy production.

2.1.5.4 : Regulatory and Compliance Requirements

Local Regulations: Zoning codes and local regulations often dictate lighting requirements to ensure safety, reduce light pollution, and maintain neighborhood aesthetics.

Accessibility: Compliance with accessibility standards, including proper illumination for pathways and entrances, is crucial in public and commercial buildings

2.1.5.5 : Building Orientation and Location

The orientation and location of a building are critical factors that shape the decisions regarding facade lighting. These considerations are pivotal in ensuring that the lighting design optimally addresses visibility, aesthetics, and functionality, taking into account the building's relationship with the sun and its urban context.

Sun Exposure:
The building's orientation and how it interacts with sunlight play a substantial role in shaping the selection of lighting methods. This aspect revolves around harnessing natural light to create visual effects, ensuring optimal visibility, and enhancing aesthetic appeal during various times of the day.

2.1.5.6 : Budget and Resources

Financial Resources: Budget constraints can affect the selection of lighting fixtures, technology, and maintenance plans.

Maintenance Costs: Long-term maintenance considerations, such as the lifespan of lighting fixtures and ease of access for maintenance, influence lighting decisions.

2.1.5.7 : User Experience and Safety

User Comfort: Lighting choices aim to enhance the experience of occupants or visitors by ensuring comfort, safety, and visibility.

Security: Adequate lighting can deter criminal activity and enhance security.

2.1.5.8 : Climate and Weather Conditions

Weather resistance is paramount in facade lighting, particularly in regions characterized by harsh and extreme weather conditions. The durability and resilience of lighting fixtures in such environments are pivotal factors that directly impact the longevity and functionality of facade illumination. Here, we delve into the crucial role of weather resistance in ensuring the reliability and performance of facade lighting:

Challenging Weather Conditions:
Regions with extreme weather conditions, whether marked by searing heat, bone-chilling cold, torrential rain, or frequent storms, place formidable demands on facade lighting systems. These conditions subject lighting fixtures to a barrage of challenges, including:

- **Temperature Extremes:** Drastic fluctuations in temperature, from scorching summers to freezing winters, can cause expansion and contraction in lighting components, potentially leading to structural damage.
- **Moisture and Corrosion:** Prolonged exposure to rain, snow, or high humidity levels can cause moisture ingress and corrosion, compromising the integrity of lighting fixtures and electrical components.
- **UV Radiation:** Intense sunlight and UV radiation can lead to fading, discoloration, and degradation of materials, impacting the aesthetic and functional aspects of facade lighting.
- **High Winds:** Wind-driven debris or extreme wind speeds can subject lighting fixtures to mechanical stress, potentially leading to breakage or misalignment

2.2. Indoor Lighting

2.2.1 : Introduction:

Lighting is an often-underestimated part of our homes and businesses. Besides having a huge impact on aesthetics and functionality, it can also have profound effects on your mood, emotions, and wellbeing. As the days get shorter and shorter and we approach the darker days of fall and winter, it's important to emphasize just how important our indoor lighting is.

Lighting is both an art and a science — it can affect our mood, appetite, and sleep. In order to implement an effective lighting strategy for our home, we will need a professional that fully understands electrical systems and lighting design. Besides the technical knowledge required, the person installing our lighting should also be concerned with mood, aesthetics, safety, and enjoyment.

Lighting Design Factors:

- Size and space
- Occupant's age and preference
- Ceiling height and shape
- Color of walls and furniture
- Existing lights and electrical setups
- Points of interest, art work, and highlight areas
- Shadows and reflections
- Surface characteristics
- Color appearance
- Lighting controls and distribution
- Source, task, and eye geometry
- Economics and energy efficiency
- Spatial perceptions
- Level of illumination (lux)
- Psychological and physiological factors
- Electrical codes, documentation, and specifications

2.2.2 : Design Consideration of Office Lighting:

2.2.2.1 : Light Quality:

Light quality[12] affects how well people can see to do visual tasks and how visually comfortable they feel. Lighting for modern work space area should be fairly uniform in brightness and has no glare. The light sources should provide correct color balance, directional control and freedom from glare. Thus light source should be chosen with high CRI (>70) and Neutral white CCT (4000K) to maximize the visual comfort in office areas.

2.2.2.2 : Light Quantity:

Light quantity[12] can be measured as the distribution of light on a horizontal surface. The purpose of lighting is to produce illumination. For detailed work, proper illumination is needed to allow more accuracy and less eyestrain. The illuminance and its distribution on the task area and the surrounding have a great impact on how quickly, safely and comfortably a person carries out the visual task. The illumination level on the working plane affects both the performance of the tasks and the appearance of the space.

2.2.2.3 : Luminance Distribution:

The luminance distribution[12] in the field of view controls the adaptation level of the eyes, which affects task visibility. Thus for office lighting a well-balanced adaptation luminance is needed to increase visual acuity, contrast sensitivity and visual comfort. It should be taken into account that luminance of the task and its surrounding should be maintained 3:1 ratios and avoidance of glare should be done by limiting the luminance of luminaires, windows and the luminance of ceiling, wall and floors.

2.2.2.4 : Glare:

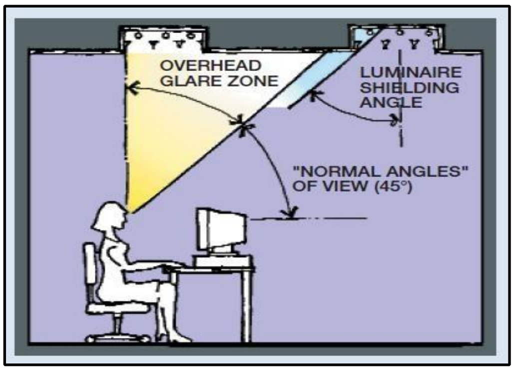
Glare[12] is very common term in lighting environment and possibly the most important lighting issue facing in modern workspace lighting. Glare caused by relatively bright source than surrounding that makes it difficult to see or causes discomfort. Glare is caused by luminaires that do not properly controlled. The two basic types of glare are discomfort glare and disability glare, and based on source of the glare it can be classified in to two categories these are directed glare and reflected glare, among all types of glare discomfort and direct glare are the important issues in office lighting. Classification of direct glare limitation of luminaire are given in Table.3

2.2.2.4.1: Discomfort Glare

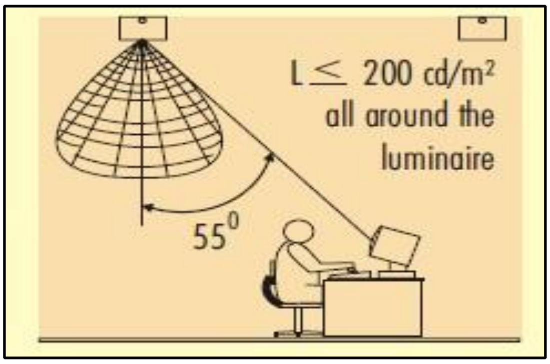
Discomfort glare[12] does not necessarily prevent the viewer from the intended task, but does cause constant adaptation of the eye to the varying light levels which in turn causes discomfort. Which generally measure by UGR, Glare Index etc.

2.2.2.4.2 : Direct Glare:

It is mostly a discomfort glare [12] caused by a relatively bright source with high contrast ratio with back ground in the field of view. To avoided direct glare luminaire that limits glare from common viewing angles should be chosen. Semi-specular or white louvers may be chosen but luminaires with specular louvers should be avoided. Semi direct or semi-indirect luminaire with high ceiling reflectivity should be used. And the direct glare from the task light may be reduces by choosing a luminaire that has an opaque front & adjustable light level but there must be no direct view of the lamp or lens from normal viewing position. Figure : 4 (a) shows the over head glare zone and fig :4(b) shows the luminaire cutoff angle.



(a)



(b)

Fig : 4 Overhead glare zone and Luminaire cutoff angle

As per IS standard luminaire has divided into three categories base d on their cut off angle (above which luminance <= 200 cd/m^2) for limiting Direct and reflected glare especially applicable for office area lighting.

2.2.3 : Recommendations for Indoor Lighting

There area some recommendation are considered . The Maintained illuminance level as per standards for indoor areas is given in Table.1.

Table 1. : Recommended Maintained Illuminance Values [1] [2]

Sl. No.	Space	Range of service Illuminance (lux)	Quality class of direct glare limitation
1	Bed Rooms	30-50-100	1
2	Reading Room	200-300-500	1
3	Reading Table	200-300-500	1
4	Bathroom	100-150-200	1
5	Corridor / Passage / Stairs	50-100-150	2
6	Lift	50-100-150	2
7	Canteen / Dinning Room	150-200-300	2
8	Washing Area/ Preparation Room / Washing Area	200-300-500	2
9	Food Preparation / Kitchen	300-500-750	2
10	Balcony	50-100-150	2
11	General office	300-500-750	1

12	Computer Work Station	300-500-750	1
13	Conference Room, Executive office	300-500-750	1
14	Computer aided design and Data Preparation Room	200-300-500	1

Table 2. Maximum allowable UGR values in Some Indoor areas [1] [2]

Category of Space	type of office	Maximum UGR
Domestic	Bed Rooms	19
	Kitchen	20
	Bathroom	22
	Canteens	22
Circulation area	Entrance halls/reception	22
	Stairs/escalators	25
	Lift lobbies	22
	Corridors	25
Primary office	Office Area	

Table 3. Classification of direct glare limitation of luminaire [1] [2]

Luminaire cut off angel(degree)	Quality class of direct glare limitation
55	1
65	2
75	3

LPD (Light Power Density) is the ratio of total wattage consumed by the luminaries in a room to the total area of that room . The recommended LPD values are given on Table .4 Based LPD values, the designer can have an idea of the energy efficiency of his/her lighting design.

Table 4. : Recommended LPD Values [4]

Space Function	LPD (W/m2)	Space Function	LPD (W/m2)
Office - Enclosed	11.8	Dining Area	9.7
Office – Open Plan	11.8	For Family Dining	22.6
Conference/Meeting/Multipurpose	14.0	Food Preparation	12.9
Classroom/Lecture/Training	15.1	Laboratory	15.1
Lobby	14.0	Restrooms	9.7

2.2.4 : Approaches of Indoor Lighting Design :

2.2.4.1 : General or Ambient Lighting

These are called "general" or "ambient" because they are simply used to make an interior space visible. They provide general lighting[13] for a space and are sometimes used to refer to natural, or existing light. Think of general/ambient light as natural light combined with light coming from normal room lights.

2.2.4.2 : Task Lighting

Task lighting[13] is directed lighting toward a specific area to give more detail to objects and provide safe passage. Any close-range work such as cooking, sewing, drawing, and writing should have task lighting—enough to see a flaws in canvas and clothing.

2.2.4.3 : Accent Lighting

Accent lighting is used to "accentuate" features and add visual interest to an object or area. It's the extra special something that makes people go "oooh" and "aaahh." Use accent lights to add drama and change the mood of a room.

2.2.4.4 : Direct Lighting:

Direct lighting[13] uses luminaires that are designed to emit the vast majority of their light output directly down onto the nominal horizontal working plane. Direct lighting luminaires can be surface mounted, recessed into the ceiling or suspended.

The main potential problem with direct lighting is the fact that the ceiling and the upper parts of the walls tend to be under lit resulting in a gloomy, cave-like appearance.

2.2.4.5 : Indirect Lighting:

Indirect lighting[13] uses luminaires where all, or almost all, of the light produced by the luminaire is reflected off some surface, usually the ceiling, before reaching the working plane. In the interests of energy efficiency it is important to ensure that the surface from which the light is reflected has a high diffuse reflectance, at least 0.7 and preferably 0.8 and higher. The best part of indirect lighting is the limitation of both direct and indirect glare.

2.2.4.6 : Direct/Indirect Lighting:

Direct/indirect lighting[13] uses a luminaire or a combination of luminaires that provides some lighting on the working plane directly and some after reflection from a surface, usually the ceiling. Direct/indirect lighting can be very effective because the two components are complementary.

2.2.4.7 : Localized Lighting:

Unlike direct lighting, [13] indirect lighting and direct/indirect lighting, which are most frequently used to provide a uniform illuminance across the whole working plane, localized lighting deliberately sets out to provide non-uniform lighting, with a higher illuminance around the workstations and a lower illuminance elsewhere. Workstations typically occupy about 25% to 30% of office floor area so this approach offers the potential for energy savings but lighting layout is depended on work station arrangement.

2.3 : Auditorium Lighting

2.3.1 : Introduction :

Auditoriums are multipurpose spaces that are used for engaging and captivating the occupants into another world of thoughts, ideas, and perceptions. Be it auditoriums in schools and colleges or theatres that are widely known sources of entertainment, one thing that remains constant is the emphasis on grabbing the attention of spectators to the highlights of the arrangement.

The careful orchestration of light can transform a simple stage into a mesmerizing spectacle, creating a captivating ambience and enhancing the audience's engagement. However, in such spaces, the choice of suitable fixtures depends upon a variety of factors, including the purpose and location of illumination. There are plenty of luminaire options that are suitable to cater to the lighting requirements of the auditorium.

2.3.2 : Types of Auditorium :

Auditoriums can be classified into different categories based on the type of event they host, the audience they target, and their location. Some types of auditoriums[8] are:

2.3.2.1 : Outdoor Auditoriums

Outdoor auditoriums, found in squares, parks, or gardens, provide a charming, relaxed experience with natural light. They feature acoustic shells for better sound projection. Design precision is crucial for optimal viewing and hearing. Challenges include weather dependence and environmental noise. Yet, they're perfect for cultural events like concerts and festivals. In fig : 5 (a) is an example of outdoor auditorium. This is a public theater.

Fig : 5 (a)The public Theater , Vineyard Theater

2.3.2.2 : Auditoriums for Schools and Universities

Educational auditoriums are versatile spaces in schools and universities, designed for various events from scholarly talks to cultural performances. They prioritize easy operation to accommodate limited staff, ensuring smooth management even by one person. In fig : 5 (b) is an Institute's auditorium

Fig : 5 (b) Tanazan Ishibashi memorial Auditorium

2.3.2.3 :Municipal, State, and National Auditoriums

Public auditoriums at municipal, state, and national levels are significant venues supported by governments. They must have top-notch infrastructure to host impactful events of various scales. In fig : 5 (c) is an example of Indian national auditorium

Fig : 5 (c) J N Tata Autorium

2.2.4 : Private Auditoriums

Private auditoriums in venues like hotels, companies, and theaters offer tailored experiences, meeting clients' specific needs and preferences with versatility.

2.3.3 : Different Areas of Auditorium :

Auditoriums come in many shapes and sizes, but designs typically consist of three main components:

- The main seating area
- The stage
- Support spaces

2.3.3.1 : The Main Seating Area

The main seating area is where the bulk of the audience sits. Standard estimates are based around guidelines of approximately 18 sq. ft per person. This allows for aisle ways, sound and light control areas, and entryways that trap the light when late-comers arrive. Viewing angles are critical components of seating layouts; every seat should have a great one.

2.3.3.2: Auditorium Stage

The stage should be sized to accommodate the largest group expected to be featured. Assume that the typical stage is 30-35 feet deep with a proscenium opening of 40-50 feet wide, and up to 30 feet tall. The side stage should be at least half the size of the proscenium opening on each side. Ideally, access to the stage is handicap accessible. That can be accomplished by the construction of side aprons on the same level as the "cross-aisle."

2.3.3.3: Auditorium Support Spaces

If the auditorium is where the heart and soul are, the support spaces are where the bones and guts of the operation are. This includes the front end which consists of the ticket booth, entrance vestibules, lobby, coat check, retail, and recessions. The front end support spaces make use of attractive or discreet designer trash cans in auditorium lobbies, and under counter trash cans for auditorium staff. The backend consists of storage rooms, dressing rooms, a “green room” which can double as rehearsal and instructional space, set construction areas, and equipment rooms. Computer-controlled stage rigging and LED theatrical lighting have become standards in most performance venues, so making sure that room for their storage and operation are part of your design will ensure that your theater is up to modern standards. The backend support spaces benefit from commercial grade trash cans, or trash cans with wheels for maximum flexibility. The support spaces are where a lot of action goes down and they need to be kept clean and tidy, which is why benefit from having large and durable indoor commercial trash cans and recycling bins. In fig : 6 shown the different areas of an auditorium.

The overall design of the auditorium is determined by the audience size and form of stage, which are both determined by the type of performance.

Auditorium Dimensions & Layout : Dimensions can get tricky, but a good rule of thumb is arranging the size of the auditorium around the type of performance and the number of audience members you plan to seat:

- **200 seats: 270m² | 2,900 ft²**
- **150 seats: 190m² | 2,000 ft²**
- **75 seats: 125 m² | 1,350 ft²**

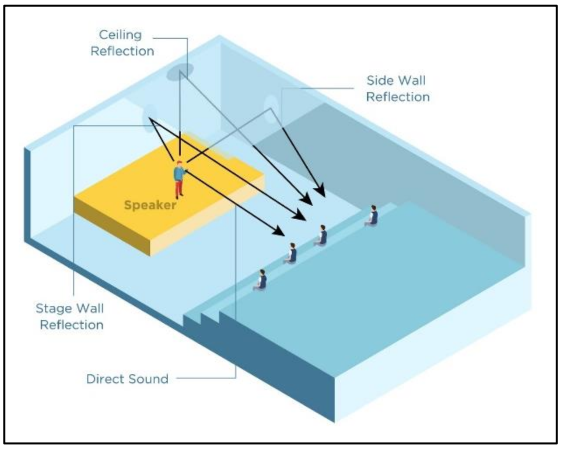


Fig : 6 Layout of Different areas in an Auditorium

2.3.4 : Auditorium Seating Layouts

In the world of auditorium design, there are three main styles of seating arrangements, multiple aisle, continental, and wide fan. Variations of the three main forms accommodate different stages.

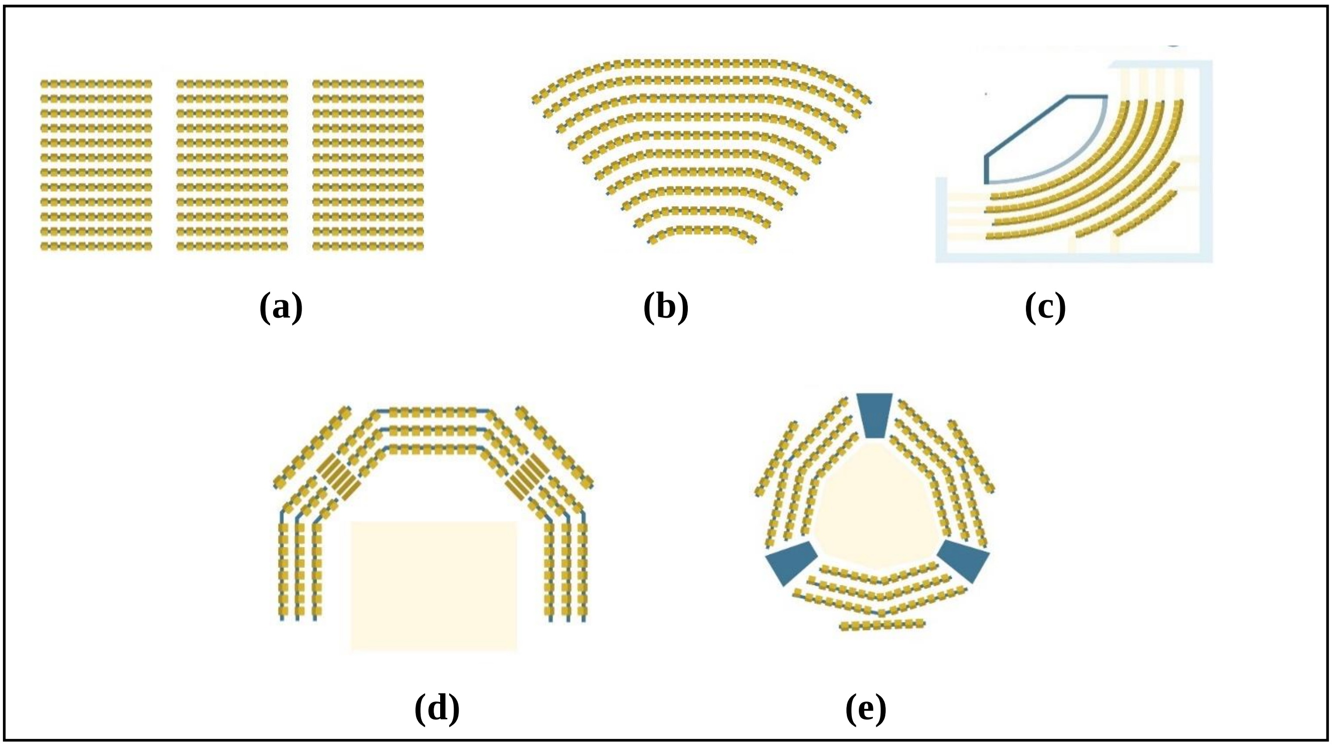


Fig : 7 Types of Seatting layouts in an auditorium

- Multiple aisle seating is a more formal setup, suitable for lecture halls and business conferences. Seat count can vary, typically you want a maximum of 14-16 chairs per row.Fig : 7 (a) is an layout image of Multiple aisle seating
- Continental seating is a good use of space and is the preferred choice for open space auditoriums and amphitheaters. Having all seats turned toward and arranged in a concave shape toward the central arena increases intimacy between performer and audience. Fig : 7 (b) is an layout image of Continental seating
- Wide fan auditoriums bring the audience up close and personal, but limits the usage of a stage to mostly speech-related activity. Fig : 7 (c) is an layout image of Wide fan auditoriums.
- A horseshoe auditorium is popular in many entertainment venues in combination with a proscenium stage. It was common in Baroque theater design for ballet, masques, and opera performances, and is still popular in theaters and auditoriums today. Fig : 7 (d) is an layout image of horseshoe auditorium.
- Beyond the three main categories of auditorium seating design, other seating arrangements are variants of the main three categories to accommodate the stage and surrounding space. One of the most dramatic variants of auditorium design is the vineyard seating, which surrounds an arena stage style. Vineyard seating is popular in concert halls, like the Berlin Philharmonic. Fig : 7 (e) is an layout image of Vineyard seating.

2.3.5 : Design Consideration of Auditorium Lighting:

The right lighting for any location is dependent upon the location itself. Since every place has its own unique considerations, lighting solutions aren’t one size fits all. For instance, when choosing the right auditorium lighting, the space makes a big difference in which solutions are encouraged. Whether your auditorium location is a college, church or a stage production house, you need the right auditorium lighting to make it all work well. Here are 5 tips to help you find the right lighting choice for your needs.

2.3.5.1 : Select the focal point: The first thing that needs to be done when working on the auditorium lighting design is to decide the focal point. The majority of auditoriums are built to allow the audience to easily look at a podium, pulpit, or stage. Through lighting, attention is drawn to this area. This is where track lighting or directional spotlights will prove useful.

2.3.5.2 : Consider Placement: Next, we need to consider the placement of the lighting. Although we want to focus on directing attention to the focal point, we cannot place the lighting in such a way so as to overpower the performers. Always position the lights higher than the focal point to reduce glare.

2.3.5.3 : Maintain three zones of lighting: As a rule of thumb, there should be three zones of lighting for the auditorium. The first one is for the board lights which project towards the screen on stage. The second layer consists of presenter lights that help shed illumination on the presented. As for the third layer, it offers audience lighting.

2.3.5.4 : Never Skip on Brightness: When working on auditorium lighting design, we have to ensure that the lighting is bright enough for people to take notes if required. If people sit in the dark, it can put a lot of strain on their eyes while staring at a stage or screen with bright lights. The goal is to ensure that the lights are adjustable. A pro tip that will prove useful is installing dimmers to have more control over the auditorium lighting.

2.3.5.5 : Focus more on artificial light: It is vital that the focus is more on artificial light as compared to natural light. Although most locations require the incorporation of both types of lighting, auditoriums need to maintain low lighting levels to make the projected screens more visible. To enable artificial lighting to meet the requirements, natural lighting needs to be minimized.

Table no : 5 is the recommended values as per standards

Table 5. : Recommended Maintained Illuminance Values [1] [2]

Sl. No.	Space	Range of service Illuminance (lux)	Quality class of direct glare limitation
1	Auditorium	50- 100-150	-
2	Dressing Room	200-300-500	-
3	Projection Room	100-150-200	-

CHAPTER : 3

3. Computer Aided Lighting Design

3.1 : Introduction:

Lighting Software provides integrated lighting solutions using computer aided drafting and simulation to create a design scheme for each setting that will optimize both the pleasing optical facets and the energy conservation of the lighting environment. With the utilization of the latest lighting simulation and modeling software, a client can quickly validate the efficiency of designs and visualize the lighting concept in a particular space.

Prior to the installation of the lighting system, computer modeling software are used to design the entire lighting system, and ultimately choose a lighting design scheme which used a combination of accent wall wash, direct lighting and indirect lighting in order to provide optimum comfort.

3.1.1 : Lighting Design Procedure :

1. Collection of Information on the application of the space to be illuminated, such as visual task working space ambiance, average age of occupants etc.
2. Comparing with relevant lighting standards/ codes to identify desired lighting design parameters.
3. Selection of Lamp based on visual task and color requirements(CRI and CCT).
4. Selection of luminaire based on the type of installation, desired lighting distribution, glare restrictions, budget etc
5. Estimation of no of luminaire to achieve desired maintained average illuminance.
6. Preparation of lighting layout as per the applicable area and to achieve desired uniformity.
7. Software simulation of desired lighting design for evaluation of the design. If Nassery provide with different lighting scheme with control strategies.

3.2 : Advantages of Lighting Design Software:

-

1. The software simulated design basically helps to estimate the entire lighting appearance.
2. Before installing the entire system the appearance, expected achieved light level can be easily estimated.
3. The perfect position of luminaires can be easily estimated by software. So in time of installation it will be easier task because the coordinate position in the entire ceiling plan is clearly shown in the software design.
4. The total power consumption, quantity of the luminaires is sharply evaluated in this system.
5. The presentation and visualization of the design is more scientific and logical.
6. The entire lighting solution with proper lamp, luminaire, ballasts are presented compactly.
7. The design process is more accurate: no eye estimation is involved within design procedure.

3.3 : Software Used for Lighting Design:

Different lighting software is now developed to design any lighting installation such as AGI-32, Dialux, Relux ,CGLux Calculux, Photolux, Sunlux, Lumen Micro, Lumen Designer etc.

All the lighting software is different, but the aim is same. Different lighting company uses different lighting software. In Crompton Greaves Limited mostly Dialux, AGI-32, CGLux and Relux , Dialux evo software has been used for lighting design. In this study the lighting design simulation has been done by mainly two software's these are **Dialux 4.13** and **Dialux evo**

3.3.1 : DIALUX 4.13 Lighting Design Software:

DIALUX 4.13 is developed by **DIAL** for professional light planning. Dialux is able to calculate and visualize Artificial Light as well as the daylight. The day lighting calculation is available for **4 Standard CIE Sky** types which overcast, clear, clear with direct sunlight and mixed sky. For artificial lighting calculation Dialux needs the **IES file** of the luminaire. Both for artificial and Daylight the lighting calculation is done by **Radiosity method** which is based on the basic principle of conservation of energy. As per Radiosity Method the total energy leaving a surface is equal to the sum of energy reflected and emitted by that surface.

DIALux 4.13

3.3.2 : DIALUX evo Lighting Design Software:

DIALUX evo is the updated version of the DIALUX software. It is more efficient for Lighting design for indoor and outdoor areas. The company behind DIALux is DIAL GmbH from Lüdenscheid in Germany. For better Design and visualization light for indoor and outdoor areas, DIALux evo is more better software than DIALUX 4.13.

4.1: Façade Lighting Designs :

4.1.1 : Façade Lighting Design for an Commercial Building

The Building is consider to facade lighting given below fig: 7. The given Figure .7 is Façade layout of a building. This is a project of a Commercial Office Building . the front view of the building is shown in fig : 7 and the other side view is shown in Fig : 8 (a) , 8 (b) and 8(c). The figure given below is the architecture prototype sample of the building.

Fig : 7 Front side view of the Building

Fig : 8 (a)

Fig : 8 (b)

Fig : 8 (c)

Fig : 8 Other sides view of the Building

Fig 9 is the floor plan layout and Fig : 10 is the all the elevation view layout plan by which it can be determine the height of the building, each of the elements dimension of the building. Such as windows positions and dimension, doors positions and dimension, number of windows and doors. By the elevation Drawing, it can also clear out if there is any grooves, cutouts or objects have.

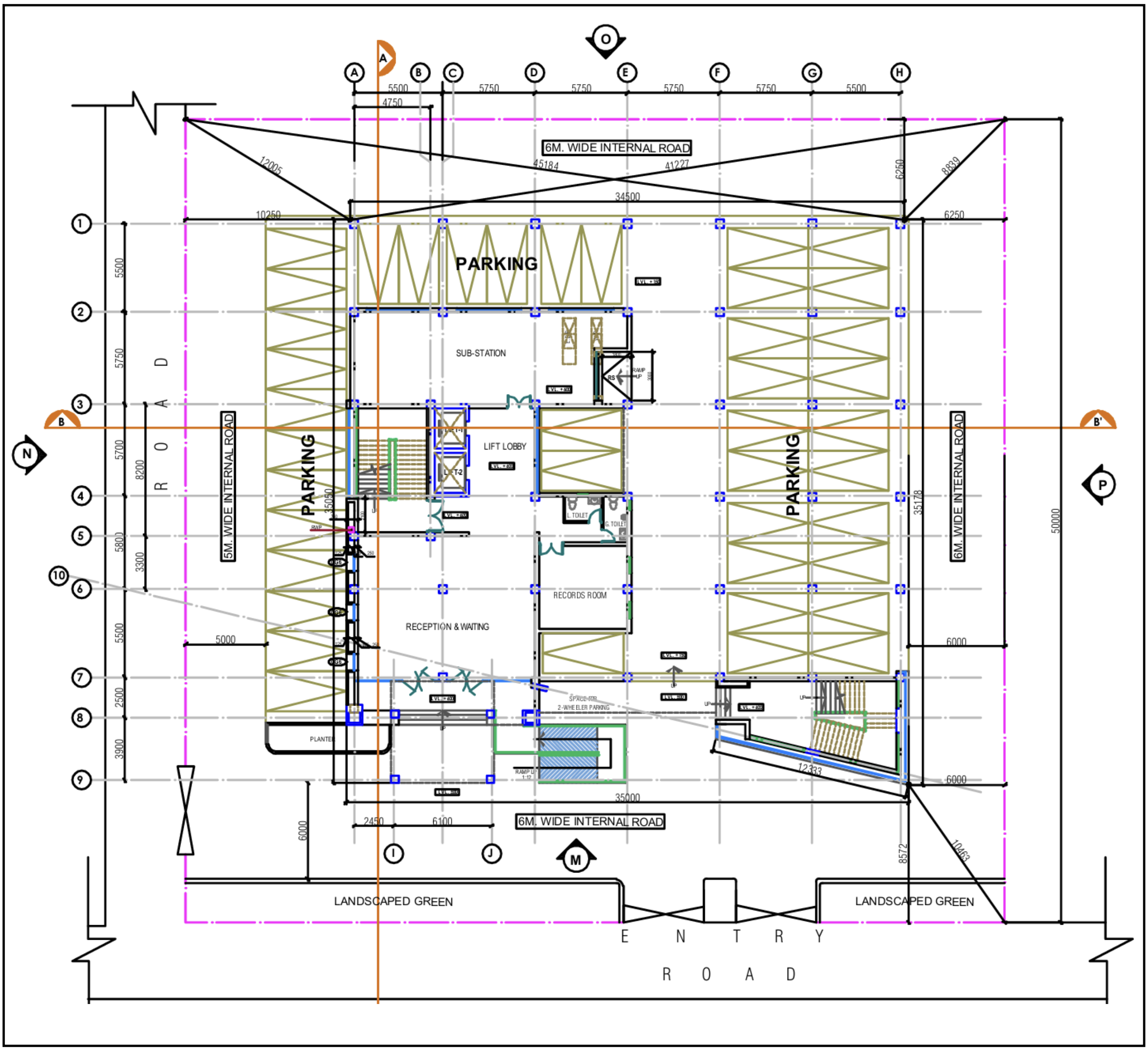


Fig : 9 Autocad Layout (Floor Plan)

The autocad plan which is the core plan which is needed for the construction of the building. Inside this plan, it also contain the positions of different types of rooms which are not needed for Facade lighting Design.

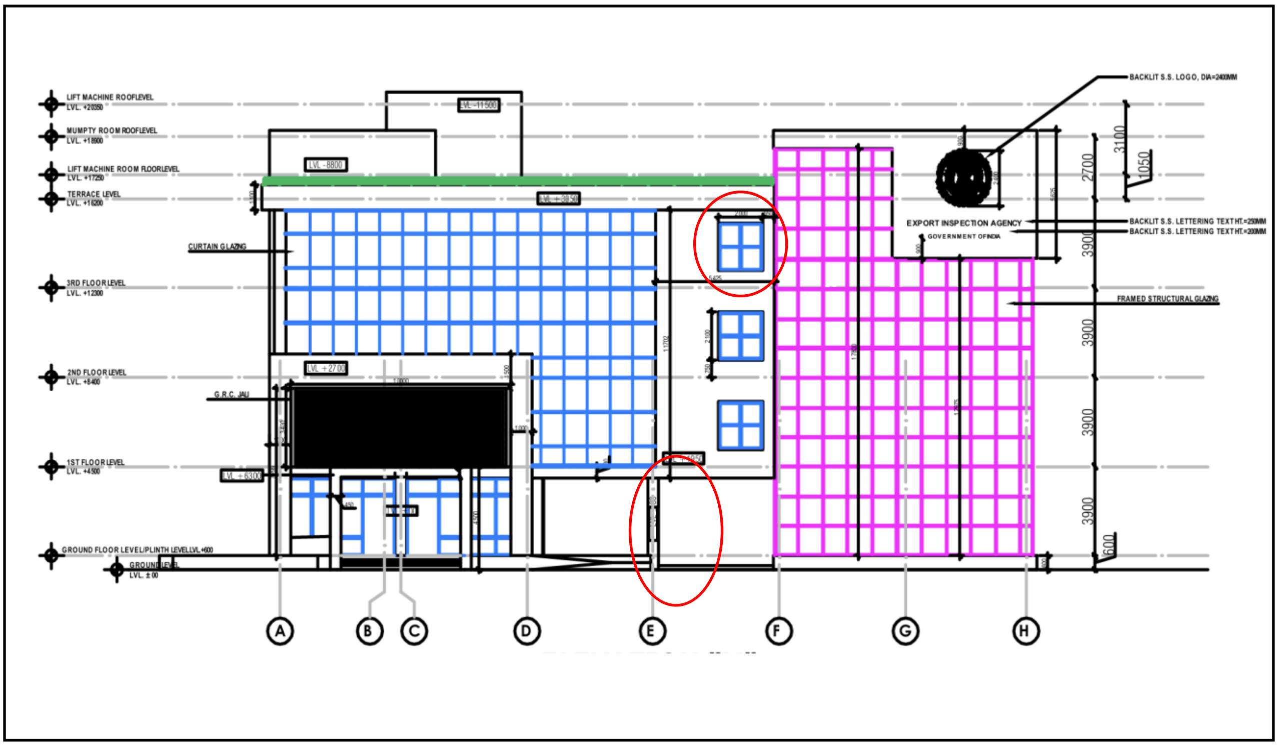


Fig : 10 (a) Front elevation " M" as shown in fig.9

From the elevation "M" as shown in fig.9 , the height of each an every element of the building is to be determine . For example, the column height and position is shown in fig 10(a) grid no. E. The position and size of the windows are shown in fig 10(a) , grid no.E to F. There are Continuous glass windows are shown in fig 10(a) ,grid no. A to E and grid no F to H.

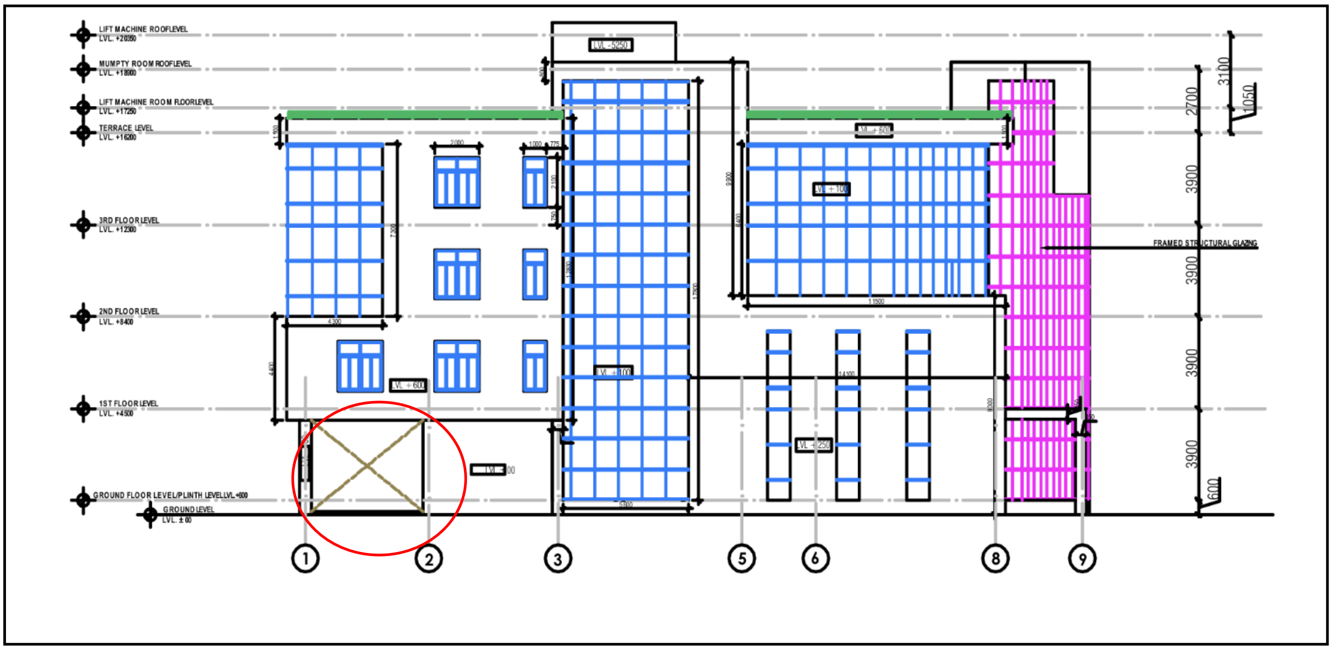


Fig 10(b) Elevation "N" as shown in fig.9

The above fig: 10 (b) ,Grid no 1 to 2, here it is shown an cross area .This cross area is defined as an open basement of the building shown in fig: 8(a) and 8 (c)

Fig 10(c) Elevation “O” as shown in fig.9

Fig : 10 (d) Elevation “P” as shown in fig.9

4.1.1.1 : Procedure or steps followed for Design in DiaLUX evo Software :

1.Import the autocad Layout → 2. Draw Extrusion Volume → 3. Set the Height → 4.Design other elements → 5.Import Luminaire IES files as per Requirement → 6.Calculation

Step 1: Import the Autocad Layouts shown in fig : 11 (a) .Then set the origin and scale for the layout. In this project the plane is imported in millimeter scale.

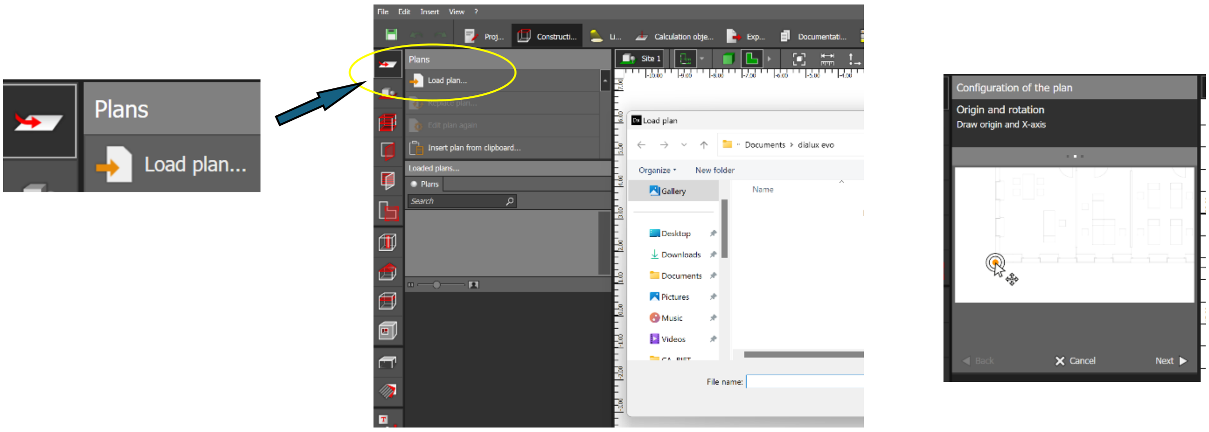


Fig : 11(a)

Now select the floor element option shown in fig. 11(b) and draw the floor element .

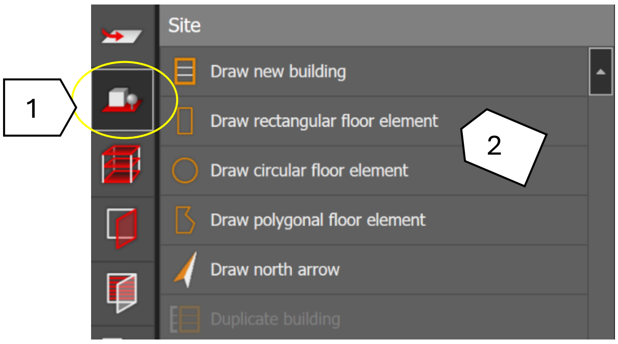


Fig : 11(b)

Step 2 : To design building structure select ‘ Draw extrusion Body’ shown in fig.12 ,

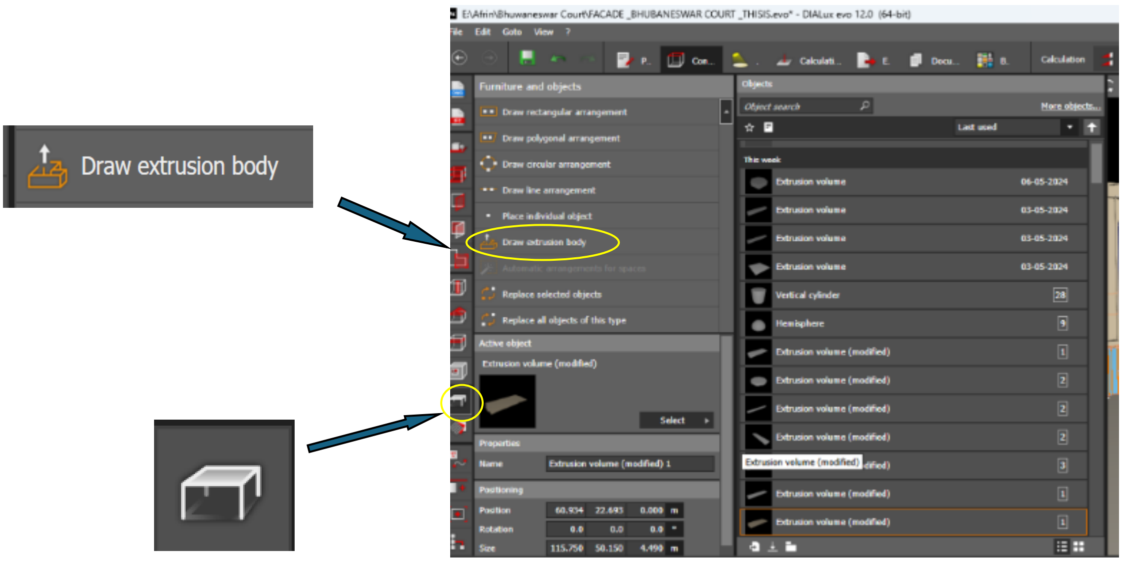


Fig :12

Step 3 : Then select the boundary or the outline of the building and select the area , shown in fig.13

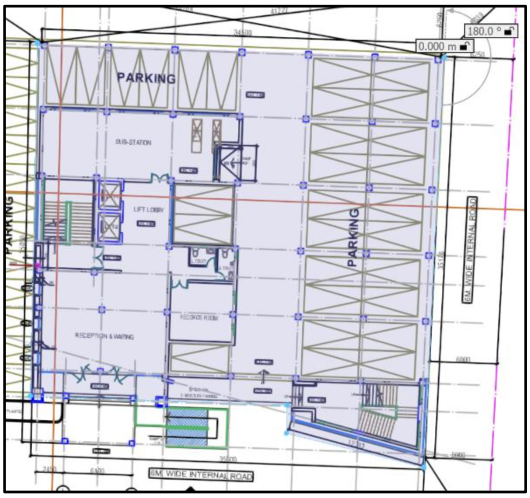


Fig : 13

Then right click on the selected area and choose 'Close Polygon' option . After closing the polygon , select the area and change the height and size as per requirement in the 'Positioning' tab on the bottom left , shown in fig. 13(a)

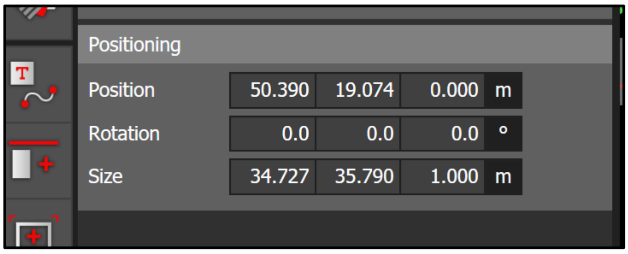


Fig : 13(a)

Step 4 : Now select the 'Furniture & Objects' option and add a window with a size as per requirement . Shown in fig. 14

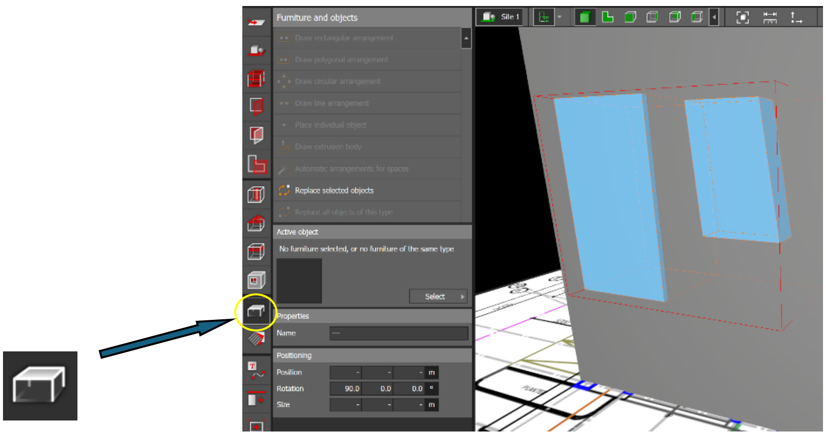
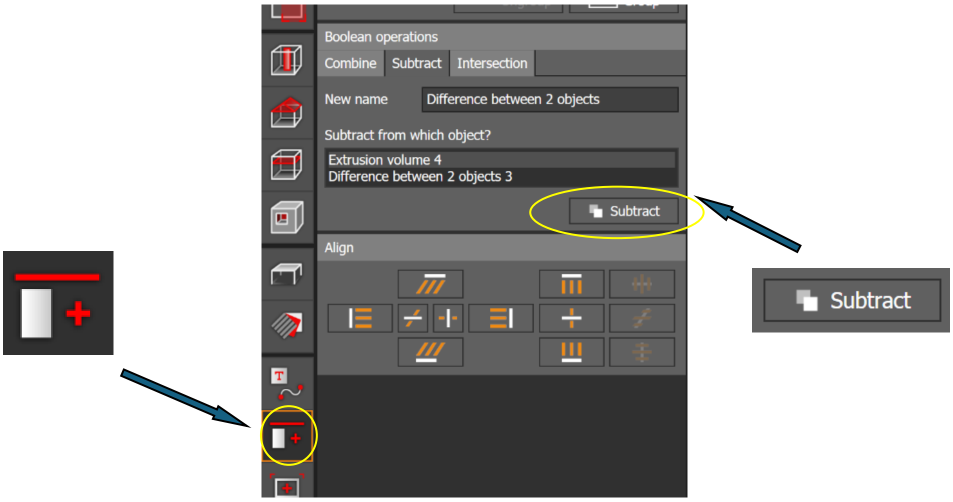


Fig : 14

Then select all the windows object and then click on the 'Copy and Arrange' option and then click on 'Subtract' shown in fig . 15(a). After subtracting the window, the object look like as shown in fig. 15(b)



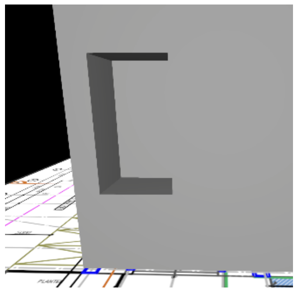


Fig : 15 (a) Fig : 15 (b)

After construction the building, select on “Material” option and choose the texture and color as per requirement shown in fig. 16.

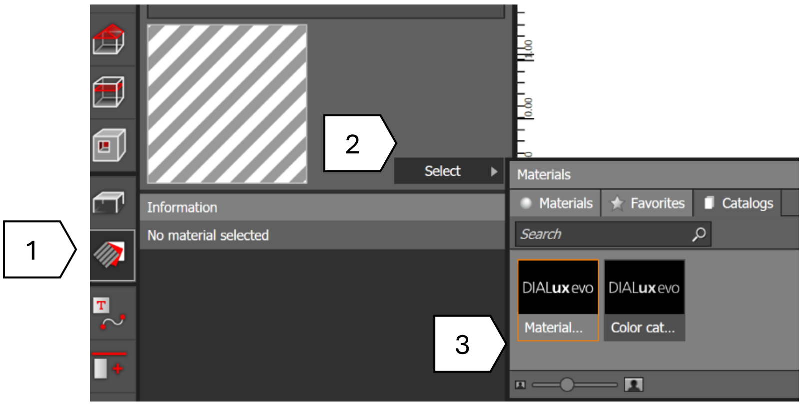


Fig : 16

after choosing the color or material, select “Apply material” option shown in fig. 17(a), then click on the area of the building where the material need to apply. Then the texture or the color will be applied on that area of the building. How it look like after applying material is shown in fig.17(b)

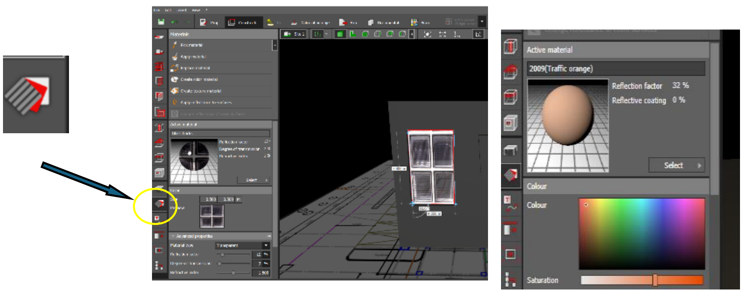


Fig : 17 (a) Fig : 17 (b)

Step 5 : After construction of the building. Now import the IES files of the luminaire as per requirement. To import the IES file some Steps are followed shown in fig. 18.

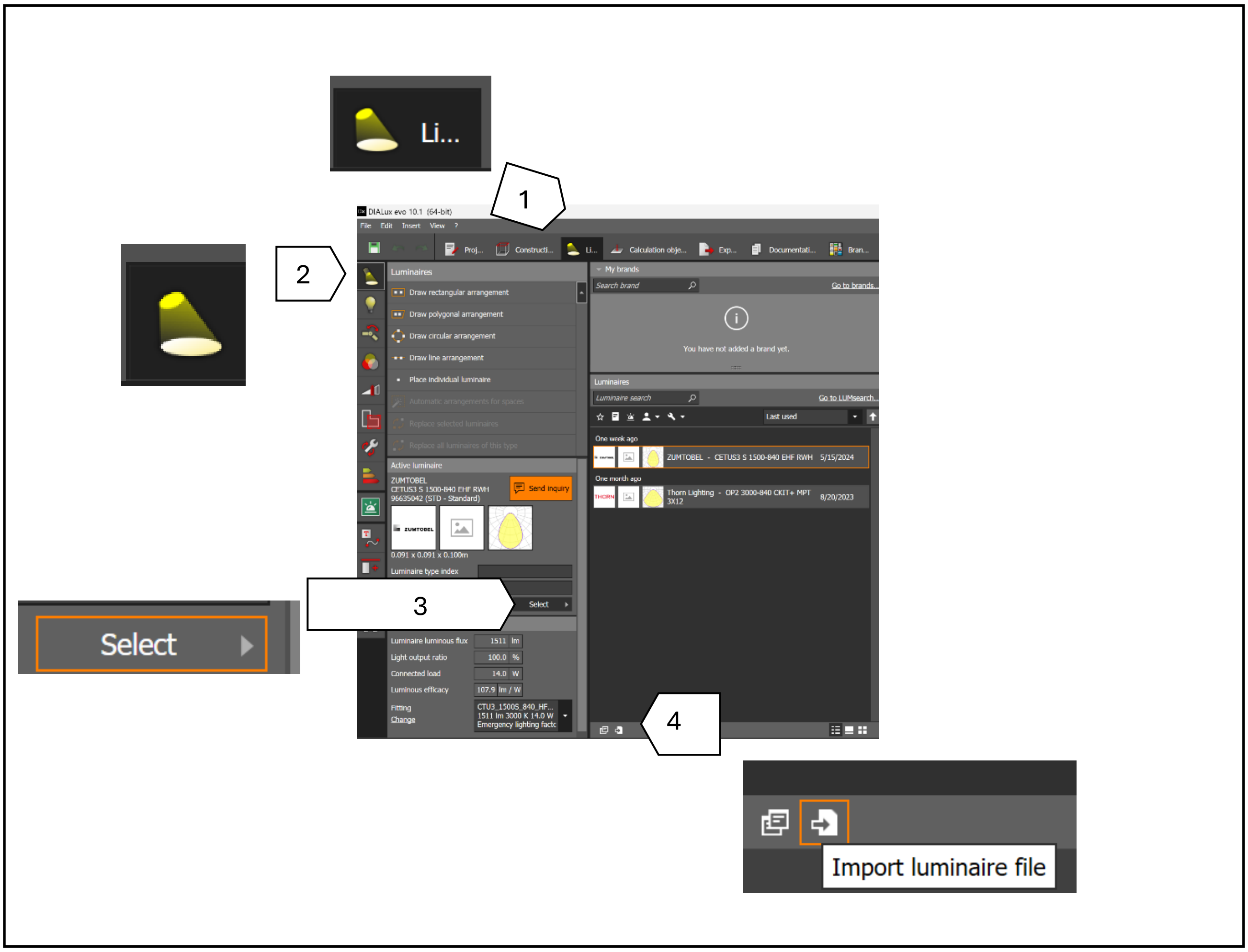


Fig : 18

After importing the IES files of the luminaires and the place them in an appropriate way which will emphasize the architecture, shown in fig.19(a) . Positioning the luminaire in an appropriate place and angle , so that the luminaire can illuminate that area in an correct way. The aiming of the luminaire is very important part in Façade Lighting . Wrong aiming should create an dark view to the area or over illuminate to an particular area which will create an spot like effect rather than enhancing the area.

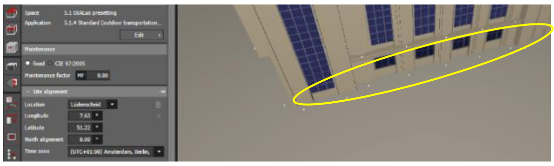


Fig : 19 (a)

The correct aiming of the luminaries, will enhance the area or create an dynamic effect to that area of the building , shown in fig.19(b)

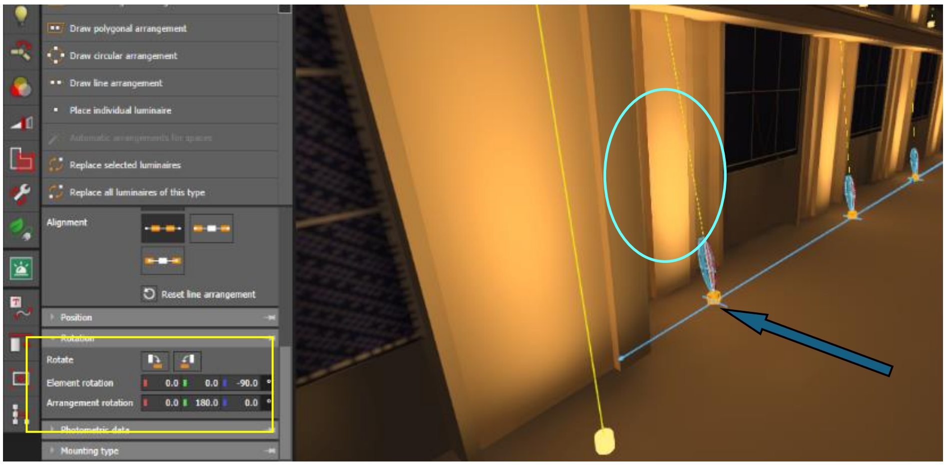


Fig : 19 (b)
Luminaire are rotated -90deg (Upward Direction) and tilted -10deg

In the above figure :19(b) the luminaire which are placed in from of the columns are tilted -10 deg angle. So that the luminaire can illuminate the columns. If we did not give required tilt, the lumen of the luminaire will still out and wasted. So , we can say required amount of tilt to a luminaire plays very important role in any façade lighting Design.

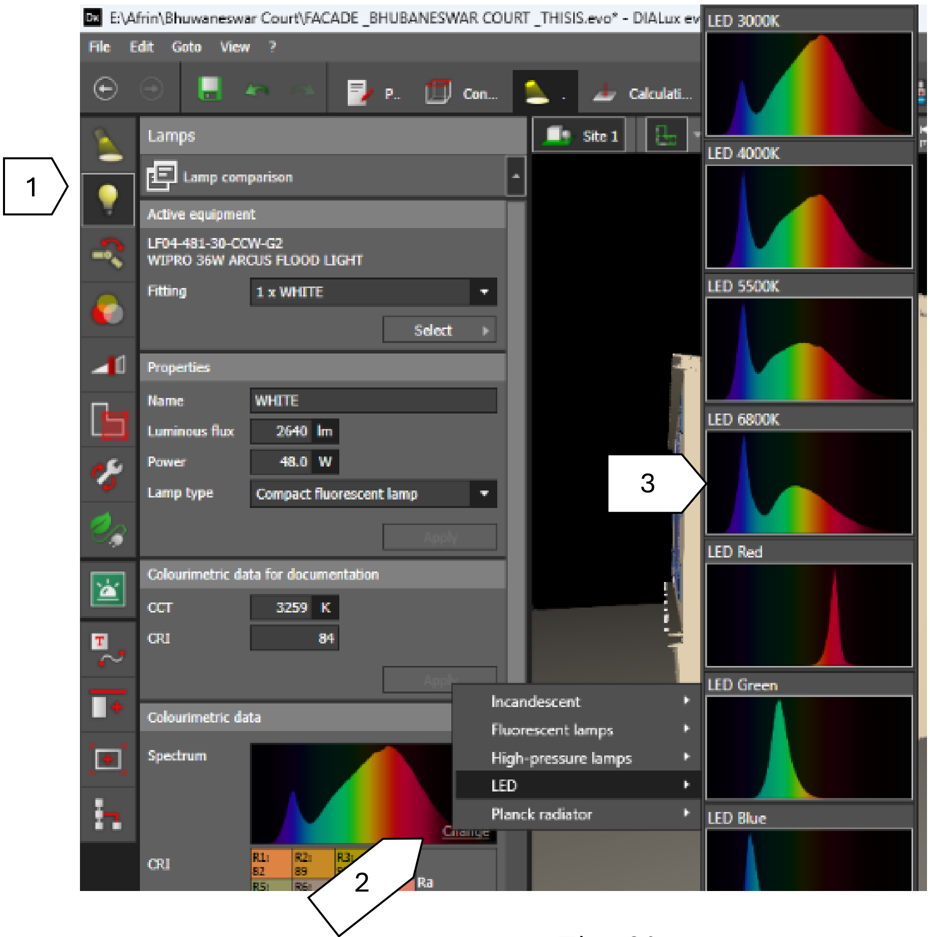


Fig : 20
After placing the luminaires in appropriate position , the CCT of the luminaires can be changed . For this , some steps are followed , shown in fig.20. First select the luminaire of which want to change the

CCT. Then select ‘Lamp ’ option. After that select ‘change ’ option from the spectrum Tab. Then a default spectrum tab open where different CCT are pre-set. From that , appropriate CCT can be selected. From the “Filter ” option different color filter can be added to the luminaire, shown in fig. 21 Some of the 3D view area shown in fig. 22 (a) to 22 (d)

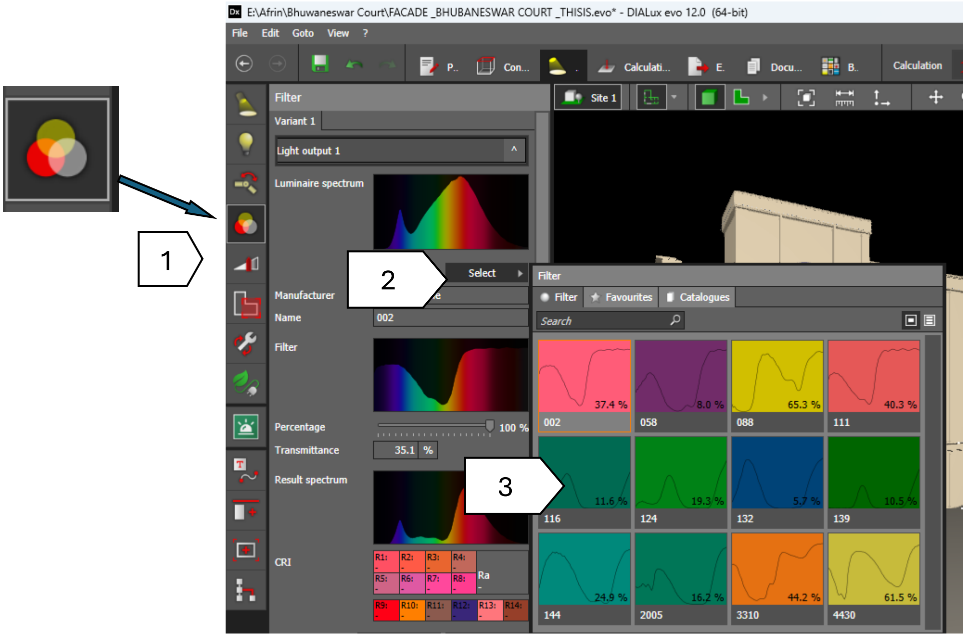


Fig : 21

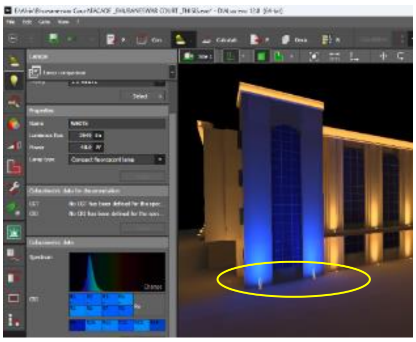


Fig: 22(a)
Luminaire Blue Spectrum

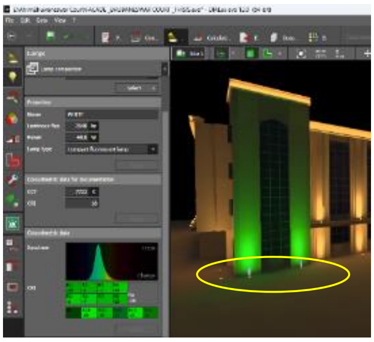


Fig : 22(b)
Luminaire CCT 7732K

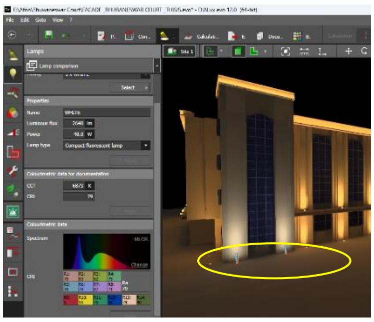


Fig : 22(c)
Luminaire CCT 6500K

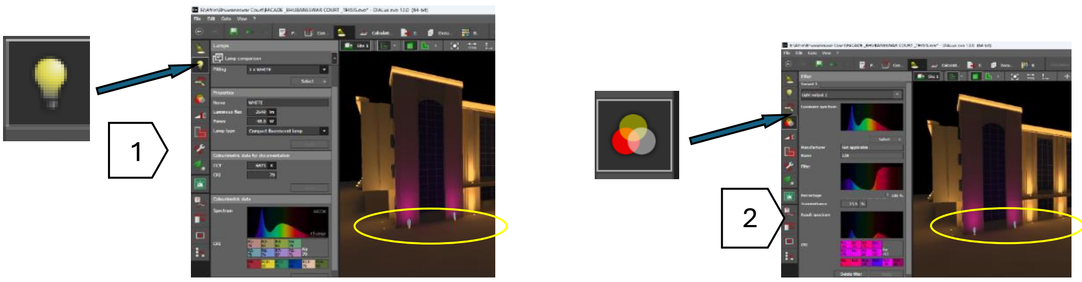


Fig : 22 (d) Luminaire CCT 6500 K with adding filter to

4.1.1.2 : The control procedure of the color changing or the dimming of the luminaires:

For the dynamic light, the DMX Control System plays a vital role. It's very important to choose the right control system for any façade lighting design. DMX controller is an apparatus that control luminaire's spectral or colors, brightness and other such effects or patterns. It is a console that employs a specific protocol and code set to control the lights.

DMX Control System includes mainly controller, fixtures and cables. Controller is the brain of the System. It send the signals to the fixtures. Then the fixture can change the color as per the signal it gets. The cables are the connecters which carry the digital signals from the controller to the fixtures. Each lines are capable of transmitting up to 512 channels of information's. Additionally DMX splitters and amplifiers may used to distribute the signal to the multiple fixtures and extend the range of the system .

Control Procedure :

- Assessing space requirements and planning layout are vital for pre-design steps. Considering highlighted areas.

- Choosing fixtures which are compatible with the DMX protocol and critical outdoor conditions .

- Careful wiring ensures correct signal transmission and durability against outdoor conditions. Fixtures are connected using DMX cables and addressed individually. A DMX controller and power supply are installed for control and power provision.

- DMX controllers transmit digital signals to compatible fixtures, allowing precise control over attributes like color and intensity. Controllers can be programmed manually or via software/apps, offering advanced features like scene creation and automation.

- Setting up the controller, assigning DMX channels to fixtures, creating scenes, chases, testing, and adjustments. Scenes are pre-set effects, while chases are sequences of scenes for dynamic effects.

- Connect the DMX controller to fixtures using DMX cables. Fixtures are daisy-chained, ensuring appropriate addressing and signal strength. Signal boosters or splitters may be necessary for extensive systems.

- Commands sent to fixtures control functions like brightness and color. Each fixture is assigned a unique DMX address, enabling individual control. Following proper steps ensures effective control of LED light fixtures.

4.1.1.3 : Design in Dialux Software (3D Dynamic View)

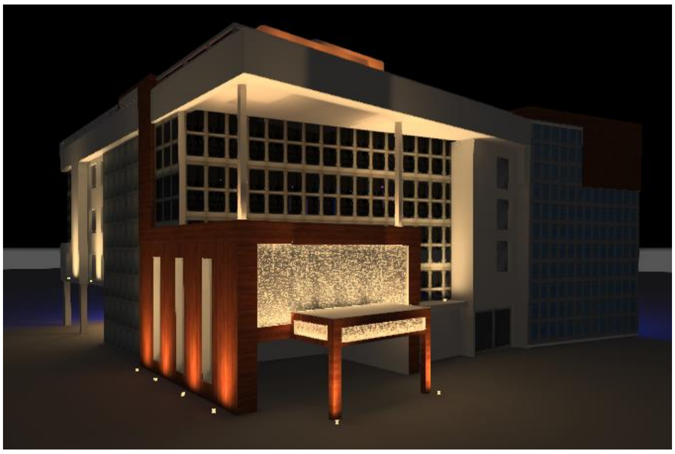


Fig : 23 (a) Luminaire CCT 3000 K (Front View)

Fig : 23 (b) Luminaire CCT 3000 K (Side View)

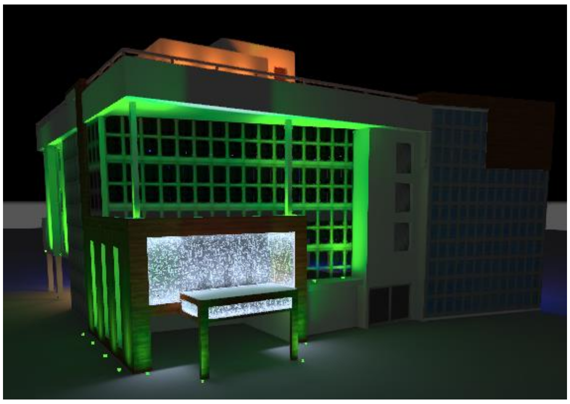


Fig : 23 (c) Luminaire CCT 7723 K (Front View)

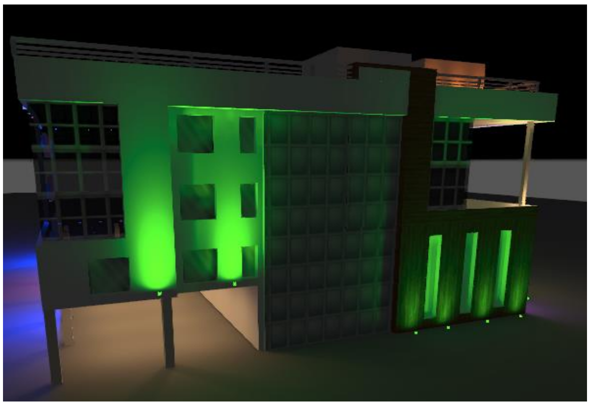


Fig : 23(d) Luminaire CCT 7723 K (Side View)

Fig : 23 (e) Luminaire CCT 3000 K (Back Side)

Fig : 23 (f) RGB Combination View (Back Side)

4.1.1.4 : Luminaire Quantity :

In this Façade design : There are 2 numbers of mini flood light luminaires wattage of 24W, 17 numbers of numbers of mini flood light luminaires wattage of 48W, 6 numbers of RGBW Linear Wall washer luminaires wattage of 24W and 10 mtr. Warm white LED Strip light. The luminaire quantity and type of the luminaires used in this project is given below Table.6.

Table: 6 Luminaire Quantity Details

Sl.No.	Specification	Quantity
1	24W RGBW Mini Floodlight	2
2	48W RGBW Mini Floodlight	17
3	24 W, 1m length Linear RGBW Floodlight	6
4	14W, 5m/spool, Warm white LED Strip	2
5	240W LED Driver for Strips	8
6	120W LED Driver	1
7	T Connector	9
8	S Connector	27
9	Master DMX Controller	1
10	DMX Splitter/Booster	4
11	6 Button Panel	1

4.1.2 : Façade Lighting Design for a Court Building

Fig : 24(a)
Façade layout(Front side of the building)

Fig : 24(b)
Façade layout(Back side of the building)

The Building is consider to facade lighting given below fig: 24 (a) and (b) is Façade layout of the building. This is a project of a Court Building Only height of the building is known . Other dimension like height of the window, doors, column etc. are not given. All of this areas are an imaginary part of the design. So, in this project luminaires quantity and type are taken as per the elements having in the building .

For example, 1.the columns , 2.base area of the windows, 3.the top round shape part of the building, 4.the window net area etc are 'Attention-Grabbing' areas of the building. So, this is taken as a key areas, shown in fig. 25 . By highlighting all these key areas, it can give a dynamic look to the building.

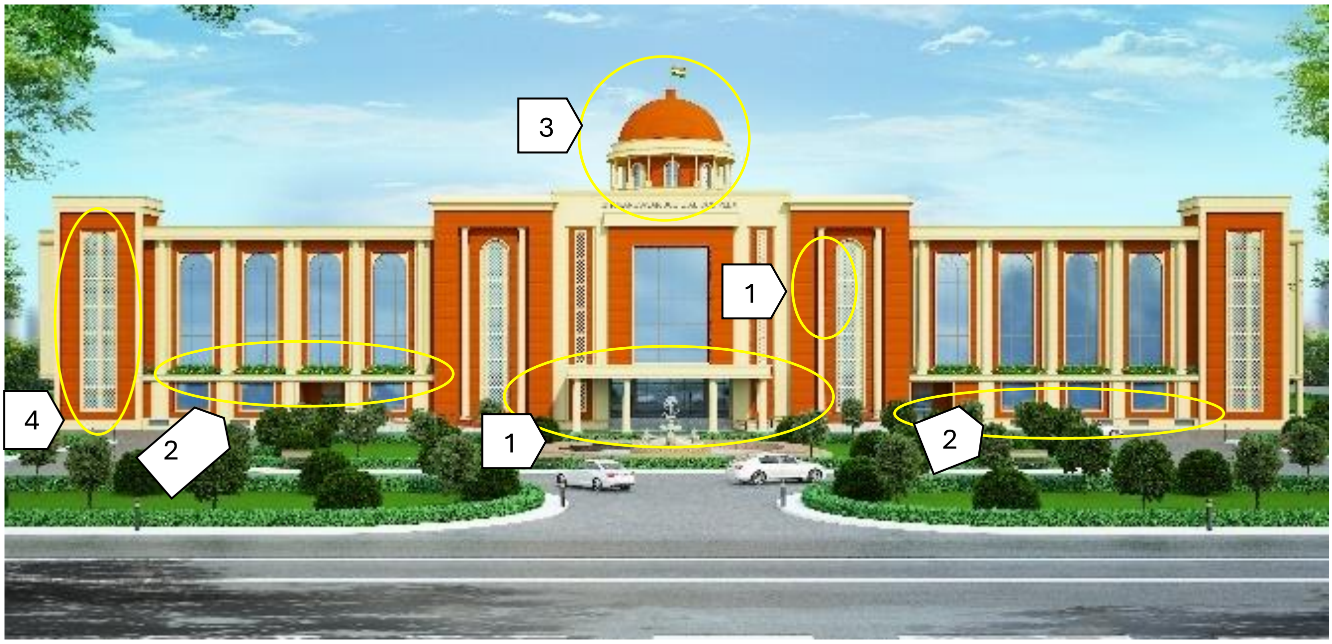


Fig : 25 Key Areas shown in the Façade layout

4.1.2.1 : Design in Dialux Software (3D Dynamic view):

Fig : 26 (a) Dialux 3D view CCT 6500K

The Above fig : 26 (a) is the Building Structure before adding any texture or color to the wall. And the fig: 26 (b) to (g) is the building Structure Views in different CCT combination of the luminaires after adding Texture and color to the walls.

Fig : 26 (b) Blue & Cool White Combination view

Fig : 26 (c) Green & cool White Combination view

Fig : 26 (d) RGB Combination view 1

Fig : 26(e) RGB Combination view 2

Fig : 26 (f) Indian Flag Color Combination View

4.1.2.2 : Luminaire Quantity:

In this Façade design : There are 49 numbers of mini flood light luminaires wattage of 24W, 70 numbers of numbers of mini flood light luminaires wattage of 48W, 38 numbers of RGBW Linear Wall washer luminaires wattage of 24W and 450 mtr. Warm white LED Strip light. The luminaire quantity and type of the luminaires used in this project is given below Table.7 .

Table: 7 Luminaire Quantity Details

Sl.No.	Specification	Qty.
1	24 W RGBW Mini Floodlight	49
2	48 W RGBW Mini Floodlight	70
3	24 W, 1m length Linear RGBW Floodlight	38
4	70W, 5m/spool, Warm white LED Strip IP67	89
5	240 W LED Driver for Strip	33
6	120 W LED Driver	58
7	T Connector	91
8	S Connector	246
9	Master DMX Controller	1
10	DMX Splitter/Booster	4
11	6 Button Panel	1

4.1.3 : Façade Lighting Design for an Institute Building

The Building is consider to facade lighting given below fig: 27(a) and (b) is Façade layout of the building. This is a project of an Institute Building. This are a prototype layouts in an image format ,shown in Fig: 28 .This image is then imported in Dialux Software, to create an structural object by the help of the floor design . After that , all areas, heights and also building height are an imaginary part of the design, with an imaginary heights all this areas are designed as per the reference image to look like an replica.

Fig : 27 (a) Façade layout 1

Fig : 27 (b) Façade layout 1

4.1.3.1 : Structural Dimension :

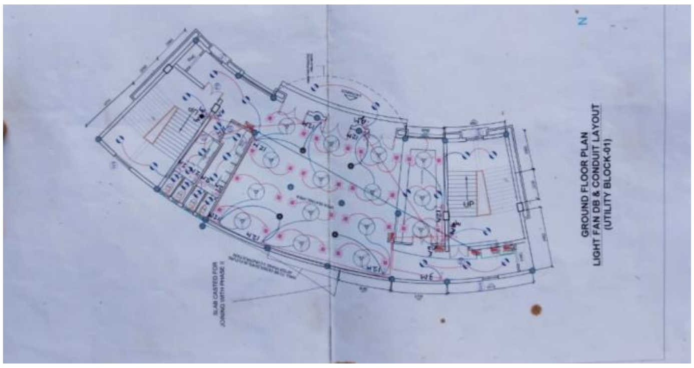


Fig : 28 Copy of the Dimension of the Building

4.1.3.2 :Site View :

Fig : 29 Design in Dialux Software
(3D Dynamic View)

Fig : 30 Site View (after Light Installation)

The fig : 29 is the Dialux Design 3d view and fig: 30 is the site view after installation of the all luminaries.

4.1.3.3: Luminaire Quantity :

In this Façade design : There are 8 numbers of Warm white Linear Wall washer luminaires wattage of 12W, 70 numbers of numbers of mini flood light luminaires wattage of 48W, 8 numbers of Warm white Linear Wall washer luminaires wattage of 36W and 100 mtr. Warm white LED Strip light. The luminaire quantity and type of the luminaires used in this project is given below Table.8

Table: 8 Luminaire Quantity Details

Sl.No.	Specification	Quantity
1	12 W Linear Wall Washer	8
2	36 W Linear Wall Washer	8
3	14W, 5m/spool, Warm white LED Strip IP67	20
4	240 W LED Driver	10
5	T Connector	10
6	S Connector	10
7	Clip for hang the Luminaire	250

4.2 : Indoor Lighting Designs :

4.2.1 : Indoor Lighting design for an office building

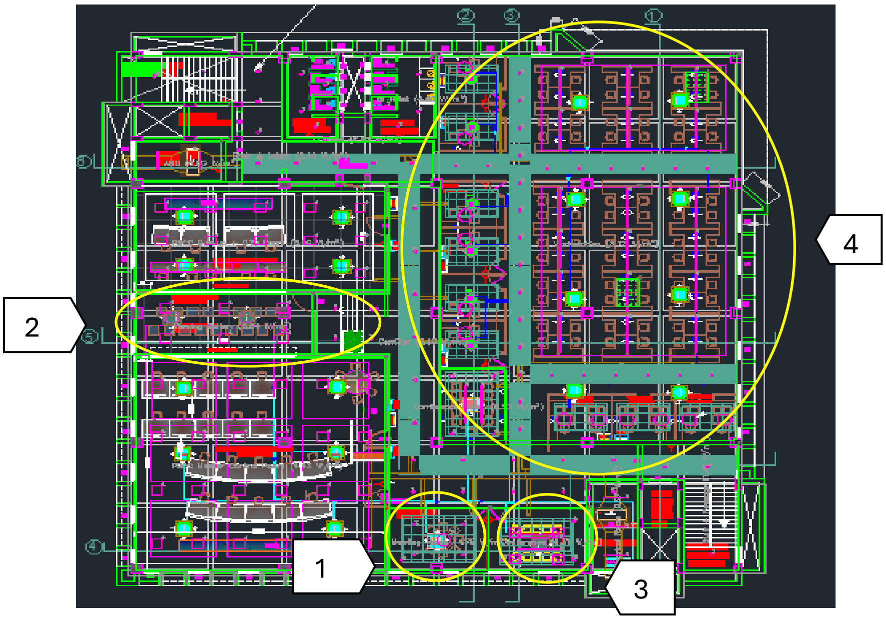


Fig : 31 Third Floor of an Office Building

This is a project that has been undertaken having total eight numbers of Floor.The Lighting design have been done only for the 3rd Floor area. It is an office area. The figure : 31 shows 3rd floor autocad layout of the building. By this layout plan , we can easily find that there are different types of rooms with their dimentions can be observed within the layout plan. There are different Types of ceiling , their dimentions can be observed within the layout plan . We can find out different type of luminaires are there for each room which is symbolised in te layout plan.

4.2.1.1: Procedure or steps followed for Design in DiaLUX evo Software :

Step 1 : Import the .dwg file Which is the autocad floor plan layout.

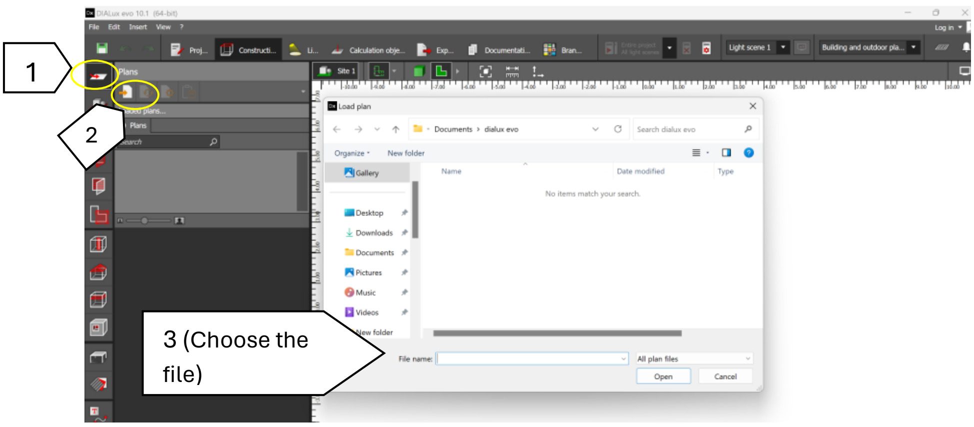


Fig : 32   Steps to import any .dwg file in Dilaux evo Software

Step 2 : Design the Floor of the Building . Below given flowchart is the steps followed to design the indoor area of the building.

1.Draw a floor element → 2. Draw a new building → 3. Set the Height of the Building → 4.Draw indoor contour → 5.Import Luminaire IES files as per Requirement → 6.Calculation

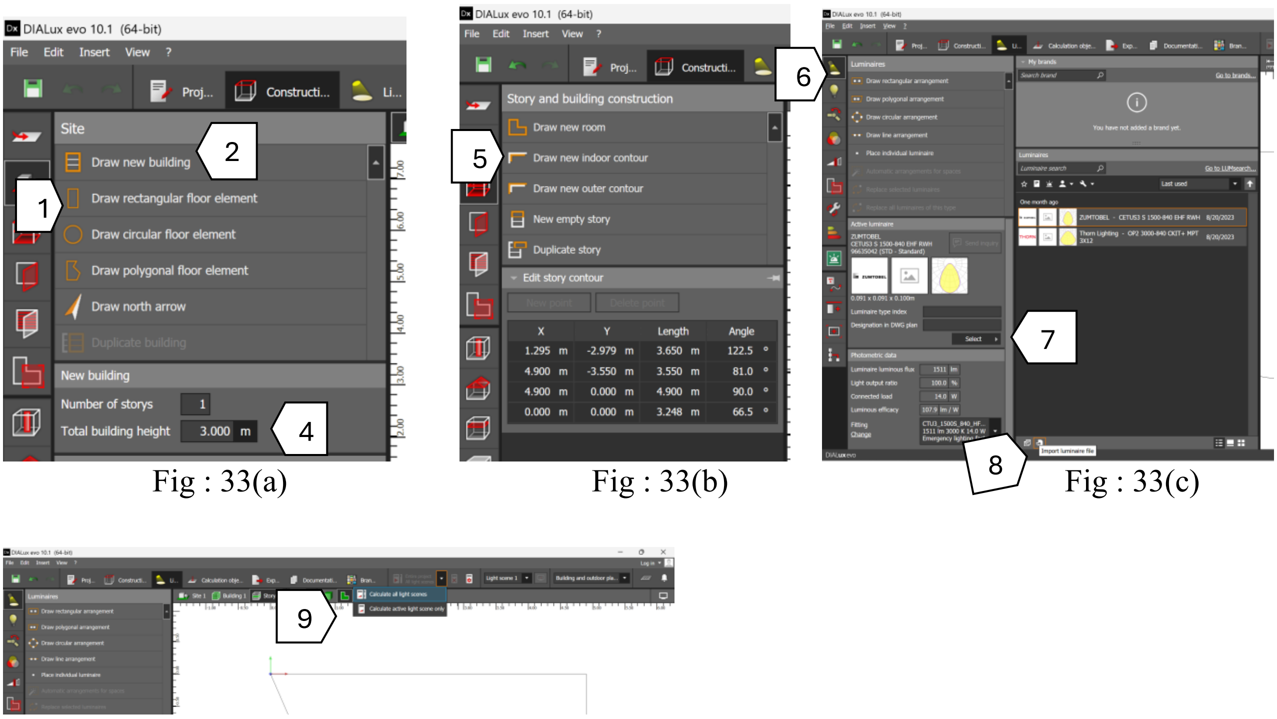


Fig : 33(a) Fig : 33(b) Fig : 33(c)

Fig : 33(d)

Fig : 33 Steps followed for design in Dialux evo Software

- After Importing the autocad layout plan. Select "Draw a floor element" to draw the floor element. Explained in (4.1.1.1 , step 1)
- Then draw the new building. Option shown in fig.33(a). After that set the height of the Floor. Here the height which should be taken 3.000m.
- After that Select "Draw new indoor contour" to draw other rooms having in that floor, shown in fig. 33(b)
- Import IES Files as per requirement , shown in fig. 33(c) . the IES file importing process is described in Fig.18,(4.1.1.1 , step 5)
- After placing the all the luminaires , calculation is needed, shown in fig.33(d) . So that the illuminance level, uniformity level all required calculation should be done.

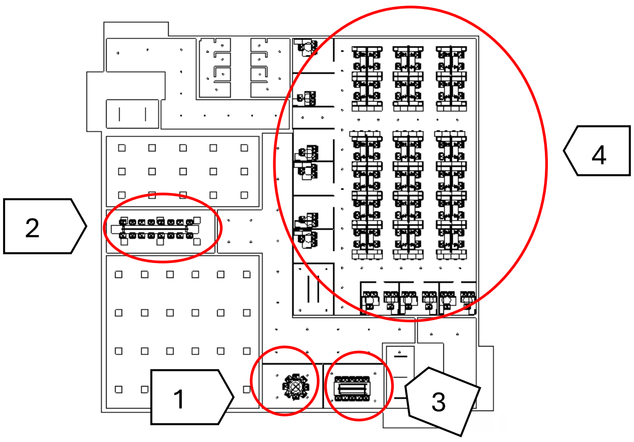


Fig : 34 Dialux 2D View (after designed as per autocad Layout)

In the above fig. 26 and fig.31, marked rooms calculated values area given below.

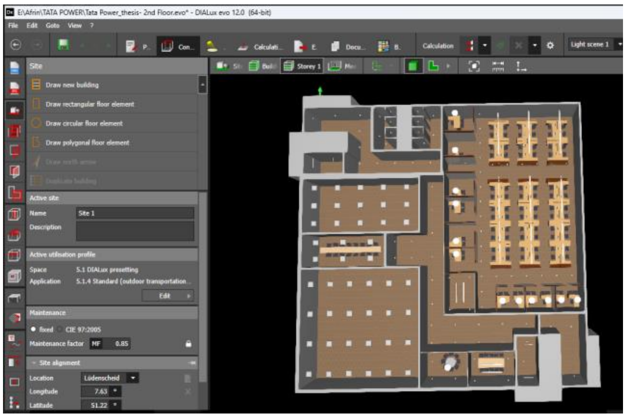


Fig : 35 (a) Dialux 3D View (Before calculation)

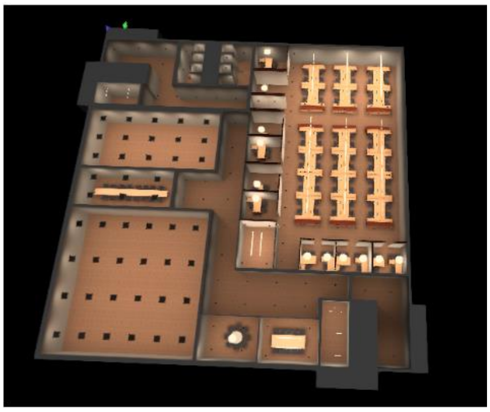


Fig : 35 (b) Dialux 3D View (After calculation)

Fig : 35(a) and (b) Dialux 3D View (after designed as per autocad Layout)

4.2.1.2 : Calculated Results each of the Rooms :

❖ **<u>Room Type 1 :</u>** <u>(Named)</u> **<u>Meeting Room</u>**

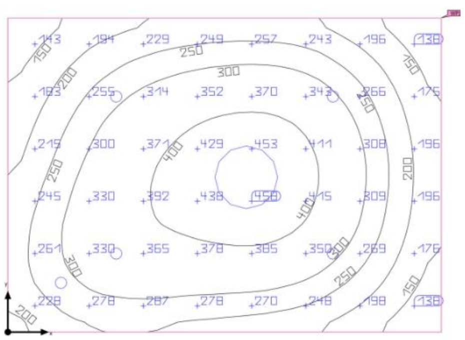


Fig : 36 Isoline diagram of the room

Fig : 37 Dialux 3D View (After calculation)

Fig. 36 Shown the isoline diagram of the room after calculation. Each isoline shows , the same illuminance level of the area of the room.

- The total area of the room is 22.09 m2
- Mounting Height of the luminaires : 3.300 m

For an indoor lighting design , some necessary key parameters should be used to design an indoor area . These key parameters are as follows : Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height: 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.85
- Room Reflectance factors : Ceiling : 50.0 %
  Wall : 30.0 %
  Floor : 20.0 %

Table: 9 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	300-500-750 lux [1]	305 Lux
Uniformity	< 0.3	0.38
LPD	> 14W/m2 [4]	4.75 W/m2

In the above Table.9 standards values of illuminance level are taken . There are three values of illuminance level that are considered. According to standards [1] the higher value of illuminance level is considered when the room reflectance are low, error area cost rectify, visual work is critical and productivity is high. The low value of the illuminance level is considered when reflectance is high or contrast, speed and accuracy of the work is not so important and task execution will happen only occasionally. In this project the mid value of the illuminance level is taken as a standard. The term

LPD[2] (Light Power Density) is the ratio of total wattage consumed by the luminaries in a room to the total area of that room .

Table: 10 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Recess Monted Downlight		Wattage : 15 W System Lumen : 100 lm/W IP 40	4
Suspended Decorative Luminaire		Wattage : 30 W System Lumen : 125 lm/W IP 20	1

Room Type 2 : (Named) Viewing Gallary

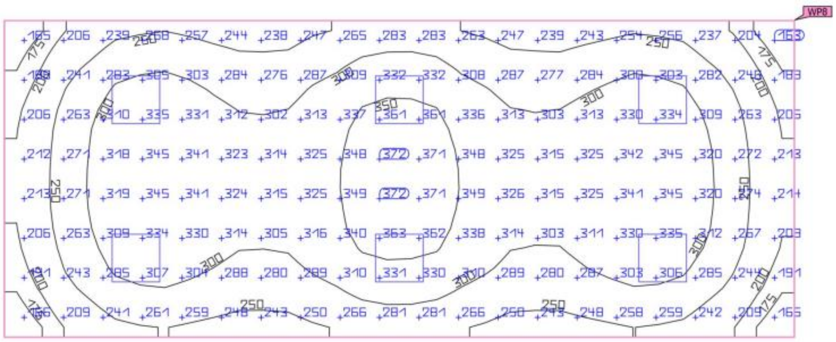


Fig : 38 Isoline diagram of the room

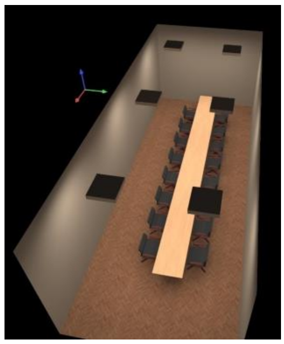


Fig : 39
Dialux 3D View (After calculation)

- The total area of the room is 38.99 m2
- Mounting Height of the luminaires : 3.300 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor: 0.85
- Room Reflectance factors : Ceiling : 50.0 %
  Wall : 30.0 %
  Floor : 20.0 %

Table: 11 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	200-300-500 lux [1]	287 Lux
Uniformity	< 0.3	0.52
LPD	> 14W/m2 [4]	5.54 W/m2

Table: 12 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Recess Monted 2ft x 2ft Tiles type Luminaire		Wattage : 36 W System Lumen : 100 lm/W IP 20	6

❖ Room Type 3 : (Named) Confaerance Room

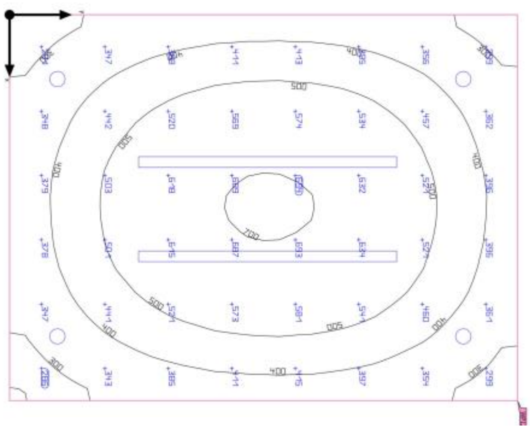


Fig : 40 Isoline diagram of the room

Fig : 41 Dialux 3D View (After calculation)

- The total area of the room is 17.01 m2

- Mounting Height of the luminaires : 3.300 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.85
- Room Reflectance factors : Ceiling : 50.0 %
Wall : 30.0 %
Floor : 20.0 %

Table: 13 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	300-500-750[1]	463 Lux
Uniformity	< 0.3	0.54
LPD	> 14W/m2 [4]	8.23 W/m2

Table: 14 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Linear Suspended Luminaire		Wattage : 40 W System Lumen : 130lm/W IP 20	2
Recess Monted Downlight		Wattage : 15 W System Lumen : 100 lm/W IP 40	4

❖ **Room Type 4 : (**Named) **Workstation**

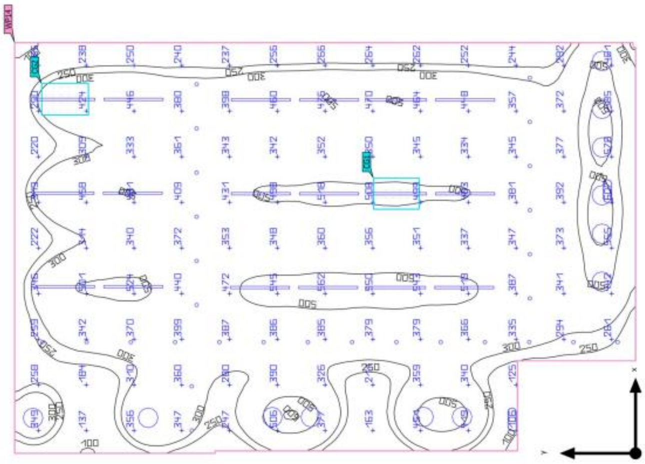


Fig : 42 Isoline diagram of the room

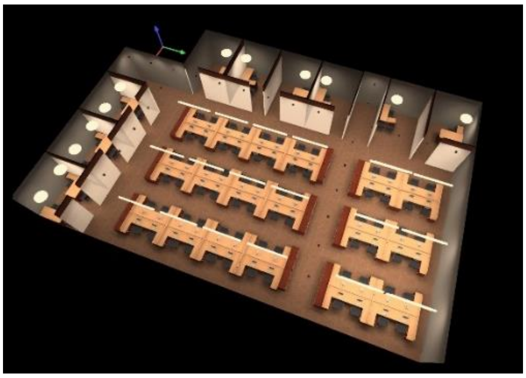


Fig : 43 Dialux 3D View (After calculation)

- The total area of the room is 403.57 m2
- Mounting Height of the luminaires : 3.300 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.85
- Room Reflectance factors : Ceiling : 50.0 %
  Wall : 30.0 %
  Floor : 20.0 %

Table: 15 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	300-500-750 lux [1]	367 Lux
Uniformity	< 0.3	0.41
LPD	> 14W/m2 [4]	3.72 W/m2

Table: 16 Summary of luminaire

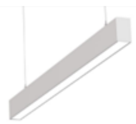
Type of the Luminaire	Picture	Luminaires Details	Quantity
Linear Suspended Luminaire		Wattage : 40 W System Lumen : 130lm/W IP 20	18
Recess Monted Downlight		Wattage : 15 W System Lumen : 100 lm/W IP 40	28
Suspended Decorative Luminaire		Wattage : 30 W System Lumen : 125 lm/W IP 20	12

Table: 17 Summary of luminaire for only the third floor of the office building

Sl.No.	Specification	Quantity
1	40W Linear Suspended Luminaire	27
2	36W 2ft x 2ft Tile Luminaire	45
3	15W Recess Downlight	78
4	15W Surface Downlight	7
5	40W LED Batten	5
6	30W Suspended Decorative Circular Luminaire	13

4.2.2 : Indoor Lighting Design for an Hostel Building

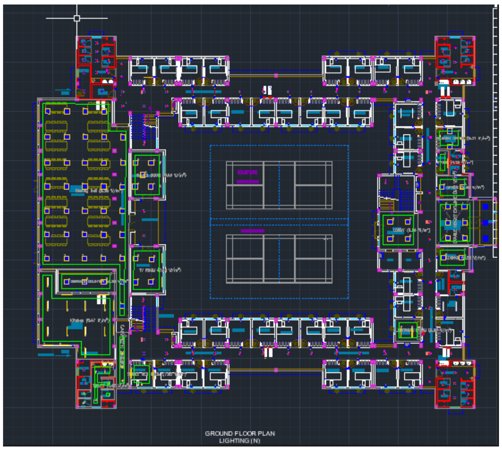


Fig : 44 Atucad Floor Plan

In this project 5 It is a hostel building , having 4 floor which have similar kind of rooms . So it is designed using similar kind of rooms as sample full stop. The above figure: 44 is the AutoCAD layout of the Ground floor . Luminaire Layout is also Proposed by the client.

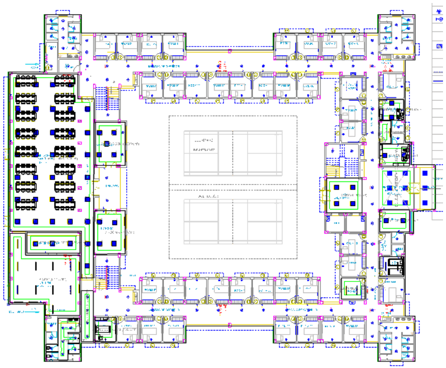


Fig : 45 (a) Dialux 2D View (AutoCAD Layout ON)

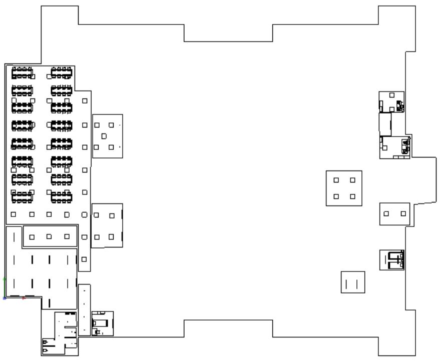


Fig : 46 (b) Dialux 2D View (AutoCAD Layout OFF)

Fig : 37 Dialux 2D View (after designed as per autocad Layout)

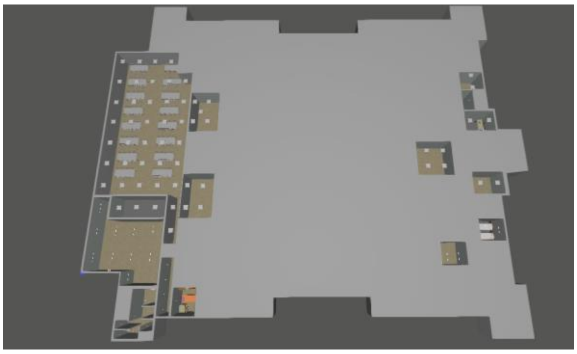


Fig : 47 (a) Dialux 3D View (Before Calculation)

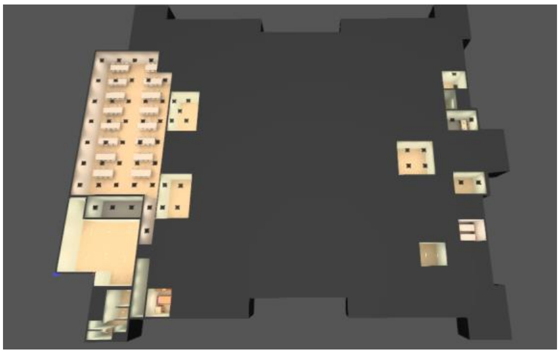


Fig :47 (b) Dialux 3D View (After Calculation)

Fig : 47 Dialux 3D View (after designed as per autocad Layout)

4.2.2.1 : Calculated Results each of the Rooms :

- **Room Type 1 : (Named) Corridor**

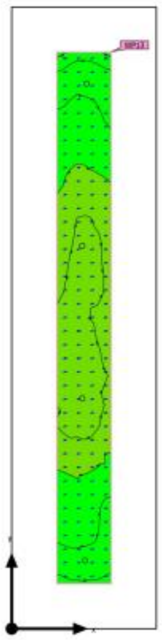


Fig : 49 Isoline diagram of the room

Fig : 50 Dialux 3D View (After calculation)

- The total area of the room is 11.04m^2
- Mounting Height of the luminaires : 3.100 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height: 0.800 m
- Wall Zone : 0.500 m

- Maintenance Factor : 0.90
- Room Reflectance factors : Ceiling : 70.0 %
  Wall : 50.0 %
  Floor : 20.0 %

Table: 18 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	50-100-150 lux [1]	201 Lux
Uniformity	< 0.3	0.84
LPD	> 14W/m2 [4]	13.56 W/m2

Table: 19 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Surface Monted Downlight		Wattage : 12 W System Lumen : 100 lm/W IP 40	4

❖ Room Type 2 : (Named) Dinning Hall

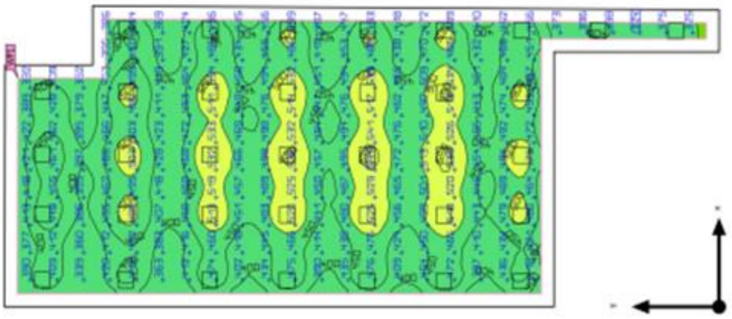


Fig : 51 Isoline diagram of the room

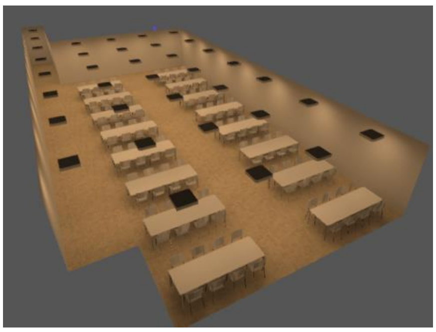


Fig : 52 Dialux 3D View (After calculation)

- The total area of the room is 246.60 m^2
- Mounting Height of the luminaires : 3.100 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.500 m
- Maintenance Factor : 0.90
- Room Reflectance factors : Ceiling : 70.0 %
  Wall : 50.0 %
  Floor : 20.0 %

Table: 20 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	150-200-300 lux [1]	455 Lux
Uniformity	< 0.3	0.84
LPD	> 14W/m2 [4]	5.25 W/m2

Table: 21 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Recess Monted 2ft x 2ft Tile type Luminaire + Surface frame (True Ceiling)		Wattage : 36 W System Lumen : 100 lm/W IP 20	36

❖ Room Type 3 : (Named) Electrical Room

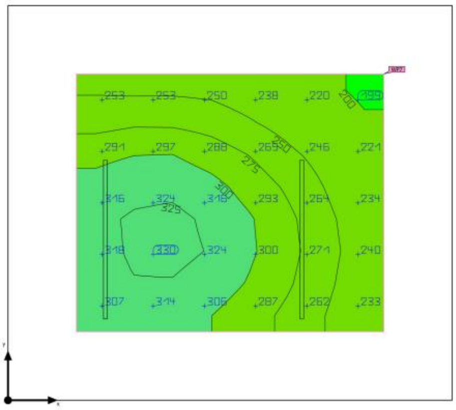


Fig : 53 Isoline diagram of the room

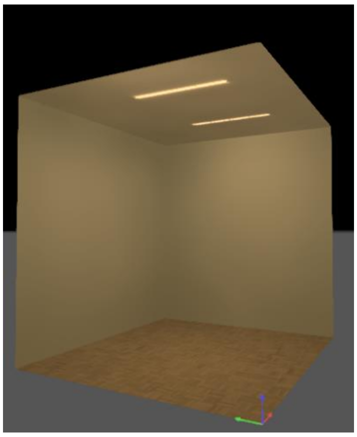


Fig : 54 Dialux 3D View (After calculation)

- The total area of the room is 9.35 m^2
- Mounting Height of the luminaires : 3.100 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.500 m
- Maintenance Factor : 0.90
- Room Reflectance factors : Ceiling : 70.0 %
  Wall : 50.0 %
  Floor : 20.0 %

Table: 22 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	150-200-300 lux [1]	276 Lux
Uniformity	< 0.3	0.70
LPD	> 14W/m2 [4]	6.42 W/m2

Table: 23 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
T8 Tube + LED tube + Double Channel		Wattage : 20 W System Lumen : 100 lm/W IP 20	4

❖ **Room Type 4 :** (Named) **Games Room**

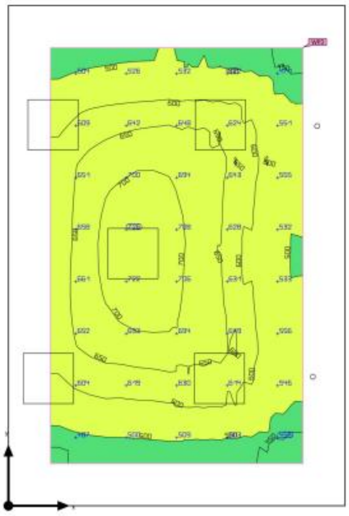


Fig : 55 Isoline diagram of the room

Fig : 56 Dialux 3D View (After calculation)

- The total area of the room is 23.65 m^2
- Mounting Height of the luminaires : 3.100 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.500 m
- Maintenance Factor : 0.90
- Room Reflectance factors : Ceiling : 70.0 %
  Wall : 50.0 %
  Floor : 20.0 %

Table: 24 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	200-300-500 lux [1]	603 Lux
Uniformity	< 0.3	0.67
LPD	> 14W/m2 [4]	8.63 W/m2

Table: 25 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Recess Monted 2ft x 2ft Tile type Luminaire + Surface frame (True Ceiling)		Wattage : 36 W System Lumen : 100 lm/W IP 20	5
Surface Monted Downlight		Wattage : 12 W System Lumen : 100 lm/W IP 40	2

❖ **Room Type 5 :** (Named) **Kitchen**

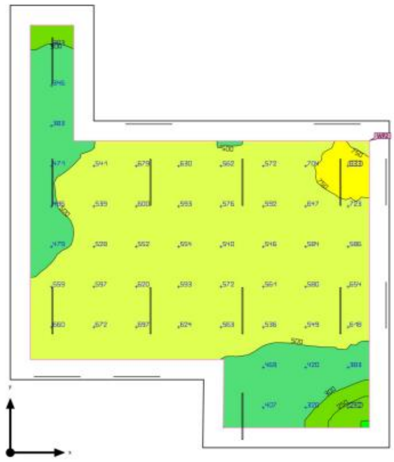


Fig : 57 Isoline diagram of the room

Fig : 58 Dialux 3D View (After calculation)

- The total area of the room is 75.60 m2
- Mounting Height of the luminaires : 3.100 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.500 m
- Maintenance Factor : 0.90
- Room Reflectance factors : Ceiling : 70.0 %
  Wall : 50.0 %
  Floor : 20.0 %

Table: 26 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	300-500-750 lux[1]	549 Lux
Uniformity	< 0.3	0.36
LPD	> 14W/m2 [4]	8.47 W/m2

Table: 27 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
T8 Tube + LED tube + Double Channel		Wattage : 20 W System Lumen : 100 lm/W IP 20	32

❖ Room Type 6 : (Named) Lobby

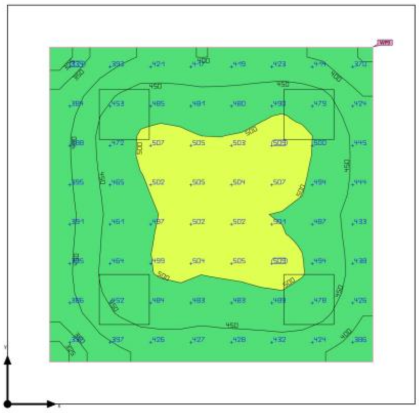


Fig : 59   Isoline diagram of the room

Fig : 60 Dialux 3D View (After calculation)

- The total area of the room is 23.00 m^2
- Mounting Height of the luminaires : 3.100 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height: 0.800 m
- Wall Zone : 0.500 m
- Maintenance Factor : 0.90
- Room Reflectance factors : Ceiling : 70.0 %
  Wall : 50.0 %
  Floor : 20.0 %

Table: 28 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	50-100-150 lux [1]	454 Lux
Uniformity	< 0.3	0.68
LPD	> 14W/m2 [4]	6.68 W/m2

Table: 29 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Recess Monted 2ft x 2ft Tile type Luminaire + Surface frame (True Ceiling)		Wattage : 36 W System Lumen : 100 lm/W IP 20	4

Room Type 7 : (Named) Office

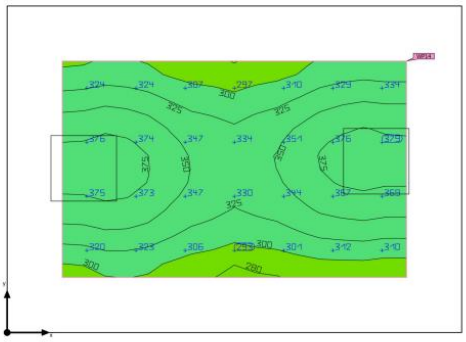


Fig : 61 Isoline diagram of the room

Fig : 62 Dialux 3D View (After calculation)

- The total area of the room is 12.23 m^2
- Mounting Height of the luminaires : 3.100 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.500 m
- Maintenance Factor : 0.90
- Room Reflectance factors : Ceiling : 70.0 %
  Wall : 50.0 %
  Floor : 20.0 %

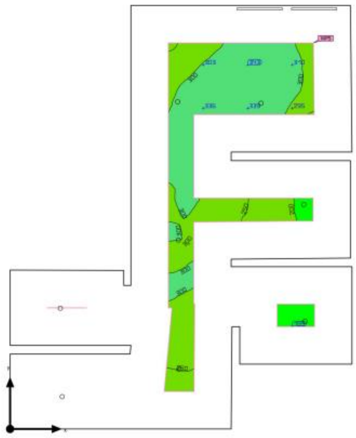
Table : 30 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	300-500-750 lux [1]	337 Lux
Uniformity	< 0.3	0.83
LPD	> 14W/m2 [4]	5.89 W/m2

Table: 31 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Recess Monted 2ft x 2ft Tile type Luminaire + Surface frame (True Ceiling)		Wattage : 36 W System Lumen : 100 lm/W IP 20	2

❖ **Room Type 7 : (Named) Toilet**



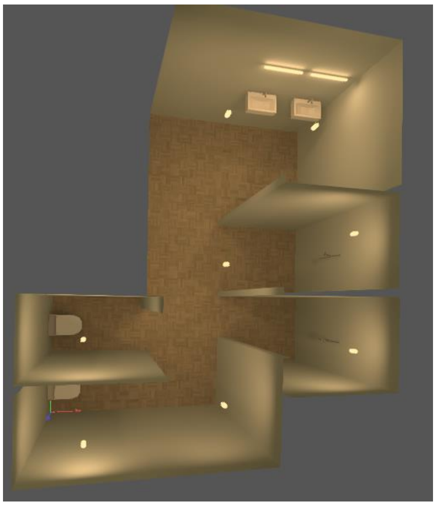


Fig : 63 Isoline diagram of the room

Fig :64 Dialux 3D View (After calculation)

- The total area of the room is 18.06 m^2
- Mounting Height of the luminaires : 3.100 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.500 m
- Maintenance Factor : 0.90
- Room Reflectance factors : Ceiling : 70.0 %

  Wall : 50.0 %

  Floor : 20.0 %

Table : 31 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	100-150-200 lux [1]	292 Lux
Uniformity	< 0.3	0.37
LPD	> 14W/m2 [4]	6.42 W/m2

Table: 32 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
10ft Mirror LED Batten		Wattage : 10 W System Lumen : 100 lm/W IP 20	2
Surface Monted Downlight		Wattage : 12 W System Lumen : 100 lm/W IP 40	8

❖ **Room Type 8 : (Named) Single Bed Room**

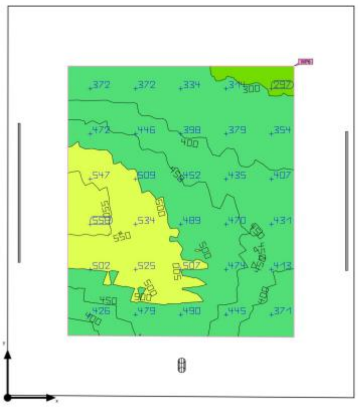


Fig : 67 Isoline diagram of the room

Fig : 68 Dialux 3D View (After calculation)

- The total area of the room is 9.38 m^2
- Mounting Height of the luminaires : 3.100 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life.

Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.500 m
- Maintenance Factor: 0.90
- Room Reflectance factors : Ceiling : 70.0 %
  Wall : 50.0 %
  Floor : 20.0 %

Table : 33 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	100-200-300 lux [1]	438 Lux
Uniformity	< 0.3	0.64
LPD	> 14W/m2 [4]	7.68 W/m2

Table: 34 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
T8 Tube + LED tube + Double Channel		Wattage : 20 W System Lumen : 100 lm/W IP 20	2
T8 Tube + LED tube + Single Channel		Wattage : 20 W System Lumen : 100 lm/W IP 20	1
LED Bulb		Wattage : 12 W System Lumen : 100 lm/W IP 20	1

❖ Room Type 9 : (Named) Double Bedroom

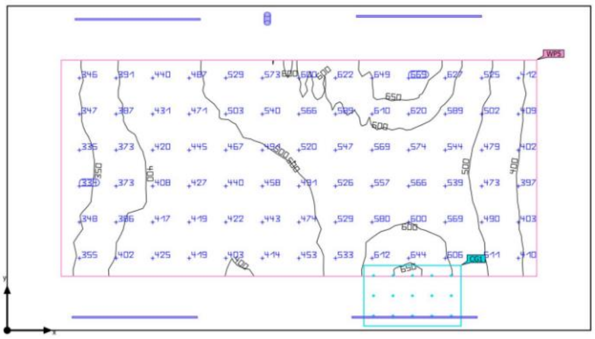


Fig : 69 Isoline diagram of the room

Fig : 70 Dialux 3D View (After calculation)

- The total area of the room is 16.20 m^2
- Mounting Height of the luminaires : 3.100 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height) : 0.800 m
- Wall Zone : 0.500 m
- Maintenance Factor : 0.90
- Room Reflectance factors : Ceiling : 70.0 %
Wall : 50.0 %
Floor : 20.0 %

Table : 35 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	100-200-300 lux [1]	487 Lux
Uniformity	< 0.3	0.66
LPD	> 14W/m2 [4]	8.15 W/m2

Table: 36 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
T8 Tube + LED tube + Double Channel		Wattage : 20 W System Lumen : 100 lm/W IP 20	2
T8 Tube + LED tube + Single Channel		Wattage : 20 W System Lumen : 100 lm/W IP 20	4
LED Bulb		Wattage : 12 W System Lumen : 100 lm/W IP 20	1

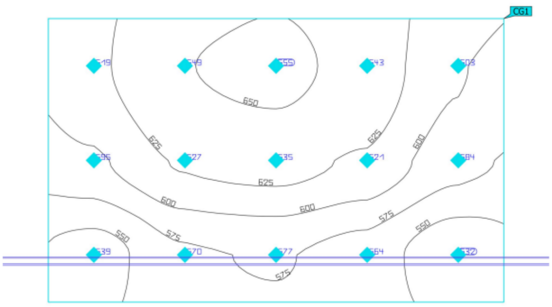


Fig : 71 Calculation Surface on the table top in Double Bed Room

Table : 37 Summary of all the calculated values on the table top

Units	As per Standards	Calculated
Illuminance level (Lux)	300-500-750 lux [1]	601 Lux
Uniformity	< 0.3	0.89

❖ Room Type 10 : (Named) Warden Room

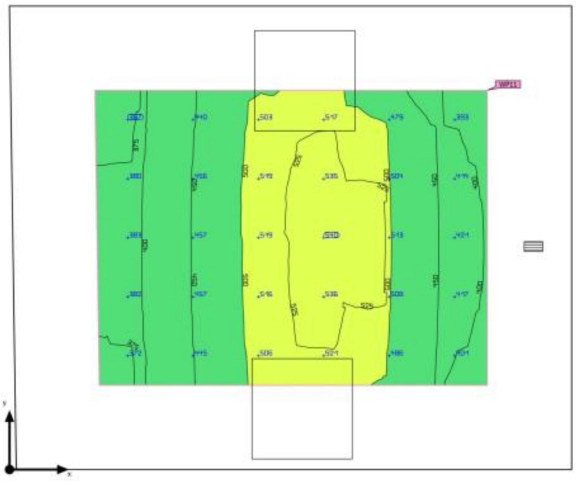


Fig : 58 Isoline diagram of the room

Fig : 59 Dialux 3D View (After calculation)

- The total area of the room is 9.12 m^2
- Mounting Height of the luminaires : 3.100 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.500 m
- Maintenance Factor : 0.90
- Room Reflectance factors : Ceiling : 70.0 %
  Wall : 50.0 %
  Floor : 20.0 %

Table : 38 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	200-300-500 lux [1]	465 Lux
Uniformity	< 0.3	0.78
LPD	> 14W/m2 [4]	9.21 W/m2

Table: 39 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Recess Monted 2ft x 2ft Tile type Luminaire + Surface frame (True Ceiling)		Wattage : 36 W System Lumen : 100 lm/W IP 20	2
LED Bulb		Wattage : 12 W System Lumen : 100 lm/W IP 20	1

❖ Room Type 11 : (Named) Sick Room

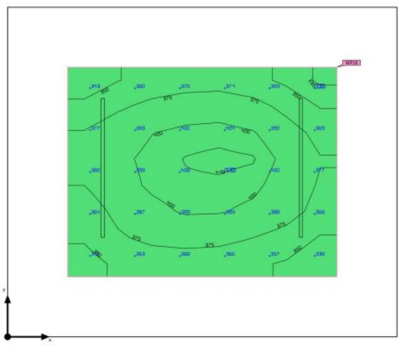


Fig : 60 Isoline diagram of the room

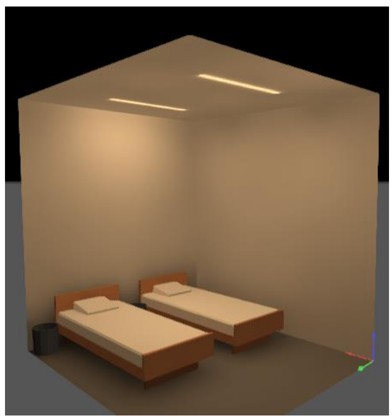


Fig : 61 Dialux 3D View (After calculation)

- The total area of the room is 8.92 m^2
- Mounting Height of the luminaires : 3.100 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.500 m
- Maintenance Factor : 0.90
- Room Reflectance factors : Ceiling : 70.0 %
  Wall : 50.0 %
  Floor : 20.0 %

Table : 40 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	300-500-750 lux [1]	377 Lux
Uniformity	< 0.3	0.86
LPD	> 14W/m2 [4]	8.96 W/m2

Table: 41 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
T8 Tube + LED tube + Double Channel		Wattage : 20 W System Lumen : 100 lm/W IP 20	4

4.3 : Auditorium Lighting Designs :

4.3.1 : Indoor Lighting Design for an Auditorium

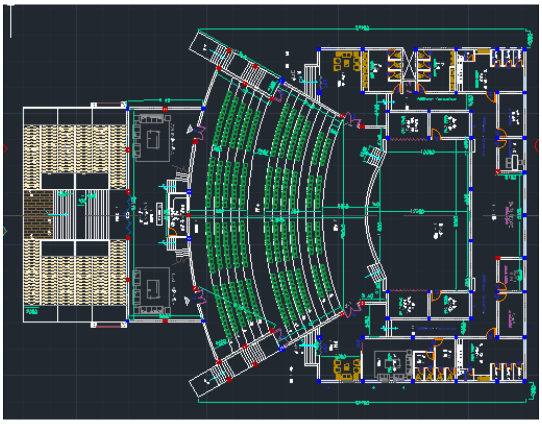


Fig : 62 (a) Autocad Floor Plan

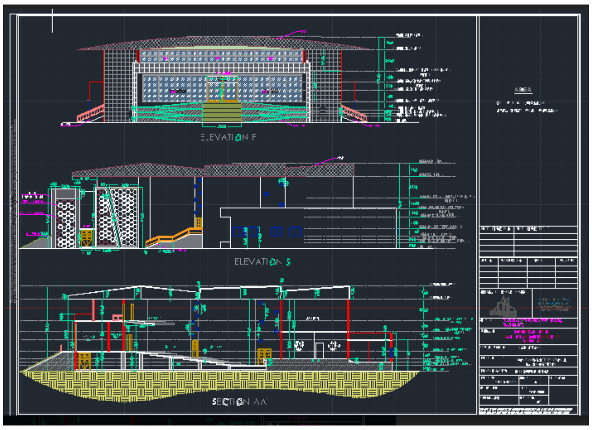


Fig : 62 (b) Autocad Section Plan

The above figure : 62(a) , is autocad layout floor plan and figure : 62 (b) is the section view , by which we can find out height of seat level of each row. This is the project of Indoor Auditorium of an institute .

In this Auditorium AutoCad layout view there is 2 layers of sitting area . Some sitting areas are situated in the back side which are at a certain height shown in fig.62(d) . Both the sitting areas are slightly elevated . The stage area is in a height of 0.9m . Thera are some other areas related to the auditorium which are at a height of 4.4m . There is no false ceiling except the auditorium , all the lights are mounted on the true ceiling height.

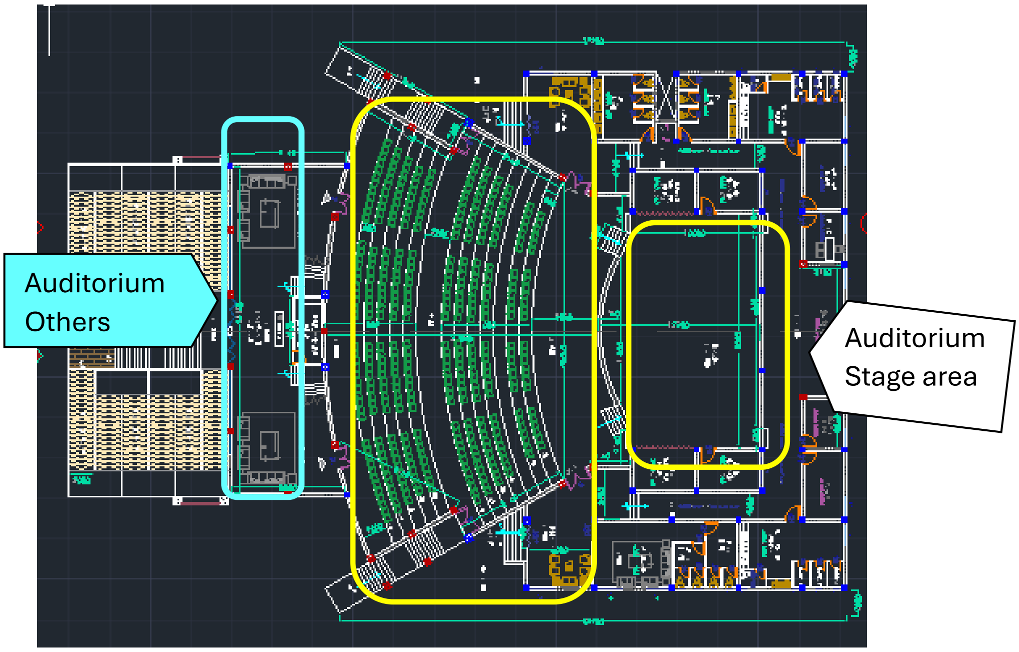


Fig ; 62 (c) Different Areas shown in Autocad layout

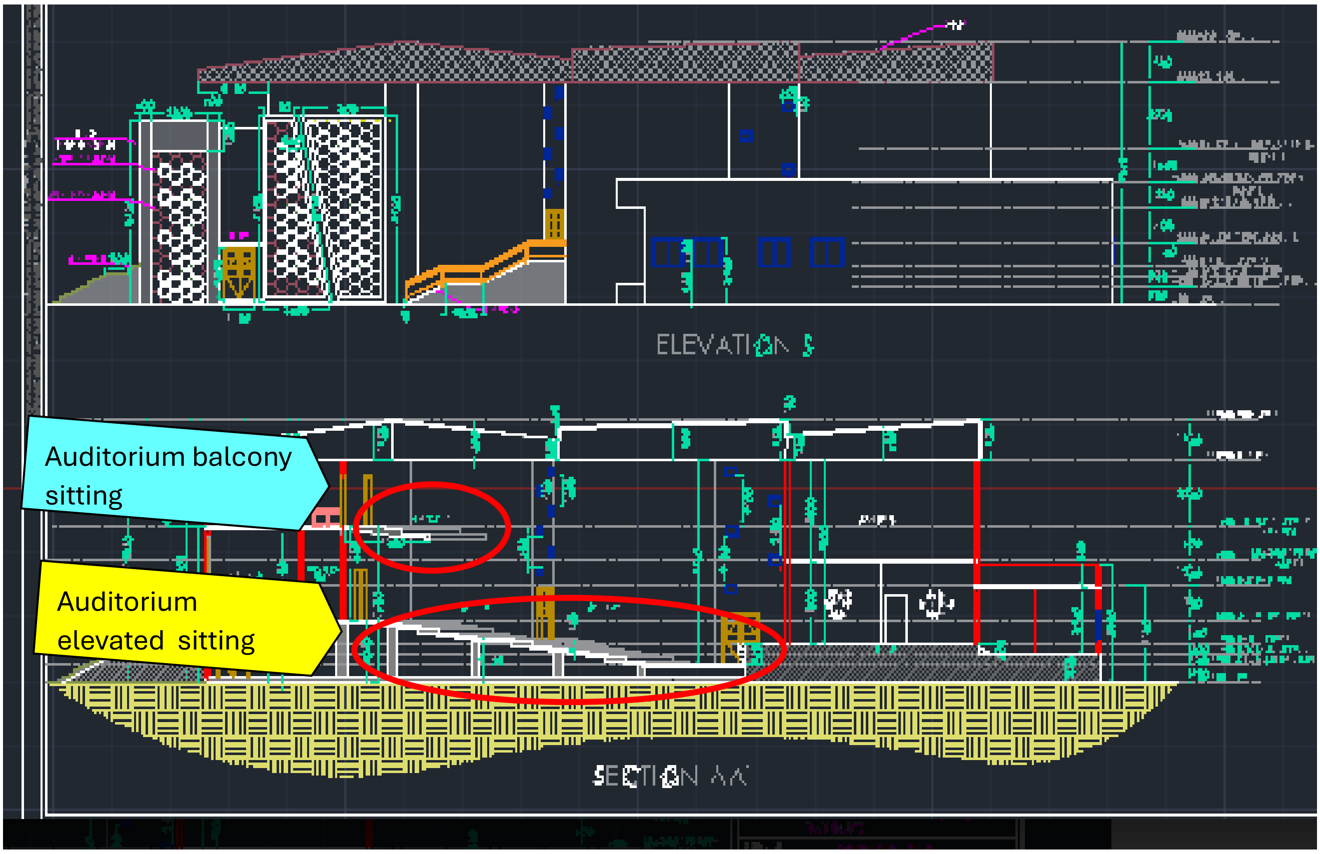


Fig : 62(d) Elevated sitting Areas shown in Autocad layout

After importing this plan as .dwg file in the Dialux Software(fig : 63), a soft copy designed in Dialux with the appropiate luminaires. After calculation , we matched the required illuminance level and uniformity level as per standards [1]

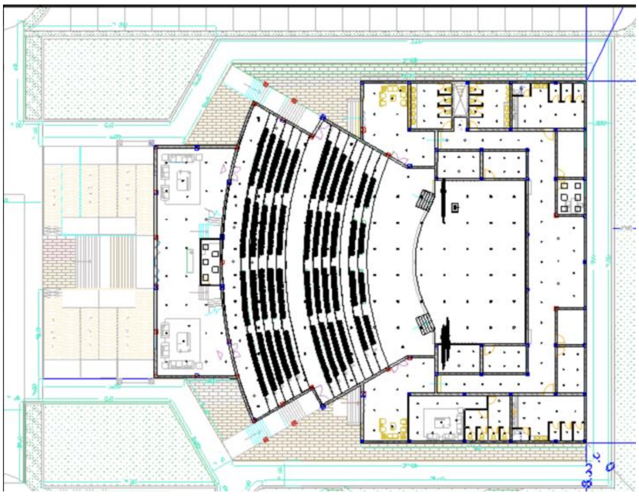


Fig : 63 (a) Dialux 2DView (Before Calculation)

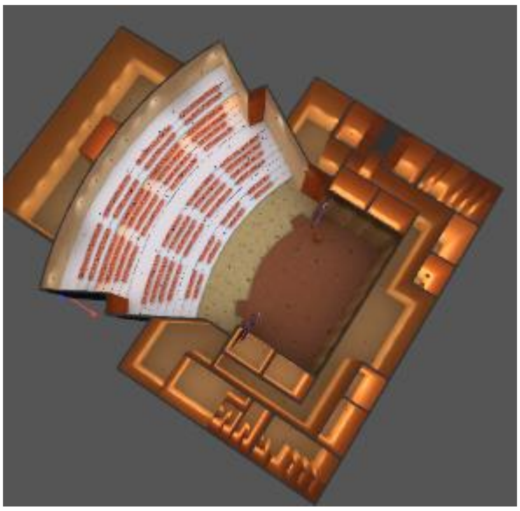


Fig : 63 (b) Dialux 3D View (After Calculation)

Fig : 63 Dialux 2D and 3D View (after designed as per autocad Layout)

4.3.1.1 : Calculated Results each of the Areas :

- **Auditorium Area :**

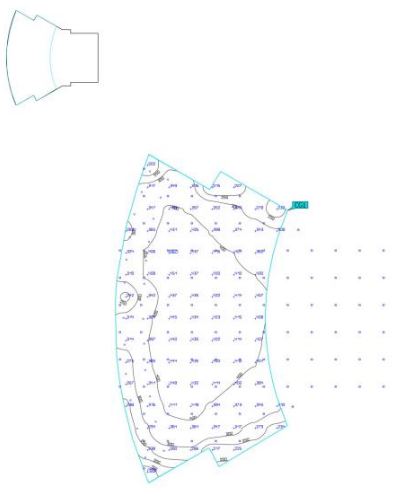


Fig : 64 (a) Calculation Surface on Setting area

Fig : 64 (b) Calculation Surface on Setting area under the Balcony

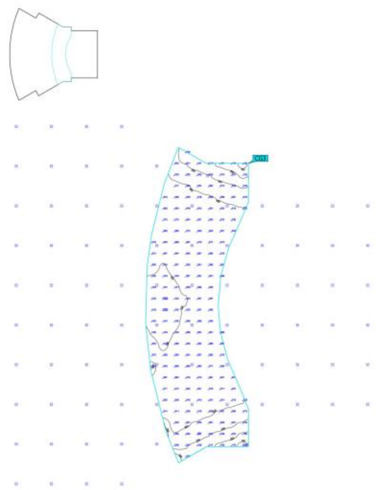


Fig : 64 (c) Calculation Surface on Ground area

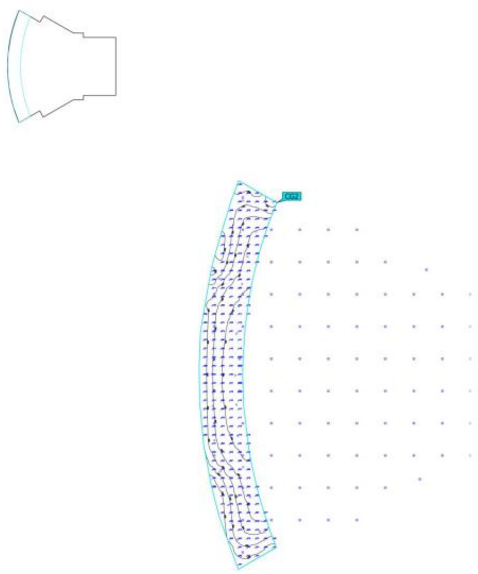


Fig : 64 (d) Calculation Surface on the balcony

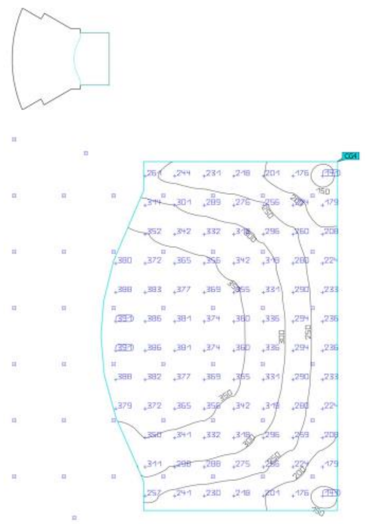


Fig : 64 (e) Calculation Surface on Stage Area

Here calculation surface of each an every area of an auditoriumn is taken seperately. So that the illumination level and uniformity level calculation shuold be more accurate. The above figures: 64 are the calculation surface taken separately.

Table : 42 Summary of all the calculated values

Areas Of The Stage	Illuminance Level (lux)		Uniformity	
	As per Standards [1]	Calculated value	As per Standards [1]	Calculated value
Setting area	50-100-150 lux	360 lux	0.3	0.37
Setting area under the Balcony	100-200-300 lux	309 lux	0.3	0.26
Ground area	100-200-300 lux	132 lux	0.3	0.39
On the Balcony	100-200-300 lux	320 lux	0.3	0.48
On the Stage area	100-200-300 lux	301 lux	0.3	0.36


Fig : 65 Dialux 3D View on the Auditorium area (after designed as per autocad Layout)

Table: 43 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
COB LED Deep Recess Downlight (Dimable)		Wattage : 20 W System Lumen : 100 lm/W IP 20	104

❖ Room Type 1 : (Named) Back stage area

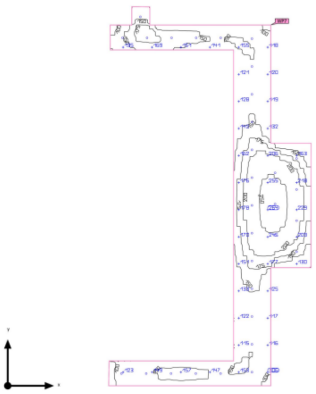


Fig : 66 Isoline diagram of Back stage area

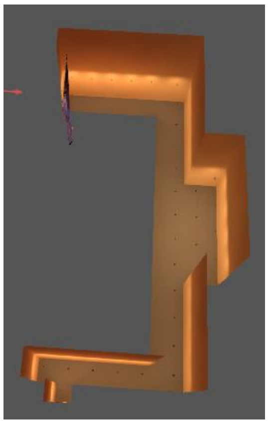


Fig : 67 Dialux 3D View (After calculation)

- The total area of the room is 161.23 m2
- Mounting Height of the luminaires : 4.400 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.80
- Room Reflectance factors : Ceiling : 50.0 %
Wall : 30.0 %
Floor : 20.0 %

Table : 44 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	200-300-500lux [1]	164 Lux
Uniformity	< 0.3	0.54
LPD	> 14 W/m2 [4]	3.46 W/m2

Table: 45 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Surface mounted Downlight		Wattage : 18 W System Lumen : 100 lm/W IP 40	31

❖ **Room Type 2 :** (Named) **Back stage area**

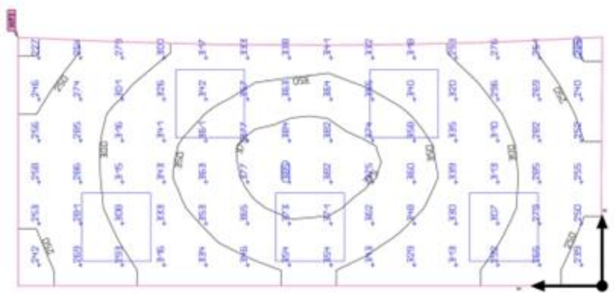


Fig : 68   Isoline diagram of Back stage area

Fig : 69 Dialux 3D View (After calculation)

- The total area of the room is 10.77 m2
- Mounting Height of the luminaires : 4.400 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.80
- Room Reflectance factors : Ceiling : 50.0 %
Wall : 30.0 %
Floor : 20.0 %

Table : 46 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	200-300-500 lux [1]	316 Lux
Uniformity	< 0.3	0.70
LPD	> 14 W/m2 [4]	5.26 W/m2

Table: 47 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Recess Monted 2ft x 2ft Tile type Luminaire + Surface frame (True Ceiling)		Wattage : 36 W System Lumen : 100 lm/W IP 20	5

❖ Room Type 3 : (Named) Quick Change

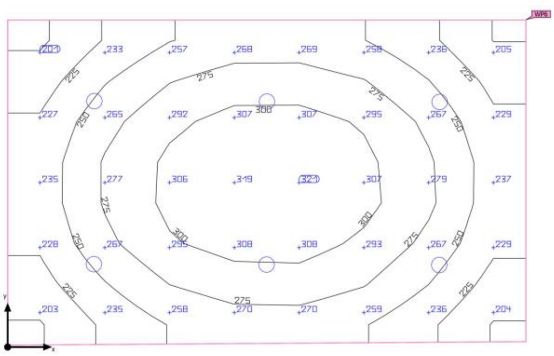


Fig : 69 Isoline diagram of the room

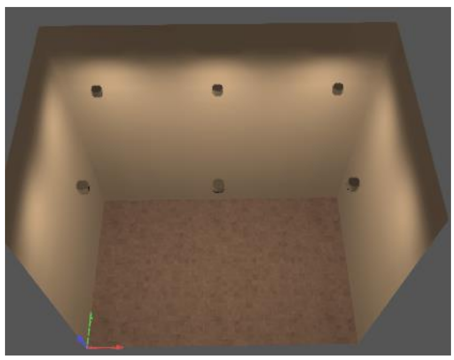


Fig : 70 Dialux 3D View (After calculation)

- The total area of the room is 14.06 m2
- Mounting Height of the luminaires : 4.400 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.80
- Room Reflectance factors : Ceiling : 50.0 %
  Wall : 30.0 %
  Floor : 20.0 %

Table : 48 Summary of all the calculated value

Units	As per Standards	Calculated
Illuminance level (Lux)	200-300-500lux [1]	263 Lux
Uniformity	< 0.3	0.74
LPD	> 14 W/m2 [4]	7.68 W/m2

Table: 49 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Surface mounted Downlight		Wattage : 18 W System Lumen : 100 lm/W IP 40	6

❖ Room Type 4 : (Named) Sound Control Room

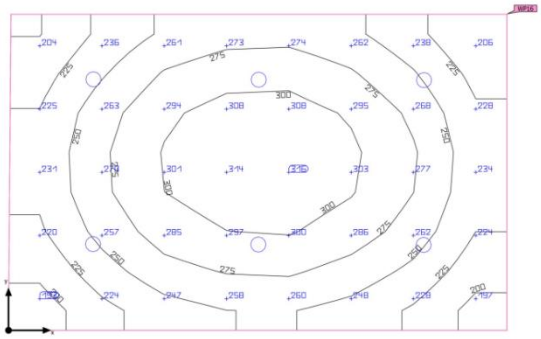


Fig : 71 Isoline diagram of the room

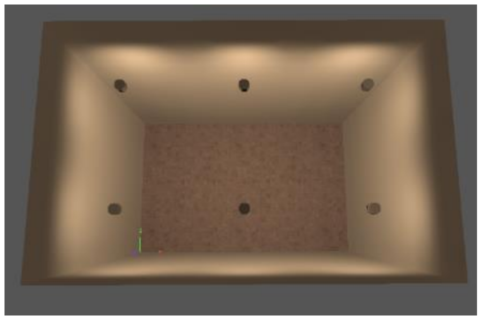


Fig : 72 Dialux 3D View (After calculation)

- The total area of the room is 14.34 m2
- Mounting Height of the luminaires : 4.400 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.80
- Room Reflectance factors : Ceiling : 50.0 %
  Wall : 30.0 %
  Floor : 20.0 %

Table : 48 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	200-300-500 lux [1]	259 Lux
Uniformity	< 0.3	0.72

LPD	> 14 W/m2 [4]	7.53 W/m2

Table: 49 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Surface mounted Downlight		Wattage : 18 W System Lumen : 100 lm/W IP 40	6

❖ **Room Type 5 : (Named) VIP Waiting Area**

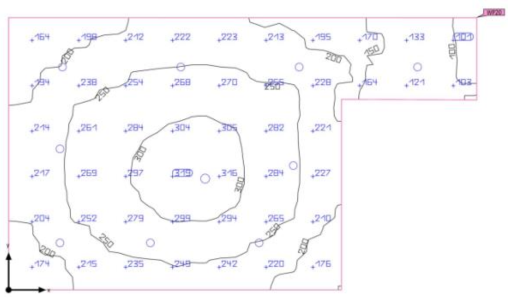


Fig : 73 Isoline diagram of the room

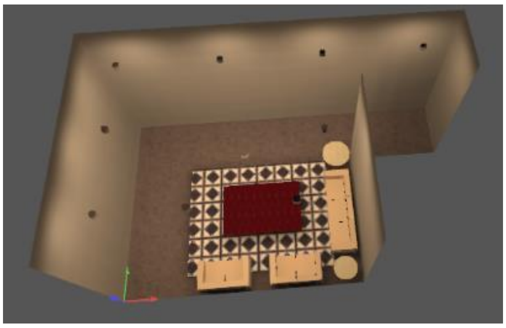


Fig : 74 Dialux 3D View (After calculation)

- The total area of the room is 34.30 m2
- Mounting Height of the luminaires : 4.400 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.80
- Room Reflectance factors : Ceiling : 50.0 %
  Wall : 30.0 %
  Floor : 20.0 %

Table : 50 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	100-1500-200lux [1]	231 Lux
Uniformity	< 0.3	0.41
LPD	> 14 W/m2 [4]	5.74 W/m2

Table: 51 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Surface mounted Downlight		Wattage : 18 W System Lumen : 100 lm/W IP 40	9
Suspended Decorative Luminaire		Wattage : 30 W System Lumen : 125 lm/W IP 20	1

❖ Room Type 6 : (Named) VIP Waiting Area

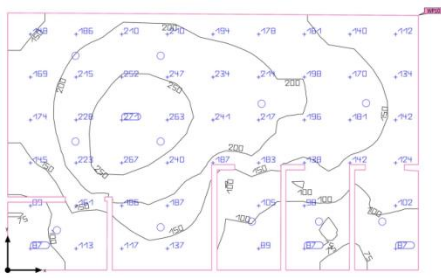


Fig : 75 Isoline diagram of the room

Fig : 76 Dialux 3D View (After calculation)

- The total area of the room is 38.68 m2
- Mounting Height of the luminaires : 4.400 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.80
- Room Reflectance factors : Ceiling : 50.0 %
  Wall : 30.0 %
  Floor : 20.0 %

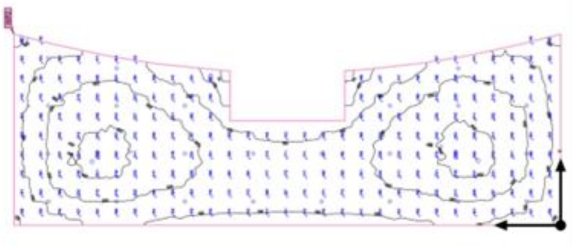
Table : 52 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	100-150-200lux [1]	166 Lux
Uniformity	< 0.3	0.41
LPD	> 14 W/m2 [4]	5.12 W/m2

Table: 53 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Surface mounted Downlight		Wattage : 18 W System Lumen : 100 lm/W IP 40	11

❖ Room Type 7 : (Named) Entance And Waiting Area



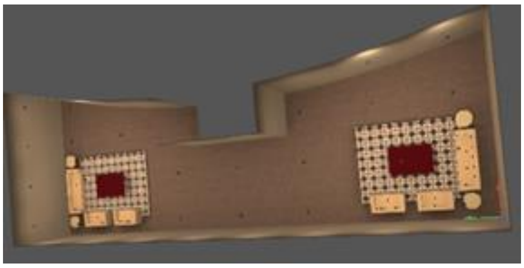


Fig : 77 Isoline diagram of the room

Fig : 78 Dialux 3D View (After calculation)

- The total area of the room is 178.95 m2
- Mounting Height of the luminaires : 4.400 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.80
- Room Reflectance factors : Ceiling : 50.0 %
  Wall : 30.0 %
  Floor : 20.0 %

Table : 54 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	100-150-200lux [1]	184 Lux
Uniformity	< 0.3	0.38
LPD	> 14 W/m2 [4]	3.01 W/m2

Table: 55 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Surface mounted Downlight		Wattage : 18 W System Lumen : 100 lm/W IP 40	26
Suspended Decorative Luminaire		Wattage : 30 W System Lumen : 125 lm/W IP 20	2

❖ **Room Type 8 : (Named) Female Toilet**

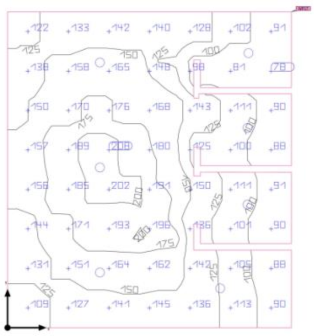


Fig : 79   Isoline diagram of the room

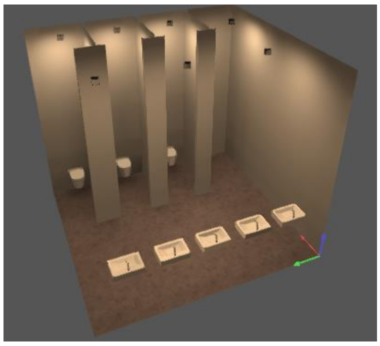


Fig : 80 Dialux 3D View (After calculation)

- The total area of the room is 21.92 m2
- Mounting Height of the luminaires : 4.400 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.80
- Room Reflectance factors : Ceiling : 50.0 %
  Wall : 30.0 %
  Floor : 20.0 %

Table : 56 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	100-150-200lux [1]	141 Lux
Uniformity	< 0.3	0.55
LPD	> 14 W/m2 [4]	5.75 W/m2

Table: 57 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Surface mounted Downlight		Wattage : 18 W System Lumen : 100 lm/W IP 40	7

❖ Room Type 9 : (Named) Male Toilet

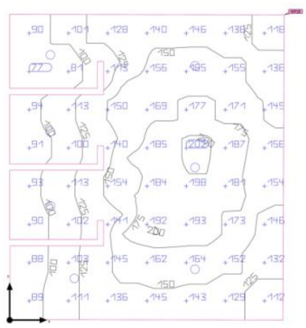


Fig : 81 Isoline diagram of the room

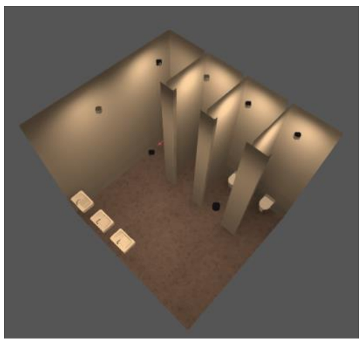


Fig : 82 Dialux 3D View (After calculation)

- The total area of the room is 21.90 m2
- Mounting Height of the luminaires : 4.400 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.80
- Room Reflectance factors : Ceiling : 50.0 %
Wall : 30.0 %
Floor : 20.0 %

Table : 58 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	100-150-200lux [1]	142 Lux
Uniformity	< 0.3	0.55
LPD	> 14 W/m2 [4]	5.75 W/m2

Table: 59 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Surface mounted Downlight		Wattage : 18 W System Lumen : 100 lm/W IP 40	7

❖ Room Type 10 : (Named) Light Control Room

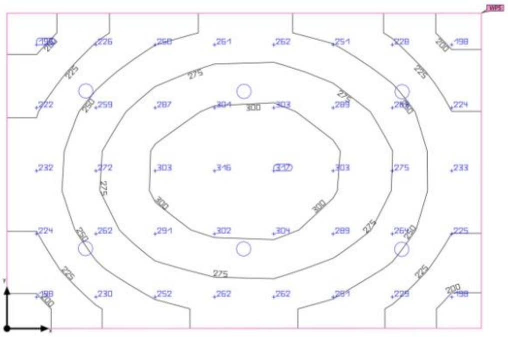


Fig : 83 Isoline diagram of the room

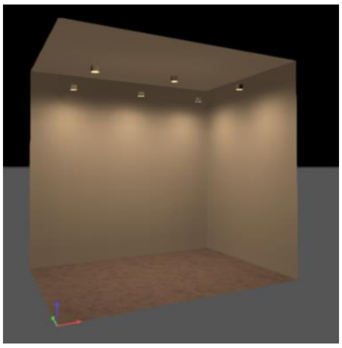


Fig : 84 Dialux 3D View (After calculation)

- The total area of the room is 21.90 m2
- Mounting Height of the luminaires : 4.400 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.80
- Room Reflectance factors : Ceiling : 50.0 %
  Wall : 30.0 %
  Floor : 20.0 %

Table : 60 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	200-300-500lux [1]	258 Lux
Uniformity	< 0.3	0.74
LPD	> 14 W/m2 [4]	7.24 W/m2

Table: 61 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Surface mounted Downlight		Wattage : 18 W System Lumen : 100 lm/W IP 40	6

❖ Room Type 11 : (Named) Office

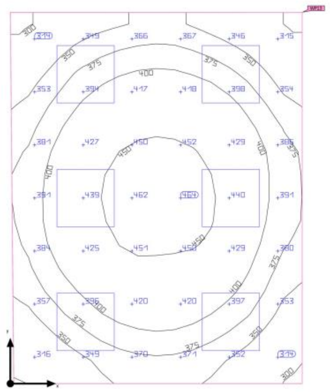


Fig : 85 Isoline diagram of the room

Fig : 86 Dialux 3D View (After calculation)

- The total area of the room is 11.58 m2
- Mounting Height of the luminaires : 4.400 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.80
- Room Reflectance factors : Ceiling : 50.0 %
Wall : 30.0 %
Floor : 20.0 %

Table : 62 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	300-500-750lux [1]	391 Lux
Uniformity	< 0.3	0.75
LPD	> 14 W/m2 [4]	5.26 W/m2

Table: 63 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Recess Monted 2ft x 2ft Tile type Luminaire + Surface frame (True Ceiling)		Wattage : 36 W System Lumen : 100 lm/W IP 20	6

❖ Room Type 11 : (Named) Projector Room

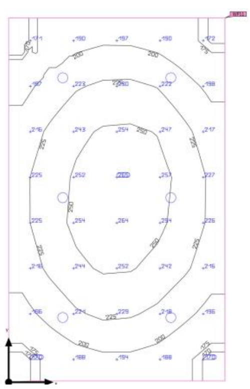


Fig : 87 Isoline diagram of the room

Fig : 88 Dialux 3D View (After calculation)

- The total area of the room is 15.75 m2

- Mounting Height of the luminaires : 4.400 m

The considered parameters are Maintenance Factor, Work plane Height and Room Reflection Factors. Maintenance Factor is applied to lighting design to account for the reduction in output of luminaires used in any lighting fixture and to ensure that the correct light levels are provided at end of life. Workplane height is the height where the illuminance level is to be calculated. As this is an office area , the workplane is to be taken on the table height level which is approx. 0.760m. the other parameter is the room reflection factor. It is taken to account for wall, ceiling, floor type. As it may be different in texture or color , for that reason reflection factors area is taken. It is the ratio of luminous flux leaving the surface to the luminous flux incident on it. Some standards[1] are preset. Which are :

70% for ceiling, 50% for the wall, 30% for the floor : For the very clean room

50% for ceiling, 30% for the wall, 20% for the floor : for the not so clean room

Last one, is the wall zone, it is the distance taken to calculate the illuminance level from the wall

All the parameters should be less than 1. [1]

In this project,

- Workplane Height : 0.800 m
- Wall Zone : 0.000 m
- Maintenance Factor : 0.80
- Room Reflectance factors : Ceiling : 50.0 %
  Wall : 30.0 %
  Floor : 20.0 %

Table : 64 Summary of all the calculated values

Units	As per Standards	Calculated
Illuminance level (Lux)	100-150-200lux [1]	219 Lux
Uniformity	< 0.3	0.76
LPD	> 14 W/m2 [4]	6.86 W/m2

Table: 65 Summary of luminaire

Type of the Luminaire	Picture	Luminaires Details	Quantity
Surface mounted Downlight		Wattage : 18 W System Lumen : 100 lm/W IP 40	6

CHAPTER : 5

5.1 : Challenges and Considerations for Façade Lighting

- **Light Pollution :**

One of the most crucial challenges in facade lighting is light pollution, which has significant environmental and health implications. Excessive or poorly directed light can lead to skyglow, obscuring the view of stars and celestial objects and disrupting ecosystems and wildlife behavior. To Resolved this light pollution, we must carefully select fixtures that minimize light spills and use shielding techniques to direct light only where needed. Additionally, intelligent lighting controls are crucial in adjusting light levels based on time, occupancy, and environmental conditions, reducing light pollution.

- **Maintenance and Long-term Sustainability:**

It is very essential to ensuring the long-term sustainability of facade lighting is installed. Regular maintenance is essential to keep lighting systems operating efficiently and prevent premature fixture failure. However, accessibility and maintenance can be complex, especially for installations on tall buildings. So we are progressively integrating low-maintenance fixtures to resolved this.

- **Balancing Aesthetics with Energy Efficiency:**

To Achieving a balance between aesthetics and energy efficiency is an ongoing consideration in facade lighting design. While visually stunning lighting designs can significantly enhance a building's appeal, they often consume more energy. We must create an equilibrium, leveraging energy-efficient technologies like LEDs and intelligent controls while preserving the desired artistic effect. This usually involves fixture types, light color temperatures, and intensity levels to meet both aesthetic goals and sustainability targets.

- **Community Engagement and Regulations:**

Façade lighting projects can impact the community and neighboring buildings, raising concerns about light trespass and its consequences. Addressing these concerns necessitates community engagement and compliance with local regulations and lighting ordinances. We must consider the impact of facade lighting on nearby residents and the nighttime environment while still achieving the desired lighting effects. This often involves conducting light impact assessments and collaborating with local authorities and stakeholders.

5.1.1 : Design Considerations :

1. Step-by-step Guide to Planning Effective Facade Lighting:

The best practices form the backbone of practical facade lighting projects. It typically begin with thoroughly analyzing the building's architecture, surrounding environment, and intended lighting objectives. Subsequently, fixture selection, placement, and control strategies to achieve the desired lighting effects is very important. This systematic approach helps avoid pitfalls like excessive light pollution or ineffective illumination.

2. Collaboration between Architects, Lighting Designers, and Engineers:
Adequate facade lighting results from close collaboration between architects, lighting designers, and engineers. The need for interdisciplinary teamwork. Architects bring their understanding of the building's form and function, while lighting designers contribute their expertise in aesthetics and illumination techniques. Engineers are pivotal in verifying the lighting scheme's technical viability and seamless integration into the building's infrastructure.

This collaboration is vital from the project's inception, allowing for seamless integration of lighting into the architectural design. It ensures that lighting enhances rather than detracts from the building's aesthetics, with fixtures and control systems that are discreetly integrated into the structure.

3. User-Centric Design:
The best practices underscore the importance of user-centric design. They emphasize the need to consider the building's occupants, visitors, and the surrounding community in the lighting plan. The user-centric design considers factors like comfort, safety, and the psychological impact of lighting on individuals. It encourages the creation of lighting environments that enhance well-being, productivity, and a sense of security.

4. Flexibility and Future-Proofing:
Incorporating flexibility and future-proofing is another core principle . Facade lighting should be designed to adapt to changing needs and technologies. It should allow for easy modifications, expansions, or upgrades as architectural or functional requirements evolve. This forward-thinking approach ensures that facade lighting remains relevant and efficient over the building's lifecycle.

5.2 : Challenges and Considerations For Indoor Lighting :

- **Budget Constraints**

  One of the most prevalent challenges in lighting design is dealing with tight budgets. Clients may have unrealistic expectations about what can be achieved within their budget, leading to compromises in the quality of fixtures or the overall design. Lighting designers must strike a balance between aesthetics and cost-effectiveness, often requiring creative solutions to make the most of available resources.
- **Inadequate Planning**

  Effective lighting design requires careful planning and consideration of various factors, including the building's architecture, the purpose of the space, and the needs of its occupants. Rushed or inadequate planning can lead to suboptimal lighting solutions that fail to meet the project's objectives. Lighting designers must work closely with architects and interior designers to ensure that lighting is integrated seamlessly into the overall design.

- **Changing Regulations**

  Building codes and regulations regarding energy efficiency and sustainability are constantly evolving. Keeping up with these changes and ensuring compliance can be a significant challenge for lighting designers. They must stay informed about the latest standards and technologies to design lighting systems that meet both current and future requirements.

- **Technological Advances**
  While technology offers exciting possibilities in lighting design, it also presents challenges. Rapid advancements in lighting technology can make it difficult to choose the right fixtures and control systems for a project. Lighting designers must continuously educate themselves about new products and trends to ensure they are providing the best solutions to their clients.

- **Environmental Considerations**

  Sustainability is a growing concern in all aspects of design, and lighting is no exception. Lighting designers must priorities energy-efficient solutions, such as LED lighting, and consider the environmental impact of their choices. Balancing aesthetics with sustainability can be a complex task, but it is essential for responsible design in the modern era.

- **Client Expectations**
  Managing client expectations can be challenging, as clients often have specific visions of how they want their spaces to look and feel. Lighting designers must navigate these expectations while also providing expert guidance to ensure that the final design is both functional and aesthetically pleasing.

- **Lighting Control and Integration**
  Integrating lighting control systems with other building systems, such as HVAC and security, can be complex. Lighting designers must collaborate with other professionals to ensure seamless integration, which requires a deep understanding of both lighting technology and building automation.

CHAPTER : 6

6. Conclusion

Modern era is an age of beautification. Architects are creating epic design day by day & enchanting the minds of people with their creativity. Along with the architects, lighting designers are also contributing greatly in this effort. Lighting helps to visualize each & every corner of the concerned area with dramatic effects. So, lighting is an inevitable part in the journey of beautification.

In case of Facade lighting, it is filled with exciting possibilities. Integration with smart Light will redefine the dynamic view of buildings what has been designed in this Thesis, shown in Section 4.1. Now a days in facade lighting represents a dynamic intersection and aesthetics. In modern days advancement in LED technology, dynamic controls, sustainable practices, contemporary facade lighting enhances the visual appeal of buildings. As designer it is observed that boundaries of creativity and functionality of facade lighting holds promise for even more transformative and engaging experiences in architectural landscapes.

In office areas, lighting helps the employees to perform their tasks properly. Lighting can create an inspiring effect in office sectors. Now in modern era indoor lighting not only illuminate the area, it also can create an aesthetic view to that area by new decorative range of indoor lights that has been designed and calculated all lighting parameters mentioned in Section 4.2 . Modern indoor lighting design represents a convergence of cutting-edge technology, aesthetic refinement, and human-centric principles mentioned in Section 4.3. By innovating LED technology, smart controls in indoor lighting solutions elevate the ambiance and comfort of indoor spaces. As a designer, it should be kept in mind to prioritize sustainability and user experience, the future of indoor lighting promises to deliver even more sophisticated and personalized environments that enhance well-being and productivity for occupants .

Annexure

[1] Export Inspection Agency Govt. of India : Project work 1

[2] Judicial Court, Bhubaneswar : Project work 2

[3] VIVEKANANDA YOGA CENTER, IIT Kharagpur. : Project work 3

[4] Tata Power, Bhubaneswar : Project work 4

[5] NIT (Boyes & Girls Hostel), Jamshedpur : Project work 5

[6] Bargarh Auditorium : Project work 6

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[2] IS 3646(Part-2): 1992, Code of Practice for Interior Illumination: Schedule of Illumination and Glare Index, Bureau of Indian Standards.

[3] IS 6665 (1972): Code of practice for industrial lighting, Bureau of Indian Standards.

[4] ECBC: 2009: Energy Conservation Building Code, Ministry of Power Govt. of India.

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[6] Illuminating Engineering Society of North America, The Lighting Handbook, 10th Edition : Reference and Application

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[8] https://www.wiprolighting.com/a-strategic-approach-to-auditorium-lighting

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[12] Lighting for energy efficient luminous environment , Ronald Helmd,PhD, P.E, University of Kansas / Indoor Lighting Design Consideration /

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