A STUDY ON OPTIMIZATION OF RESOURCES FOR ACCOMMODATION OF INCREASING POPULATION

A thesis submitted towards partial fulfilment
of the requirements for the degree of

Master of Technology (Illumination Technology and Design)

Submitted by

Shubhajit Pal

ROLL NO : 001931101021
EXAM ROLL NO : M6ILT22021

Under the guidance of
Dr. KAMALIKA GHOSH
and
Sri Joy Krishna Paul

School of Illumination Science, Engineering and Design
Jadavpur University

Course affiliated to
Faculty of Engineering and Technology
Jadavpur University
Kolkata-700032
India

2022

M.Tech. (Illumination Technology and Design)
course affiliated to
Faculty of Engineering and Technology
Jadavpur University
Kolkata, India

CERTIFICATE OF RECOMMENDATION

This is to certify that the thesis entitled **" A study on optimization of resources for accommodation of increasing population "** is a bonafide work carried out by **SHUBHAJIT PAL** under my / our supervision and guidance for partial fulfilment of the requirement of **M.Tech. (Illumination Technology and Design)** in School of Illumination Science, Engineering and Design, during the academic session 2019-2022.

THESIS ADVISOR

Dr. Kamalika Ghosh,
Associate Professor
School of Illumination Science,
Engineering and Design
Jadavpur University,
Kolkata-700 032

THESIS CO-ADVISOR

Mr. Joy Krishna Paul
Faculty
School of Illumination Science,
Engineering and Design
Jadavpur university
Kolkata-700 032

DIRECTOR
Mr. Parthasarathi Satvaya
School of Illumination Science,
Engineering and Design
Jadavpur University,
Kolkata-700 032

DEAN - Faculty of Inter-disciplinary
Studies, Law & Management (FISLM)
Jadavpur University,
Kolkata-700 032

M.Tech. (Illumination Technology and Design)
course affiliated to
Faculty of Engineering and Technology
Jadavpur University
Kolkata, India

CERTIFICATE OF APPROVAL **

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.

Committee of final examination for evaluation of Thesis

DECLARATION OF ORIGINALITY AND COMPLIANCE OF ACADEMIC ETHICS

I hereby declare that this thesis contains literature survey and original research work by the undersigned candidate, as part of his **M.Tech. (Illumination Technology and Design)** studies during academic session 2019-2022 .

All information in this document has been obtained and presented in accordance with academic rules and ethical conduct.

I also declare that, as required by this rules and conduct, I have fully cited and referred all material and results that are not original to this work.

NAME: SHUBHAJIT PAL

CLASS ROLL NUMBER : **001931101021**

EXAM ROLL NO : **M6ILT22021**

THESIS TITLE: **A STUDY ON OPTIMIZATION OF RESOURCES FOR ACCOMMODATION OF INCREASING POPULATION**

SIGNATURE:

DATE:

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Last but not the least, my special thanks to all my classmates who helped me directly in completing my thesis successfully.

Date :
Place : Kolkata [SHUBHAJIT PAL]

CHAPTER 1:

INTRODUCTION

CHAPTER 1: INTRODUCTION

1.1 AIMS AND OBJECTIVES OF STUDY

In the day of modern era the population is getting increase day by day. Today, population of Indian become around 130 cores having one of the most highest population density. This is not only problem of India but also problem of whole world. The land is limited but population increases day by day. People need to move from village to town/city for better education , job , medical facilities , etc.
Earlier people could afford to live in Bungalow type house with wide land area. But due to urbanisation there is a scarcity of land . So multiple people / families are trying to accommodate in the same land .This brings the concept of dwelling in flats with multiple stories .Thus in the same spaces multiple families can be accommodated , staying in tires .Usually the people living in a Bungalow type house are financially well off and can afford to go for better lighting arrangement for their house. People dwelling in a flat usually lives in an optimum way . So lighting arrangement for them is also little bit economic one.

In bungalow type houses usually building to building clearances are large apart but in modern flat type housing complex the inter building space is less, inadequate for availing Daylight. Considering security Bungalow dwellers need to provide more light for peripheral area of the building .

Life style of Aristocrat Bungalow dwellers is such that they can utilize daylight and spend less time during dark hours for study /work. When inter building space decreases availability of daylight becomes insufficient . In modern lifestyle people also need to work prolonged people during dark hours , supported by Artificial lights powered by electric supply.

Thus light become on for 24 hours. So we need to analyses the consequences of the two types of dwelling housings . So here we are dealing with two models - one is bungalow model and another is multi - storied building and analyse the lighting style as well as energy consumption. For energy generation we need natural resource which causes environmental pollution as well as depletion of natural resources. Nowadays lighting consumes significant part of Energy. This calls for usage of energy efficient lighting system which reduces the pollution as well as environmental aspects in balance. As the resources become scarce and energy costs growing, it becomes imperative for everyone to save energy or to use the available energy judiciously. Energy efficiency in lighting involves building architecture, selection of proper luminaries , light sources , Daylight integration etc., Here an effort has been made to optimise land , energy , natural resources , etc., to cater the presence demand of urbanization.

1.2 METHODOLOGY ADOPTED :

- On-site survey of the spaces .
- Study of the lighting requirements of individual spaces.
- Designed abiding relevant codes and standards.
- Prepare the list of required lamps and luminaires if conventional light sources needed to use , considering space , wall texture and reflectivity , objects / furniture , etc.
- Measurement of the lighting parameters for the conventional lighting design.
- Problem identification of conventional lighting design with respect to energy efficiency and lighting requirements.
- Selection of different lamps and luminaries that could be used for indoor lighting design of general areas of residential building.

1.3 ABOUT THE SITES

Daily life comprises of performance of many activities requiring sight. The physiological operations in the eyes are turned on by light, giving rise to the sensation of vision. Light is also one of the elements of design which should be used for visual comfort and to attain emotional responses from the lighted environment. Lighting must have both quality and quantity for two purposes; for bringing good environmental brightness which is comfortable for the occupant and for sanctioning a high degree of efficiency in seeing whatever is of special interest.

The proposed lighting design of affordable housing by Dhanuka at Minto park, Kolkata is still under construction. It is approved by West Bengal RERA.

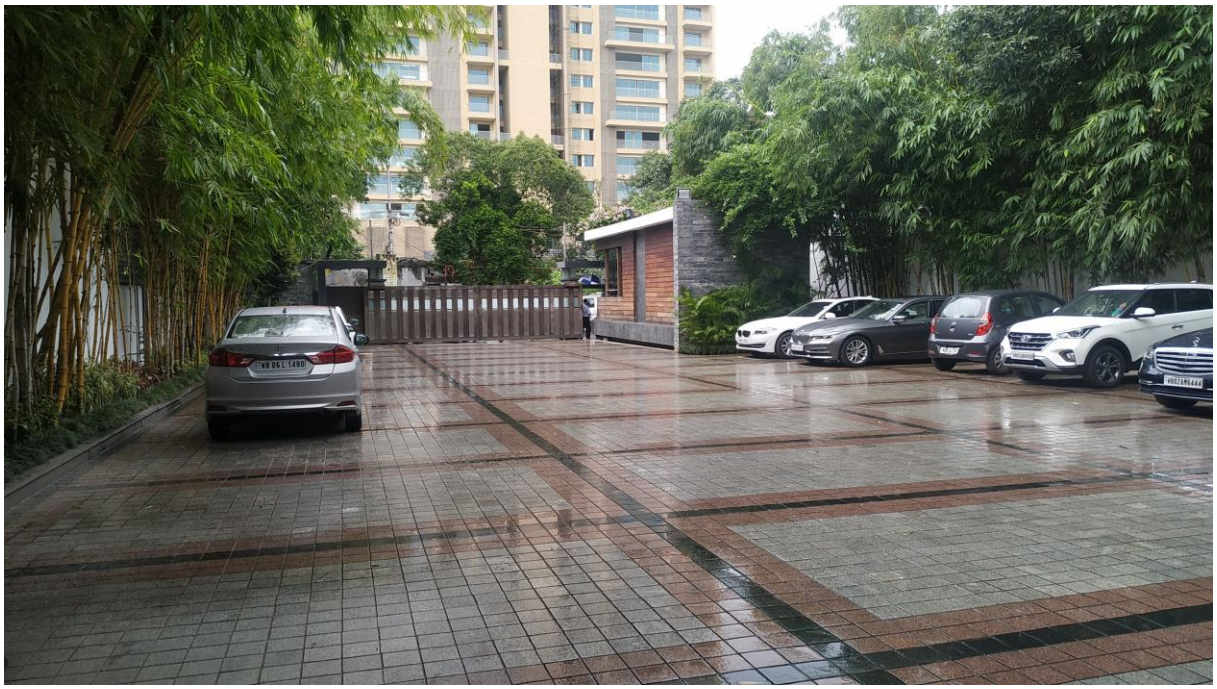


Fig-1.1: Outdoor area of the bungalow area

Fig-1.2 : Actual side view-2 of bungalow area

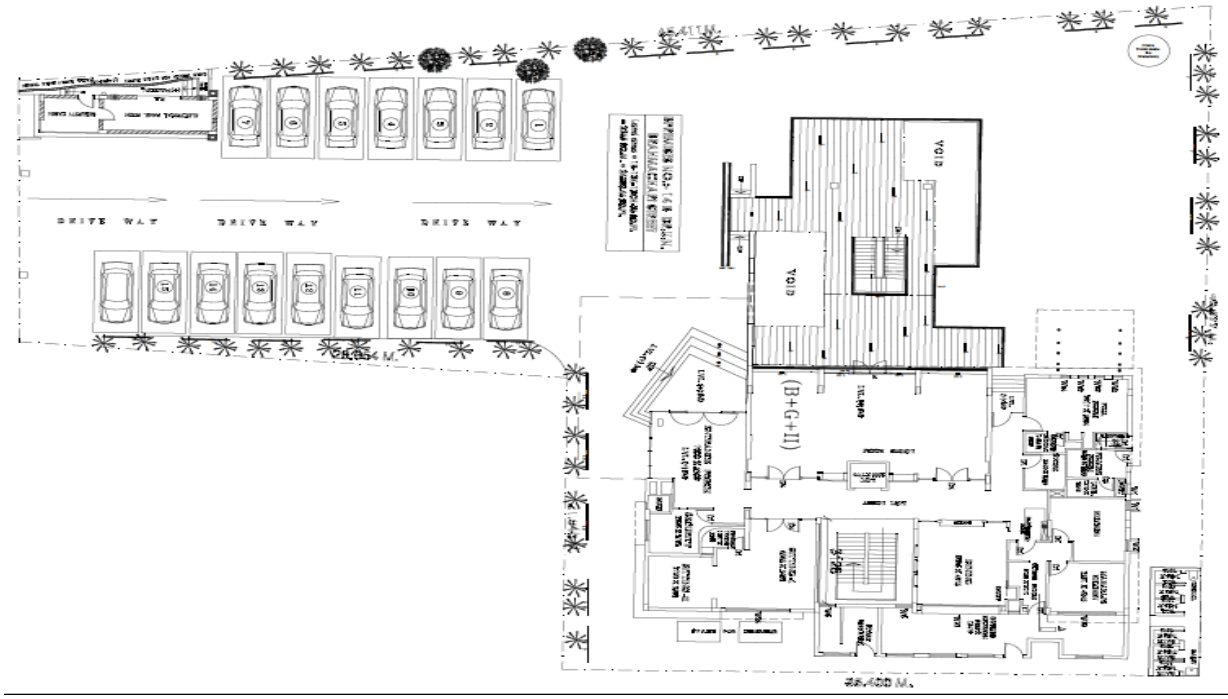


Fig-1.3: Lavout for Bungalow area

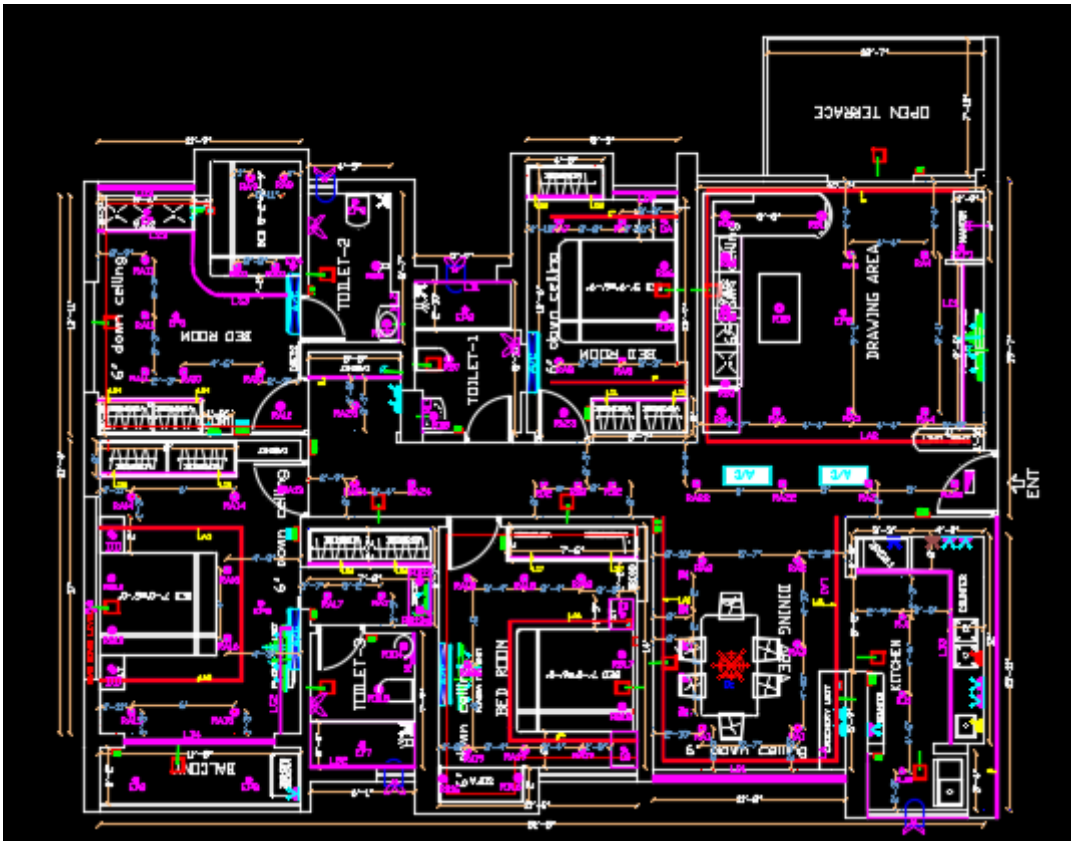


Fig-1.4: Layout for Multi-storied residential building

CHAPTER 2:

REVIEW ON RELEVANT CODES & GUIDELINES

CHAPTER 2: REVIEW ON RELEVANT CODES & GUIDELINES

2.1 IESNA-ILLUMINATION ENGINEERS SOCIETY NORTH AMERICA

In the lighting profession among all other reference documents, the IESNA[5]is the most important document to refer to for lighting design. One professional is able to achieve its mission of improving the lighted environment by assembling the people who are proficient in lighting and transferring that skill into executions for the sake of general people.

RESIDENCE LIGHTING DESIGNING CONCEPT AS PER IESNA:

As per IESNA several conditions influence the interior lighting designing[14],[18]of a residence:

- The style of architectural and interior design[10]which strongly reflects the user's own sense of style. Luminaire styles and the types of lighting effects in lighting design should respond to traditional, transitional, contemporary styles. A key step of the design process is to review luminaire selections and lighting effects with the owner.

- Divergence in lighting methodologies[12] and illuminance throughout the residence must follow the number of users living in it and their age. Depending on occupancy, works, and time of day, lighting control devices can be applied in straightforward operations.

- Hours of use is another condition to be considered. The lighting decisions and controls may be well influenced by use patterns like, some residences require near twenty-four hours operation and some require either dark hours or daylight hours on weekends.

- Activities in daily life categorise spaces along with their design in the house. Some residences are quite active and will have spaces and equipment to support sports or exercising activities, whereas some residences will have activities like entertaining, cooking, reading, dedicated life of raising children etc. A good lighting design will detail these life activities and serve an outline of lighting needs.

- Sustainability aspects should be a vital factor on the designer's design selections. Efficient and long-lasting lamps can result in energy saving and low maintenance. Simple sensor-controlled lighting devices can have a positive influence on energy use.

2.2 ECBC – ENERGY CONSERVATION BUILDING CODE:

"The Energy Conservation Building Code (ECBC)[6] was developed and released by the Govt. of India on 27th May 2007, as a first step towards promoting energy efficiency[37] in the building sectors". ECBC sets minimum energy standards for buildings in India. The state governments have the flexibility to modify the code to suit local needs by giving notice. Nowadays, many states are following ECBC, wherein most of building construction activities are happening.

The objective of the Energy Conservation Building Code (Code) is "to provide minimum requirements for the energy-efficient design and construction of buildings and their systems".

The new ECBC 2021 has been revised to introduce new and advanced technologies. It incorporates extra parameters that are related to renewable energy integration. It is one of the first building energy codes to recognize beyond code performance. In ascending order of efficiency, three levels of energy performance standards are included in the code known as ECBC, ECBC Plus and Super ECBC.

According to the new ECBC 2021, the norms applicable to:

- The casing and cover of building
- Mechanical bodies and appliances, like thermostat, ventilation, air-conditioner, water-heater.
- Indoor and outdoor lighting
- Electrical power and motors, and unconventional energy bodies.

Interior Lighting Power

The installed lighting power in the interior of a building should not outstrip the interior LPD allowed limit determined in obedience with the code. There are 2 methods mentioned in ECBC 2021 known as "Building Area Method" and "Space Function Method".

BUILDING AREA METHOD:

- Determination the allowed lighting power density from the provided tables for each appropriate building area type.
- For each building area type, calculate the gross lighted floor area.
- The addition of products of the total lit floor area of every building area multiplied by the permitted LPD for that building area type gives actual interior lighting power allowance.

SPACE FUNCTION METHOD:

- Identification of the appropriate building type from the tables enlisted below.
- Calculate the total Watt/$m^2$for each area type in a building.
- The interior lighting powers of different areas of the specific building cannot outstrip the total wattage to be compliance as per given tables.

In this project, the LPD values has been followed from the Space function method of ECBE 2021.

2.3 IS-3646 (PART- 1) : 1992

According to the Indian Standard Guidelines, area specific standard illumination levels in interior lighting design are recommended in IS-3646 (Part-1)[7]. As per the required illumination level, all the area specific illumination level for this project is tabulated below:

Building and other areas

Type of Interior or Activity	Range of Service Illuminance (in **lux)** [E_{min}-E_{avg}-E_{max}]
Bedroom area	200-250-300
Dinning room	150-200-300
Kitchens, Canteens	150-200-300
Restrooms	100-150-200
Toilet area	100-125-150
Corridor	50-100-150
Lifts	50-100-150

2.4 SP-72 : NATIONAL LIGHTING CODE (NLC): 2010

According to this code, basic social safety and environmental objectives is achieved significantly by lighting technology. The code informs about how light pollution, glare, light trespass and energy uses can be minimized by good lighting practices and systems while maintaining safety, security and productivity[34].

Lighting levels and quantity, and safety parameters for public interest, a set of minimum provisions has been highlighted in it. Detailed guidelines have been provided along with the scope of integrity for the lighting designers[30] that helps in choosing the right lighting products and method.

Lighting design for large varieties of interior and exterior installations along with hospitals, sports complexes etc can be done with the help of this code under the control of qualified persons.

The National Lighting Code[8]provides the following ideas of:

- ❖ Various types of occupancies in illuminating engineering practices.
- ❖ Design, selection, installation and maintenance of lighting system for indoor and outdoor spaces.
- ❖ Physics of life, electric light sources, luminaries and photometry related to science of illumination.
- ❖ Coordination of day lighting with the artificial lighting in lighting design.
- ❖ Effective and efficient use of light sources with the help of energy management and energy conservation in lighting installation.

2.5 NATIONAL BUILDING CODE(NBC) : 20 16

The National Building Code (NBC)[9], provides guidelines for regulating the building construction activities in all over India. All kinds of building construction like, PWD or any other government construction department, Pvt construction organizations adopt the model of NBC. Organisational directives, development control acts and common building needs like fire safety, building material, design and construction, plumbing services etc. are the main focus of this code. Following pat is applicable and considered herein.

Part : 8 Building Services :

Section-1 : Lighting and Natural Ventilation
Section -2 : Electrical and Allied installation

CHAPTER 3 :

USE OF LIGHTING SOFTWARE

CHAPTER 3 : USE OF LIGHTING SOFTWARE

3.1 INTRODUCTION TO THE SOFTWARE[27], DIALux

DIALux, a three-dimensional graphics software was launched by DIAL GmbH in Ludenscheid, Germany in 1994for lighting plan in interior and exterior spaces and available in free of charge. The world's leading manufacturers of lamps-luminaires provide plugins for their products to make the photometric properties available in DIALux ILLUMINATION allowing the greatest possible freedom to the design exercise.

3.2 ADVANTAGES OF DIAILLUMINATION SOFTWARE IN INTERIOR LIGHTING

- ❖ Plan the lighting in simple but professional way.
- ❖ Available in free of cost with luminaire data of the world's leading manufacturers.
- ❖ Availability of light scenes along with location and date-time for daylight visualization.
- ❖ Plan the colour and intensity with LED or other colour changing luminaires.
- ❖ Incorporates control groups to control the lighting scheme in different areas.
- ❖ Energy evaluation within seconds.

3.3 SELECTION CRITERIA OFDIAILLUMINATION SOFTWARE FOR SIMULATION

- ✓ Complete software package free of cost.
- ✓ Available in many languages all over the world.
- ✓ Import and export all CAD programs in '.DXF' and '.DWG' formats.
- ✓ Realistic models as 3DS file can be easily imported.
- ✓ Simple drag and drop method to use any object like work-planes, luminaire, furniture etc.
- ✓ Prepare photo-realistic visualization of the plan with lighting.
- ✓ Functional in most common Operating Systems.
- ✓ Ready customizable Indoor, Road, Area and Sports lighting calculation.
- ✓ Provision of saving results in a '.PDF' format.

3.4 STEPS TO FOLLOW TO USE DIALux LUMINATION FOR INTERIOR DESIGN

Opening the software, the following window will appear => Select “New Interior Project”

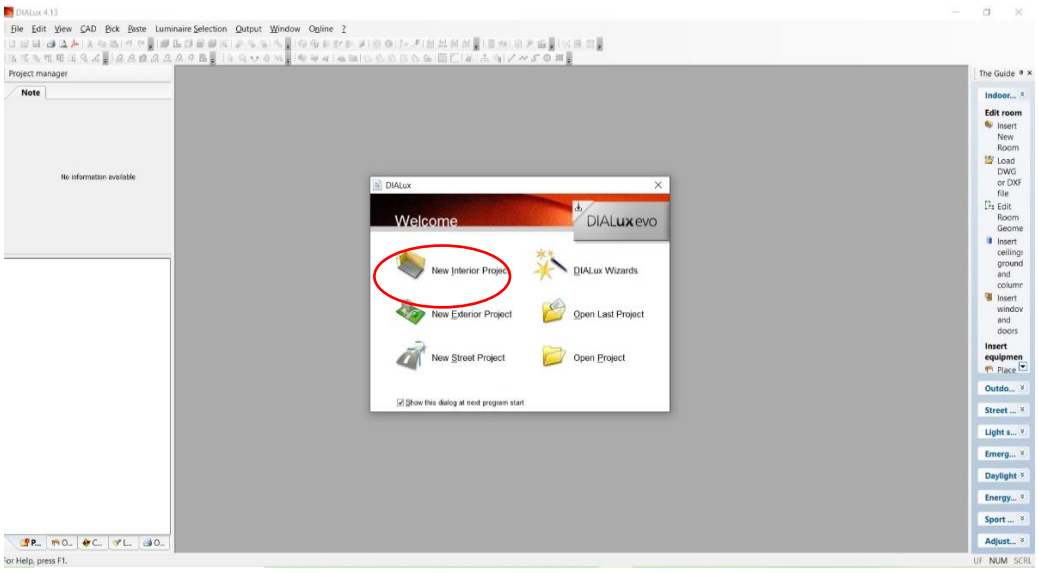


Fig 3.1: New Interior Project

It will open the following window with “Room Editor” and “Room Properties”.

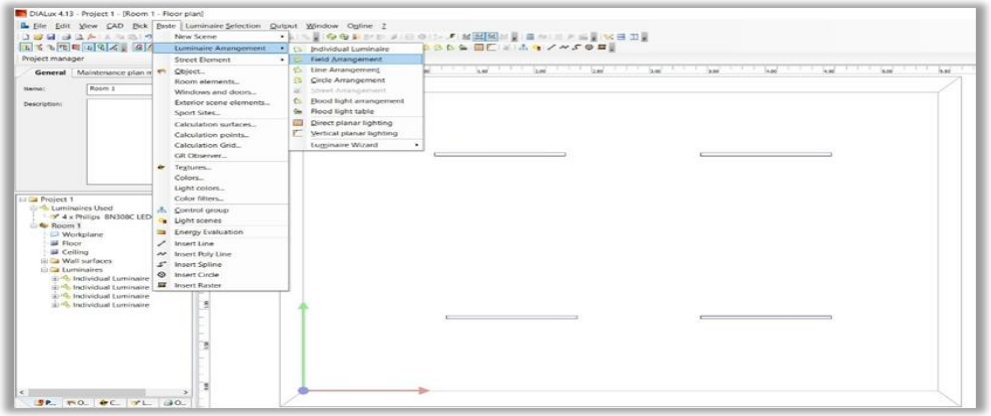


Fig 3.2: Room Editor and Room Properties

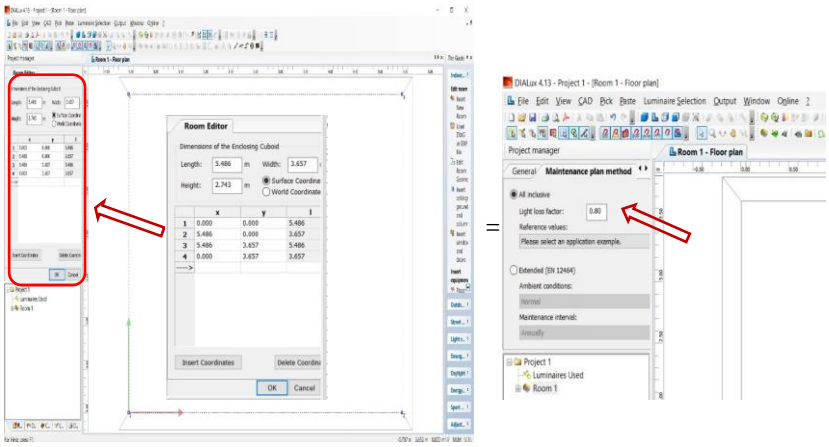


Fig 3.3: Luminaire Positioning and then Calculation

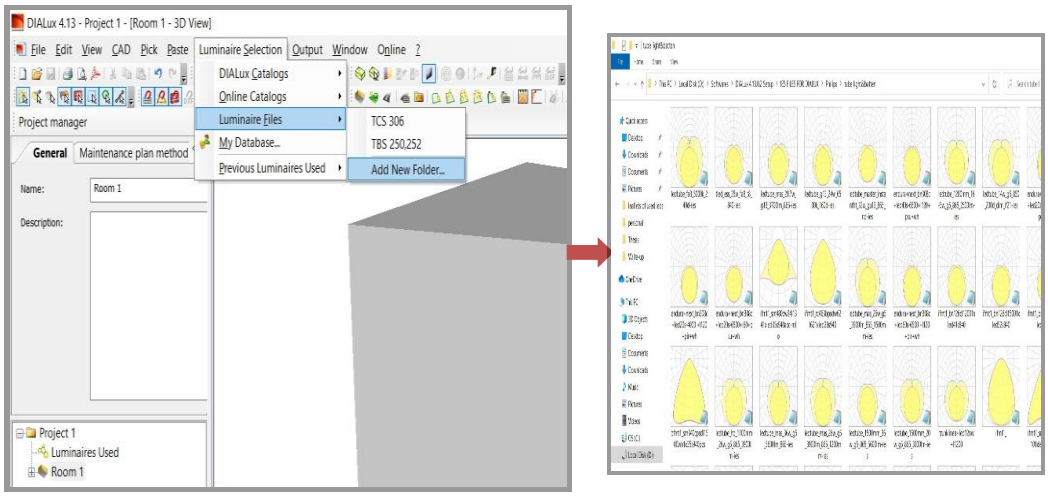


Fig 3.4 : Result of the Calculation

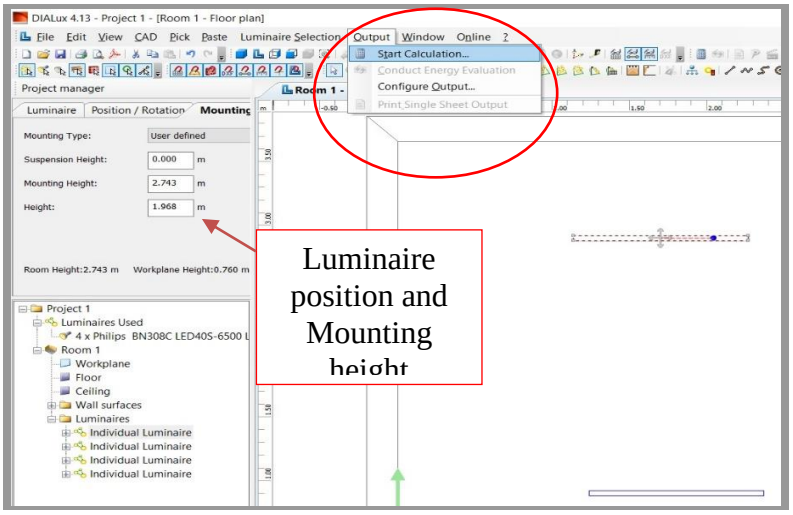
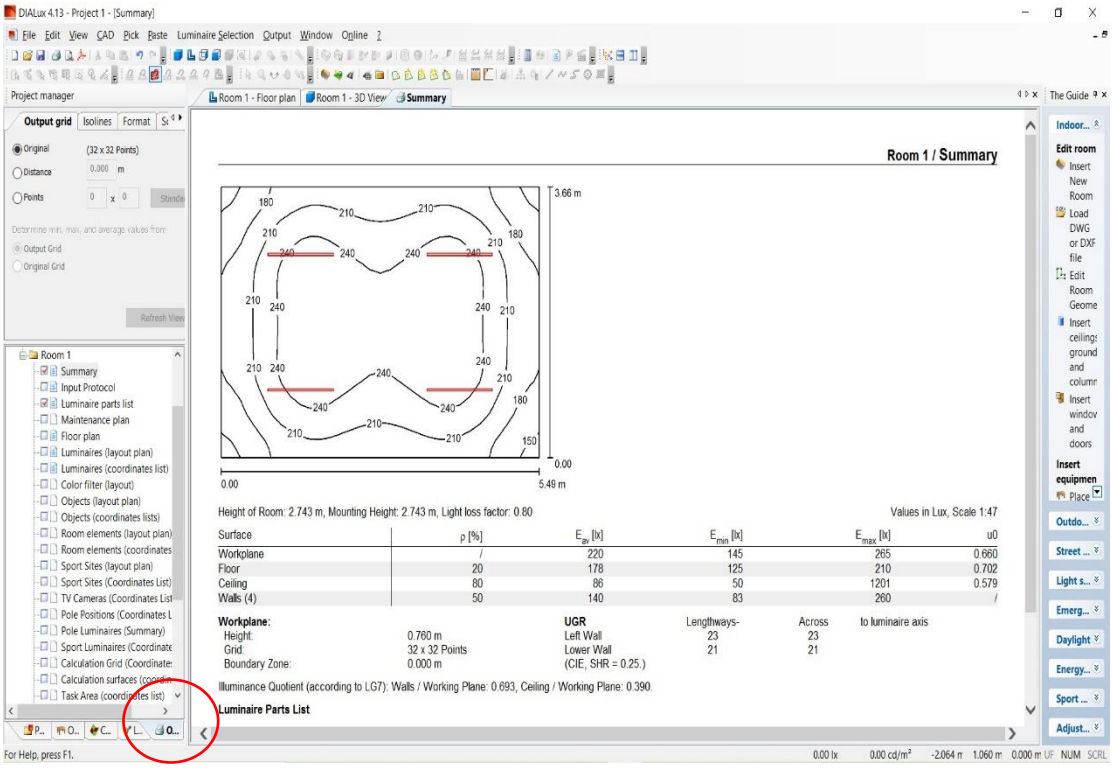


Fig 3.5 : Start the Calculation



3.5 SOME GUIDELINES ON USAGE OF DIALux LUMINATION SOFTWARE

The following points should be kept in mind to design lighting installation with low energy usage:

1) Proper choice of light sources with excellent luminous efficacy for the efficient design which suit the required task.

2) Choice of luminaires with the correct light distribution and cut-off characteristics.

3) Effective use of light scene for utilisation of daylight[32], [33].

4) Combination of artificial and natural light[31]for uniform light in the area.

5) Control of lighting through control groups as per space requirement.

6) Provision of dimming control in the control group.

7) Selection of lighting to obtain high maintenance factor that will offer long term service.

CHAPTER - 4 :

Lamps and Luminaries

CHAPTER - 4 : Lamps and Luminaries

4.1 Lamps and luminaries used in the bungalow area :

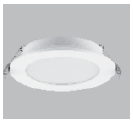
Make of Light fixture : Legero lighting

PRODUCT IMAGE	PRODUCT NAME/WATTAGE/ CATELOGUE NO	LOCATION
	Nova /14W/LRS 5114	Bedrooms, Dining area To highlight the floor area.
	Comet /8W/LCT 1008	Living area To highlight the floor area.
	Gia /8W/ LRS 8007	Toilets area Its use as a downlight
	Vela / 8W/ LHR 6508	Bedrooms, drawing area To highlight the wall painting.
	Opal / 20W / LRS 6020	Passage area,Store room To illuminate the floor area.
	D-lite / 12W/LDTE 300	Balcony area It illuminate the extended portion of the bungalow.
	Lynx / 20W / LRS 2106	Living area , Drawing area It used in the cove area of the fulse ceiling.

	Modena / 36W / LER 2636	Kitchen area It illuminate the floor area of the kitchen.
	Elava / 3W/ LOD 44503	Living area To highlight the small portion of the ceiling.
	Edge / 4W/ LSA 3003	Landscape area It used in the wall light
	Mushroom / 6W / LBF 7010	Landscape area To illuminate pathway and landscapes for pedestrian use and safety.
	Perdu / 6W/LRS 1403	Bedrooms, living area To high lighter the furniture and sofa.
	Torch /12W/LPO 3512	Landscape area To illuminated the gate area.
	Mini / 18W/LPT 4530	Landscape area It used as a under water light in the swimming pool.
	Palco / 8W/ LSF 3308	Landscape area To create a focus light onto a specific feature such as tree or sculpture.
	Micro sparks/4W/ LSM 1004	Landscape area It used enhances the safety aspect.

4.2 Lamps and luminaries used in the multi stories building:

Make of Light fixture : Legero lighting

PRODUCT IMAGE	PRODUCT NAME/WATTAGE/ CATELOGUE NO	LOCATION
	Pearl round / 18W/LRS 2018	Passage area To illuminate floor area
	Nova /14W/LRS 5114	Bedrooms, Dining area To highlight the floor area.
	Comet /8W/LCT 1008	Living area To highlight the floor area.
	Gia /8W/ LRS 8007	Toilets area Its use as a downlight
	D-lite / 12W/LDTE 300	Balcony area It illuminate the extended portion of the bungalow.
	Modena / 36W / LER 2636	Kitchen area It illuminate the floor area of the kitchen.
	Coral surface / 6W/LRS 3106	Stair area
	Cribo / 5W/ LRS 1205	Bedrooms ,living area To high lighter the particular elements.

	Strix /40W/ LSB 1240	Outdoor area To illuminate the parking zone
	Torch /45W/LPO 3512	Outdoor area To illuminated the gate area.
	Edge / 6W/ LSA 3003	Outdoor area It used in the wall light
	Oreon /15W/LCO 4315	Outdoor It used in the entry position of the gate

CHAPTER - 5 :

STUDIES ON LIGHTING DESIGN OF A TYPICAL BUNGALOW TYPE BUILDING

CHAPTER 5 : STUDIES ON LIGHTING DESIGN OF A TYPICAL BUNGALOW TYPE BUILDING

5.0 ILLUMINATION DESIGN

An effort has been made for lighting design of a typical Bungalow type building as furnished herein below.

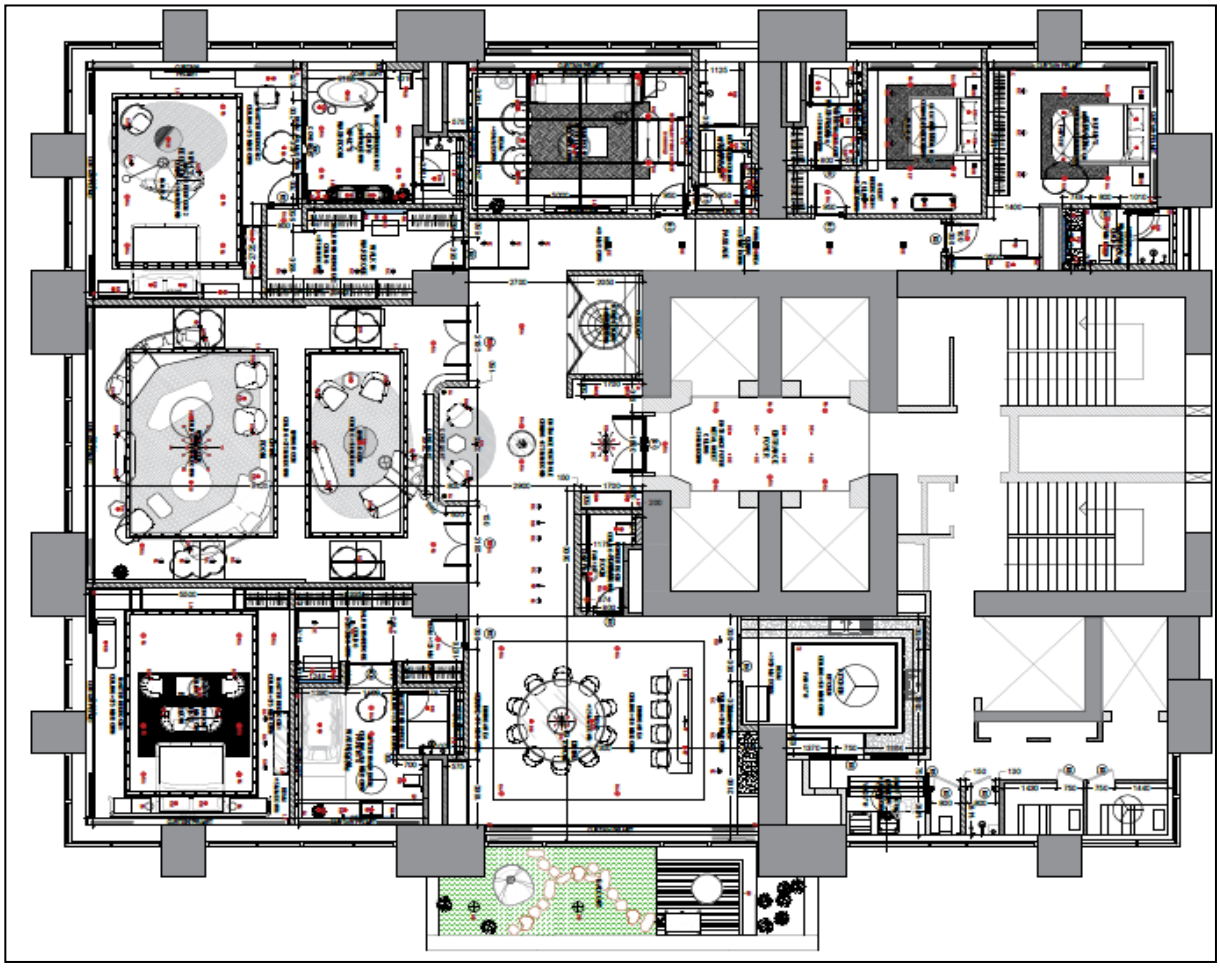


Fig.-5.1 : Layout of the bungalow under consideration

This bungalow consist of different areas such as

Living and Dining rooms: Two of the 3 BHK (C & D) and 2 BHK (G & H) flats which are already in use, has the walls coloured with acrylic plastic paint over a coat of primer on the putty surface. In other flats the walls are not painted yet. Floor finish is done with Vitrified tiles. Specific electrical outlet for lighting with concealed wiring. Balcony is connected with the dining room with daylight availability.

Bedrooms: The walls are same as the living room and floor finishing is of Ceramic tiles. Specific electrical outlet for lighting with concealed wiring. One slider window with aluminium framing.

Kitchens: Floor is made up of anti-skid ceramic tiles and the dado is made with glazed ceramic tiles up to 2 ft. height above kitchen counter. The counter is made with granite and has a stainless-steel sink with drain board.

Toilets: Floor is made up of anti-skid ceramic tiles and the dado is of glazed ceramic tiles. The toilet is white coloured European type and washbasin is ceramic. Provision of geyser point. Doors are laminated to protect from water splash. Electrical wiring is concealed with PVC conduits and modular switches are available.

Corridor/Lobby, Staircases and Balconies: Lobby's floor has marble finishing, staircase has marble flooring and Balcony's floor has tiles.

Balcony area : There are various ways to cantilever a balcony and in today's building another important factor that must be taken into account, particularly when using a steel balcony, is thermal bridging (conductivity). To meet U values and part L, there must be a thermal "break" created. To overcome this there are several companies offering "Thermal break" balcony joints in the market, or a break is created using two steel balcony connection plates with a HDPE (high-density polyethylene) sandwiched between them.

5.1 INDOOR LIGHTING DESIGN OF BUNGALOW

We know that in the bungalow area most of the rich peoples are lived. They are looking for good amount of light so for that the power consumption required very high. The people wanted to decorate their bedroom and living area different kind of LED lights. That's why the illumination level and power consumption are very high. Here we have show in the design criteria**,**

Design criteria :

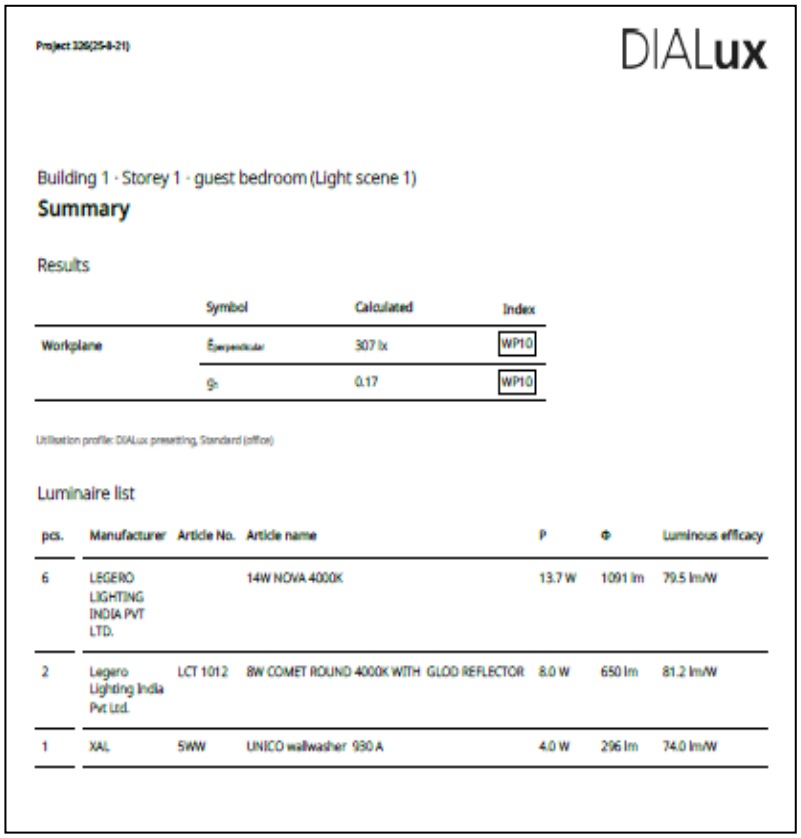
1. ILLUMINATION DESIGN OF BEDROOM-1

- In the real estate world, a space can be considered a bedroom if it has a door that can be closed, a window, and a closet. The closet requirement is not covered in the IRC and is instead a bedroom feature more related to comfort and liveability than safety.

- AREA :

  Length of the room = 4.1meter.
  Breadth of the room = 4.1 meter.
  So, total area of the room = (4.1*4.1) = 16.1 meter.^{2}

  Average Illumination under consideration = 300 lux



Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · guest bedroom (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	307 lx	WP10
	g_1	0.17	WP10

Utilisation profile: DIALux prewetting, Standard (office)

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
6	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W
2	Legero Lighting India Pvt Ltd.	LCT 1012	8W COMET ROUND 4000K WITH GLOD REFLECTOR	8.0 W	650 lm	81.2 lm/W
1	XAL	5WW	UNICO wallwasher 930 A	4.0 W	296 lm	74.0 lm/W

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · guest bedroom

Luminaire layout plan

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · guest bedroom (Light scene 1)

Workplane (guest bedroom)

Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
Workplane (guest bedroom) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	307 lx	51.7 lx	530 lx	0.17	0.098	WP1.0

Utilisation profile: DIALux presetting, Standard (office)

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Bedroom-1	Nova(downlight)	14W,4000K	6
2		Gia (spot light)	8W,4000K	2
3		Wall washer	4W,4000K	1

CALCULATED OF LPD & ILLUMINATION LEVEL OF BEDROOM-1

- POWER CONSUMPTION:

  Total wattage = 102.2 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = 102.2/16.08 = 6.35 Watt/meter.^{2}

- ILLUMINATION CALCULATION:

  Average Illumination = 307 lux

2. ILLUMINATION DESIGN OF ATTACHED TOILET-1

- A primary bathroom is one that is connected to the primary, or largest, bedroom in the house. A primary bathroom is also called an en suite bathroom or an attached bathroom. Typically, the primary bathroom is a full bathroom or a three-quarter bathroom.
- AREA :

  Length of the room = 2.2 meter .
  Breadth of the room = 2.2 meter.
  So, total area of the room = (2.2*2.2) = 4.4 meter.^{2}

  Average Illumination under consideration = 150 lux

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · guest wshroom (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	185 lx	WP11
	g_1	0.083	WP11

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

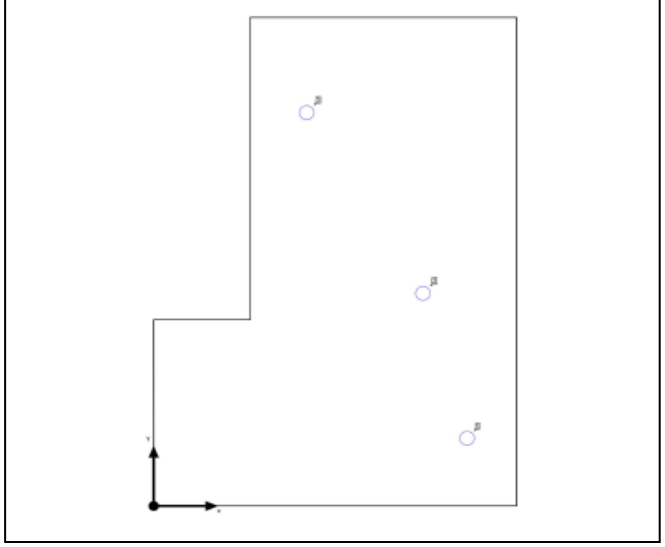
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
3	Legero Lighting India Pvt Ltd.	LCT 1012	8W COMET ROUND 4000K WITH GLOD REFLECTOR	8.0 W	650 lm	81.2 lm/W

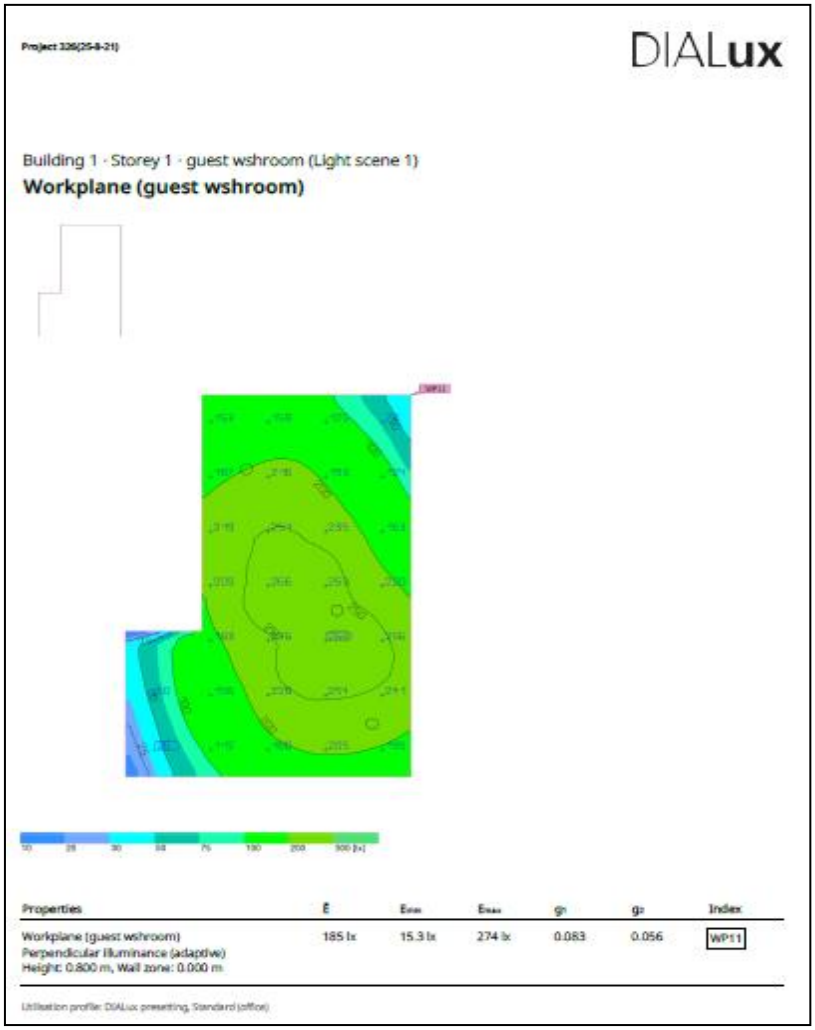
Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · guest wshroom

Luminaire layout plan





BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Toilet-1	Comet round (downlight)	8W,6500K	3

CALCULATED OF LPD & ILLUMINATION LEVEL OF TOILET-1

- POWER CONSUMPTION :

  Total wattage = 24 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = 24/5.01 = 4.79 Watt/meter.^{2}

- ILLUMINATION CALCULATION: Average Illumination = 185 lux.

3. ILLUMINATION DESIGN OF BALCONY AREA

A balcony is a platform on the outside of a building, enclosed by walls or balustrades, and supported by columns or console brackets. The platform projects from the wall of a building, usually above the ground floor. Balconies are typically small and are not used as social spaces or for entertainment purposes.

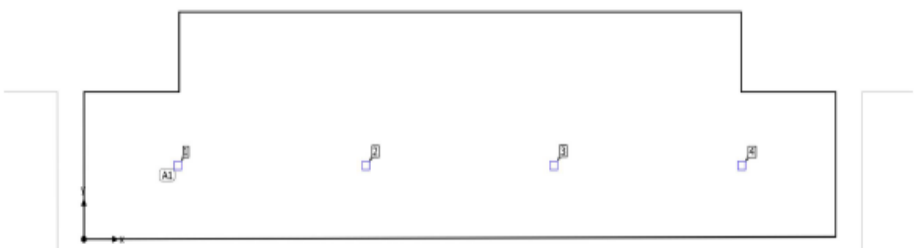
- AREA :

  Length of the room = 4.8 meter.
  Breadth of the room = 4.8 meter.
  So, total area of the room = (4.8*4.8) = 9.15 meter.^{2}

  Average Illumination under consideration = 150 lux

Building 1 · Storey 1 · BALCONY

Luminaire layout plan



Building 1 · Storey 1 · BALCONY (Light scene 1)

Summary

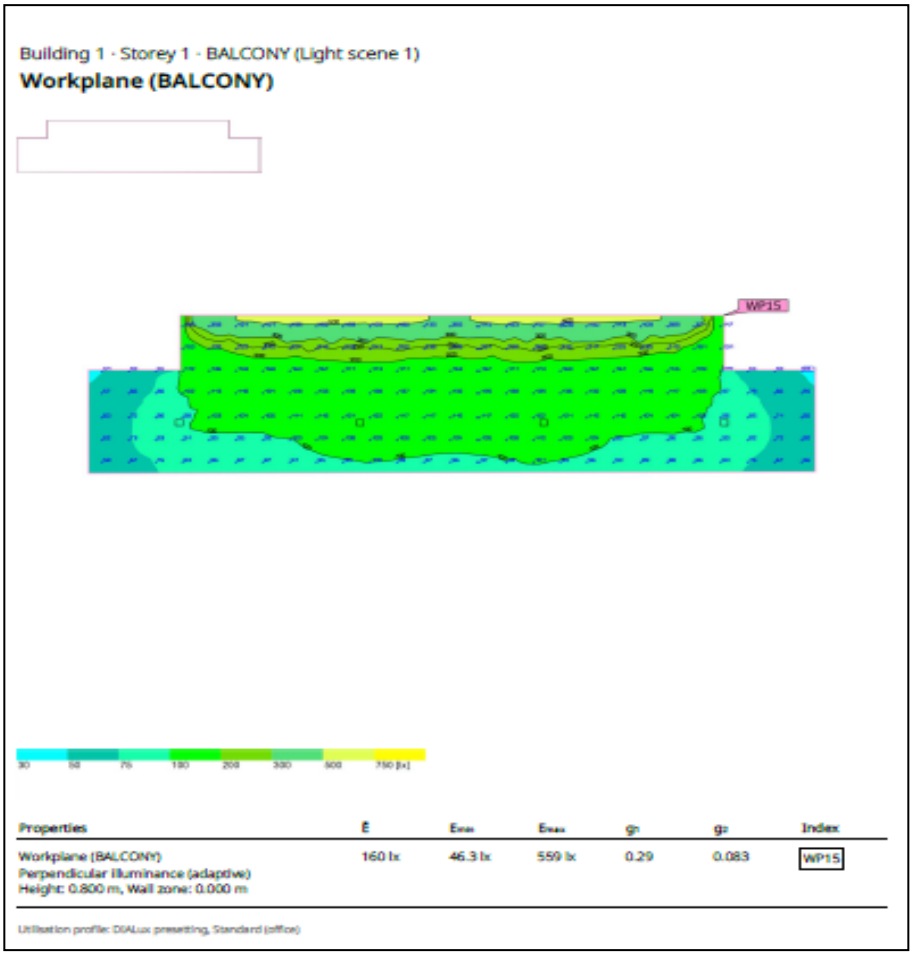
Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	160 lx	WP15
	g_1	0.29	WP15

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
4				12.7 W	1110 lm	87.7 lm/W



BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Balcony	D-lite (decorative light)	13W,6500K	4

CALCULATED OF LPD & ILLUMINATION LEVEL OF BALCONY AREA

- POWER CONSUMPTION:

  Total wattage = 52 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area =52/23.09 = 2.25 Watt/meter.^{2}

- ILLUMINATION CALCULATION:

  Average Illumination = 160 lux

4. ILLUMINATION DESIGN OF DEN AREA

In general terms, a den room is a small room in a house that can be used for private activities. It is different from other rooms in the house in terms of size, layout, and even functionality. Usually, it is windowless and in some cases door less. A den room is a versatile space.

- AREA :

  Length of the room = 5.2 meter.
  Breadth of the room = 5.2 meter.
  So, total area of the room = (5.2*5.2) = 27.04 meter.^{2}

  Average Illumination under consideration = 200 lux

Building 1 · Storey 1 · den room (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	276 lx	WP3
	g_1	0.061	WP3

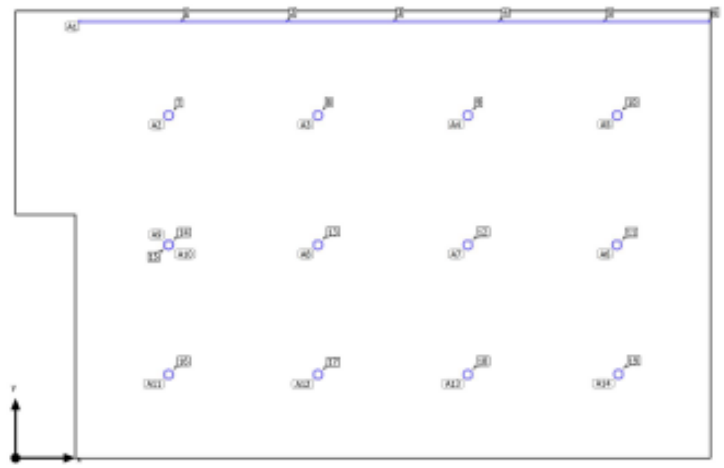
Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
6	Duralamp	07U30242 0XWG	07U302420XWG	19.2 W	1799 lm	93.7 lm/W
13	SHANTILAL AND BROTHERS (MFG.DEPT)		PERDU 1X ,NARROW BEAM,CREE XHP-35HI-3000K,LTECH DRIVER(350mA)	5.5 W	283 lm	51.5 lm/W

Building 1 · Storey 1 · den room

Luminaire layout plan

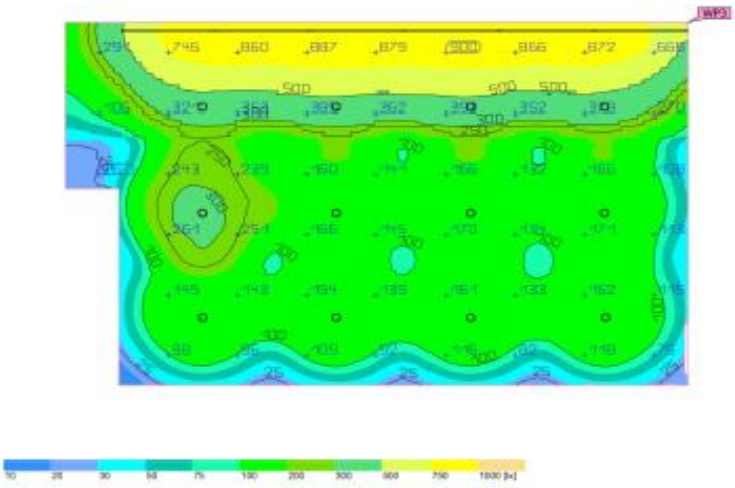


Project 336(25-8-21)

DIALux

Building 1 · Storey 1 · den room (Light scene 1)

Workplane (den room)



Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
Workplane (den room) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	276 lx	16.9 lx	986 lx	0.061	0.017	WP3

Utilisation profile: DIALux presenting, Standard (office)

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Den area	LED strip	20W,6500K	4
2		Perdu(spot light)	6W,6500K	13

CALCULATED OF LPD & ILLUMINATION LEVEL OF DEN AREA

- POWER CONSUMPTION:

  Total wattage = 186.7 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area =186.7/27.35 = 2.20 Watt/meter.^{2}

- ILLUMINATION CALCULATION:

  Average Illumination = 276 lux

5. ILLUMINATION DESIGN OF DEN WASHROOM AREA

- A primary bathroom is one that is connected to the primary, or largest, bedroom in the house. A primary bathroom is also called an en suite bathroom or an attached bathroom. Typically, the primary bathroom is a full bathroom or a three-quarter bathroom.
- AREA :

  Length of the room = 2.3 meter.
  Breadth of the room = 2.3 meter.
  So, total area of the room = (2.3*2.3) = 5.6 meter.^{2}

  Average Illumination under consideration = 150 lux

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · den washroom (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	191 lx	WP16
	g_1	0.31	WP16

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

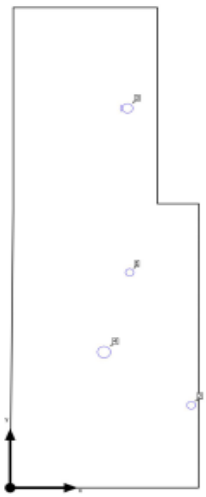
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
1	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W
2	LEGERO LIGHTING INDIA PVT LTD.		8W GIA 4000K	6.1 W	366 lm	60.3 lm/W
1	Legero Lighting India Pvt Ltd.	LCT 1012	8W COMET ROUND 4000K WITH GLOD REFLECTOR	8.0 W	650 lm	81.2 lm/W

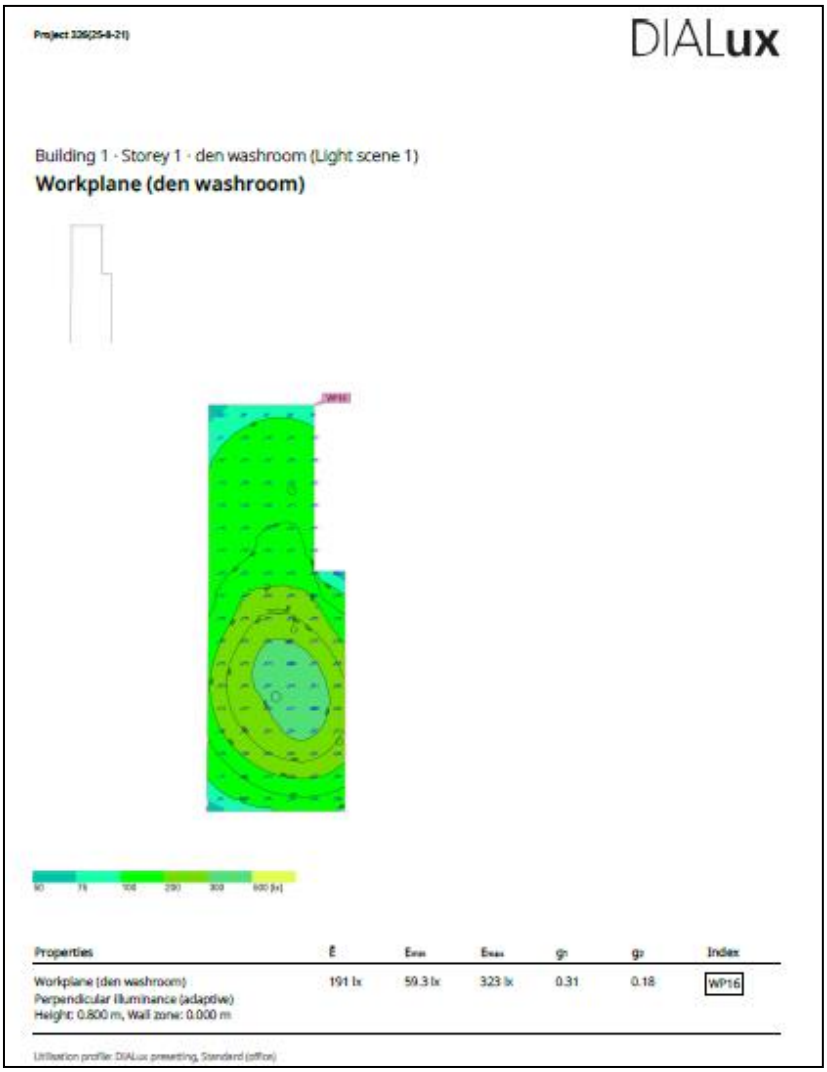
Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · den washroom

Luminaire layout plan





BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Den washroom	Nova(downlight)	14W,6500K	1
2		Gia(spot light)	8W,6500K	2
3		Comet round(downlight)	8W,6500K	1

CALCULATED OF LPD & ILLUMINATION LEVEL OF DEN WASHROOM AREA

- POWER CONSUMPTION:

  Total wattage = 33.9 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area =186.7/27.35 = 2.20 Watt/meter.^{2}

- ILLUMINATION CALCULATION:

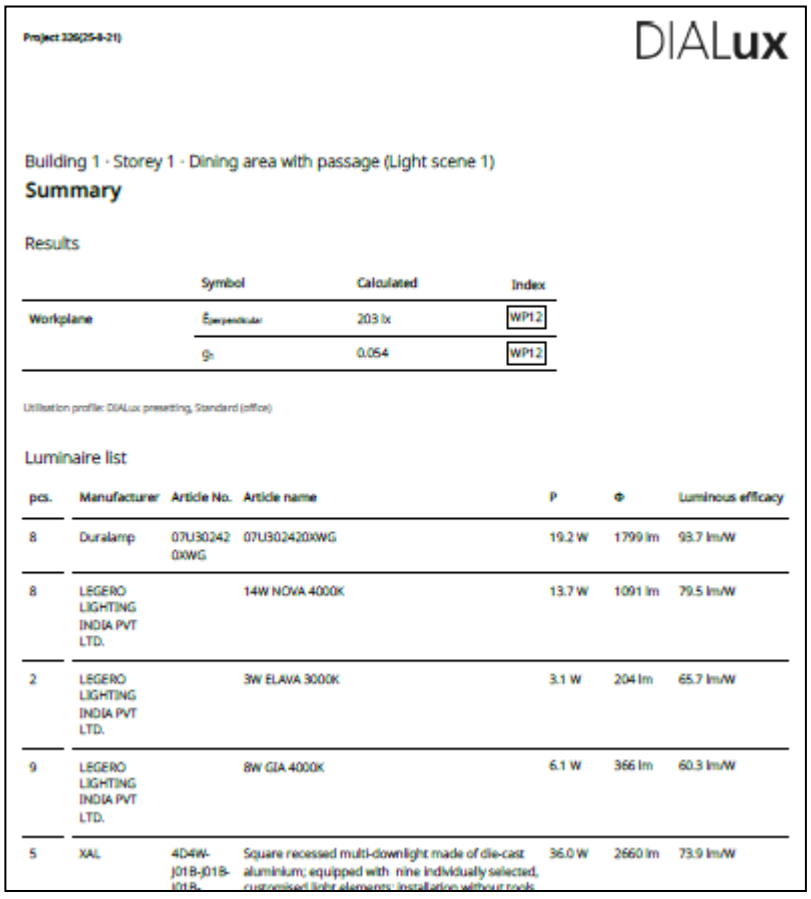
  Average Illumination = 191 lux

6. ILLUMINATION DESIGN OF DINING AREA

- A dining room is a room in a house, apartment, school etc that is reserved primarily for eating meals (breakfast, lunch or dinner) although other activities may also take place there outside of meal time.
- AREA :

  Length of the room = 10.3meter.
  Breadth of the room = 10.3 meter.
  So, total area of the room = (10.3*10.3) = 106.3 meter.^{2}

  Average Illumination under consideration = 200 lux



Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · Dining area with passage (Light scene 1)

Summary

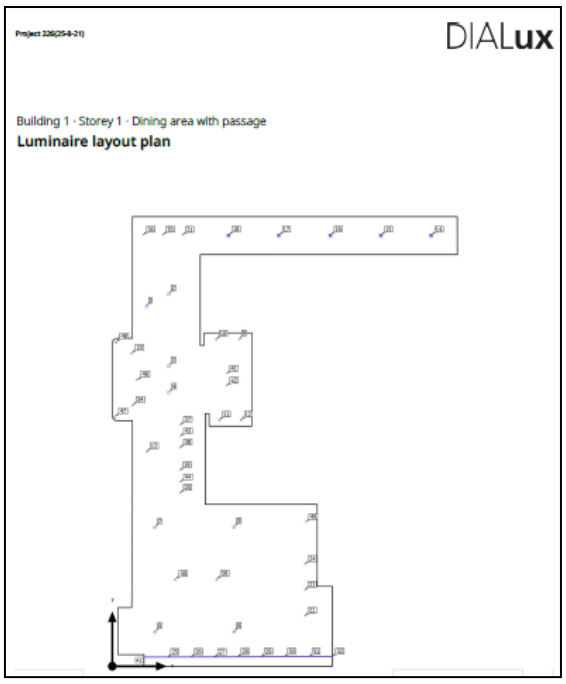
Results

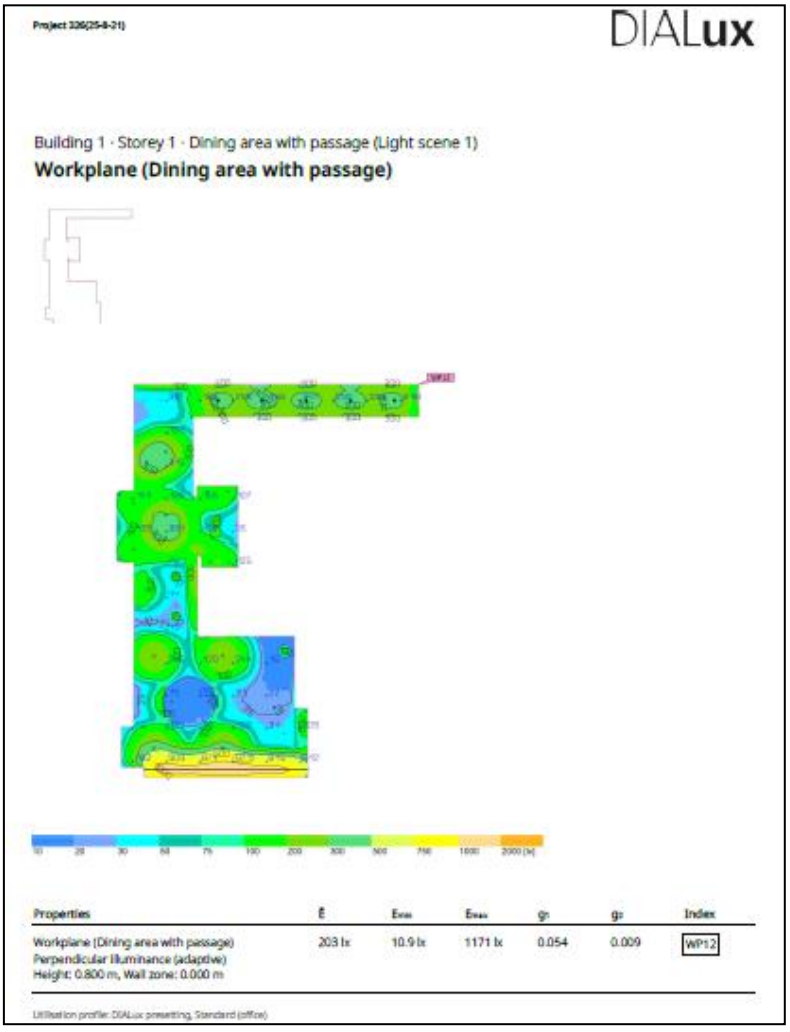
	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	203 lx	WP12
	g_1	0.054	WP12

Utilisation profile: DIALux presenting, Standard (office)

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
8	Duralamp	07U30242 0XWG	07U302420XWG	19.2 W	1799 lm	93.7 lm/W
8	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W
2	LEGERO LIGHTING INDIA PVT LTD.		3W ELAVA 3000K	3.1 W	204 lm	65.7 lm/W
9	LEGERO LIGHTING INDIA PVT LTD.		8W GIA 4000K	6.1 W	366 lm	60.3 lm/W
5	XAL	4D4W-J018-J018-J018-	Square recessed multi-downlight made of die-cast aluminium; equipped with nine individually selected, customised light elements; installation without tools	36.0 W	2660 lm	73.9 lm/W


Project 326(25-8-21)
DIALux
Building 1 · Storey 1 · Dining area with passage
Luminaire layout plan


Project 326(25-8-21)
DIALux
Building 1 · Storey 1 · Dining area with passage (Light scene 1)
Workplane (Dining area with passage)
Properties
Ē
Emin
Emax
g1
g2
Index
Workplane (Dining area with passage)
Perpendicular illuminance (adaptive)
Height: 0.800 m, Wall zone: 0.000 m
203 lx
10.9 lx
1171 lx
0.054
0.009
WP12

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Dining area	LED strip light	20W,4000K	8
2		Nova (downlight)	14W,4000K	8
3		Elava (inground)	3W,4000K	2
4		Gia (spot light)	8W,4000K	9
5		Wall washer	8W,4000K	5
6		Oal (Downlight)	25W,4000K	5
7		Palco (spot light)	8W,4000K	6
8		Vela(Wall washer)	7W,4000K	5

CALCULATED OF LPD & ILLUMINATION LEVEL OF DINING AREA

- WATTAGE CALCULATION:

  Total wattage = 612.3 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage / Total area = 612.3/106.29 = 5.76 Watt/meter.^{2}

- ILLUMINATION CALCULATION:

  Average Illumination = 203 lux

7. ILLUMINATION DESIGN OF ENTRANCE FOYER

- A foyer is an area at the front of the home, entered after passing through the front door. The foyer connects a home's entrance with the rest of the interior. ... A foyer in a residence is usually a small area behind a front door that separates a home's main rooms from the outside of the house.
- AREA :

  Length of the room = 3.9meter.
  Breadth of the room =3.9 meter.
  So, total area of the room = (3.9*3.9) = 15.9 meter.^{2}

  Average Illumination under consideration = 300 lux

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · entrance Foyer (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	302 lx	WP7
	g_1	0.31	WP7

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

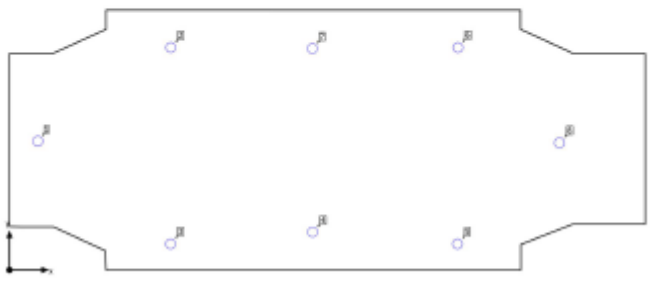
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
8	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W

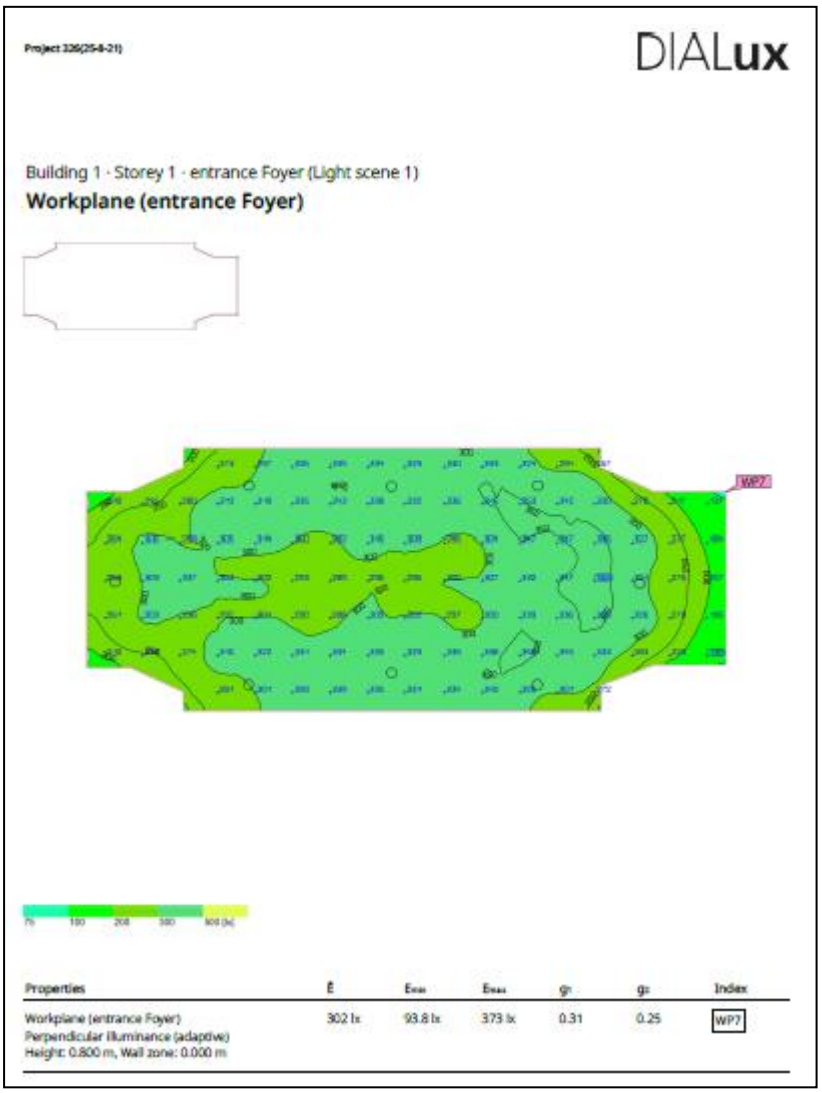
Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · entrance Foyer

Luminaire layout plan





BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	ENTRANCE FOYER	Nova(downlight)	14W,4000K	8

CALCULATED OF LPD & ILLUMINATION LEVEL OF ENTRANCE FOYER

- POWER CONSUMPTION:

  Total wattage = 109.6 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = 109.6/15.99 = 6.85 Watt/meter.^{2}

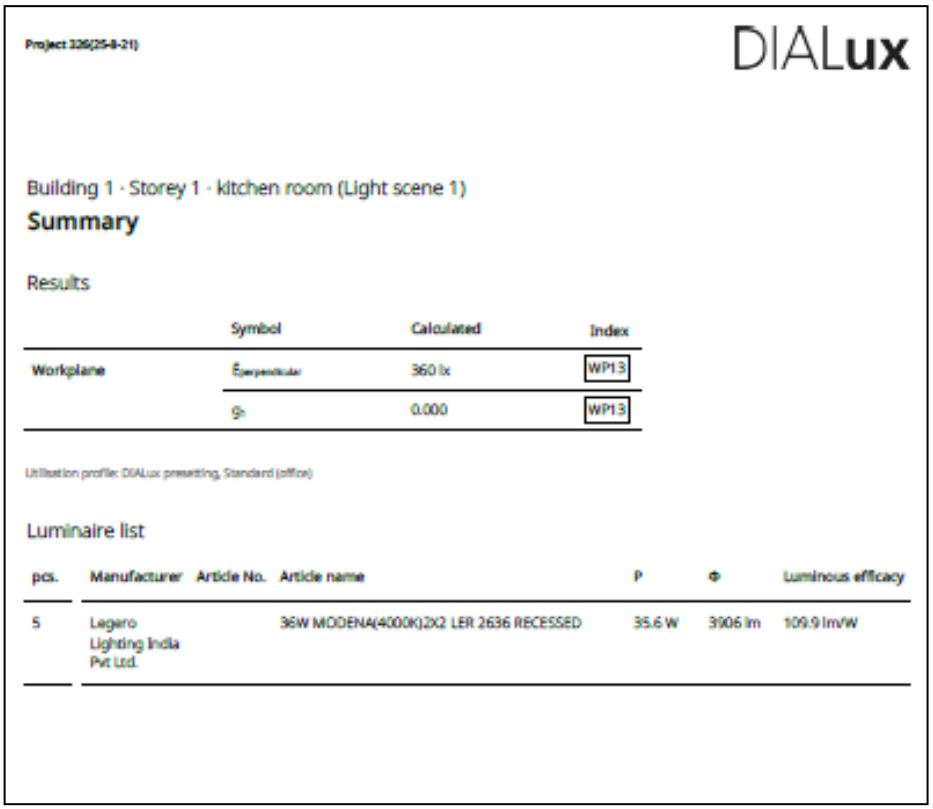
- ILLUMINATION CALCULATION: Average Illumination = 302 lux

8. ILLUMINATION DESIGN OF KITCHEN ROOM

The Common Kitchen is a place where emerging food entrepreneurs can thrive and grow, supported by one another, the local community, and a fully-equipped commercial kitchen accompanied by retail spaces, seating, and a bar serving coffee, juices, and cocktails.

- AREA CALCULATION:

Length of the room = 4.3 meter.
Breadth of the room = 4.3 meter.
So, total area of the room = (4.3*4.3) = 18.6 meter.^{2}
Average Illumination under consideration = 350 lux



Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · kitchen room (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	360 lx	WP13
	g_1	0.000	WP13

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

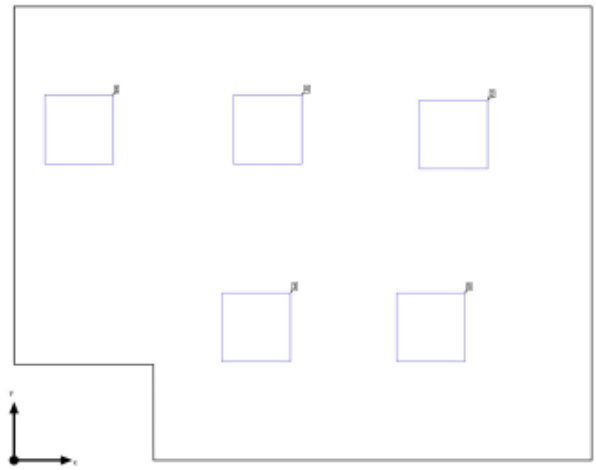
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
5	Legero Lighting India Pvt Ltd.		36W MODENA(4000K)2X2 LER 2636 RECESSED	35.6 W	3906 lm	109.9 lm/W

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · kitchen room

Luminaire layout plan



Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · kitchen room (Light scene 1)

Workplane (kitchen room)

Properties	Ē	Emin	Emax	g1	g2	Index
Workplane (kitchen room) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	360 lx	0.002 lx	649 lx	0.000	0.000	WP13

Utilisation profile: DIALux presenting, Standard (office)

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Kitchen area	Modena(2x2)(panel light)	36W,6500K	5

CALCULATED OF LPD & ILLUMINATION LEVEL OF KITCHEN ROOM

- POWER CONSUMPTION:

  Total wattage = 178.0 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area =178/18.62 = 9.60 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 360 lux

9. ILLUMINATION DESIGN OF LIVING ROOM

Living area means the interior habitable area of a dwelling unit, including basements and attics, but does not include a garage or any accessory structure.

- AREA CALCULATION:

  Length of the room = 8.9 meter.
  Breadth of the room = 8.9 meter.
  So, total area of the room = (8.9*8.9) = 78.9 meter.^{2}
  Average Illumination under consideration = 250 lux

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · living room (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	290 lx	WP9
	g_1	0.33	WP9

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

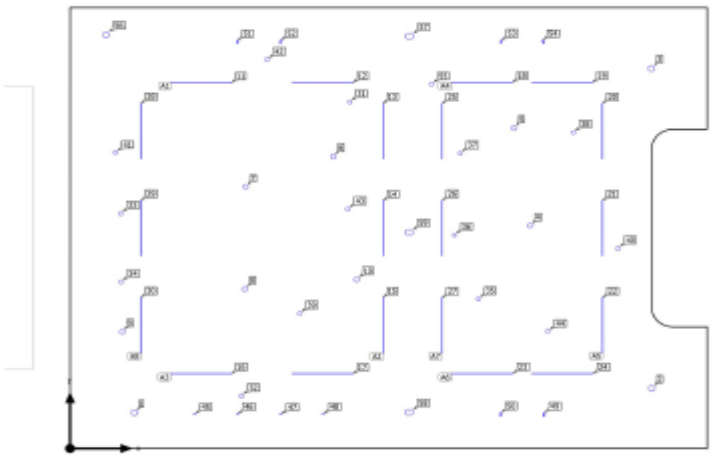
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
20	Duralamp	07U30242 0INUHD	07U302420INUHD	20.0 W	1701 lm	85.1 lm/W
7	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W
15	LEGERO LIGHTING INDIA PVT LTD.		8W GIA 4000K	6.1 W	366 lm	60.3 lm/W
7	Legero Lighting India Pvt Ltd.	LCT 1012	8W COMET ROUND 4000K WITH GLOD REFLECTOR	8.0 W	650 lm	81.2 lm/W
4	XAL	SWW	UNICO wallwasher 930 A	8.0 W	592 lm	74.0 lm/W
6	iGuzzini Illuminazione S.p.A	Palco LV spotlight Ø 37 - Framer - 6.5W 620lm - 3000K - CRI 90	Q650+GOBO_D05+F_MIN_830A	8.0 W	24 lm	3.1 lm/W

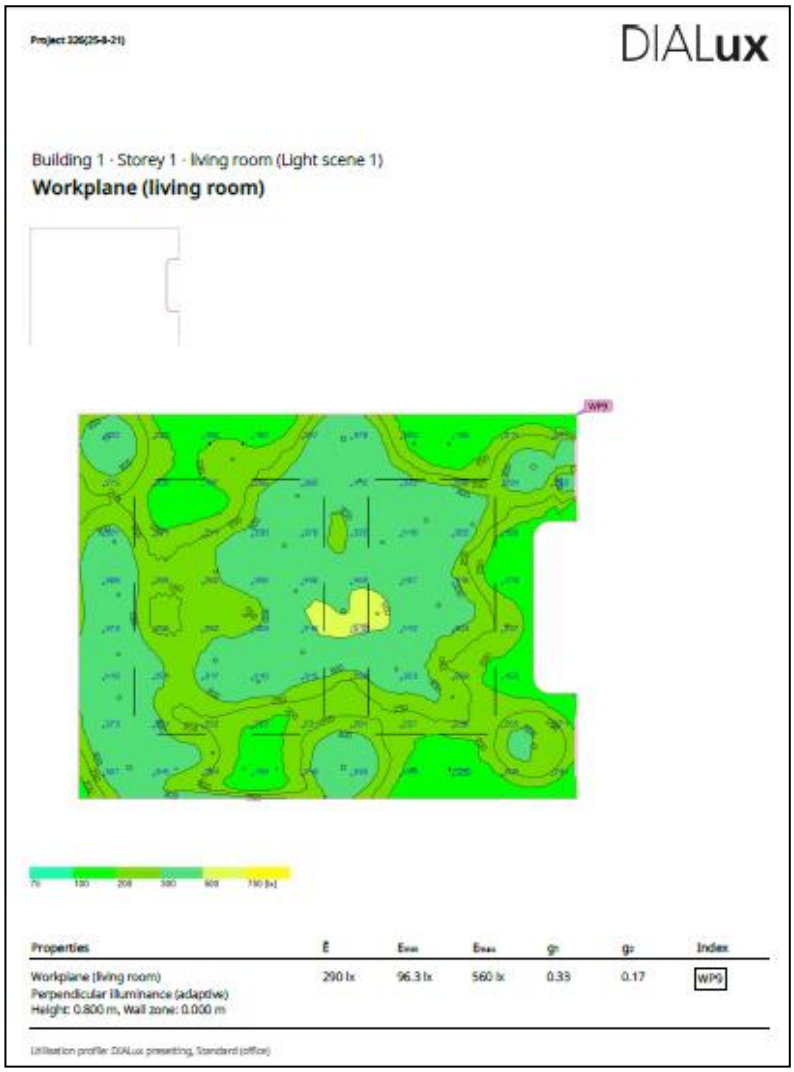
Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · living room

Luminaire layout plan





BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Living area	LED strip	20W,4000K	20
2		Nova(downlight)	14W,4000K	7
3		Gia(spot light)	8W,4000K	15
4		Comet round (downlight)	8W,4000K	7
5		Vela(Wall washer	8W,4000K	4
6		Palco (spot light)	8W,4000K	6

CALCULATED OF LPD & ILLUMINATION LEVEL OF LIVING ROOM

- POWER CONSUMPTION: Total wattage = 723.4 Watt.
- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = 723.4/78.92 = 9.17 Watt/meter.^{2}
- ILLUMINATION CALCULATION :

  Average Illumination = 290 lux

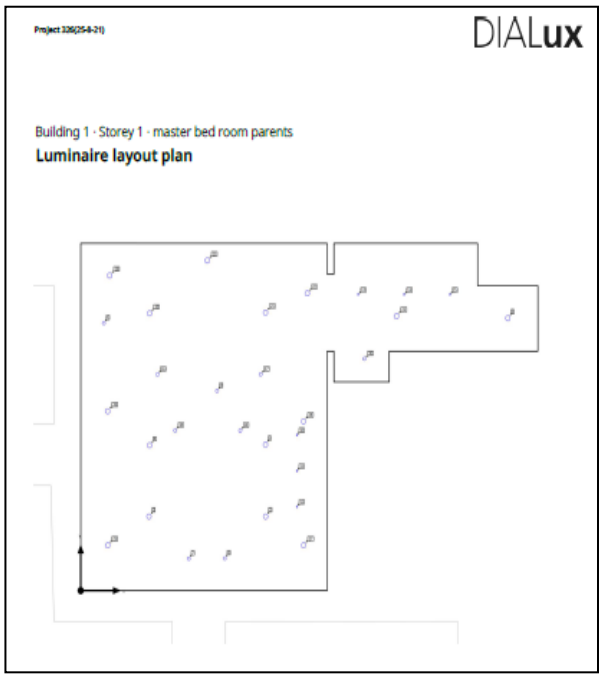
10. ILLUMINATION DESIGN OF BEDROOM-2

- In the real estate world, a space can be considered a bedroom if it has a door that can be closed, a window, and a closet. The closet requirement is not covered in the IRC and is instead a bedroom feature more related to comfort and liveability than safety.

- AREA :

Length of the room = 8.3meter.
Breadth of the room =8.3 meter.
So, total area of the room = (8.3*8.3) = 67.73 meter.^{2}

Average Illumination under consideration = 250 lux



Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · master bed room parents (Light scene 1)

Summary

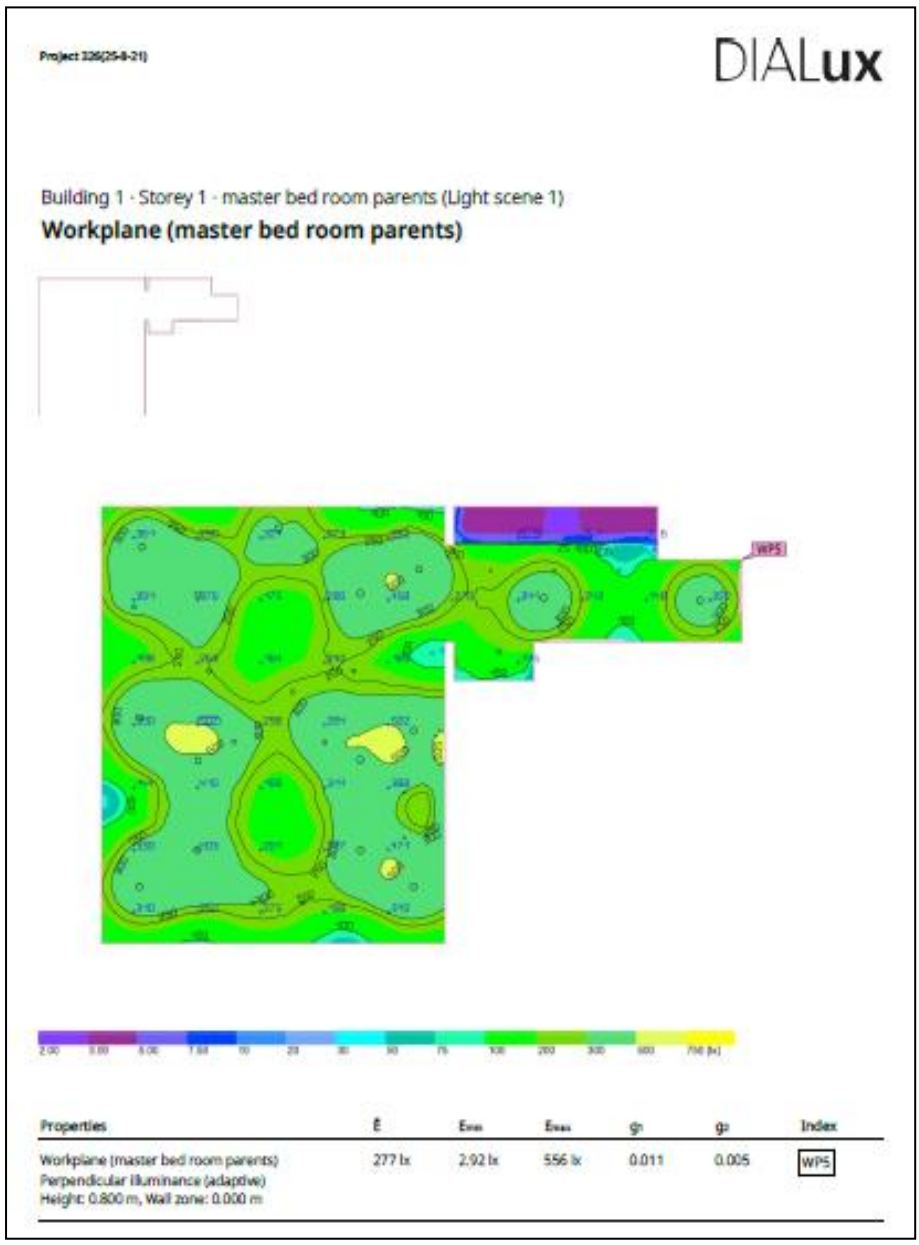
Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	277 lx	WPS
	g_0	0.011	WPS

Utilisation profile: DIALux prewritting, Standard (office)

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
15	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W
9	LEGERO LIGHTING INDIA PVT LTD.		8W GIA 4000K	6.1 W	366 lm	60.3 lm/W
6	XAL	5WW	UNICO wallwasher 930 A	8.0 W	592 lm	74.0 lm/W



BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Bedroom-2	Nova(downlight)	14W,4000K	15
2		Gia(spot light)	8W,4000K	9
3		Vela(wall washer)	8W,4000K	6

CALCULATED OF LPD & ILLUMINATION LEVEL OF BEDROOM-2

- POWER CONSUMPTION:Total wattage = 308.4 Watt.
- LPD (LIGHT POWER DENSITY): Total wattage/Total area = = 6.60 Watt/meter.^{2}
- ILLUMINATION CALCULATION : Average Illumination = 277 lux

11. ILLUMINATION DESIGN OF ATTACHED TOILET-2

- A primary bathroom is one that is connected to the primary, or largest, bedroom in the house. A primary bathroom is also called an en suite bathroom or an attached bathroom. Typically, the primary bathroom is a full bathroom or a three-quarter bathroom.

- AREA :

Length of the room = 4.1 meter.
Breadth of the room = 4.1 meter.
So, total area of the room = (4.1*4.1) = 16.65 meter.^{2}

Average Illumination under consideration = 150 lux

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · master washroom (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	191 lx	WP6
	g_1	0.065	WP6

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

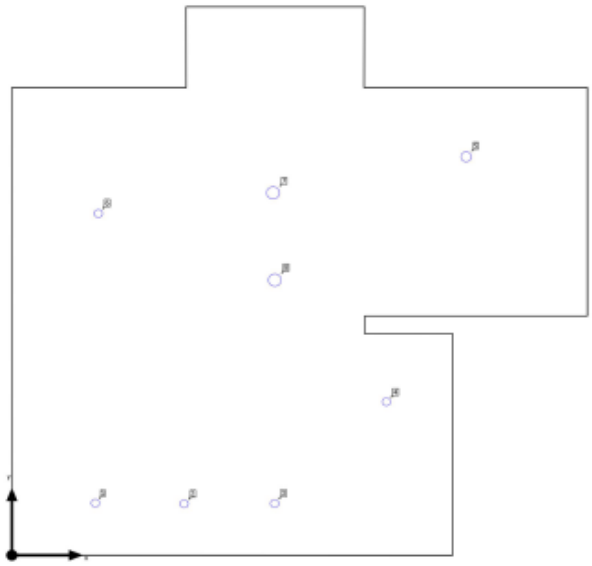
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
2	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W
5	LEGERO LIGHTING INDIA PVT LTD.		8W GIA 4000K	6.1 W	366 lm	60.3 lm/W
1	Legero Lighting India Pvt Ltd.	LCT 1012	8W COMET ROUND 4000K WITH GLOD REFLECTOR	8.0 W	650 lm	81.2 lm/W

Project 326(25-8-21)

DIALux

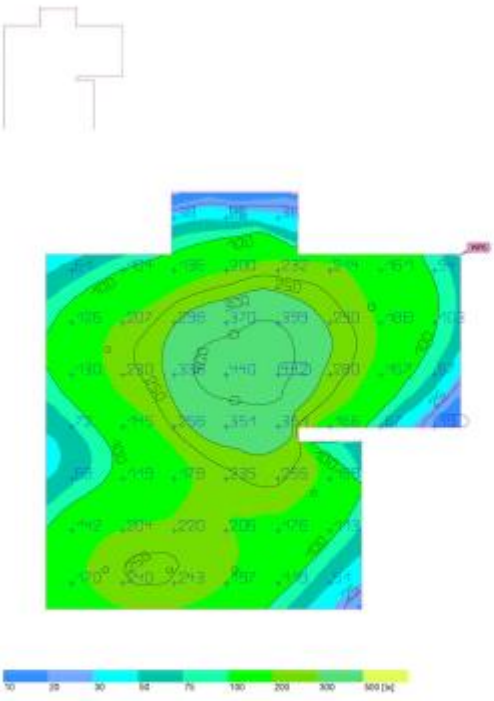
Building 1 · Storey 1 · master washroom

Luminaire layout plan



Building 1 · Storey 1 · master washroom (Light scene 1)

Workplane (master washroom)



Properties	Ē	Emin	Emax	g1	g2	Index
Workplane (master washroom) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	191 lx	12.5 lx	469 lx	0.065	0.027	WP6

Utilisation profile: DIALux presetting, Standard (office)

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Toilet-2	Nova(downlight)	14W,6500K	2
		Gia(spot light)	8W,6500K	5
		Comet round(downlight)	8W,6500K	1

CALCULATED OF LPD & ILLUMINATION LEVEL OF TOILET-2

- POWER CONSUMPTION:

  Total wattage = 65.9 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (65.9/16.64) = 3.96 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 191 lux

12. ILLUMINATION DESIGN OF BEDROOM-3

In the real estate world, a space can be considered a bedroom if it has a door that can be closed, a window, and a closet. The closet requirement is not covered in the IRC and is instead a bedroom feature more related to comfort and liveability than safety.

- AREA CALCULATION:

  Length of the room = 4.7822 meter.
  Breadth of the room = 4.7822 meter.
  So, total area of the room = (4.7822*4.7822) = 22.87 meter.^{2}

  Average Illumination under consideration = 300 lux

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · NUPUR'S bedroom (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	279 lx	WP4
	g_1	0.006	WP4

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

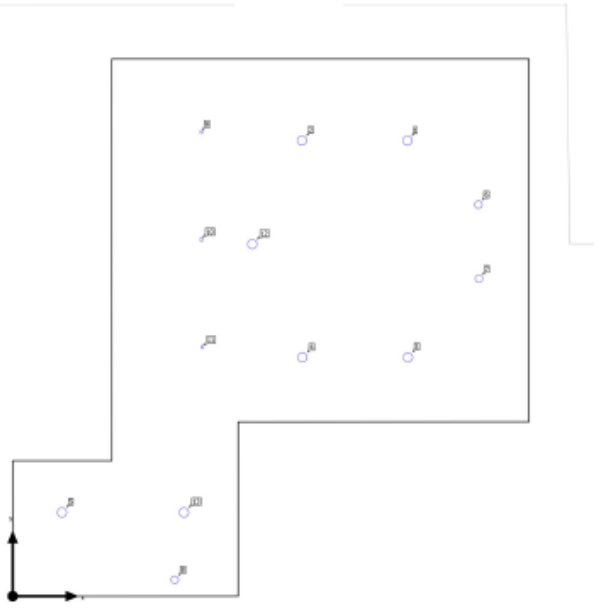
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
7	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W
3	Legero Lighting India Pvt Ltd.	LCT 1012	8W COMET ROUND 4000K WITH GLOD REFLECTOR	8.0 W	650 lm	81.2 lm/W
3	XAL	SWW	UNICO wallwasher 930 A	8.0 W	592 lm	74.0 lm/W

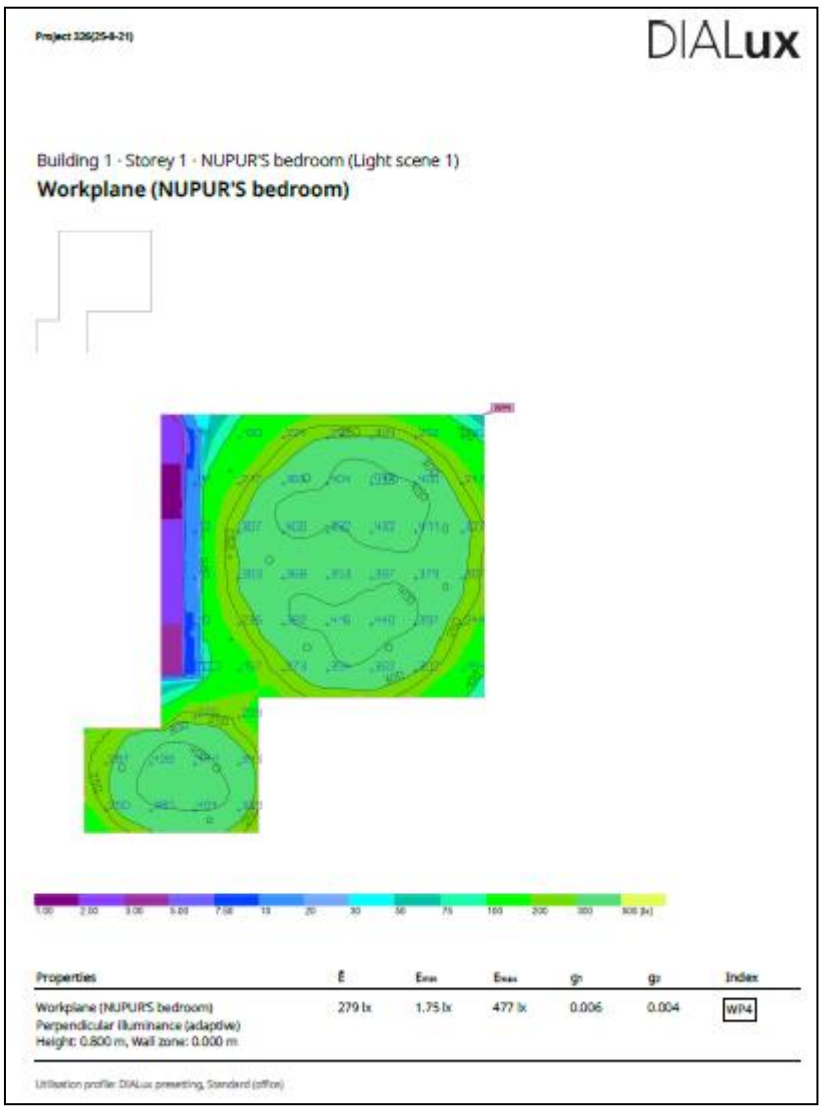
Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · NUPUR'S bedroom

Luminaire layout plan





BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Bedroom-3	Nova(downlight)	14W,4000K	7
2		Comet round (spot light)	8W,4000K	3
3		Unico(wall washer)	8W,4000K	3

CALCULATED OF LPD & ILLUMINATION LEVEL OF BEDROOM-3

- POWER CONSUMPTION:

  Total wattage = 143.9 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (143.9/22.87) = 6.29 Watt/meter.^{2}

- ILLUMINATION CALCULATION : Average Illumination = 279 lux

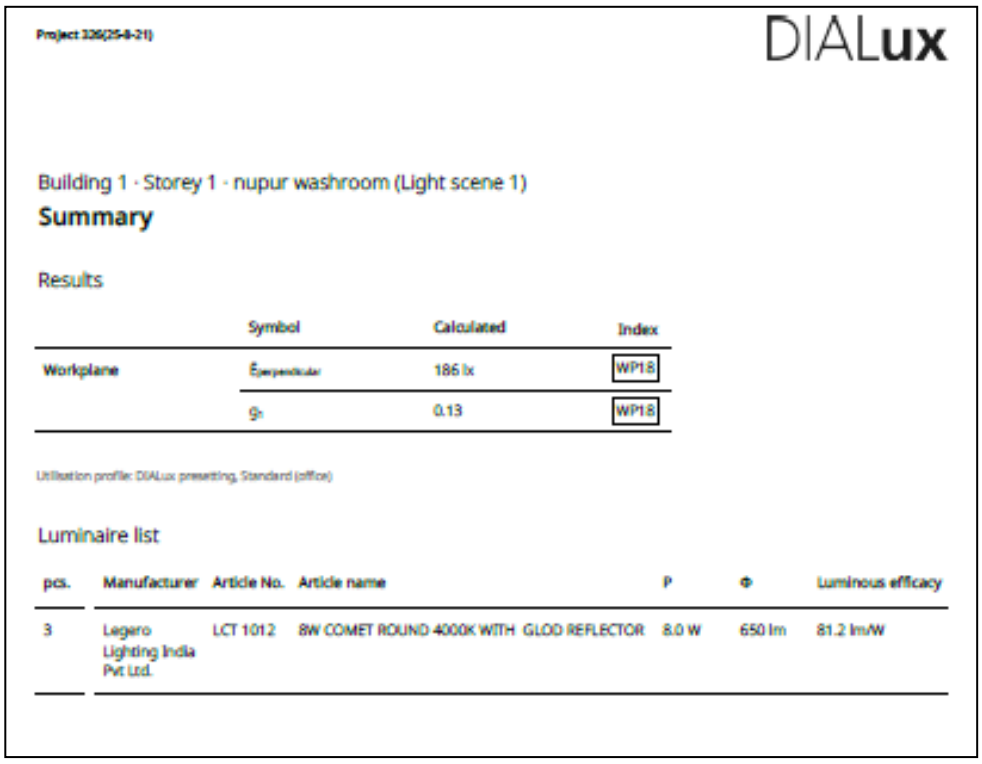
13. ILLUMINATION DESIGN OF ATTACHED TOILET-3

- A primary bathroom is one that is connected to the primary, or largest, bedroom in the house. A primary bathroom is also called an en suite bathroom or an attached bathroom. Typically, the primary bathroom is a full bathroom or a three-quarter bathroom.

- AREA :

Length of the room = 2.3 meter.
Breadth of the room = 2.3 meter.
So, total area of the room = (2.3*2.3) = 5.5 meter.^{2}

Average Illumination under consideration = 150 lux



Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · nupur washroom (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	186 lx	WP18
	g_1	0.13	WP18

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

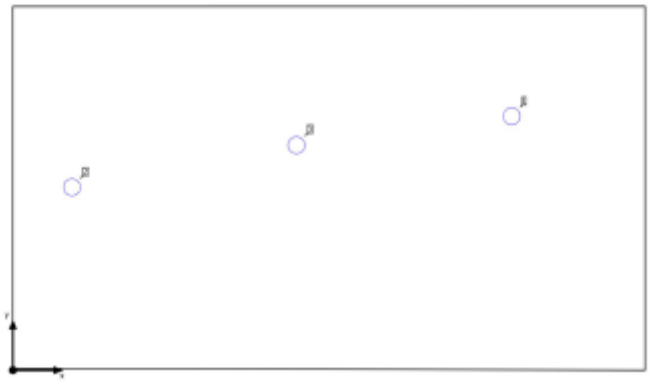
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
3	Legero Lighting India Pvt Ltd.	LCT 1012	8W COMET ROUND 4000K WITH GLOD REFLECTOR	8.0 W	650 lm	81.2 lm/W

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · nupur washroom

Luminaire layout plan

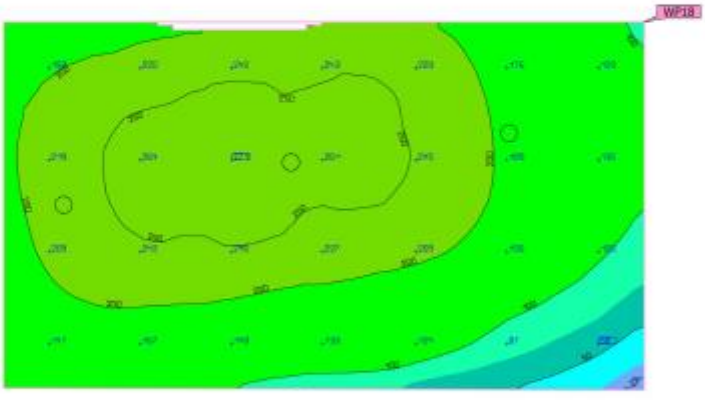


Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · nupur washroom (Light scene 1)

Workplane (nupur washroom)



Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
Workplane (nupur washroom) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	186 lx	23.9 lx	271 lx	0.13	0.088	WP18

Utilisation profile: DIALux presenting, Standard (office)

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Toilet-3	Comet round (spot light)	8W,6500K	3

CALCULATED OF LPD & ILLUMINATION LEVEL OF TOILET-3

- POWER CONSUMPTION:

  Total wattage = 24 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (24/5.55) = 4.33 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 186 lux

14. ILLUMINATION DESIGN OF STORE ROOM

Store room where we can store the excessive material very easily in residential building. This types of store room has been seen here near to dining area. We need good type of lighting required for searching items.

- AREA :

  Length of the room = 1.9 meter.
  Breadth of the room = 1.9 meter.
  So, total area of the room = (1.9*1.9) = 3.8 meter.^{2}

  Average Illumination under consideration = 200 lux

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · powder room (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	208 lx	WP14
	g_1	0.30	WP14

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

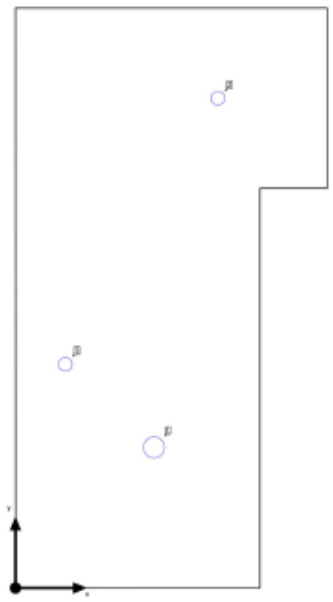
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
1	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W
2	LEGERO LIGHTING INDIA PVT LTD.		8W GIA 4000K	6.1 W	366 lm	60.3 lm/W

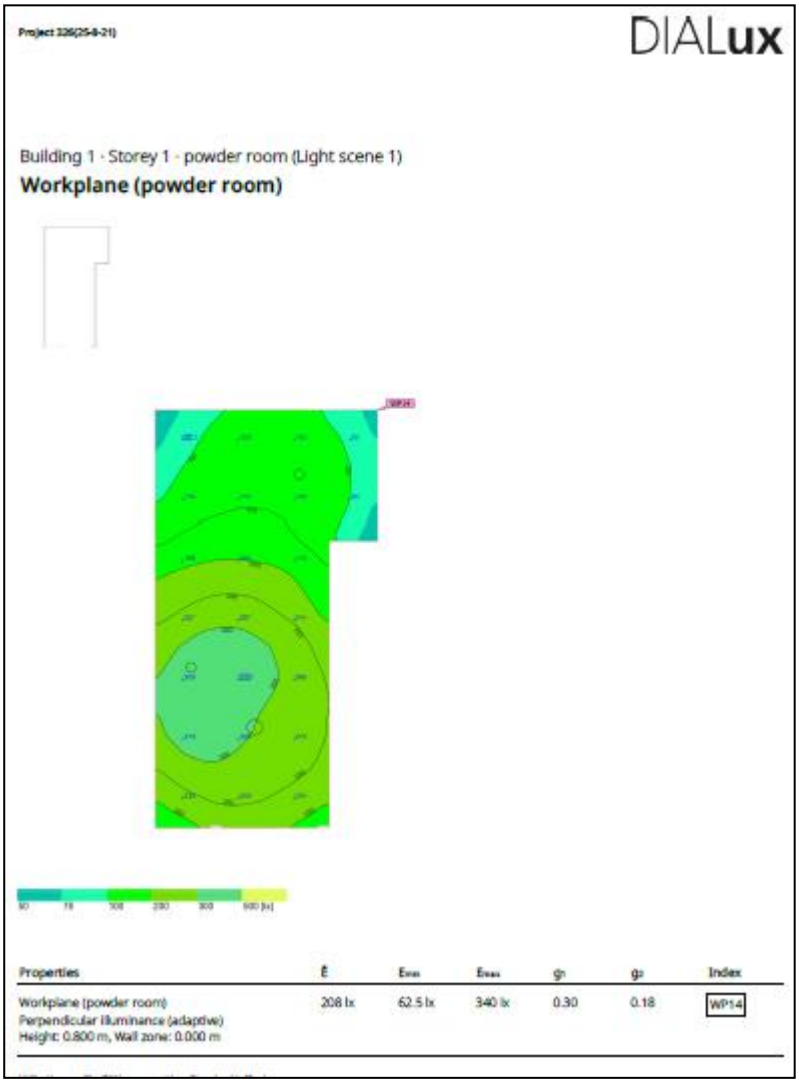
Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · powder room

Luminaire layout plan





BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Store	Nova(downlight)	14W,6500K	1
2		Gia(spot light)	8W, 6500K	2

CALCULATED OF LPD & ILLUMINATION LEVEL OF STORE ROOM

- POWER CONSUMPTION:

  Total wattage = 25.9 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (25.9/3.57) = 7.25 Watt/meter.^{2}

- ILLUMINATION CALCULATION : Average Illumination = 208 lux

15. ILLUMINATION DESIGN OF BEDROOM-4

In the real estate world, a space can be considered a bedroom if it has a door that can be closed, a window, and a closet. The closet requirement is not covered in the IRC and is instead a bedroom feature more related to comfort and liveability than safety.

- AREA CALCULATION:

Length of the room = 6.1 meter.
Breadth of the room = 6.1 meter.
So, total area of the room = (6.1*6.1) = 36.53 meter.^{2}

Average Illumination under consideration = 300 lux

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · vipul's bedroom (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	309 lx	WP1
	g_0	0.26	WP1

Utilisation profile: DIALux presenting, Standard (office)

Luminaire list

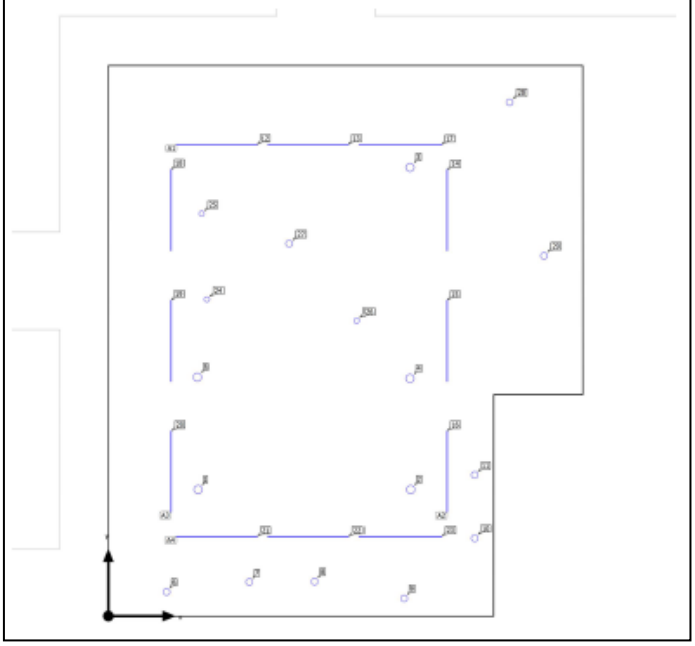
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
12	Duralamp	07U30242 0INUHD	07U302420INUHD	20.0 W	1701 lm	85.1 lm/W
5	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W
3	LEGERO LIGHTING INDIA PVT LTD.		8W GIA 4000K	6.1 W	366 lm	60.3 lm/W
9	Legero Lighting India Pvt Ltd.	LCT 1012	8W COMET ROUND 4000K WITH GLOD REFLECTOR	8.0 W	650 lm	81.2 lm/W

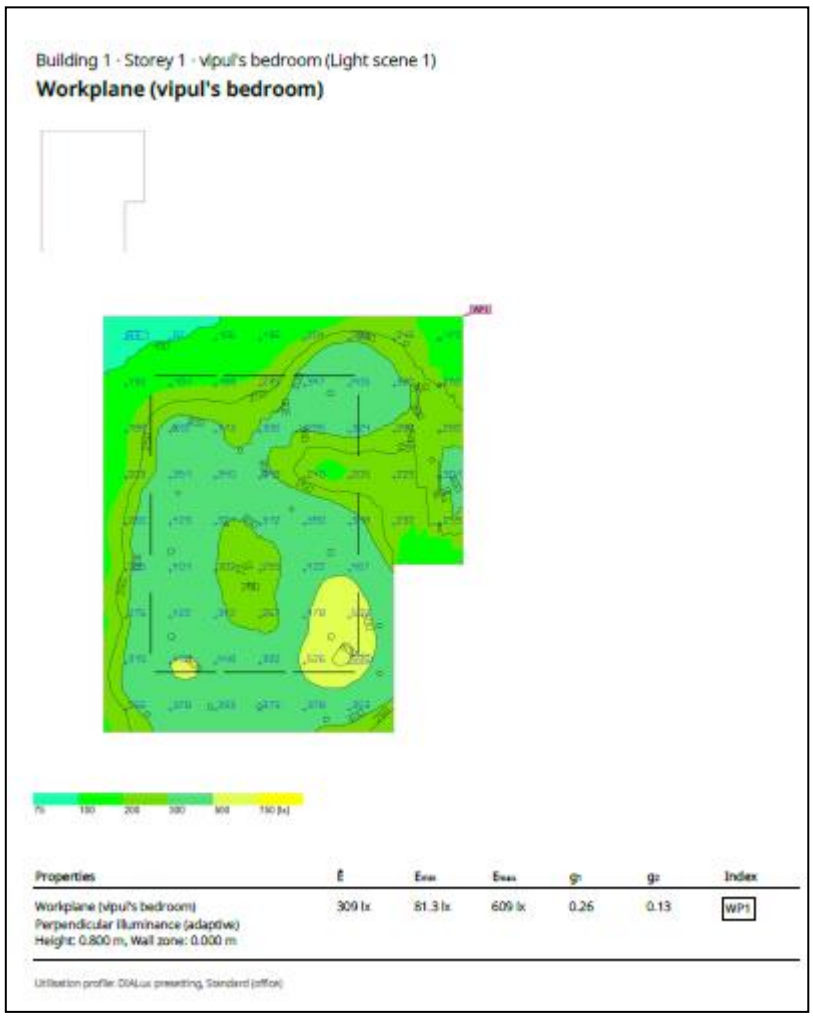
Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · vipul's bedroom

Luminaire layout plan





BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Bedroom-4	LED strip	20W,4000K	12
2		Nova(downlight)	14W,4000K	5
3		Gia(spot light)	8W,4000K	3
4		Comet round(spot light)	8W,4000K	9

CALCULATED OF LPD & ILLUMINATION LEVEL OF BEDROOM-4

- POWER CONSUMPTION:

  Total wattage = 398.8 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (398.8/36.53) = 10.92 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 309 lux

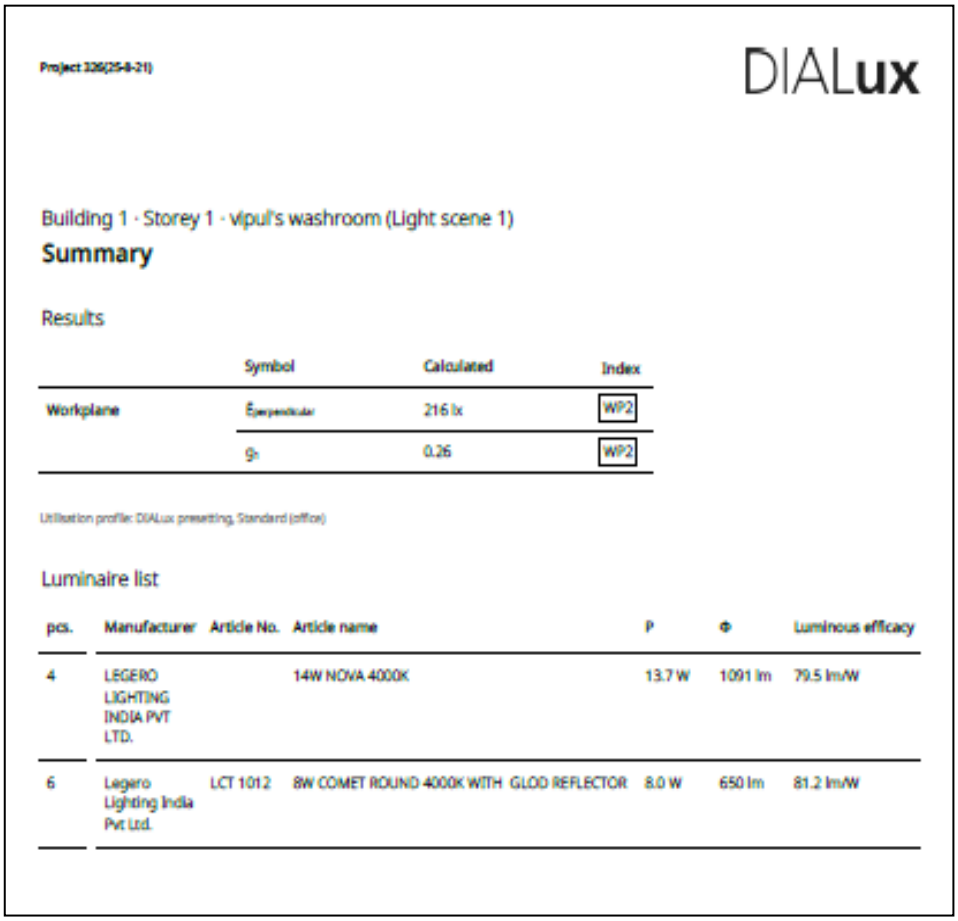
16. ILLUMINATION DESIGN OF ATTACHED TOILET-4

- A primary bathroom is one that is connected to the primary, or largest, bedroom in the house. A primary bathroom is also called an en suite bathroom or an attached bathroom. Typically, the primary bathroom is a full bathroom or a three-quarter bathroom.

- AREA :

  Length of the room = 3.9 meter.
  Breadth of the room = 3.9 meter.
  So, total area of the room = (3.9*3.91) = 14.7 meter.^{2}

Average Illumination under consideration = 150 lux



Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · vipul's washroom (Light scene 1)

Summary

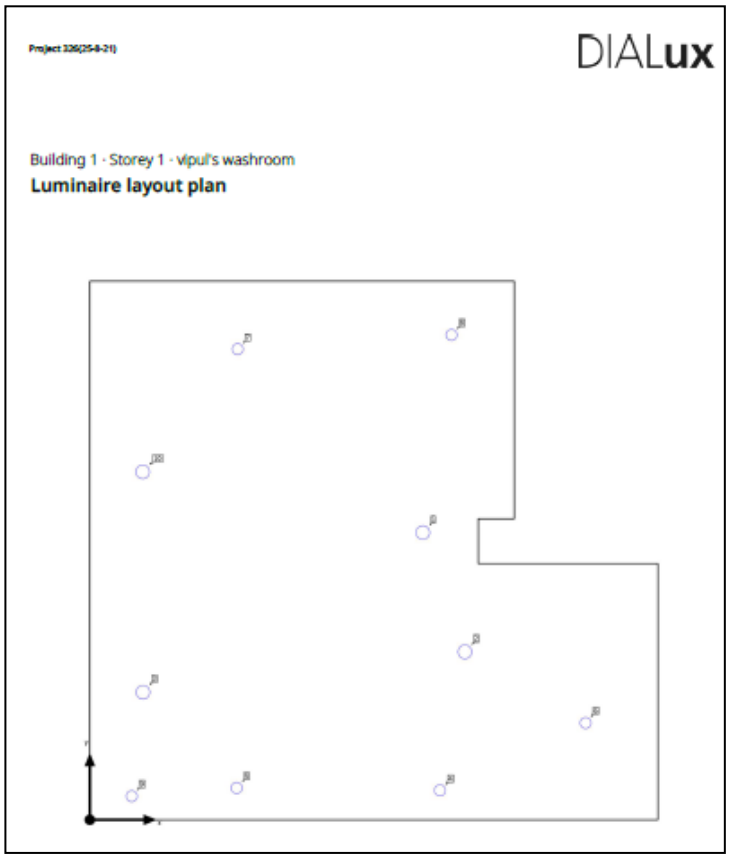
Results

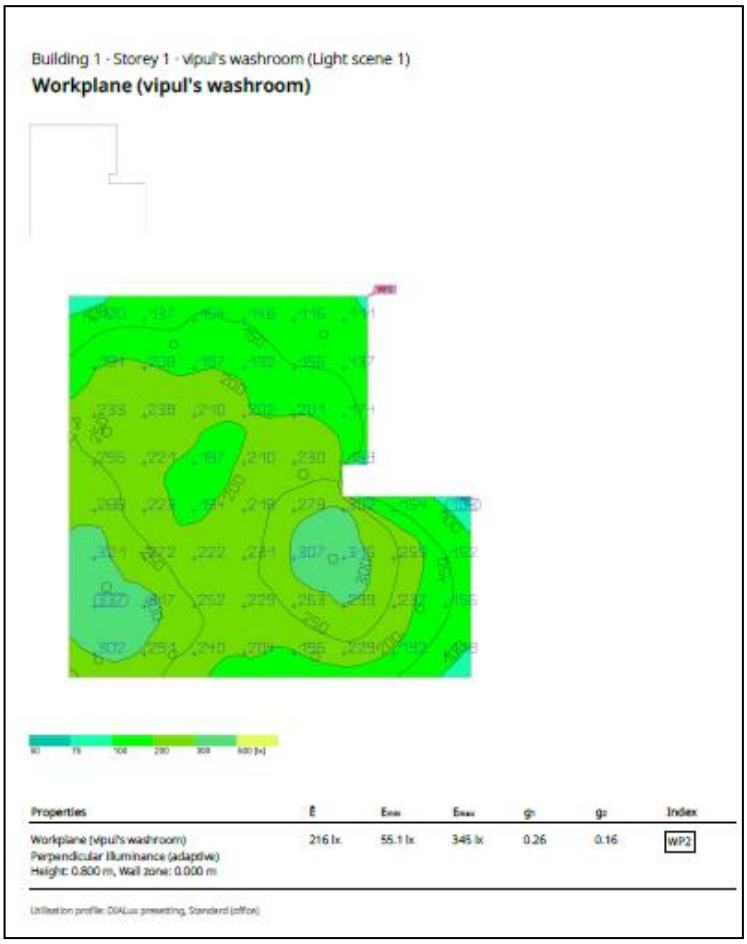
	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	216 lx	WP2
	g_1	0.26	WP2

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
4	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W
6	Legero Lighting India Pvt Ltd.	LCT 1012	8W COMET ROUND 4000K WITH GLOD REFLECTOR	8.0 W	650 lm	81.2 lm/W


Project 326(25-8-21)
DIALux
Building 1 · Storey 1 · vipul's washroom
Luminaire layout plan



BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Toilet-4	Nova(downlight)	14W,6500K	4
2		Comet round(spot light)	8W,6500K	6

CALCULATION OF LPD & ILLUMINATION LEVEL OF TOILET-4

- POWER CONSUMPTION:

  Total wattage = 102.8 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (102.8/14.71) = 6.99 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 216 lux

17. ILLUMINATION DESIGN OF WALKING PASSAGE AREA

- A passage is a long narrow space with walls or fences on both sides, which connects one place or room with another area. Here in the Bungalow building has a long passage area commonly know as corridor.
- AREA

Length of the area = 3.6meter.
Breadth of the area =3.6 meter.
So, total area of the space = (3.6*3.6) = 12.6 meter.^{2}

Average Illumination under consideration = 150 lux

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · working passage area (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	181 lx	WP8
	g_1	0.020	WP8

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

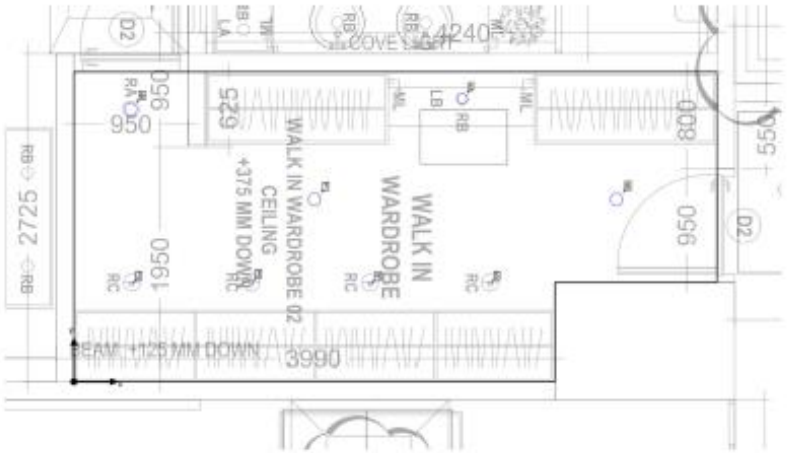
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
3	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W
1	Legero Lighting India Pvt Ltd.	LCT 1012	8W COMET ROUND 4000K WITH GLOD REFLECTOR	8.0 W	650 lm	81.2 lm/W
4	XAL	SWW	UNICO wallwasher 930 A	4.0 W	296 lm	74.0 lm/W

Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · working passage area

Luminaire layout plan

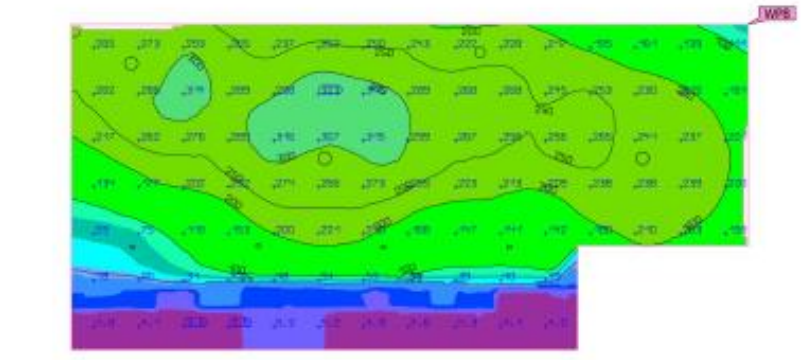


Project 326(25-8-21)

DIALux

Building 1 · Storey 1 · working passage area (Light scene 1)

Workplane (working passage area)



Properties	Ē	Emin	Emax	g1	g2	Index
Workplane (working passage area) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	181 lx	3.61 lx	327 lx	0.020	0.011	WP8

Utilisation profile: DIALux presetting, Standard (office)

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Walking passage area	Nova(downlight)	14W,6500K	3
2		Comet round(spot light)	8W,6500K	1
3		Vela (wall washer)	7W,6500K	4

CALCULATED OF LPD & ILLUMINATION LEVEL OF WALKING PASSAGE AREA

- POWER CONSUMPTION:

  Total wattage = 65.1 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (65.1/12.63) = 5.15 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 181 lux

5.2 LANDSCAPE AREA

Landscape lighting or garden lighting refers to the use of outdoor illumination of private gardens and public landscapes; for the enhancement and purposes of safety, night times aesthetics, accessibility, recreation , sports , social and misc.event uses. Landscape luminaires is more than just illuminating outdoors. it is about putting the heart out in your surroundings to suit it. At Wipro Lighting, we provide a wide range of creative options curate for landscape lighting needs. We believe in enabling better environment, by providing luminaires that are aesthetic and leave no room for error.

The landscape lighting design has been made as follows:

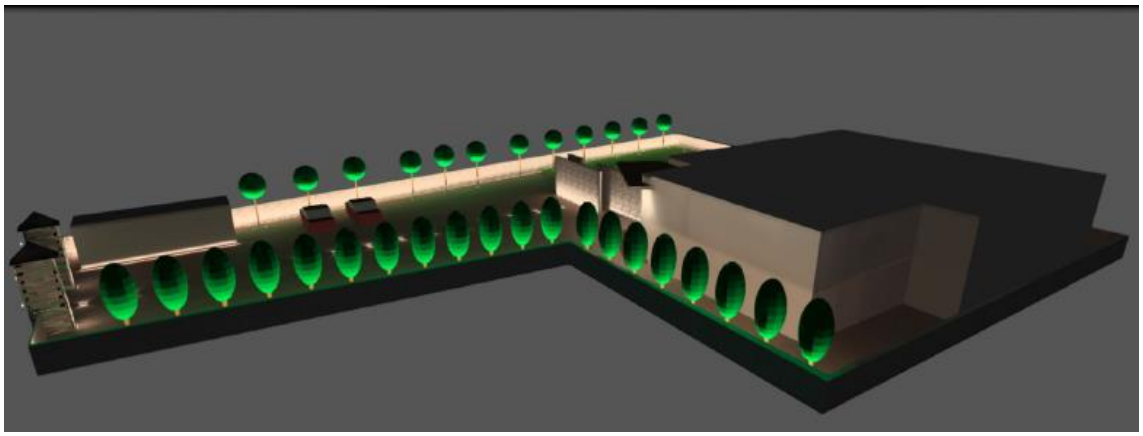


Fig :5.1 Calculation Surface -1

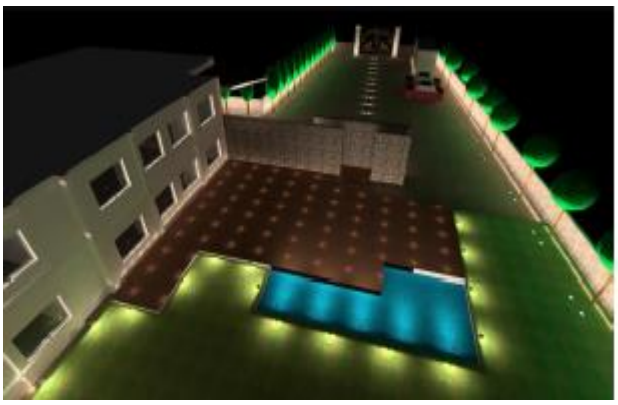


Fig:5. 2 3D top view of the bungalow

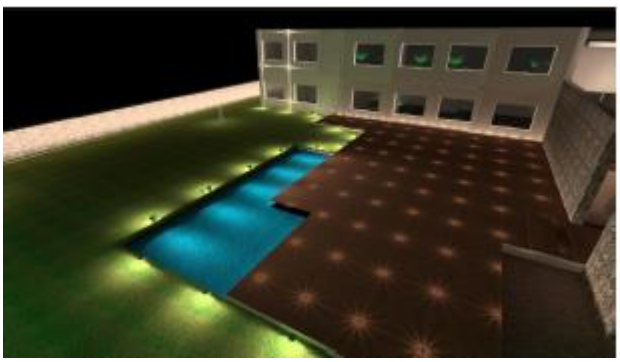


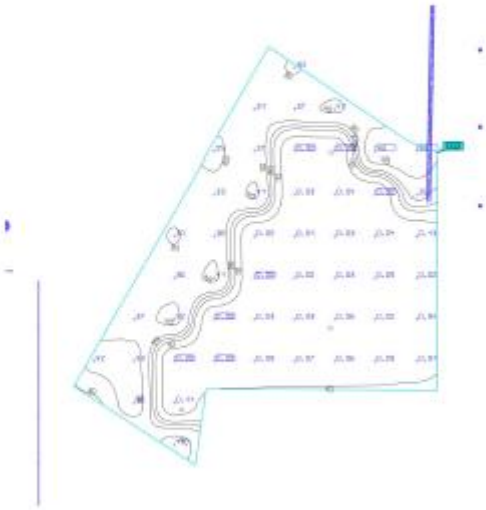
Fig:5. 3 3D side view of the

CALCULATED OF ILLUMINATION LEVEL OF CALCULATION SURFACE -2

- Average Illumination = 16.2 lux

(Light scene 1)

Calculation surface 2

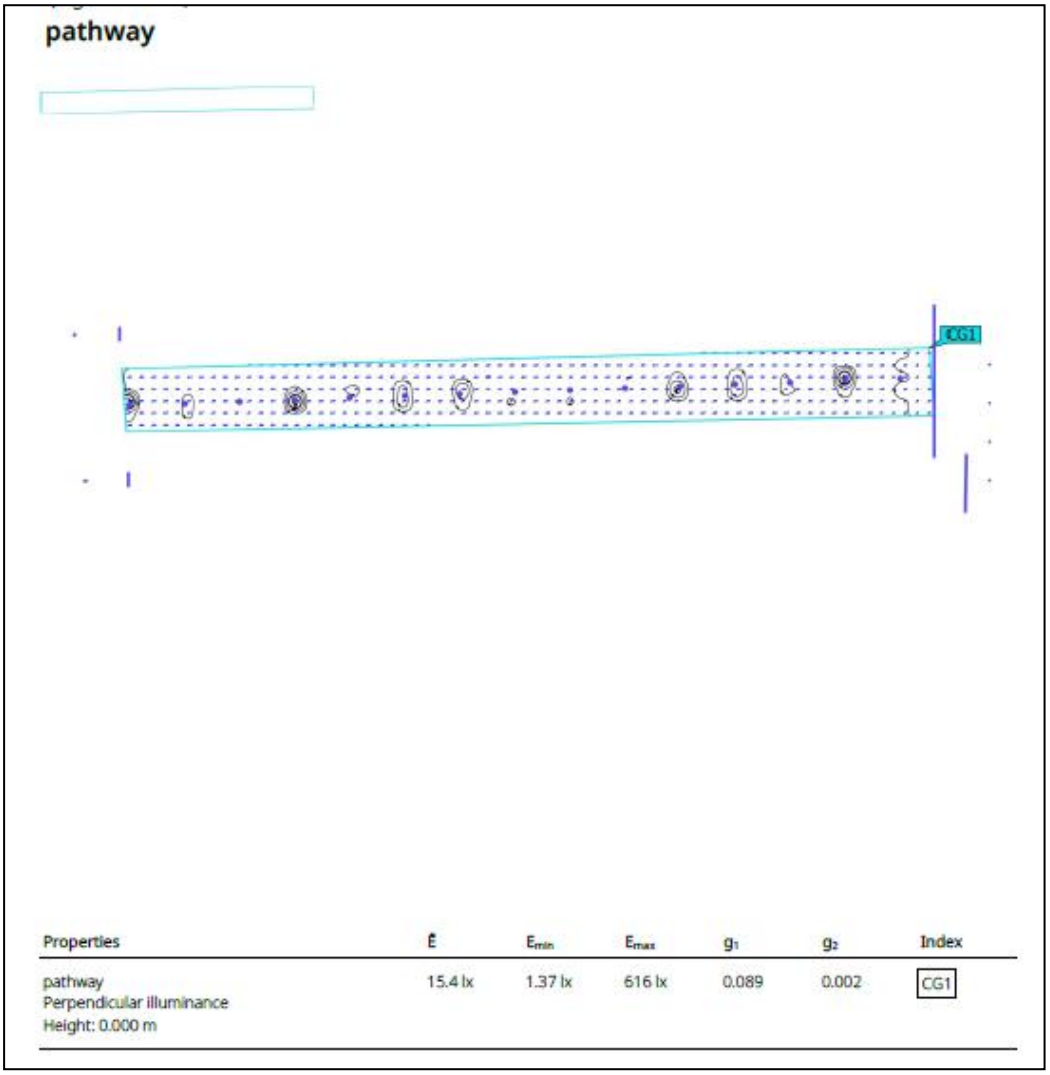


Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
Calculation surface 2 Perpendicular Illuminance Height: 0.000 m	16.2 lx	0.00 lx	47.8 lx	0.00	0.00	CG2

Utilization profile: DIALux prewetting, Standard (outdoor transportation area)

CALCULATED OF ILLUMINATION LEVEL OF CALCULATION PATHWAY

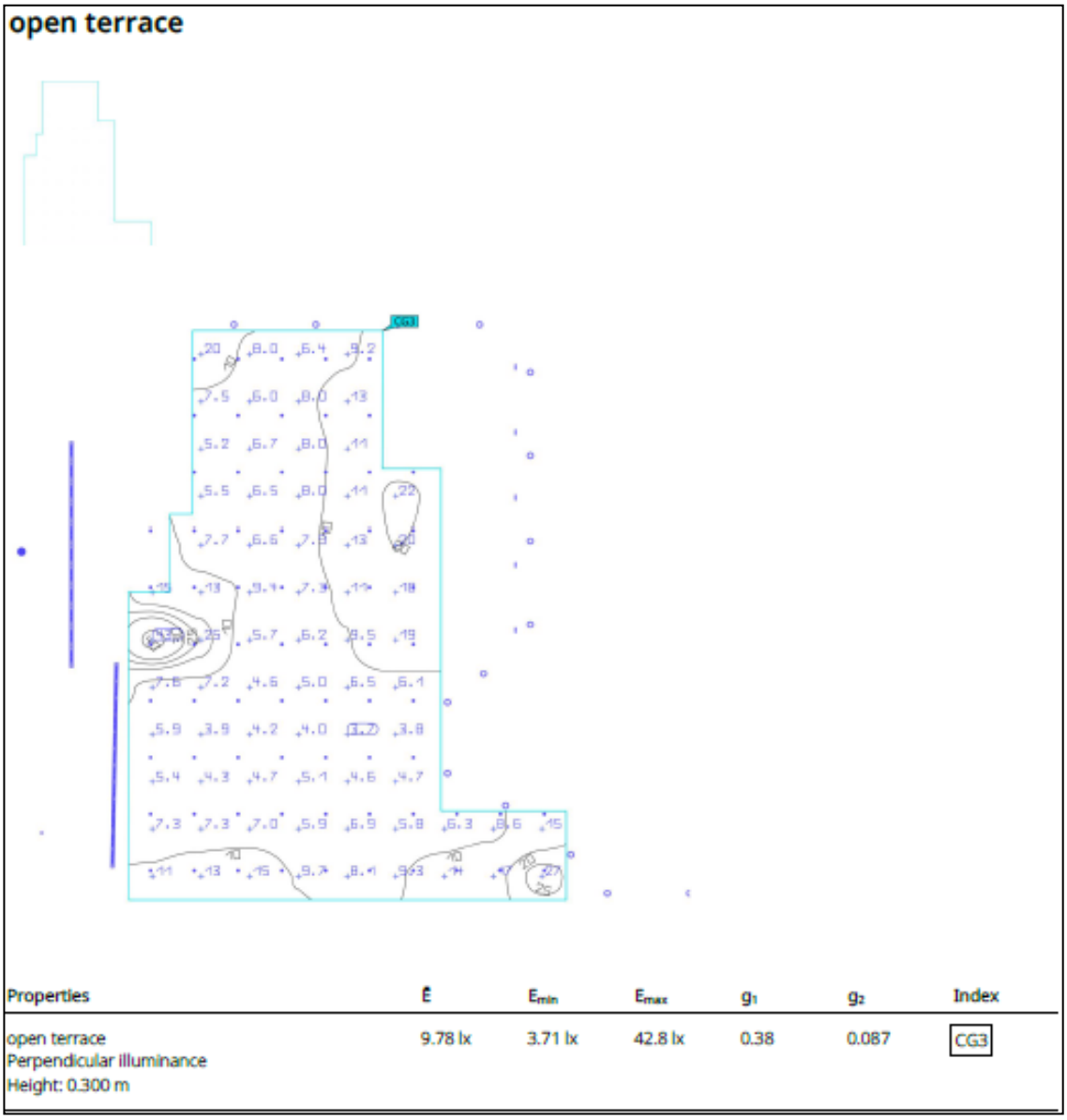
- Average Illumination = 15.4 lux



Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
pathway Perpendicular illuminance Height: 0.000 m	15.4 lx	1.37 lx	616 lx	0.089	0.002	CG1

CALCULATED OF ILLUMINATION LEVEL OF OPEN TERRACE AREA

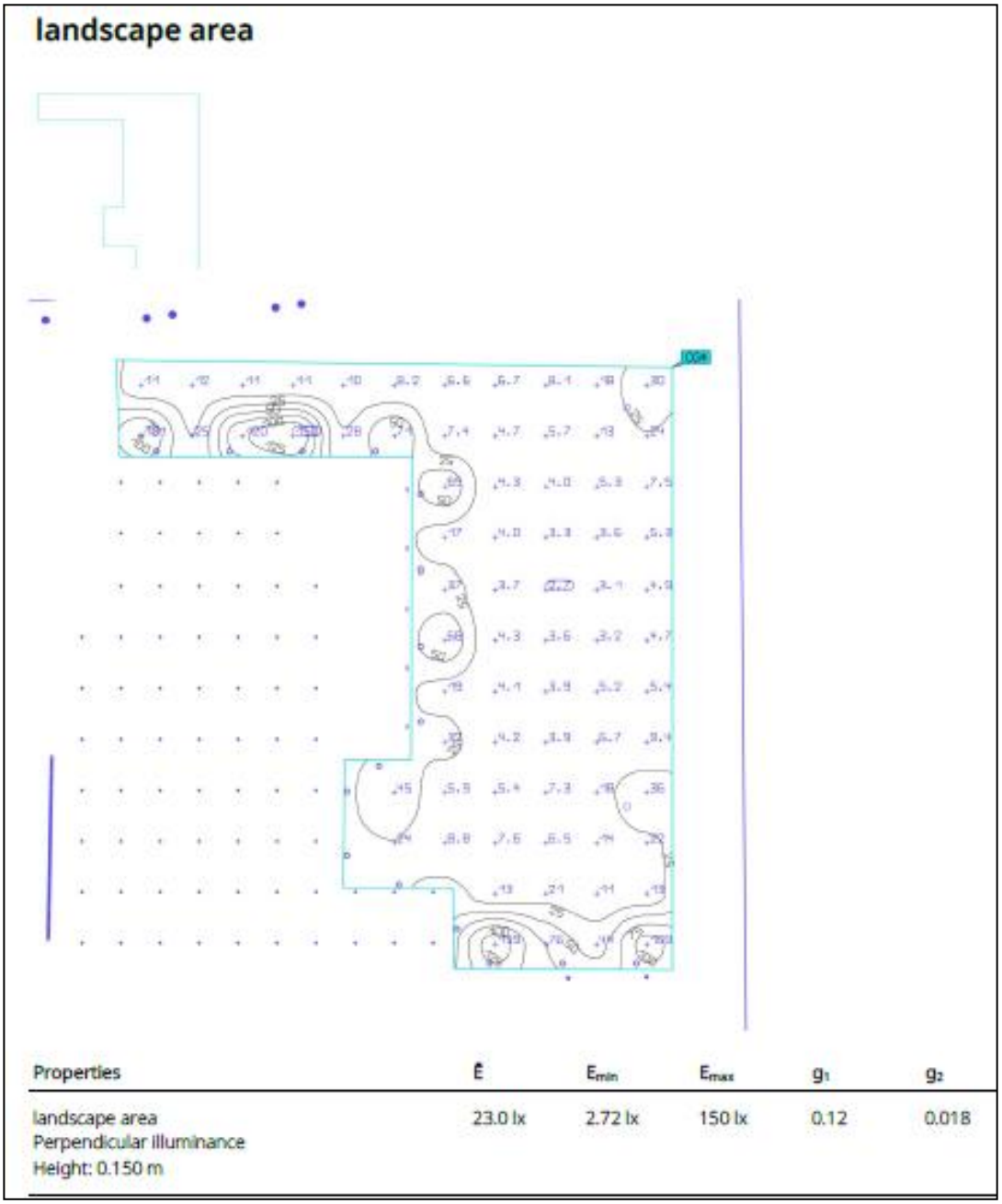
- Average Illumination = 9.78 lux



Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
open terrace Perpendicular illuminance Height: 0.300 m	9.78 lx	3.71 lx	42.8 lx	0.38	0.087	CG3

CALCULATED OF ILLUMINATION LEVEL OF OPEN TERRACE AREA

- Average Illumination = 23 lux



Properties	Ē	E_{min}	E_{max}	g_1	g_2
landscape area Perpendicular illuminance Height: 0.150 m	23.0 lx	2.72 lx	150 lx	0.12	0.018

BILL OF MATERIALS
For Bungalow outdoor area:

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1.	Outdoor area	Torch(downlight)	12W,6500K	2
		Edge(post top)	3W,6500K	4
		Strahler(step light)	20W,6500K	5
		Durastrip(LED strip)	5W,6500K	9
		Lynx (LED strip)	6W/meters	146 meters
		Mashroom(bollard)	6W,6500K	15
		Mini (under water light)	18W,6500K	16
		Micro sparks(foot light)	4W,6500K	71
		Trick (wall grazer)	8W,6500K	12
		Flush frame(uplight)	22W,6500K	48
		Linea (linear light)	22W,6500K	25
		Ring mini(post light)	13W,6500K	3
		Oreon surface (wall light)	20W,6500K	4
Total power consumption			**5365.2 W**	

CHAPTER - 6:

CASE STUDY OF LIGHTING DESIGN OF MULTI STORIED BUILDING

CHAPTER 6: CASE STUDY OF LIGHTING DESIGN OF MULTI STORIED BUILDING

6.1 Classifications of multi stories steel buildings:

Depending on the height, need and various other factors, multi storey buildings are classified into following.

1. *Low Rise building*: A low rise multi storey building has few storeys (typically less than four), with the usage of elevators and stairs for vertical circulation.

2. *Mid Rise building*: A Mid Rise building has number of storeys ranging from 4 to 12.

3. *High Rise building*: A High Rise building has number of storeys ranging from 12 to 40, with usage of lifts and stairs.

4. *Skyscraper building*: A tall and habitable steel building having storeys more than 40 but height less than 300m is considered as Sky Scrapper Multi storey building.

5. *Super tall building*: Super tall building is the steel building with its height exceeding 300m are Super tall Multi storey building.

6. *Mega tall building*: Super tall building is the steel building with its height exceeding 600m are Super tall Multi storey building.

6.2 Illumination Design

In this case we have considered a building of six storied (G+6) with mediocre class of people.

In the multi-story building most of the very common peoples are lived. So they want most economic lighting to illuminate their room and others place. In this design we have to consider the most economical design –

6.3 INDOOR LIGHTING DESIGN OF MULTI STORIED BUILDING

1. ILLUMINATION DESIGN OF BEDROOM-1

- In the real estate world, a space can be considered a bedroom if it has a door that can be closed, a window, and a closet. The closet requirement is not covered in the IRC and is instead a bedroom feature more related to comfort and liveability than safety.

- AREA :

Length of the room = 4.1 meter.
Breadth of the room =4.1 meter.
So, total area of the room = (4.1*4.1) = 16.2 meter.^{2}

Average Illumination under consideration = 300 lux

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · DAUGHTER ROOM (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$E_{perpendicular}$	285 lx	WP1
	g_1	0.12	WP1

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

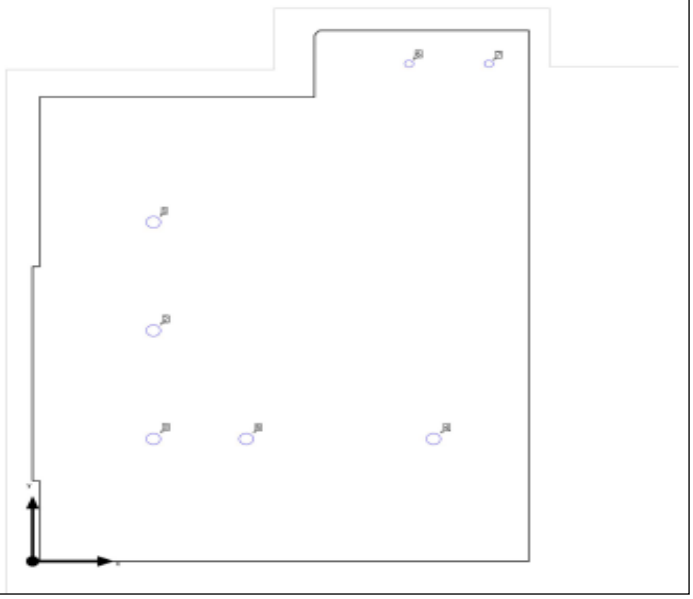
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
2	LEGERO LIGHTING INDIA PVT LTD		5W Cribo(4000K)	4.9 W	398 lm	81.3 lm/W
5	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · DAUGHTER ROOM

Luminaire layout plan



SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · DAUGHTER ROOM (Light scene 1)

Calculation objects

Work planes

Properties	Ē	E_{min}	E_{max}	g_1	g_2
Workplane (DAUGHTER ROOM) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	285 lx	33.5 lx	809 lx	0.12	0.041

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Bedroom-1	Nova(downlight)	14W,4000K	5
2		Cribo(spot light)	5W,4000K	2

CALCULATED OF LPD & ILLUMINATION LEVEL OF BEDROOM-1

- POWER CONSUMPTION:

  Total wattage = 78.3 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (78.3/16.25) = 4.82 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 285 lux

2. ILLUMINATION DESIGN OF ATTACHED TOILET-1

- A primary bathroom is one that is connected to the primary, or largest, bedroom in the house. A primary bathroom is also called an en suite bathroom or an attached bathroom. Typically, the primary bathroom is a full bathroom or a three-quarter bathroom.

- AREA :

  Length of the room = 2.7 meter.
  Breadth of the room = 2.7 meter.
  So, total area of the room = (2.7*2.7) = 7.4 meter.^{2}

  Average Illumination under consideration = 150 lux

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · TOILET-3 (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	166 lx	WP1.2
	g_1	0.31	WP1.2

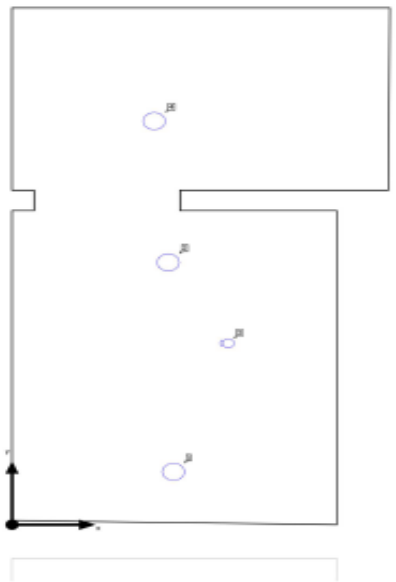
Utilisation profile: DIALux presetting, Standard (office)

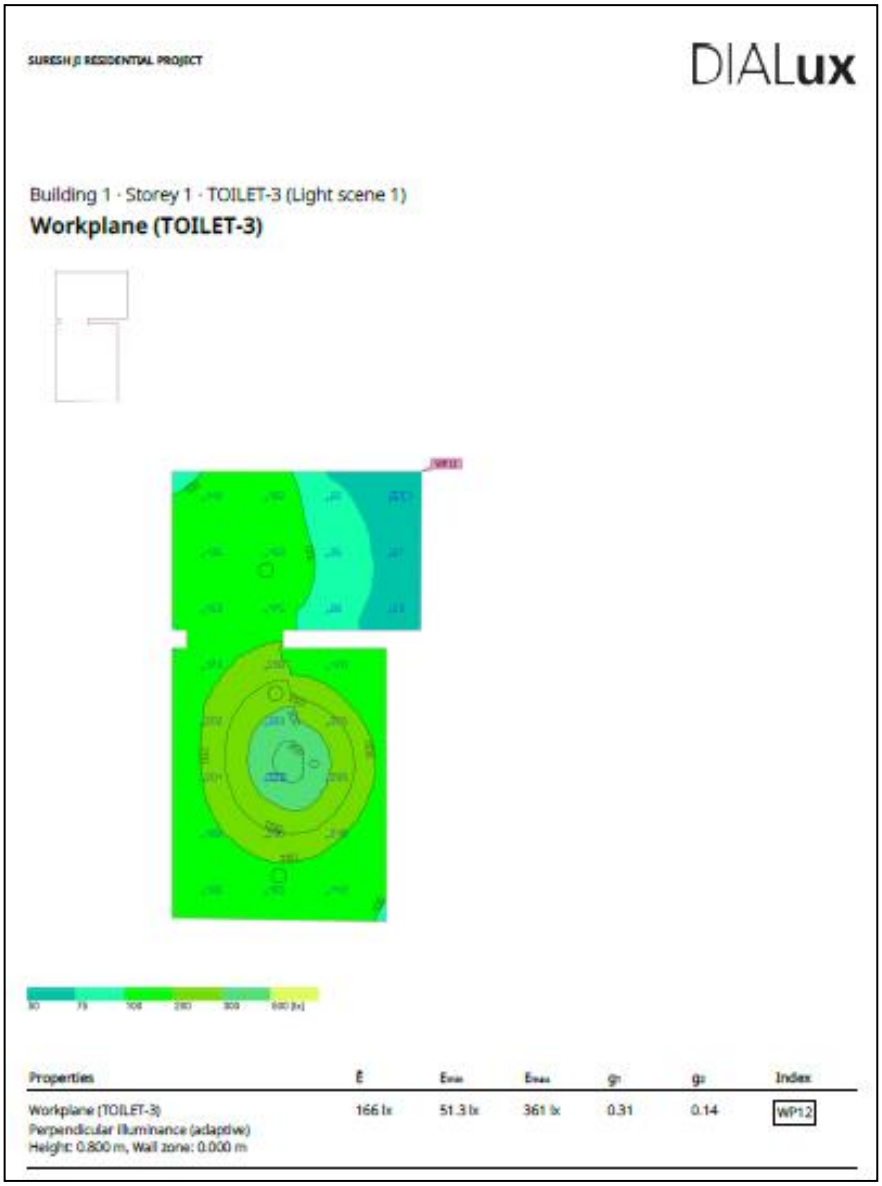
Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
3	LEGERO LIGHTING INDIA PVT LTD.		12W PEARL ROUND(4000K) LRS1212 RECESSED	11.3 W	935 lm	82.7 lm/W
1	LEGERO LIGHTING INDIA PVT LTD.		8W GIA 4000K	6.1 W	366 lm	60.3 lm/W

Building 1 · Storey 1 · TOILET-3

Luminaire layout plan





BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Toilet-1	Pearl round (downlight)	12W,6500K	3
2		Gia(spot light)	8W,6500K	1

CALCULATED OF LPD & ILLUMINATION LEVEL OF TOILET-1

- POWER CONSUMPTION :Total wattage = 40 Watt.
- LPD (LIGHT POWER DENSITY):
- Total wattage/Total area =(40/7.43)=5.38 Watt/meter.^{2}
- ILLUMINATION CALCULATION : Average Illumination = 166 lux

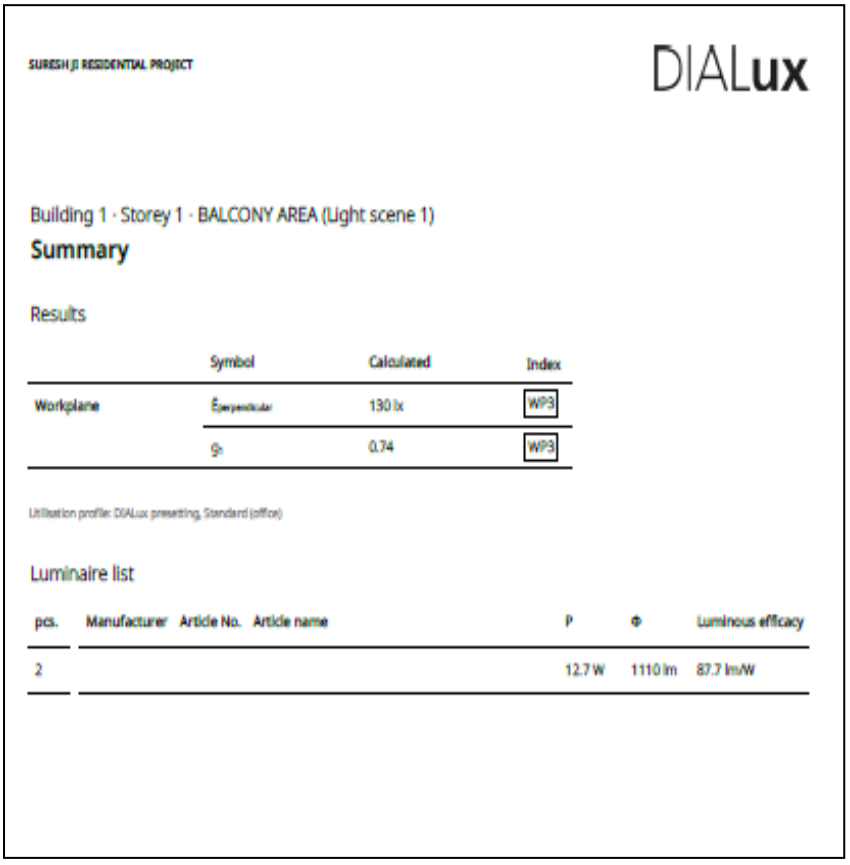
3. ILLUMINATION DESIGN OF COVERED BALCONY AREA

A balcony is a platform on the outside of a building, enclosed by walls or balustrades, and supported by columns or console brackets. The platform projects from the wall of a building, usually above the ground floor. Balconies are typically small and are not used as social spaces or for entertainment purposes.

- AREA :

  Length of the room = 1.8 meter.
  Breadth of the room = 1.8 meter.
  So, total area of the room = (1.8*1.8) = 3.4 meter.^{2}

  Average Illumination level under consideration = 150 lux



SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · BALCONY AREA (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	130 lx	WP3
	g_1	0.74	WP3

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
2				12.7 W	1110 lm	87.7 lm/W

Building 1 · Storey 1 · BALCONY AREA

Luminaire layout plan

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · BALCONY AREA (Light scene 1)

Calculation objects

Work planes

Properties	Ē	E_{min}	E_{max}	g_1	g_2
Workplane (BALCONY AREA) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	130 lx	96.2 lx	143 lx	0.74	0.67

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Balcony	D-lite(decorative light)	12W,6500K	2

CALCULATED OF LPD & ILLUMINATION LEVEL OF BALCONY AREA

- POWER CONSUMPTION:

  Total wattage = 25.4 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (25.4/3.43) = 7.40 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 130 lux

4. ILLUMINATION DESIGN OF DINNING AREA

- A dinning room is a room in a house, apartment, school etc that is reserved primarily for eating meals (breakfast, lunch or dinner) although other activities may also take place there outside of meal time.

- AREA :

  Length of the room = 3.9 meter.
  Breadth of the room = 3.9 meter.
  So, total area of the room = (3.9*3.9) = 15.2 meter.^{2}

Average Illumination under consideration = 250 lux

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · DINING AREA (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	316 lx	WP10
	g_1	0.36	WP10

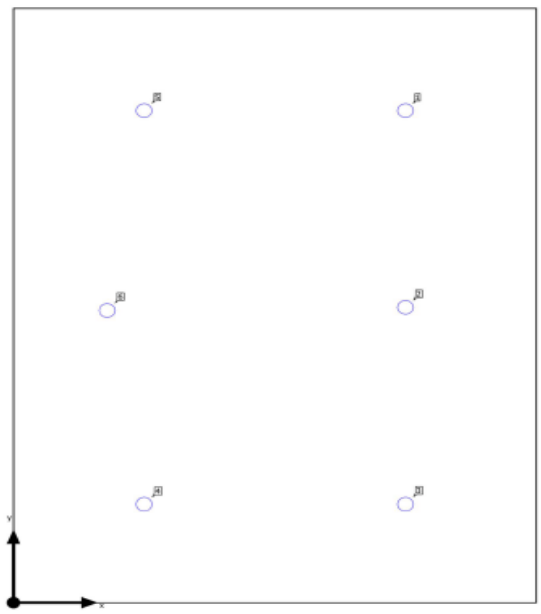
Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
6	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W

Building 1 · Storey 1 · DINING AREA

Luminaire layout plan



SURESH JI RESIDENTIAL PROJECT

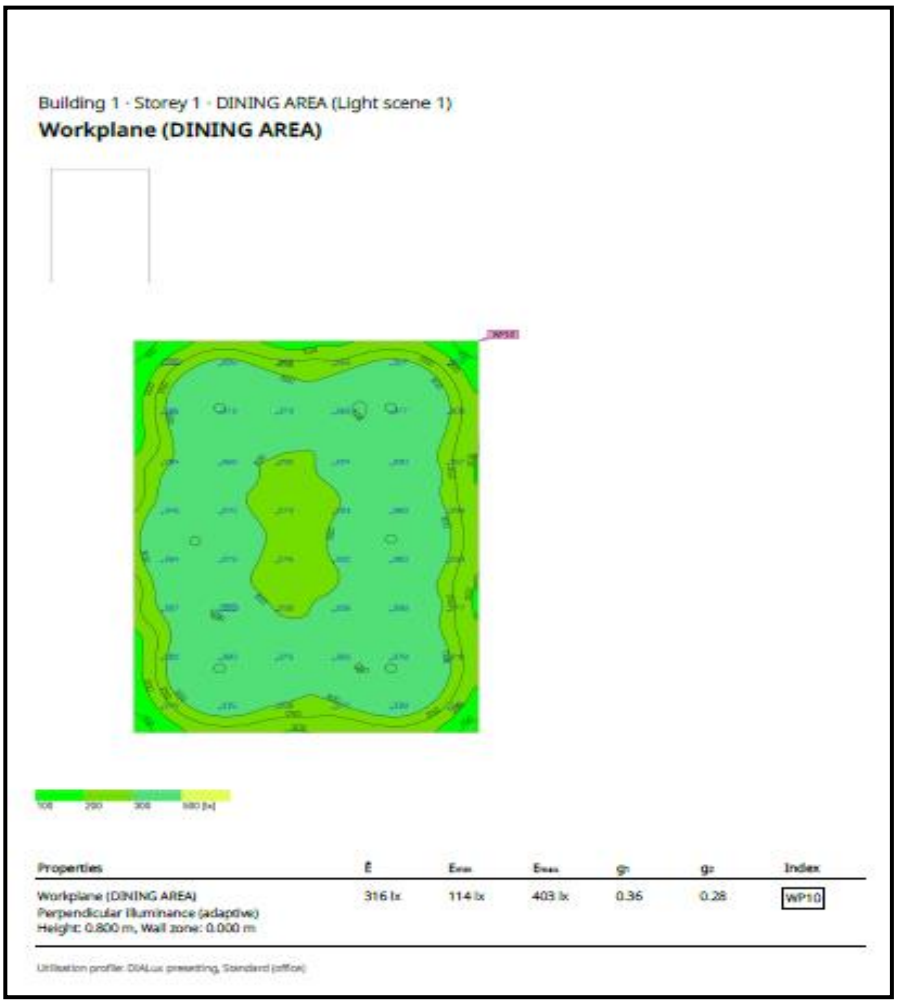
DIALux

Building 1 · Storey 1 · DINING AREA (Light scene 1)

Calculation objects

Work planes

Properties	Ē	E_{min}	E_{max}	g_1	g_2
Workplane (DINING AREA) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	316 lx	114 lx	403 lx	0.36	0.28



BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1.	Dining area	Nova(downlight)	14W,4000K	6

CALCULATED OF LPD & ILLUMINATION LEVEL OF DINING AREA

- POWER CONSUMPTION:Total wattage = 82.2 Watt.
- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (82.2/15.22) = 5.40 Watt/meter.^{2}
- ILLUMINATION CALCULATION : Average Illumination = 316 lux

5. ILLUMINATION DESIGN OF DRAWING AREA

In general terms, a den room is a small room in a house that can be used for private activities. It is different from other rooms in the house in terms of size, layout, and even functionality. Usually, it is windowless and in some cases door less. A den room is a versatile space.

- AREA :

Length of the room = 4.8 meter.
Breadth of the room = 4.8 meter.
So, total area of the room = (4.8*4.8) = 23.3 meter.^{2}

Average Illumination under consideration = 250 lux

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · DRAWING AREA (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	328 lx	WP8
	g_1	0.35	WP8

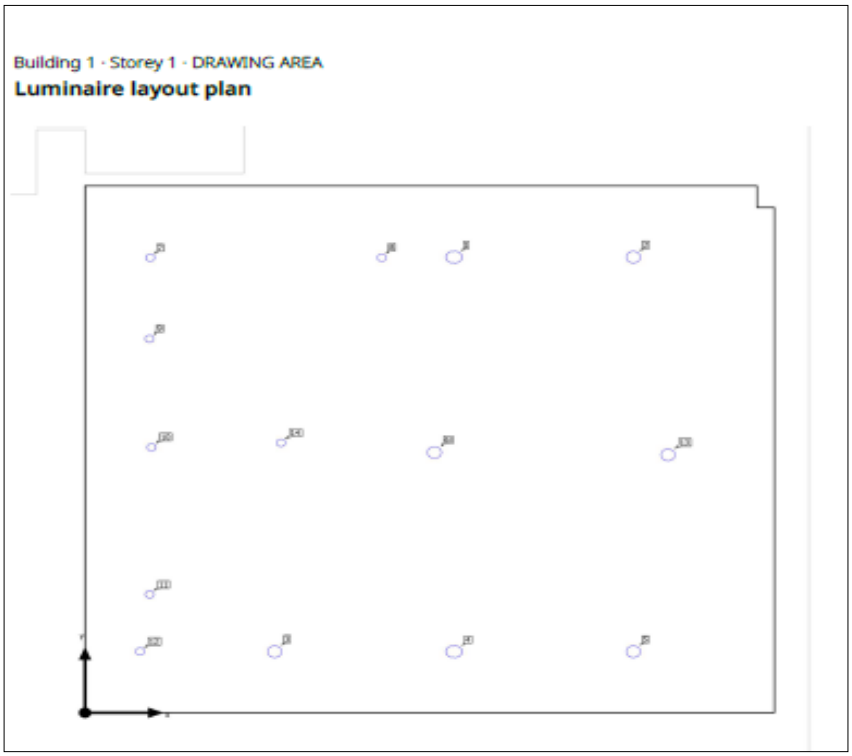
Utilisation profile: DIALux prewetting, Standard (office)

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
7	LEGERO LIGHTING INDIA PVT LTD		5W Cribo(4000K)	4.9 W	398 lm	81.3 lm/W
7	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W

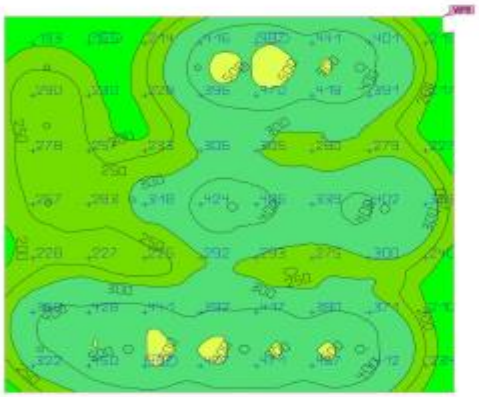
Building 1 · Storey 1 · DRAWING AREA

Luminaire layout plan



Building 1 · Storey 1 · DRAWING AREA (Light scene 1)

Workplane (DRAWING AREA)



Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
Workplane (DRAWING AREA) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	328 lx	114 lx	526 lx	0.35	0.22	WP6

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Drawing area	Nova(downlight)	14W,6500K	7
2		Cribo(spot light)	5W,6500K	7

CALCULATED OF LPD & ILLUMINATION LEVEL OF DRAWING AREA

- POWER CONSUMPTION:

  Total wattage = 130.2 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (130.2/23.34) = 5.58 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 328 lux

6. ILLUMINATION DESIGN OF BEDROOM-2

- In the real estate world, a space can be considered a bedroom if it has a door that can be closed, a window, and a closet. The closet requirement is not covered in the IRC and is instead a bedroom feature more related to comfort and liveability than safety.

- AREA :

  Length of the room = 3.4 meter.
  Breadth of the room =3.4 meter.
  So, total area of the room = (3.4*3.4) = 11.3 meter.^{2}

  Average Illumination under consideration = 300 lux

Building 1 · Storey 1 · GUEST ROOM (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	309 lx	WP6
	g_1	0.19	WP6

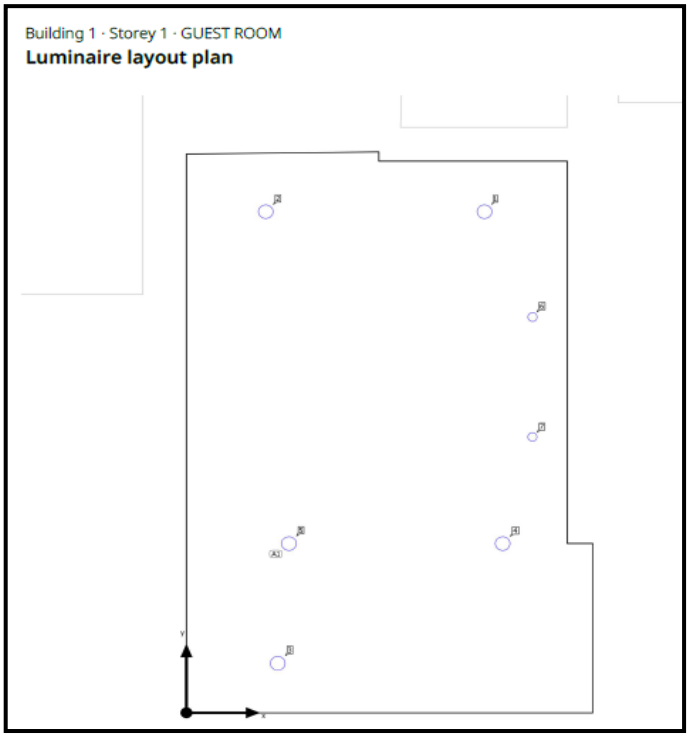
Utilisation profile: DIALux presetting, Standard (office)

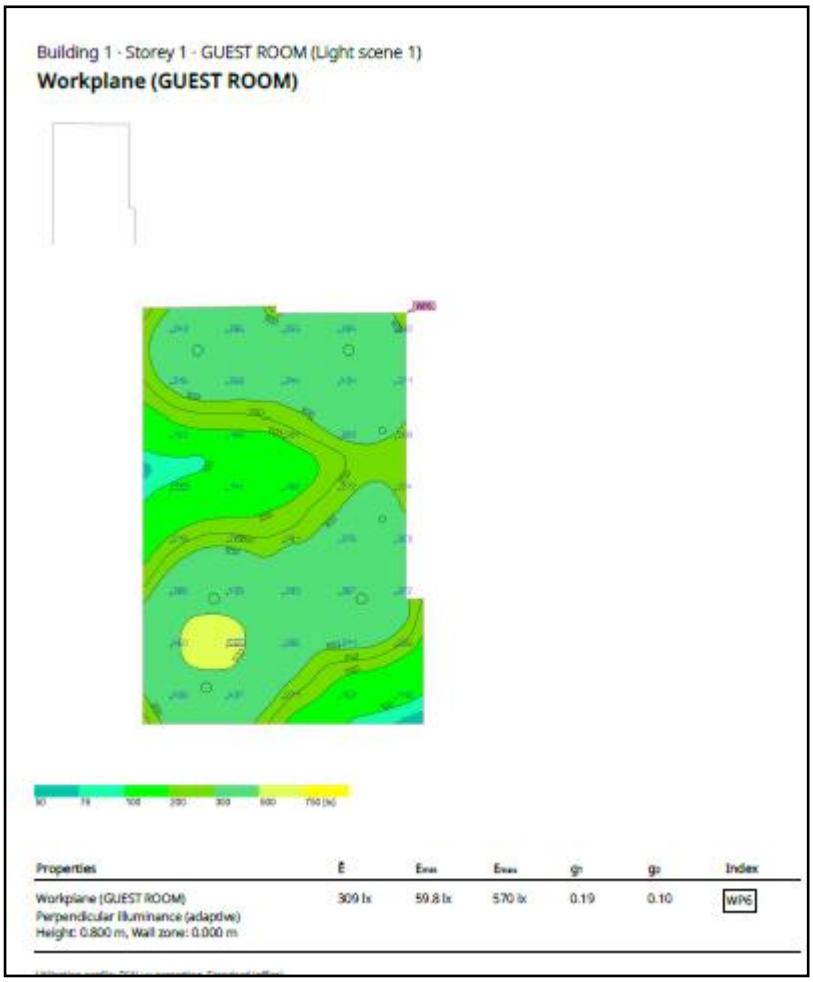
Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
2	LEGERO LIGHTING INDIA PVT LTD		5W Cribo(4000K)	4.9 W	398 lm	81.3 lm/W
5	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W

Building 1 · Storey 1 · GUEST ROOM

Luminaire layout plan





BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Bedroom-2	Nova(downlight)	14W,4000K	5
2		Cribo(spot light)	5W,4000K	2

.

CALCULATED OF LPD & ILLUMINATION LEVEL OF BEDROOM-2

- POWER CONSUMPTION:

  Total wattage = 78.3 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (78.3/11.35) = 6.90 Watt/meter.^{2}

- ILLUMINATION CALCULATION : Average Illumination = 309 lux

7. ILLUMINATION DESIGN OF ATTACHED TOILET-2

- A primary bathroom is one that is connected to the primary, or largest, bedroom in the house. A primary bathroom is also called an en suite bathroom or an attached bathroom. Typically, the primary bathroom is a full bathroom or a three-quarter bathroom.
- AREA :

Length of the room = 2.2 meter.
Breadth of the room = 2.2 meter.
So, total area of the room = (2.2*2.2) = 4.4 meter.^{2}

Average Illumination under consideration = 150 lux

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · TOILET AREA-1 (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	175 lx	WP7
	g_1	0.41	WP7

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

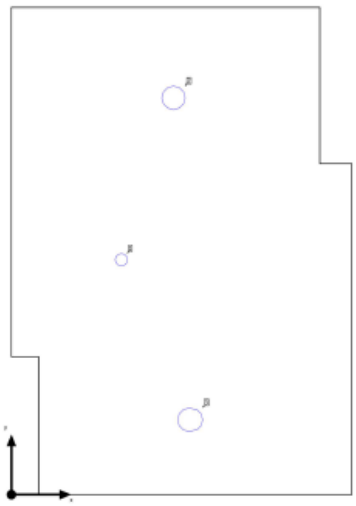
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
2	LEGERO LIGHTING INDIA PVT LTD.		12W PEARL ROUND(4000K) LRS1212 RECESSED	11.3 W	935 lm	82.7 lm/W
1	LEGERO LIGHTING INDIA PVT LTD.		8W GIA 4000K	6.1 W	366 lm	60.3 lm/W

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · TOILET AREA-1

Luminaire layout plan

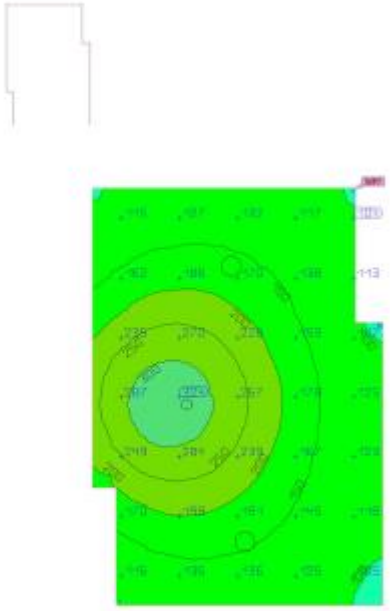


SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · TOILET AREA-1 (Light scene 1)

Workplane (TOILET AREA-1)



Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
Workplane (TOILET AREA-1) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	175 lx	72.5 lx	326 lx	0.41	0.22	WP7

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Toilet-2	Pearl round (downlight)	12W,6500K	2
2		Gia(spot light)	8W,6500K	1

CALCULATED OF LPD & ILLUMINATION LEVEL OF TOILET-2

- POWER CONSUMPTION:

  Total wattage = 28.7 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (28.7/4.79) = 5.99 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 175 lux

8. ILLUMINATION DESIGN OF KITCHEN ROOM

The Common Kitchen is a place where emerging food entrepreneurs can thrive and grow, supported by one another, the local community, and a fully-equipped commercial kitchen accompanied by retail spaces, seating, and a bar serving coffee, juices, and cocktails.

- AREA CALCULATION:

  Length of the room = 3.2 meter.
  Breadth of the room = 3.2 meter.
  So, total area of the room = (3.2*3.2) = 10.4 meter.^{2}

  Average Illumination under consideration = 350 lux

Building 1 · Storey 1 · KITCHEN AREA (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	382 lx	WP4
	g_1	0.58	WP4

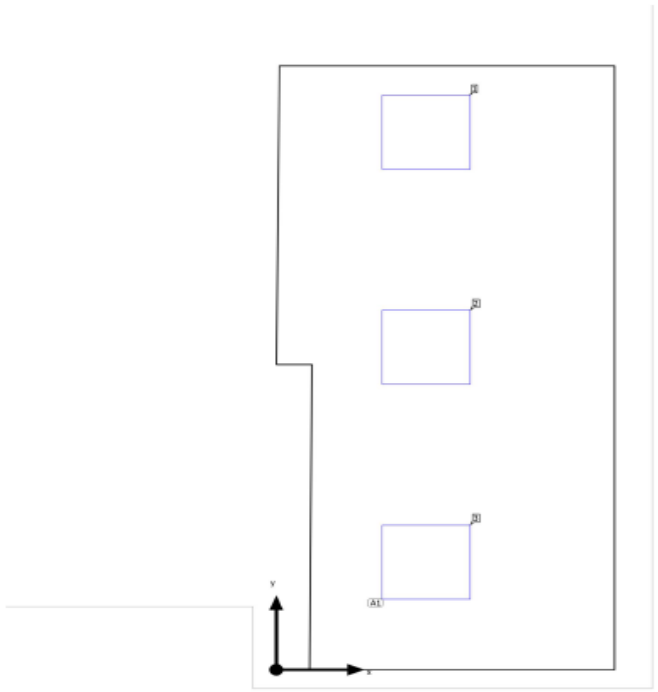
Utilisation profile: DIALux presenting, Standard (office)

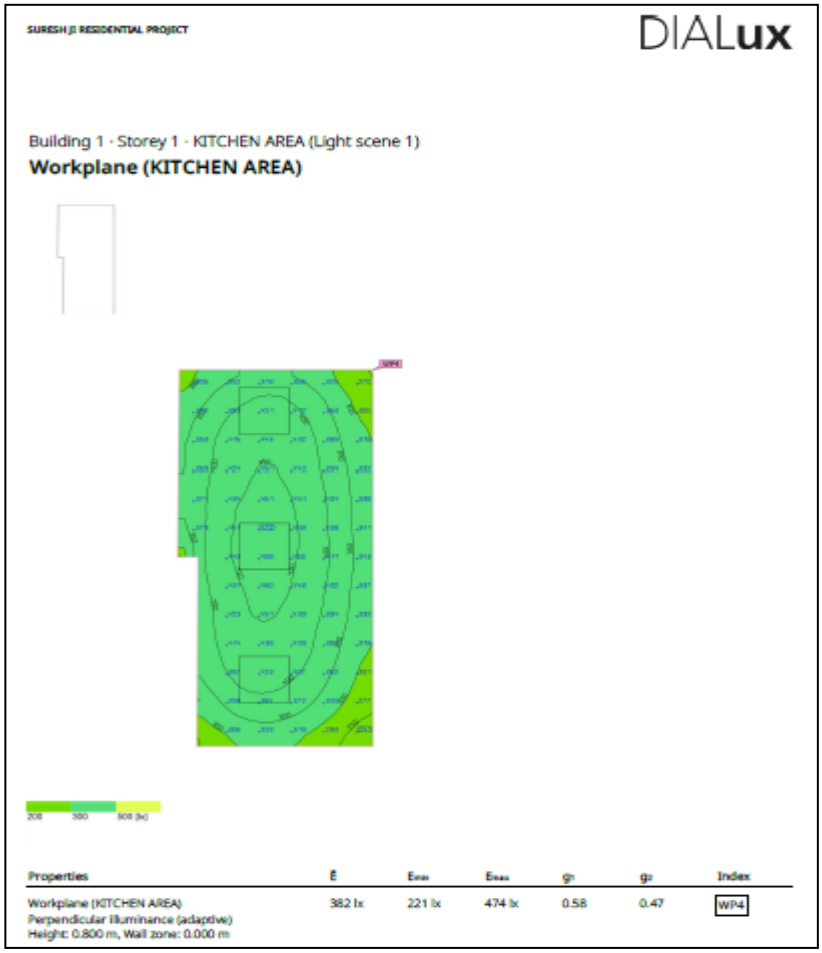
Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
3	Legero Lighting India Pvt Ltd.		28W MODENA(6000K)2X2	28.2 W	3209 lm	113.9 lm/W

Building 1 · Storey 1 · KITCHEN AREA

Luminaire layout plan





BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Kitchen area	Modena(2x2)(panel light)	28W,6500K	3

CALCULATED OF LPD & ILLUMINATION LEVEL OF KITCHEN ROOM

- POWER CONSUMPTION:

  Total wattage = 84.6 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (84.6/10.47) = 8.08 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 382 lux

9. ILLUMINATION DESIGN OF OPEN TERRACE

A terrace is a paved or tiled outdoor area next to or at the top of a building. It's open, flat, and (when not located on a rooftop), it's slightly raised. The word terrace has origins in 16th-century Old French, as well as Latin, in which the word terra means earth.

- AREA :

  Length of the room = 3.1 meter.
  Breadth of the room = 3.1 meter.
  So, total area of the room = (3.1*3.1) = 9.1 meter.^{2}

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · OPEN TERRACE (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	148 lx	WP9
	g_1	0.64	WP9

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

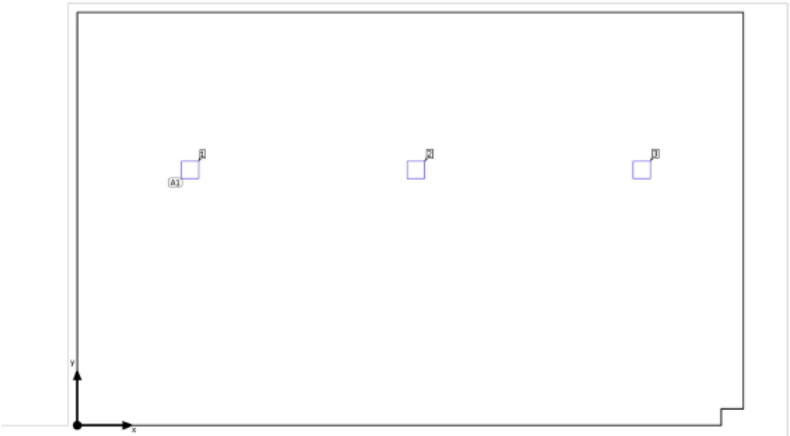
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
3				12.7 W	1110 lm	87.7 lm/W

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · OPEN TERRACE

Luminaire layout plan

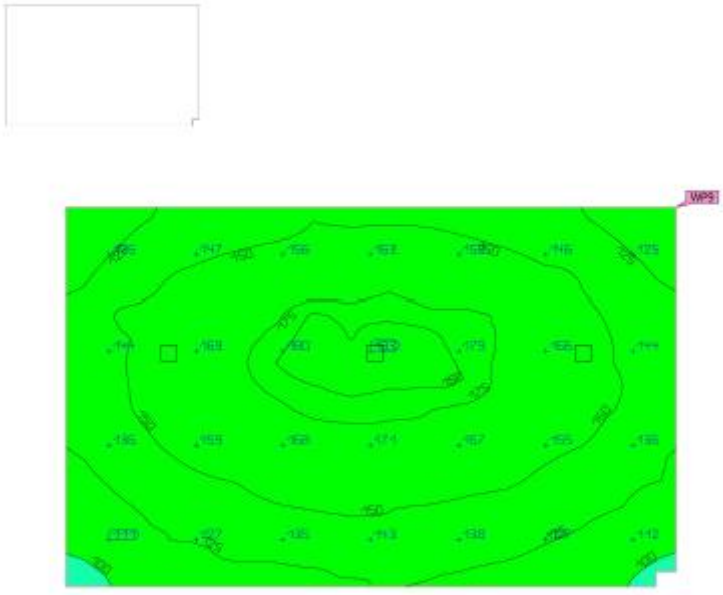


SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · OPEN TERRACE (Light scene 1)

Workplane (OPEN TERRACE)



Properties	Ē	Emin	Emax	g1	g2	Index
Workplane (OPEN TERRACE) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	148 lx	94.0 lx	183 lx	0.64	0.51	WP3

Utilisation profile: DIALux presenting, Standard (office)

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Open terrace	D-lite(decorative light)	12W,6500K	3

CALCULATED OF LPD & ILLUMINATION LEVEL OF OPEN TERRACE

- POWER CONSUMPTION:

  Total wattage = 38.1 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (38.1/9.12) = 4.18 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 148 lux

10. ILLUMINATION DESIGN OF BEDROOM-3

- In the real estate world, a space can be considered a bedroom if it has a door that can be closed, a window, and a closet. The closet requirement is not covered in the IRC and is instead a bedroom feature more related to comfort and liveability than safety.

- AREA :

  Length of the room = 4.1meter.
  Breadth of the room =4.1 meter.
  So, total area of the room = (4.1*4.1) = 16.1 meter.^{2}

  Average Illumination under consideration = 300 lux

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · PARENT'S ROOM (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	325 lx	WP5
	g_1	0.30	WP5

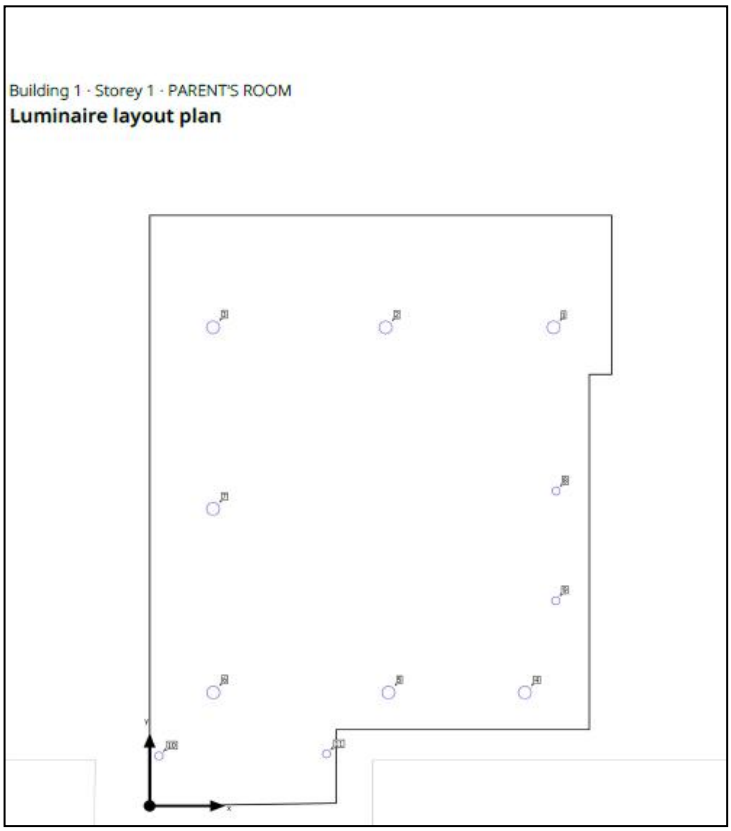
Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
4	LEGERO LIGHTING INDIA PVT LTD		5W Cribo(4000K)	4.9 W	398 lm	81.3 lm/W
7	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W

Building 1 · Storey 1 · PARENT'S ROOM

Luminaire layout plan

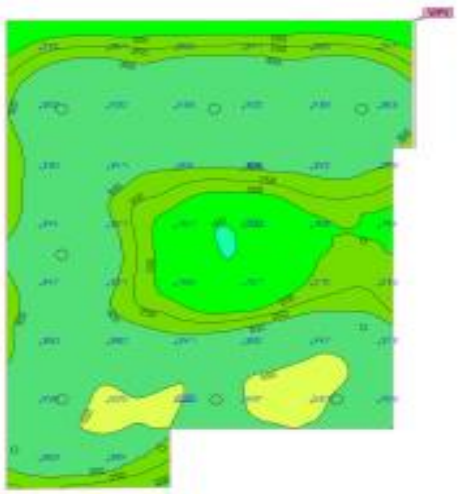


SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · PARENT'S ROOM (Light scene 1)

Workplane (PARENT'S ROOM)



Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
Workplane (PARENT'S ROOM) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	325 lx	98.2 lx	556 lx	0.30	0.18	WP5

Utilisation profile: DIALux presenting, Standard (office)

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Bedroom-3	Nova(downlight)	14W,4000K	7
2		Cribo(spot light)	5W,4000K	4

CALCULATED OF LPD & ILLUMINATION LEVEL OF BEDROOM-3

- POWER CONSUMPTION:

  Total wattage = 115.5 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (115.5/16.12) = 7.17 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 325 lux

11. ILLUMINATION DESIGN OF ATTACHED TOILET-3

- A primary bathroom is one that is connected to the primary, or largest, bedroom in the house. A primary bathroom is also called an suite bathroom or an attached bathroom. Typically, the primary bathroom is a full bathroom or a three-quarter bathroom.
- AREA :

  Length of the room = 1.9 meter.
  Breadth of the room = 1.9 meter.
  So, total area of the room = (1.9*1.9) = 3.8 meter.^{2}

  Average Illumination under consideration = 150 lux

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · TOILET AREA-2 (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$E_{perpendicular}$	194 lx	WP11
	g_1	0.46	WP11

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

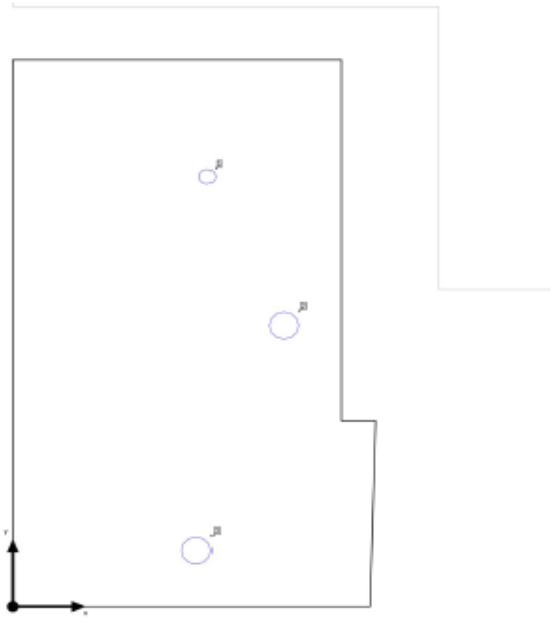
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
2	LEGERO LIGHTING INDIA PVT LTD.		12W PEARL ROUND(4000K) LRS1212 RECESSED	11.3 W	935 lm	82.7 lm/W
1	LEGERO LIGHTING INDIA PVT LTD.		8W GIA 4000K	6.1 W	366 lm	60.3 lm/W

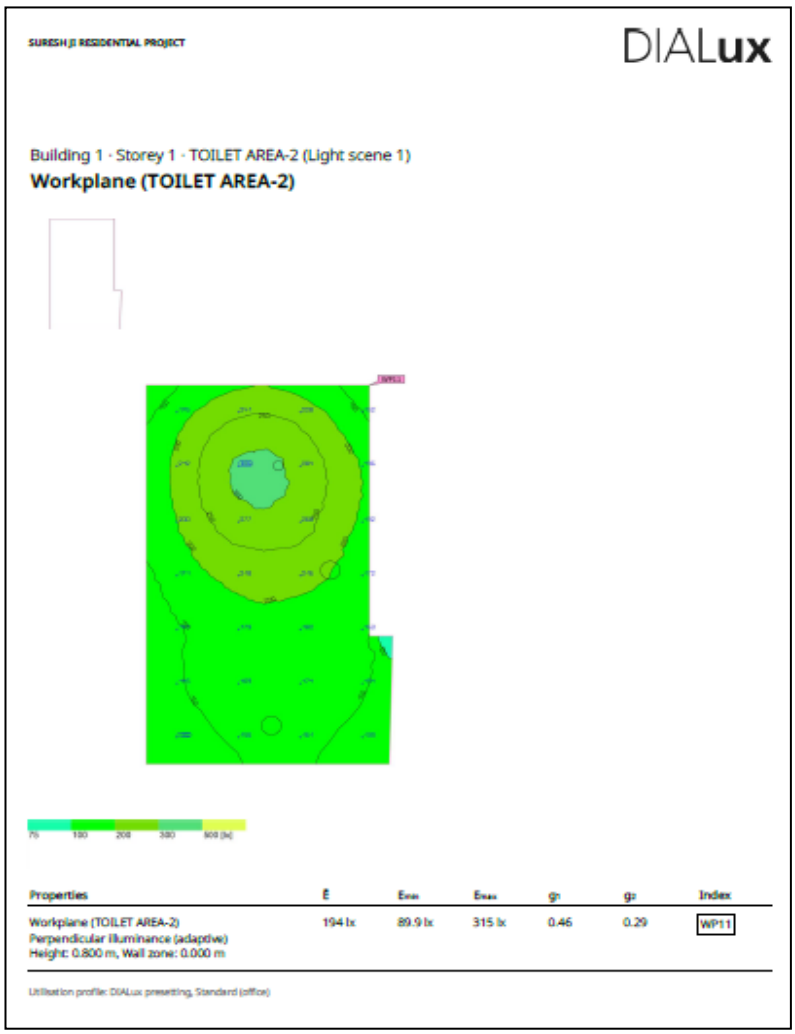
SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · TOILET AREA-2

Luminaire layout plan





BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Toilet-3	Pearl round (downlight)	12W,6500K	2
2		Gia(spot light)	8W,6500K	1

CALCULATED OF LPD & ILLUMINATION LEVEL OF TOILET-3

- POWER CONSUMPTION:

  Total wattage = 28.7 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (28.7/3.91) = 7.34 Watt/meter.^{2}

- ILLUMINATION CALCULATION : Average Illumination = 194 lux

12. ILLUMINATION DESIGN OF PASSAGE AREA

- A passage is a long narrow space with walls or fences on both sides, which connects one place or room with another area. Here in the residential building has a long passage area commonly know as corridor.
- AREA

Length of the area = 4.3meter.
Breadth of the room =4.3 meter.
So, total area of the room = (4.3*4.3) = 18.4 meter.^{2}

Average Illumination under consideration = 150 lux

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · PASSAGE AREA (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	184 lx	WP13
	g_1	0.52	WP13

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

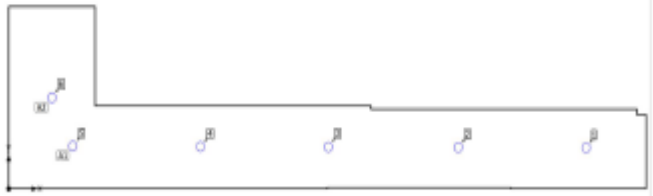
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
6	Legero Lighting India Pvt Ltd.		18W PEARL(4000K) ROUND LRS 2018	17.7 W	1494 lm	84.5 lm/W

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · PASSAGE AREA

Luminaire layout plan

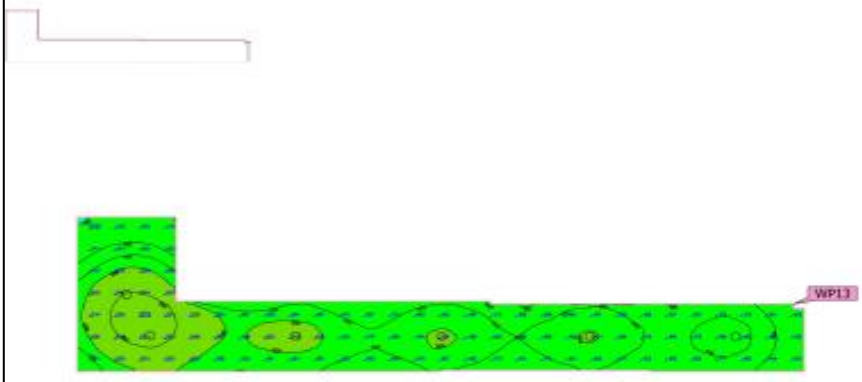


SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · PASSAGE AREA (Light scene 1)

Workplane (PASSAGE AREA)



Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
Workplane (PASSAGE AREA) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	184 lx	96.3 lx	273 lx	0.52	0.35	WP13

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Passage area	Pearl round(downlight)	18W,6500K	6

CALCULATED OF LPD & ILLUMINATION LEVEL OF PASSAGE AREA

- POWER CONSUMPTION:

  Total wattage = 106.2 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (106.2/18.49) = 5.75 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 184 lux

13. ILLUMINATION DESIGN OF BEDROOM-4

- In the real estate world, a space can be considered a bedroom if it has a door that can be closed, a window, and a closet. The closet requirement is not covered in the IRC and is instead a bedroom feature more related to comfort and liveability than safety.

- AREA :

  Length of the room = 4.3meter.
  Breadth of the room =4.3 meter.
  So, total area of the room = (4.3*4.3) = 18.4 meter.^{2}

  Average Illumination under consideration = 300 lux

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · SON'S BEDROOM (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	266 lx	WP2
	g_1	0.22	WP2

Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

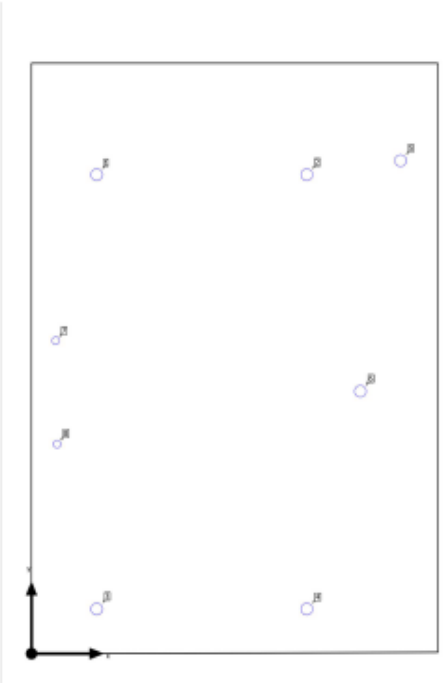
pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
6	LEGERO LIGHTING INDIA PVT LTD.		14W NOVA 4000K	13.7 W	1091 lm	79.5 lm/W
2	LEGERO LIGHTING INDIA PVT LTD.		8W GIA 4000K	6.1 W	366 lm	60.3 lm/W

SURESH JI RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · SON'S BEDROOM

Luminaire layout plan

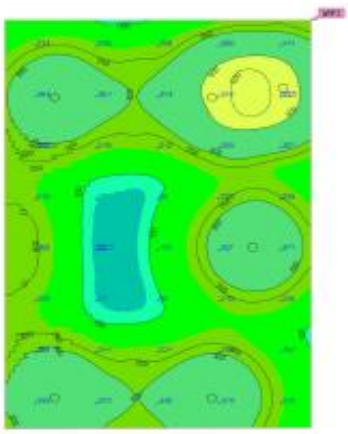


SURESH.β RESIDENTIAL PROJECT

DIALux

Building 1 · Storey 1 · SON'S BEDROOM (Light scene 1)

Workplane (SON'S BEDROOM)



Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
Workplane (SON'S BEDROOM) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	266 lx	58.2 lx	669 lx	0.22	0.087	WP2

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Bedroom-4	Nova(downlight)	14W,4000K	6
2		Gia(spot light)	8W,4000K	2

CALCULATED OF LPD & ILLUMINATION LEVEL BEDROOM-4

- POWER CONSUMPTION:

  Total wattage = 94.4 Watt.

- LPD (LIGHT POWER DENSITY):

  Total wattage/Total area = (94.4/18.41) = 5.13 Watt/meter.^{2}

- ILLUMINATION CALCULATION :

  Average Illumination = 266 lux

6.4: ILLUMINATION DESIGN OF OUTDOOR AREA

The outdoor area consists of followings:
Gate with post top lantern ,
security lighting at Boundary area ,
garage / parking lot at ground floor.

1. ILLUMINATION DESIGN OF GARAGE / PARKING LOT AT GROUND FLOOR

- Parking garage lighting is a term used to describe both outdoor lighting and indoor lighting that is commonly surface, pendant, or recessed mounted to a structure's ceiling, soffit, or overhang. This type of lighting is generally used to provide illumination to areas for vehicle and pedestrian use. Generally, 250-300 lux light level is sufficient at the entrance and the exit sections of the indoor parking.
- AREA :

Length of the room = 17.1 meter.
Breadth of the room = 17.1 meter.
So, total area of the room = (17.1*17.1) = 292.4 meter.^{2}

Average Illumination under consideration = 200 lux

Building 1 · Storey 1 · Parking and driveway and water tank (Light scene 1)

Summary

Results

	Symbol	Calculated	Index
Workplane	$\bar{E}_{perpendicular}$	211 lx	WP1
	g_1	0.20	WP1

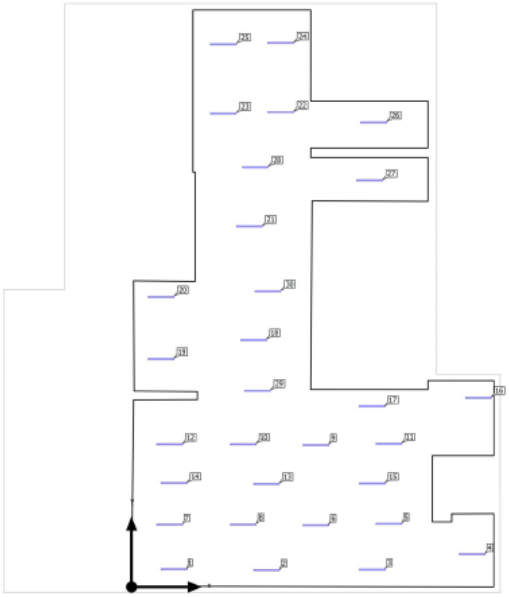
Utilisation profile: DIALux presetting, Standard (office)

Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
30	LEGERO LIGHTING INDIA PVT LTD.		40W STRIX 4000K WHITE	37.6 W	3890 lm	103.4 lm/W

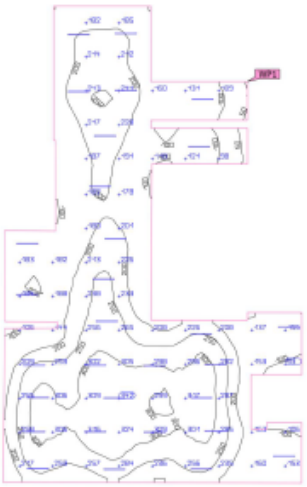
Building 1 · Storey 1 · Parking and driveway and water tank

Luminaire layout plan



Building 1 · Storey 1 · Parking and driveway and water tank (Light scene 1)

Workplane (Parking and driveway and water tank)



Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
Workplane (Parking and driveway and water tank) Perpendicular illuminance (adaptive) Height: 0.000 m, Wall zone: 0.000 m	211 lx	42.5 lx	348 lx	0.20	0.12	WP1

Utilisation profile: DIALux presetting, Standard (office)

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Parking area	Strix (LED batten)	40W,6500K	30

CALCULATED OF ILLUMINATION LEVEL OF PARKING AREA

- Average Illumination = 211 lux

2. **ILLUMINATION DESIGN OF SECURITY LIGHTING AT BOUNDARY AREA**

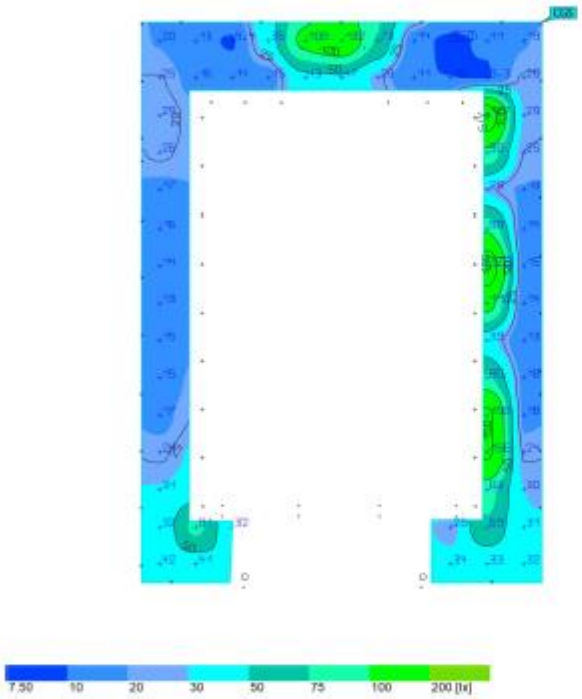
- In the field of physical security, security lighting is lighting that intended to deter or detect intrusions or other criminal activity occurring on a property or site. It can also be used to increase a feeling of safety. Security lighting provides a level of illumination to clearly identify persons or objects and creates a psychological deterrent to criminal activity in the area being protected.
- AREA :

Length of the area = 21 meter.
Breadth of the area = 10 meter.
So, total area of the room = (21*10) = 210 meter.^{2}

Average Illumination under consideration = 35 lux

Site 1 (Light scene 1)

Calculation surface on boundary area



Properties	Ê	E_{min}	E_{max}	g_1	g_2	Index
Calculation surface on boundary area Perpendicular illuminance Height: 0.600 m	42.1 lx	8.97 lx	179 lx	0.21	0.050	CG5

Utilisation profile: DIALux presetting, Standard (outdoor transportation area)

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Boundary area	Edge(wall light)	6W,6500K	28

CALCULATED OF ILLUMINATION LEVEL OF BOUNDARY AREA

- Average Illumination = 42 lux

3. ILLUMINATION DESIGN OF ENTRY POSITION AREA

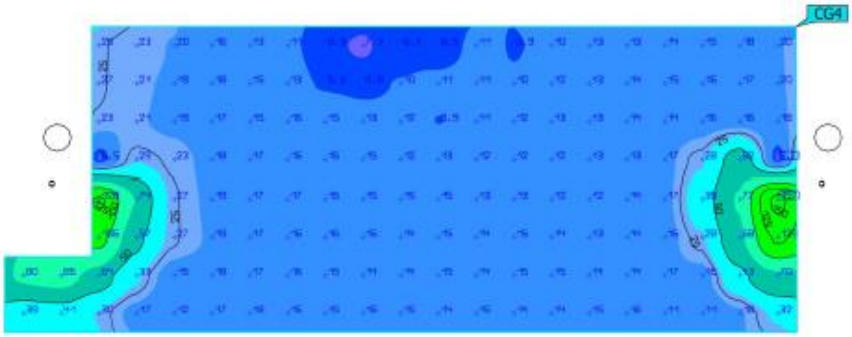
- Lighting an outdoor entryway serves several important functions for the threshold of your home. A well-lit front entry welcome guests, enables a bright, safe passage, let's you identify visitors and makes that ever-important first impression of your home. Selecting the right lighting in this space includes choosing the right size, style and more.
- AREA :

Length of the area = 5 meter.
Breadth of the area = 8 meter.
So, total area of the room = (5*8) = 40 meter.^{2}

Average Illumination under consideration = 15 lux

Site 1 (Light scene 1)

Calculation surface on entry position



Properties	Ē	E_{min}	E_{max}	g_1	g_2	Index
Calculation surface on entry position Perpendicular illuminance Height: 0.600 m	22.3 lx	6.04 lx	157 lx	0.27	0.038	CG4

BILL OF MATERIALS

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Entry position area	Torch (post top lantern)	45W,6500K	2
2		Oreon (surface)	15W,6500	2

CALCULATED OF ILLUMINATION LEVEL OF ENTRY POSITION AREA

- Average Illumination = 23 lux

BILL OF MATERIALS
for multi-storied building of outdoor area:

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Parking area	Strix (LED batten)	40W,6500K	30
2	Boundary area	Edge(wall light)	6W,6500K	28
3	Entry position area	Torch (post top lantern)	45W,6500K	2
4		Oreon (surface)	15W,6500	2
Total power consumption			**1488 W**	

CHAPTER 7 :

ENERGY EFFICIENT LIGHTING DESIGNING FOR INTERIOR SPACES

CHAPTER 7 : ENERGY EFFICIENT LIGHTING DESIGNING FOR INTERIOR SPACES

7.1 THE CRITERIA FOR GOOD ENERGY EFFICIENT LIGHTING DESIGNING[1], [15], [16], [19]

- ❖ Avails the required amount of light in all areas.
- ❖ Follow Code, Standards and budget friendly.
- ❖ Available in large numbers of wattage rating and sizes.
- ❖ Long life with less maintenance.
- ❖ Be environmentally friendly.
- ❖ Respond to the architecture and interior design[12],[13].
- ❖ Produce good colour.
- ❖ Achieve the desired moods and eye soothing ambience of each space

7.2 SELECTION OF ENERGY EFFICIENT LIGHT SOURCE FOR RESIDENTIAL LIGHTING DESIGNING[11], [17], [20], [21]

LED as a Light Source:

- LED, is a solid-state, non-toxic & fully dimmable lamp in modern lighting era.
- It has efficacy up to 200 lumen/watt, which is a very high compared to other artificial light sources.
- It has approximately 50000 hrs. of life-span.
- It works on DC supply, so rectifier and filter assembly are needed for direct application with AC supply.
- LEDs require heat sink or heat management due to high heat production by them.
- They are used in indoor as well as outdoor lighting due to their less energy consumption compare to the conventional ones.
- As LEDs comes in less voltage and wattage rating, they can operate with battery source for emergency cases.
- LEDs can emit wide range of colours direct from source with its combination of different metal and semiconductor without the use of colour filters that traditional lighting methods require.
- The LED can be designed to produce direct light without the use of any reflector.
- LEDs are well known for their robustness and can easily with-stand external force due to drop.
- Start-up time of LED lamps are very less.

- LEDs can be used in a frequent on and off cycle without damaging it unlike the conventional lights most of which requires comparatively high starting time.
- LEDs comes in small sizes as they acquire very less space on the chip on board.

Selection criteria forLED for interior lighting[35]:

- ✓ long life and low energy consumption
- ✓ Easy to replace lamps
- ✓ Non-toxic nature offers less risks to user
- ✓ Long-lasting and reduced running costs
- ✓ Dimmable over wide range
- ✓ Produces directional light
- ✓ Size is very small with respect to wattage
- ✓ Also operates in low voltage condition
- ✓ Maintenance free
- ✓ No IR or UV component

7.3 USE OF PROPER LIGHTING CONTROL[24], [28], [36]

Addition of the lighting control devices provides the scope of efficient lighting design in any residential building where traffic and light use patterns are specific. Theses control system may incorporate the followings devices:

Electronic Timer: These can be set to use to turn on light and keep them on for specific time where the traffic pattern similar every day. They have to ability to handle lighting loads of up to 20 A.They also come with over-ride facility to use the light continuously or to keep it turned off when required.

Occupancy Sensors: These devices are used where the traffic pattern is random and operates depending on the presence of occupant[29] within its range. When the occupants are not within range, they keep the lights turned off for efficient lighting with reduced energy consumption by the lights. Ultrasonic occupancy sensors, Passive Infrared occupancy sensors are some common examples that are used.

Photo Sensors: These are used with daylight integration in a space. For example, when there is enough amount of daylight available the artificial lights stay off and turns on the

lights when the Illuminance level is not up to the predefined level. These sensors generate electrical signal depending on its light sensing and then the signal is fed to a control system which does the operation of turning on-off of lights.

Dimming Control: The dimming of lights can be done either manually or automatically. For example, when the space is not is use, the lights can be made dim manually with a pot switch. Another example is to dim a group of lights to a certain percentage that is close to the window and having daylight access inside, so that uniformity can be maintained throughout the day.

7.4 LUMINAIRES TO BE USED FOR DIFFERENT APPLICATION

Selection criteria for Luminaires for Interior Lighting[20]:

- **Indoor Ceiling Mounted Luminaire:** This type of luminaire is used to provide the general lighting in an indoor space with uniform light distribution. They provide required ILLUMINATION level to light the ambience within a space.

Fig 7.1: Surface (ceiling) mounted Luminaire

- **Indoor Recessed Fixtures:** This type of luminaire may work as general lighting or as wall wash as some of them has the mechanism to tilt the inner part of the luminaire holding the lamp to direct the light in particular direction.

Fig 7.2: Surface ceiling) mounted Luminaire

- **Indoor Wall-mounted/wall-recessed luminaires:** Wall mounted luminaires are used as indirect ambience lighting whereas wall recessed luminaires are generally used to light the steps, floor etc for safety of users in the absence of ambience lighting.

(a)

(b)

Fig 7.3: (a) Wall-mounted & (b) Wall-recessed Luminaire

Path Lighting

Path Lighting is the small pools of light are down at your feet, right where you need them to safely traverse from one location in the landscape to another. Hunt Irrigation can illuminate those colorful annuals; show casing a rainbow of colors all glowing and coming to life under a small and inconspicuous path lights. In professional outdoor lighting, it's the effect that is to be seen for years. For over a decade Hunt Irrigation has been using the design philosophy, To see the effect of the lighting and enjoying the aesthetic value of the path light fixture you have chosen.

Path Lights are the one fixture you will see everyday and should be a highlight of your landscape, whatever your taste may be you will find it in our extensive line of manufactures.

Up Lighting

This style of lighting is never seen in nature, so its unusual effect demands attention. Up Lighting is dramatic and is usually reserved for highlighting focal points. This technique's flair for drama augments large shadows that could be considered design elements in the scene themselves. Up Lighting is achieved by locating the source close to the ground and aiming the light upwards.Wall washing and grazing, large specimen tree lighting and ornamental shrub illumination are all achieved through Up Lighting techniques.

Down Lighting

It's just as Mother Nature intended. Down lighting is the technique of lighting objects and areas from above. It imitates nature and creates the most natural effects. Fixtures mounted in trees can simulate moonlighting as the light filters through leaves and branch structure and cast graceful shadows and outlines on the ground. This technique is very desirable for safety and security lighting

Deck Lighting

On a post or wall or under a railing, full-size or mini, our exclusive deck and patio designs extend your home's living space at night, highlighting the setting and enhancing the safety and security of the home's perimeter.

From simple, classic shapes to eclectic, imaginative designs that coordinate with your deck features and landscape area. Hunt Irrigation can design your deck and patio lights to add a unique element of style to compliment your outdoor setting. Deck Lighting adds the finishing touch to your outdoor amenities.

In-Ground Lighting

As a model landscape lighting contractor, you want to have a lighting solution for every customer and situation. Yet what happens when you need an accent light, but you cannot have a fixture sticking up from the surface? Or, what if your customer wants to spread light along the ground in several directions?

That's when you need to know about in-ground lighting.

In-ground lighting is popular with commercial accounts because a below-ground fixture is less likely to get damaged from activity around the light, including lawn care, as well as foot and auto traffic. In addition, it prevents theft. But the style can be right for residential customers

7.5 COMPOSITE BILL OF MATERIALS

COMPOSITE BILL OF MATERIALS
For Bungalow area:

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Den washroom	Nova (downlight)	14W,6500K	1
		Gia (spot light)	8W,6500K	2
		Comet (downlight)	8W,6500K	1
2	Balcony	D-lite(decorative light)	12W,6500K	4
3	Den area	LED strip light	20W,6500K	4
		Perdu (spot light)	6W,6500K	13

4	Kitchen area	Modena panel light(2x2)	36W,6500K	5
5	Dining area	Led strip light	20W,4000K	8
		Nova (downlight)	14W,4000K	8
		Elava (inground)	3W,4000K	2
		Gia (spot light)	8W,4000K	9
		Wall washer	8W,4000K	5
		Opal (Down light)	25W,4000K	5
		Palco (spot light)	8W,4000K	6
		Wall washer	4W,4000K	5
6	Bedroom-1	Nova(downlight)	14W,4000K	6
		Gia (spot light)	8W,4000K	2
		Wall washer	4W,4000K	1
7	Toilet-1	Comet round (downlight)	8W,6500K	3
8	Entrance foyer	Nova(downlight)	14W,4000K	8
9	Store room	Nova(downlight)	14W,6500K	1
		Gia (spot light)	8W,6500K	2
10	Bedroom-2	Nova(downlight)	14W,4000K	15
		Gia (spot light)	8W,4000K	9
		Wall washer	8W,4000K	6
11	Toilet-2	Nova(downlight)	14W,6500K	2
		Gia (spot light)	8W,6500K	5
		Comet (downlight)	8W,6500K	
12	Living area	LED strip	20W,4000K	20
		Nova(downlight)	14W,4000K	7
		Gia(spot light)	8W,4000K	15
		Comet round (downlight)	8W,4000K	7
		Vela(Wall washer)	8W,4000K	4
		Palco (spot light)	8W,4000K	6
13	Bedroom-3	Nova(downlight)	14W,4000K	7
		Comet round (downlight)	8W,4000K	3
		Wall washer	8W,4000K	3
14	Toilet-3	Comet round (downlight)	8W,6500K	3
15	Bedroom-4	LED strip	20W,4000K	12
		Nova(downlight)	14W,4000K	5
		Gia(spot light)	8W,4000K	3
		Comet round (downlight)	8W,4000K	9
16	Toilet-4	Nova(downlight)	14W,6500K	4

		Comet round (downlight)	8W,6500K	6
17	Walking passage area	Nova (downlight)	14W,6500K	3
		Comet round (downlight)	8W,6500K	1
		Vela(Wall washer)	4W,6500K	4
18	Outdoor area	Torch (Gate light)	12W,6500K	2
		Edge (wall light)	3W,6500K	4
		Strahler (step light)	20W,6500K	5
		Durastrip(LED strip)	5W,6500K	9
		Lynx (LED strip)	6W/meters	146 meters
		Mashroom (bollard)	6W,6500K	15
		Mini (under water light)	18W,6500K	16
		Micro sparks(foot light)	4W,6500K	71
		Trick (wall grazer)	8W,6500K	12
		Flush frame(uplight)	22W,6500K	48
		Linea (linear light)	22W,6500K	25
		Ring mini(post light)	13W,6500K	3
		Oreon surface (wall light)	20W,6500K	4

COMPOSITE BILL OF MATERIALS
For Multi-storied building area:

Sl.no.	**Location**	**Type of Fixtures** (Legero make)	**Lamp details**	**Qty (no.)**
1	Bedroom-1	Cribo (spot light)	5W,4000K	2
		Nova(downlight)	14W,4000K	5
2	Dining area	Nova(downlight)	14W,6500K	6
3	Drawing room	Cribo(spot light)	5W,4000K	7
		Nova(downlight)	14W,4000K	7

4	Balcony area	D-lite (decorative light)	12W,6500K	2
5	Bedroom-2	Cribo(spot light)	5W,4000K	2
		Nova(downlight)	14W,4000K	5
6	Kitchen	Modena(2x2) (panel light)	28W,4000K	3
7	Open terrace	D-lite (decorative light)	12W,4000K	3
8	Bedroom-3	Cribo(spot light)	5W,4000K	4
		Nova(downlight)	14W,4000K	7
9	Passage area	Pearl round (downlight)	18W,6500K	6
10	Bedroom-4	Nova(downlight)	14W,4000K	6
		Gia (spot light)	8W,4000K	2
11	Toilet-1	Pearl round(downlight)	12W,6500K	3
		Gia (spot light)	8W,6500K	1
12	Toilet-2	Pearl round(downlight)	12W,6500K	2
		Gia (spot light)	8W,6500K	1
13	Toilet-3	Pearl round(downlight)	12W,6500K	2
		Gia (spot light)	8W,6500K	1
14	Corridor area	Pearl round(downlight)	8W,6500K	6
15	Stair case	Coral round(downlight)	6W,6500K	6
16	Parking area	Strix (LED batten)	40W,6500K	30
17	Boundary area	Edge(wall light)	6W,6500K	28
18	Entry position area	Torch (post top lantern)	45W,6500K	2
19		Oreon (surface)	15W,6500	2

CHAPTER 8:

ASSESSMENT OF ENERGY CONSUMPTION

CHAPTER 8: ASSESSMENT OF ENERGY CONSUMPTION

8.1 LOAD CALCULATIONS OF INDOOR LIGHTING OF BUNGALOW AREA

Sl.no.	Location	Power consumption (W)
1.	Den room	186.7
2.	Den washroom	33.9
3.	Dining area	612.3
4.	Balcony area	50.8
5.	Entrance foyer area	109.6
6.	Bedroom-1	102.2
7.	Toilet-1	24.0
8.	Kitchen room	178.0
9.	Living area	723.4
10.	Master bedroom-2	308.4
11.	Toilet-2	65.4
12.	Bedroom-3	143.9
13.	Toilet-3	24.0
14.	Store room	25.9
15.	Bedroom-4	398.8
16.	Toilet-4	102.8
17.	Walking passage area	65.1
TOTAL POWER CONSUMPTION (W)		**3155 .0 W**

8.2 LOAD CALCULATIONS OF OUTDOOR LIGHTING OF BUNGALOW AREA

Total wattage in outdoor of bungalow area = 5365.2 W
= 5.365 KW

In the bungalow , we know that eight persons are live there. Here , we have to see total energy consumption per person

Total power consumption in the bungalow area = (3155.7+5365.2) W
= 8520.9 W
= 8.520 KW

Total power consumption per person = 8520.9/8= 1065.2 W

8.3 LOAD CALCULATIONS OF INDOOR LIGHTING OF RESIDENTIAL MULTI-STORIED BUIILDING

Sl.no.	Location	Power consumption (W)
1.	BEDROOM-1	78.3
2.	DINING AREA	82.2
3.	DRAWING AREA	130.2
4.	BALCONY AREA	25.4
5.	BEDROOM-2	78.5
6.	KITCHEN AREA	84.6
7.	OPEN TERRACE	38.1
8.	BED ROOM-3	115.5
9.	PASSAGE AREA	106.2
10.	BEDROOM-4	94.4
11.	TOILET-1	40
12.	TOILET-2	28.7
13.	TOILET-3	28.7
TOTAL POWER CONSUMPTION (W)		**930.6 W**

Total wattage in Corridor =48*6 = 288 W

8.4 LOAD CALCULATIONS OF OUTDOOR LIGHTING OF MULTI-STORIED AREA

Total wattage in outdoor residential building = 1488 W

Total wattage in Six Stairways =36* 6 = 216 W

As we know this building has six floor and every floor contains two flats.

So,
Total nos of floor in the multi-story building = (6*2) = 12 nos

wattage for indoor residential building = (930.6*12) = 11167.2 W

Total wattage of residential multi-story building = (11167.2+1488+216+288) W
= 13159.2 W

Total power consumption per person = 13159.2/48 = 274.2 W

CHAPTER 9 :

COMPARISON OF PROPOSED DESIGN IN DIALUX 4.13 VS DIALUX Evo 9.1 SOFTWARES

CHAPTER 9 : COMPARISON OF PROPOSED DESIGN IN DIALUX 4.13 VS DIALUX Evo 9.1 SOFTWARES

9.1 SPECIAL FUNCTIONALITIES OF DIAlux Evo 9.1:

- ✓ Faster output with better result.
- ✓ Capable of handling more complex projects.
- ✓ Material visualization directly in CAD for painted and metallic materials.
- ✓ Respond to the Architecture and Interior Design[22] and achieve the desired moods of each space.
- ✓ Parallel planning of several schemes, e.g., different geometries or luminaire arrangements.
- ✓ Better 3D[23] visualization with coloured light scenes with LED or other colour changing luminaires.
- ✓ Extremely simplified GUI which makes the planning of simple rectangular rooms possible, similar to DIALux Light.
- ✓ Available in both 64-bit and 32-bit version.
- ✓ HDR image export.

9.2 APPLICATIONOF DIALUX Evo IN THE PROJECT TO VISUALIZE THE DIFFERENCE COMPARED TO DIALUX 4.13:

The following pictures are some of the results of different areas of a 3BHK flat from software DIALux 4.13 and DIALux evo 9.1. It can be easily visualized that the results from the DIALux evo are much more realistic and texture and colour of walls and objects are accurately rendered in the artificial lighting. The comparisons are given below:

Fig 9.1: 3D visualization of Master Bedroom in DIALux 4.13 vs DIALux evo 9.1

Fig 9.2:3D visualization ofLiving & Dining in DIALux 4.13 vs DIALux evo 9.1

Fig 9.3:3D visualization of Balcony in DIALux 4.13 vs DIALux evo 9.1

Fig 9.4:3D visualization of Toilet 1 in DIALux 4.13 vs DIALux evo 9.1

Fig 9.5: 3D visualization of Bungalow area and balcony in DIALux evo 9.1

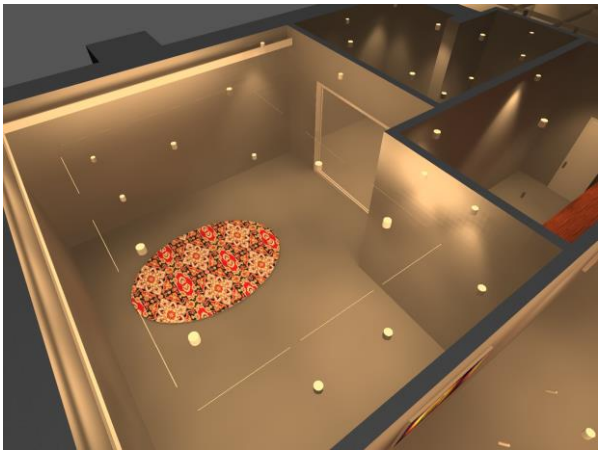


Fig 9.6: 3D visualization of passage area and living area in DIALux evo 9.1

CHAPTER 10 :

SUMMARY AND CONCLUSION

CHAPTER 10 : SUMMARY AND CONCLUSION

The continuous development and up gradation of lighting technology incorporating the newly developed energy efficient lighting devices has opened up vast ways of concepts of lighting design to any lighting designer. The LED lights and its luminaires are therefore mostly used as energy efficient lighting system that provides not only efficient energy uses but also provides excellent aesthetic lighting because of its flexibility of size and colour ranges.

. DIALux evo software have been used in this study to get all parameters which are essential for any residential lighting design and also to help in total lighting load calculations. In the future trend of indoor lighting design, DIALux evo can be used instead of normal DIALux 4.13 software where 3D visualization and faster, better result, capable of handling more complex projects can be obtained.

Energy efficient lighting systems help to preserve our limited natural resources and reduce the impact of activities on the environment. Thus, the design of affordable residential interiors should consider energy saving.

It is seen from above calculation that total per head power consumption in a bungalow is very high compare with multi-story building. We have seen the result the total power consumption per person in the bungalow increase due to big area with luxury lifestyle but in case of residential multi-storied building with the same area with economic life style lower power consumption per person.

Till now power generation is mostly carried out by coal fired thermal power plants which creates pollution as well as depletes natural resources. Energy efficient lighting systems help to preserve our limited natural resources and reduce the impact of activities on the environment. Thus, the design of affordable residential interiors should be considering as above.So by this approach we are saving land , energy consumption , natural resources , environment , etc.

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