

**Studies on Energy Efficient Lighting Design for
Modern Office Building**

*A thesis submitted towards partial fulfilment
of the requirements for the degree of*
Master of Technology

In
Illumination Technology and Design

Submitted by
Sreenita Pain
EXAM ROLL NO: M6ILT19009

Under the supervision of
Mr. SUDDHASATWA CHAKRABORTY
Assistant Professor,
Electrical Engineering Department,
Jadavpur University

Course affiliated to:-
Faculty of Interdisciplinary Studies, Law & Management
Jadavpur University
Kolkata-700032
India

2019

**JADAVPUR UNIVERSITY
FACULTY OF INTERDISCIPLINARY STUDIES,
LAW & MANAGEMENT
SCHOOL OF ILLUMINATION SCIENCE, ENGINEERING & DESIGN**

CERTIFICATE OF RECOMMENDATION

*This is to certify that the thesis entitled “**Studies on Energy Efficient Lighting Design for Modern Office Building**” is a bonafide work carried out by **SREENITA PAIN** 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 2016-2019.*

THESIS ADVISOR

Mr. Suddhasatwa Chakraborty
Assistant Professor,
Electrical Engineering Department,
Jadavpur University ,
Kolkata - 700032

Countersigned by:

Mrs. Kamalika Ghosh,
DIRECTOR

School of Illumination Science , Engineering and Design
Jadavpur University,
Kolkata-700 032

DEAN –FISLM
JadavpurUniversity,
Kolkata-700 032

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**

** Only in case the thesis is approved.

**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 her **M.Tech (Illumination Technology and Design)** studies during academic session 2016-2019.

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: SREENITA PAIN

ROLL NUMBER: **M6ILT19009**

THESIS TITLE:

SIGNATURE:

DATE:

ACKNOWLEDGEMENT

Before going to the details of the project report, I am highly indebted and thankful to **Mr. Atul Jawase, Group Manager- Lighting Solution Group, Wipro Lighting** for his guidance and constant support during internship in Wipro Lighting. Also I want to thank **Mr. Surajit Sinha, Senior Executive - Lighting Solution Group, Wipro Lighting, Mr. Anurag Ravi, Executive - Lighting Solution Group, Wipro Lighting, Mr. Rajesh Mukesh, Senior Manager- Lighting Solution Group, Wipro Lighting, Mr. Shant Kumar Sambargimath, Manager- Lighting Solutions Group, Wipro Lighting** for their support during the internship in Wipro Lighting.

I take this opportunity to express my deep sense of gratitude and indebtedness to my Project Guide **Mr. Suddhasatwa Chakraborty, Assistant Professor, Electrical Engineering Department, Jadavpur University, Kolkata** for showing me the right path towards successful completion of this project with his constant guidance, supervision, valuable time and helpful suggestions.

I would like to acknowledge my sincere thanks to **Prof. (Dr.) Kamalika Ghosh, Director of School of Illumination Science, Engineering and Design, Jadavpur University, Kolkata** and her valuable suggestions and encouragements in carrying out this project work.

Also I am also thankful to Mr. Gairik Saha, Mr. Pradip Paul, Mr. Gobindo Paul of Illumination Engineering Laboratory for their co-operation during my project work. Finally, this thesis would not have been possible without the confidence, endurance and support of my friends with whom I share tons of fond memories. They are always been a source of inspiration and encouragement.

Last but not least, I wish convey my gratitude to my parents, whose love, teachings and support have brought me this far.

Date:
Place:

Sreenita Pain

ABSTRACT

The main objective of designing an office lighting plan is to support the work. The lighting solution affects the ambiance of the office, the psychological well being, interest, and enthusiasm of its employees. It should enhance the feeling of well-being and productivity, so consideration must be given to the design of the office interior to create a stimulating work place. It is essential that office lighting be included as a vital consideration towards the successful operation of any business.

Here, three offices are chosen which is included in the study.

The office layout plan has been created in AutoCAD after taking the measurements of the office. Furniture layout is also included in order to study the lighting effects with the actual situation.

The office plan is then imported into Dialux software for starting the design with Conventional Luminaires and LED Luminaires and perform the calculations.

Design considerations like LLF, Surface reflectances are chosen according to the standards.

Standards like IS-3646, IESNA, CIE, ECBC have been referred during the design of the lighting plan of the four offices.

Comparative Study of the lighting plan (Conventional Luminaires and LED Luminaires) of the three offices are done and the data are represented in tabular form.

During study, the parameters need to be checked are

1. lux level has to be maintained according to the standards,
2. In Indoor Lighting design, uniformity ratio (\square_0) has to be maintained above 0.6.
3. Lighting Power density (LPD) value should be within limits.
4. Glare should be within limits.

The final part of the work comparison of the design conventional and LED shows how to minimize the energy consumption by using LED luminaire over conventional luminaire.

CONTENTS

CHAPTER 1	INTRODUCTION TO OFFICE LIGHTING DESIGN	PAGE NO
1.1	Introduction of Project	1
1.2	Motivation	1
1.3	Aim of Project	1
1.4	Indoor Lighting Design Parameters	1
CHAPTER 2 DIFFERENT INTERNATIONAL & NATIONAL RECOMMENDATIONS ON OFFICE LIGHTING DESIGN		
2.1	IS 3646 (PART I AND PART II)-1992	5
2.2	IESNA LIGHTING HANDBOOK	11
2.3	CIE 180:2007	15
2.4	ENERGY CONSERVATION BUILDING CODE	21
CHAPTER 3 LIGHTING DESIGN & CALCULATIONS		
3.1	Powerful Tool for Lighting Design: Co-efficient of Utilization	24
3.2	Point Calculation Method	27
CHAPTER 4 OFFICE LIGHTING DESIGN		
4.1	Layers of Lighting	31
4.2	Considerations for Office Lighting	32
4.3	Lighting of Different Areas of Office	32
CHAPTER 5 DESCRIPTION OF LUMINAIRE USED IN DESIGN		
5.1	Luminaire Selection	35
5.2	Technical Details of Conventional Luminaire Used	35
5.3	Technical Details of LED Luminaires Used	40

CHAPTER 6	INTRODUCTION TO LIGHTING DESIGN SOFTWARE	
6.1	INTRODUCTION	46
6.2	DIALux 4.13	46
6.3	Autocad 2016	46
CHAPTER 7	COMPARATIVE CASE STUDIES OF DIFFERENT OFFICES WITH CONVENTIONAL & LED LUMINAIRES	
7.1	Introduction	48
7.2	Case Study –I : Lighting design of Office A_Ahmedabad	48
7.2.1	Lighting Design of Office A_Ahmedabad with Conventional Luminaires	48
7.2.2	Lighting Design of Office A_Ahmedabad with LED Luminaires	66
7.3	Case Study –II : Lighting design of Office B_Bangalore	86
7.3.1	Lighting Design of Office B_Bangalore with Conventional Luminaires	86
7.3.2	Lighting Design of Office B_Bangalore with LED Luminaires	115
7.4	Case Study –III : Lighting design of Office C_Cuttack	145
7.4.1	Lighting Design of Office C_Cuttack with Conventional Luminaires	145
7.4.2	Lighting Design of Office C_Cuttack with LED Luminaires	173
CHAPTER 8	CONCLUSION & FUTURE ASPECTS	
8.1	Conclusion	202
8.2	Future Aspects	202
	BIBLIOGRAPHY	203

List of Tables

SerialNo.	Table Description	Page No.
1	Table 2.1 gives the recommended illuminance ranges for different tasks and activities.	6
2	Table 2.2. Co-related Color Temperature	9
3	Table 2.3 Color Rendering Index	9
4	Table 2.4. Standard Illuminance for Task Area and Surroundings	17
5	Table 2.5. Colour Corrected Temperature	19
6	Table 2.6. Limit of average luminance of luminaires	19
7	Table 2.7 the schedule of interiors (areas) tasks and activities with specification of illuminance, glare limitation and colour quality	20
8	Table 2.8. Interior Lighting Power for ECBC Buildings – Space Function Method	22
9	Table 7.1 Design Parameters of Office_A_Amhedabad with Conventional Luminaire	35
10	Table 7.2 Design Parameters of Office_ A_Amhedabad with LED Luminaire	35
11	Table 7.3 Design Parameters of Office_B_Bangalore with Conventional Luminaire	143
12	Table 7.4 Design Parameters of Office_B_Bangalore with LED Luminaire	144
13	Table 7.5 Design Parameters of Office_C_Cuttack with Conventional Luminaire	199
14	Table 7.6 Design Parameters of Office_C_Cuttack with LED Luminaire	200

List of Figures

Serial No.	Figure Description	Page No.
1	Fig 2.1 Radiant Zone of a Luminaire	7
2	Fig 2.2 Diagram I	8
3	Fig 2.3 Diagram II	8
4	Fig 2.4 Fig 2.4 Initial Illuminance Level Fall w.r.t Time	11
	Fig 2.5 Reflectances recommended for room and furniture surface in office	12
5	Fig 3.1 Conic solid angle zones of 10° width for use in calculating zonal flux.	25
6	Fig. 5.1. Dimension Drawing of TMS022 1x36W	35
7	Fig.5.2 Image of TMS022-1x36W	36
8	Fig. 5.3 Intensity Distribution Curve	36
9	Fig. 5.4 Dimension Drawing of NLP73240	36
10	Fig. 5.5 Intensity Dimension Curve	36
11	Fig. 5.6 Image of NLP72340	36
12	Fig. 5.7 Image of NLP72432	37
13	Fig. 5.8 Dimension Drawing of NLP72432	37
14	Fig. 5.9. Intensity Distribution Curve	37
15	Fig. 5.10 Image of NLP72443	38
16	Fig. 5.11 Dimension Drawing of NLP7244	38
17	Fig 5.12 Intensity Distribution Curve of NLP2443	38
18	Fig. 5.13 Image of TMS022	39
19	Fig. 5.14 Intensity Distribution Curve of Lineco TMS022	39
20	Fig 5.15 Dimension Drawing of Lineco TMS022xTL-D18W HFS	39
21	Fig. 5.16 Image of NLP52603	39
22	Fig.5.17 Dimension Drawing of NLP52603	39
23	Fig. 5.18 Intensity Distribution Curve of NLP52603	40
24	Fig. 5.19 Dimension Drawing of Luxspace2 Compact Low Height	40
25	Fig. 5.20 Intensity Distribution Curve	41
26	Fig. 5.21 Image of Luxspace2 Compact Low Height DN570B	41
27	Fig 5.22 Dimension Drawing of Luxspace 2 Compact LED12S/830	41
28	Fig 5.23 Image of Luxspace 2 Compact	41
29	Fig 5.24 Intensity Distribution Curve	41
30	Fig 5.25 Image of PowerBalance	42
31	Fig 5.26 Intensity Distribution Curve Gen2 LED40S/840	42
32	Fig 5.27 Dimension Drawing of PowerBalance Gen2 LED40S/840	42
33	Fig 5.28 Image of PowerBalance Gen2	43
34	Fig 5.29 Intensity Distribution Curve LED34S/840	43
35	Fig 5.30 Dimension Drawing of PowerBalance Gen2 LED34S/840	43
36	Fig 5.31 Image of Trueline Suspended	43
37	Fig 5.32 Dimension Drawing of Trueline Suspended	44
38	Fig 5.33 Intensity Distribution Curve	44
39	Fig 5.34 Dimension Drawing of CoreLine Batten	44
40	Fig 5.35 Intensity Distribution Curve	44

41	Fig 5.36 Image of CoreLine Batten	44
42	Fig. 7.1 Typical Layout of Office A_Ahmedabad	48
43	Fig 7.2 Conventional Luminaire Layout of Office A_Ahmedabad	49
44	Fig 7.3 Image of the Workstation of Office A_Ahmedabad in Dialux	49
45	Fig 7.4 shows the conference room with LED Lighting design	66
46	Fig. 7.5 LED Luminaire Arrangement of Office A_Ahmedabad	67
47	Fig. 7.6 shows the layout of office B_Bangalore.	86
48	Fig. 7.7 Lighting plan of Office B_bangalore with Conventional Layout	87
49	Fig. 7.8 LED Luminaire Layout of Office B_Bangalore	115
50	Fig. 7.9 Value Chart of Table Top of 4Pax Meeting Room	118
51	Fig. 7.10 Value Chart of Table Top of 4Pax Meeting Room	122

CHAPTER 1
INTRODUCTION
TO
OFFICE LIGHTING DESIGN

1.1 INTRODUCTION

The office environment has a significant impact on an individual's performance at work in a variety of ways. One of the most influential factors in the office environment is lighting. From concentration to satisfaction levels, studies have shown that an individual's health, well-being and performance at work can change at the flick of a switch.

Office lighting plans must be cohesive and effectively illuminate different types of spaces that coexist under one roof: the reception area, open office space and meetings rooms of varying sizes, conference rooms etc. It must represent and reinforce the corporate image.

While designing an office interior, the followings are need to be considered :-

- i) A cohesive environment that enhances the feeling of well-being and productivity of the office staff.
- ii) A flexible lighting plan that enables employees to perform tasks comfortably, effectively, and safely.
- iii) A lighting plan for long-term employee comfort, with a proper balance of energy savings and lighting quality.
- iv) Integrate and balance ambient, task, accent, and decorative lighting into each area of the office.
- v) Integration and control of daylight to improve employee morale and cut energy costs

1.2 MOTIVATION

A lighting designer must consider a variety of key characteristics when developing their lighting plan including lamp life, system efficiency, lumen maintenance, colour rendering and appearance, daylight integration and control, light distribution, points of interest, cost, system control and flexibility. It is a challenge for a lighting engineer to design not only the standard design parameters but also to keep in mind the occupants' health conditions such as occupant's age, eye strain, headaches, tiredness, sleep, listlessness.

1.3 AIM OF PROJECT

In this project, three office lighting plans are designed with both conventional and energy efficient ways.

1. The first objective is to design and calculate the quantity and wattage of conventional luminaire & LED luminaire required to illuminate an office area maintain the standards.

2. And the second objective is comparative studies between conventional & LED luminaires and calculation of the energy consumption.

1.4 INDOOR LIGHTING DESIGN PARAMETERS

- i) Illuminance (E): The illuminance defines the amount of light falling on a surface and is measured in lux.
In case the work area is yet not defined or the building owner wants flexibility, the designer can choose between 1) the best illuminance in the work area or 2) provide the workstations with task lighting and have basic lighting in the rest of the area.
- ii) Luminance (Lv): Luminance (Lv) is the illuminance per unit solid angle, measured in lm/m²/sr. In other words, luminance is the density of visible radiation (photopic or scotopic) in a given direction. Luminance is the measurable quantity that most resembles a person's perception of brightness, although they are not quite the same. The luminance distribution in a room is

determined by the windows, the position of the luminaires, the light distribution and the reflective surfaces in the room. A well balanced luminance distribution increases visual acuity and contrast sensitivity.

- iii) **Uniformity (U_0):** Lighting uniformity is the ratio of minimum to average illumination for a given area. Lighting uniformity refers to the evenness of illumination across the work area, floor and walls respectively. Uniform lighting is particularly important for work areas.
- iv) **Luminous Efficacy (lm/W):** The ratio of luminous flux emitted by a lamp to the power consumed by the lamp. When the power consumed by control gear is taken into account, this term is sometime known as lamp circuit luminous efficacy and is expressed in. Y lumens/circuit watt.
- v) **Room Surface Reflectance:**The light that falls on a seeing task, comes from two sources, the luminaire itself (the direct component) and the surfaces of the room (the interreflected component). The room characteristics that affect the amount of light reaching the task directly from the luminaires and maintenance and temperature. Each major room surface (walls, ceiling & floor) have a different reflectance. The reflectance of each has a different effect on the contribution of reflected light to the illumination level produced in a room.
- vi) **CCT: Correlated Colour Temperature, or CCT,** is a measure of a lamp's colour appearance when lighted. All lamps are given a colour temperature based on the colour of the light emitted. White light falls into three general categories: warm, neutral and cool, measured in Kelvin (K). White light with a hint of yellow-like candlelight is called "warm white" (below 3000K); it enhances reds and oranges, dulls blues, and adds a yellow tint to whites and greens. Neutral white (3000K – 3500K) enhances most colors equally, and does not emphasize either yellow or blue. Bluish white, like moonlight on snow, is considered "cool white" (above 3500K); enhancing blues, dulls reds and imparts a bluish tint to whites and greens. Warm light makes a space feel smaller, more comfortable and familiar, where cooler light make areas appear more spacious.
- vii) **CRI: The CRI is defined by CIE as the average of the colour rendering indexes for eight test colours with low chromatic saturation. Color Rendering Index, or CRI,** is a measure of how a light source renders colors of objects compared to how a reference light source renders the same colors. CRI can be used to compare sources of the same type and CCT.
The higher the CRI of a light source, the better – and more natural – colors appear. For products to be presented in a true-to-life way, which increases visual comfort, a CRI value of 80 – 100 is recommended.
- viii) **LPD: Lighting Power Density** technically represents the load of any lighting equipment in any defined area, or the watts per square foot or square meter of the lighting equipment.
- ix) **Glare: The presence of a bright area in an observer's field of view may rise to sensation of glare.** This discomfort is measured by Glare Index. Glare value should be below the index value.
- x) **Light Loss Factors: The LLF is defined as ratio of illuminance under actual working conditions for a given area to the value that would occur if lamps are operated at their rated lumen output and if no system variation or depreciation had occurred.** Components of this factor may be either initial or maintained. These components are called recoverable factors. They are: Lumen Depreciation Factor (LLD), Luminaire Dirt Depreciation Factor (LDD), Room Surface Dirt Depreciation Factor (RSDD) and Lamp Burnout Factor (LBO).

CHAPTER 2

DIFFERENT INTERNATIONAL & NATIONAL RECOMMENDATIONS ON OFFICE LIGHTING DESIGN

2.1 Lighting Standards

The following standards are considered while implementing the lighting designs.

- a. IS 3646 PART I & PART II:1992
- b. IESNA LIGHTING HANDBOOK
- c. CIE
- d. ECBC

2.1.1 IS 3646

IS 3646 represents “Indian Standard Code of Practice for Interior Illumination”. The primary object of this code is to indicate the factors which should be taken into account to achieve good lighting. It confines itself primarily to the lighting of working interiors, such as factories, workshops, offices, commercial premises, public buildings, hospitals and schools, keeping two objects in mind, namely, to make the task easy to see and to create a good visual environment.

IS 3646 was first published in three parts, Part 1 covering principles for good lighting and aspects of design, Part 2 covering schedule of illumination and glare index, and Part 3 covering calculation of coefficient of utilization by the BZ method. Since calculation of coefficient of utilization by the BZ method has become obsolete, therefore, in the first revision a new method of calculation of glare indices has been introduced.

According to the standard IS 3646 Part I, the lighting of an interior should fulfil three functions. It should:

- (a) Ensure the safety of people in the interior,
- (b) Facilitate performance of visual tasks, and
- (c) Aid the creation of an appropriate visual environment.

Lighting affects safety, task performance and the visual environment by changing the extent to and the manner in which different elements of the interior are revealed. Safety is ensured by making any hazards visible. Task performance is facilitated by making the relevant details of the task easy to see. Different visual environments can be created by changing the relative emphasis given to the various objects and surfaces in an interior. However, A lighting installation should satisfy the functions based on the following lighting engineering criteria i.e.

- (i) Lighting level,
- (ii) Luminance distribution,
- (iii) Glare restriction,
- (iv) Direction of incidence of light and shadow effect, and –
- (v) Colour appearance and colour rendering.

2.1.1.1 Lighting Levels:

The lighting level produced by a lighting installation is usually qualified by the illuminance produced on a specified, plane. In most cases, this plane is the major plane of the tasks in the interior and is commonly called the working plane. The illuminance provided by an installation affects both the performance of the tasks and the appearance of the space.

The following scale of illuminances is recommended.

20-30-50-75-100-150-200-300-500-750-1000 -1500-2000 lux.

For different interiors used for the same application or for different conditions for the same kind of activity, a range of illuminances is recommended for each type of interior or activity intended of a single value of illuminance. Each range consists of three successive steps of the recommended scale of illuminances. For working interiors the middle value of each range represents the recommended service illuminance that would be used unless one or more of the following factors are considered.

The higher value of the range should be used

- Unusually low reflectance or contrasts are present in the task;
- Errors are costly to rectify;
- Visual work is critical;
- Accuracy or higher productivity is of great importance; and
- The visual capacity of the worker makes it necessary.

The lower value of the range may be used

- Reflectance or contrasts are unusually high;
- Speed and accuracy is not important; and
- The task is executed only occasionally.

Type of Interior	Range of service Illumination in Lux
Entrance halls, lobbies, waiting rooms	150-200-300
Enquiry desks	300-500-750
General Offices	300-500-750
Deep plan general offices	500-750-1000
Computer Workstation	300-500-750
Conference Rooms, Executive offices	300-500-750
Computer and data preparation rooms	300-500-750
Filing Rooms	200-300-500
Reception	200-300-500
Corridors, Passageways, stairs	50-100-150
Canteens, cafeterias, dining rooms,	150-200-300
Food preparation and cooking	300-500-750
Bathroom	50-100-150
Store Rooms	50-100-150
Electrical Room	100-150-200
Telephone apparatus rooms	100-150-200

Table 2.1 gives the recommended illuminance ranges for different tasks and activities.

2.1.1.2 Luminance Distribution:

The distribution of luminance should be regarded as complementary to the design on the illuminance in the interior. It should take into account the following aspects:

- (i) Luminance of the task and its immediate surroundings:
The luminance of the immediate surroundings of the task should be lower than the task luminance, preferably not less than 1/3 of the value. This implies that the ratio of the reflectance of the immediate background of a task to that of the task itself should preferably be in the range 0.3 to 0.5.
- (ii) Luminance of ceiling, walls and floor:

The average luminance in the peripheral field of view should not be lower than 1/10th of the task luminance. In working interior, in order to reduce the contrast between luminaires and surrounding ceiling, the ceiling reflectance should be as high as possible. In order to obtain a well balanced luminance distribution, the ratio of the minimum to the average illuminance should not be less than 0.8.

The average illuminance of the general areas of a working interior should normally not be less than 1/3 of the average illuminance of the task area(s).

The average illuminance of adjacent interiors should not vary from each other by a ratio exceeding 5 : 1.

- (iii) Avoidance of glare by limiting the luminance of luminaires and windows.

2.1.1.3 Restriction of Glare

In interior lighting, discomfort glare from lamps and luminaires is likely to be more of a problem than disability glare. Glare may be caused by lamps, luminaires and windows (direct glare) or by the reflection of bright sources from surface with high reflectance (reflected glare).

- (a) **Restriction of Direct Glare:** Direct glare is deemed to be adequately restricted, if the mean luminance of the luminaires in the critical glare range $45^\circ < \gamma < 85^\circ$, does not exceed the limiting luminance plotted in Diagram I and Diagram II. The luminance curves represent the luminance limits for luminaires, in relation to the viewing angle from nadir (from 45° to 85°), for quality classes 1, 2 and 3 of glare restriction corresponding to values 1.5, 2.2 and 2.55 of glare rating G, for different illuminance and horizontal distance $a > h_s$, where h_s is the vertical -distance between observers eye and the foremost luminaire.

The stepped scales of the glare rating G is based on the following interpretation of observers' impressions:

0 = No glare,

2 = Perceptible,

6 = Uncomfortable, and

6 = Intolerable glare, representing quality classes from 1 to 3, for various values of illuminance.

For different activities and/or interiors, the importance and. extent of glare, limitation is different.

For that reason, proper quality classes from 1 to 3 has to be selected for various values of illuminance:

1. Class 1 High quality
2. Class 2 Medium quality
3. Class 3 Low quality

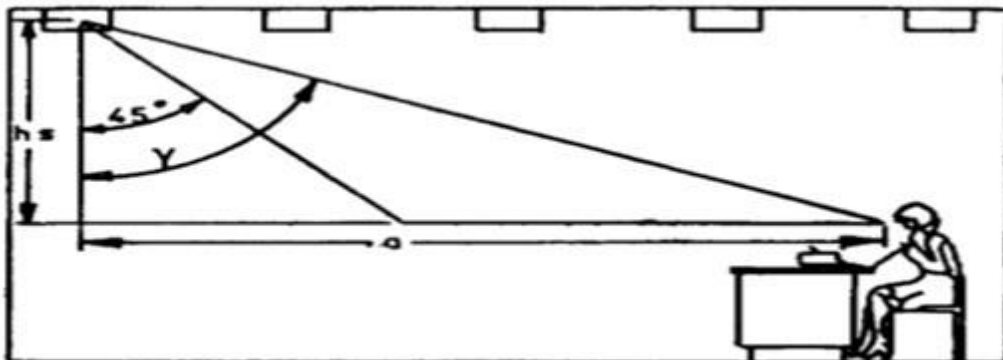


Fig 2.1 Radiant Zone of a Luminaire in which the luminance has to be considered. It lies between 45° ($\frac{a}{h_s} - 1$) and the connecting line between the eye of the observer and the remotest luminaire, $\gamma = \frac{a}{h_s}$.

The following factors have to be kept in view while using the curves in Diagrams I and II:

- They are intended to be used for working interiors only,
- It is assumed that the luminaires are arranged in a regular pattern in the ceiling,
- The curves are valid for medium to bright room surface reflectances (ceiling reflectance of not less than 0.5 and wall reflectance of not less than 0.25),
- A luminaire is considered to be elongated if the ratio of the length to the width of its luminous area is equal to or greater than 2 : 1, and
- Luminaires without luminous sides include those with projected luminous area less than 0.03 m in height.

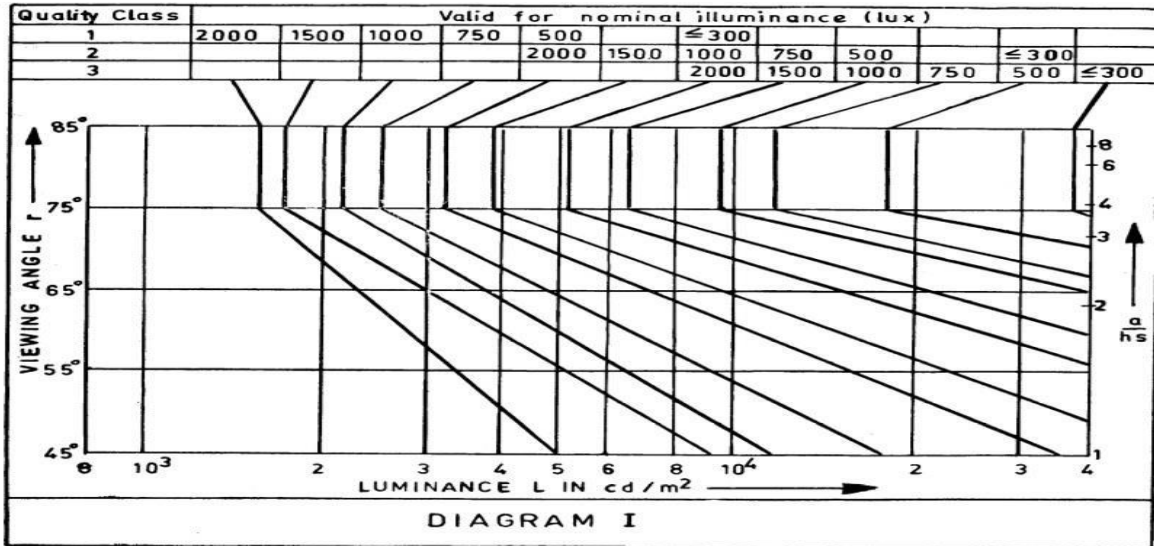


Fig 2.2 Diagram I

The luminances limiting curves of Diagram I should be used for all luminaires without luminous sides and for elongated luminous sides when viewed parallel to their longitudinal axis.

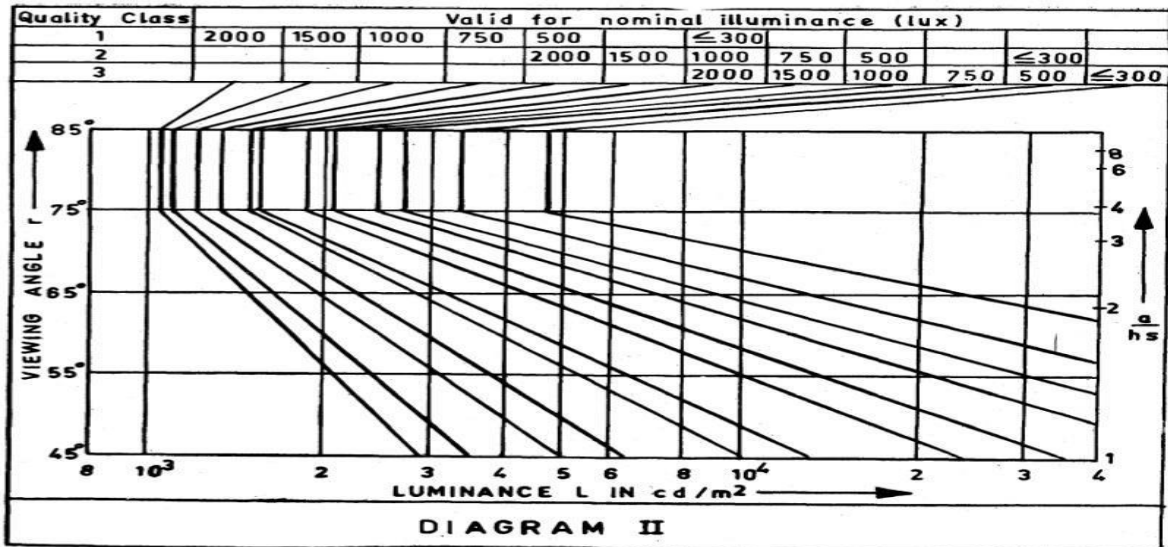


Fig 2.3 Diagram II

The curves of Diagram II should be used for luminaires with luminous sides viewed at right angles to their longitudinal axis.

- (b) **Restrictions of Reflected Glare:** The most effective method for restricting reflected glare is by arranging the location of the worker and the light source such that reflections from the latter are not

towards the eyes, but directed away or to the sides. It shall also be minimized using large area, low luminance luminaires and by using non-glassy finishes on furniture, equipment, and room surfaces.

2.1.1.4 Color Appearance & Color Rendering

The colour of light emitted by a source can be indicated by its correlated colour temperature (CCT). Each lamp type has a specific correlated colour temperature, but for practical use the correlated colour temperatures have been grouped into three classes (Table 2.2). The choice of appropriate apparent colour of light source in a room is largely determined by the function of the room. This may involve such psychological aspects of the colour as the impression given of warmth, relaxation, clarity, etc, and more mundane considerations such as ‘the need to have a colour appearance compatible with daylight and yet to provide a white colour at night. The ability of the light source to render colours of surfaces accurately may be conveniently quantified by the general colour rendering index. The colour rendering groups of the various lamps to be used for lighting of interiors are specified.

Correlated Color Temperature (CCT)	CCT Class
CCT < 3300K	Warm
3300K < CCT < 5300K	Intermediate
5300K < CCT	Cold

Table 2.2. Co-related Color Temperature

Colour Rendering Groups	CIE General Colour Rendering Index (Ra)	Typical Application
1A	Ra > 40	Wherever accurate colour matching is required, for example, colour printing inspection
1B	80 < Ra < 90	Wherever accurate colour judgements are necessary and/or good colour rendering is required for reasons of appearance, for example, shops and other commercial premises
2	60 < Ra < 80	Wherever moderate colour rendering IS required
3	40 < Ra < 60	Wherever colour rendering is of little significance but marked distortion of colour is unacceptable
4	20 < Ra < 40	Wherever colour rendering is of no importance at all and marked distortion of colour is acceptable

Table 2.3 Color Rendering Index

2.1.1.5 LIGHTING SYSTEMS

Once the general requirements of the lighting installation and the room to be lighted are known. an analysis of the visual task may lead to more special requirements for the illumination of the interior. This will determine the choice of lighting system to be used and the location and arrangement of the luminaires.

1. General lighting produced by a regular array of luminaires with or without an indirect component results in a specific horizontal illuminance with a certain uniformity. In some situations, luminaires with a special light distribution are preferred so that the light comes predominantly from one direction.
2. Localized General Lighting is an alternative to arrangements of uniformly spaced luminaires. Advantages in cost and energy saving can sometimes be realized by relating the light to the working zones.
3. Local Lighting can be provided by additional luminaires placed at a small distance from the visual task, which illuminate only a limited area. In industrial cases, this IS often referred to as supplementary lighting.
4. Local lighting is recommended for working areas when: - (a) The work involves very critical visual task, especially where the increased illuminance is required only on restricted areas; - (b) Perception of forms and textures requires strongly directional light; - (c) The general lighting does not penetrate to certain places because of obstructions; - (d) Higher illuminances are necessary for people with reduced eye sight; or - (e) It is necessary to compensate for contrast reductions caused by the general lighting.

2.1.1.6 LIGHTING MAINTENANCE AND LIGHT LOSS FACTOR SCHEDULE

Illuminance values obtained during the maintenance cycles as an average are always less than the initial illuminances by a ratio depending on the characteristics of the installation. This loss of light can be considered under three headings.

- (1) Lamp Lumen Depreciation and Failure
- (2) Luminaire Depreciation
- (3) Room Surface Depreciation

- **Lamp Lumen Depreciation and Failure**

The luminous flux emitted by all-lamps decreases with time of use but the rate of decrease varies widely between lamp types. It should be noted that the lamp lumen depreciation will be based on certain assumptions regarding operating conditions and one or more of the following factors may influence the rate of depreciation:

- a) Ambient temperature;
- b) Lamp operating position;
- c) Supply voltage and
- d) Type of control gear used

- **Luminaire Depreciation**

The lamp lumen depreciation mentioned above takes place even if the lamp is perfectly clean, but in practice further light loss results from the accumulation of dirt on the surfaces of the lamp and luminaire. The rate at which this soiling occurs depends mainly on the type of luminaire, the nature of the interior and the location of the building.

- **Room Surface Depreciation**

In majority of cases the illuminance produced on the relevant surfaces in an interior depends to some extent on inter-reflection from surfaces in the room. The proportion of illuminance so produced will be governed by the light distribution of the luminaires and the reflectance of the relevant surfaces. Luminaires with a high proportion of direct illuminance, such as down-lighters, will not be much affected by inter-reflection but indirect schemes will be totally dependent on it. With the passage of time, dirt deposited on the room surfaces will reduce their reflectance and this will result in loss of illuminance.

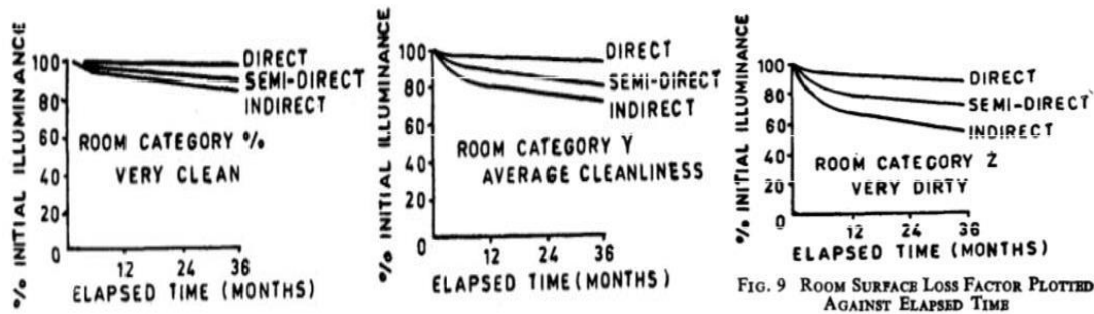


Fig 2.4 Initial Illuminance Level Fall w.r.t Time

• Light Loss Factor

The light loss factor (LLF) is the ratio of the illuminance produced by the same installation when new, It estimates the effect on the illuminance provided by the installation of the fall in the lamp luminous flux with hours of use and the depreciation caused by dirt deposited on luminaires and room surfaces. Light loss factor is, therefore, product of three other factors.

Light-loss factor = Lamp lumen maintenance factor x Luminaire maintenance factor x Room surface maintenance factor

It is, therefore, recommended that in interiors with fairly clean atmosphere, for example, offices, air-conditioned factory interiors, a light loss factor of 0.8, in interiors, which are prone to accumulate dust faster, for example, most industrial interiors, an LLF of 0.7 and in highly dirt-prone interiors an LLF of 0.6 may be adopted for calculating the number of luminaires to be installed for a particular service illuminance. It will also mean that the average illuminance should be measured at intervals after the installation is commissioned and as soon as it reaches a predetermined level below the designed service illuminance, the cleaning schedule is due. Thereafter, the cleaning should be carried out at regular intervals of similar period so as to ensure that the designed service illuminance is maintained.

The light loss factor can be used in the lumen method of illuminance calculation to estimate what the illuminance produced by the installation will be at any particular stage in its life. This is achieved by the following formula:

$$E = \frac{\phi \times n \times N \times U \times LLF}{A}$$

Where,

E = Illuminance in lux;

ϕ = Initial luminous flux of the light source; n

= Number of lamps per luminaire

N = Number of luminance

A = Area to be lit (in \square^2)

U = Utilization factor for type of luminaire in specific room conditions

LLF = Light loss factor

By calculating the light loss factor for different maintenance patterns,.it is possible to predict the pattern of illuminance produced by the installation in relation to elapsed time. This pattern may be used to assess the merits of alternative maintenance schedules.

2.1.2 IESNA –The Lighting Handbook

The Illuminating Engineering Society was founded in 1906. The IESNA is the recognized technical authority on illumination. For over ninety years its objective has been to communicate information on all aspects of good lighting practice to its members, to the lighting community, and to consumers through a variety of programs, publications, and services. The strength of the IESNA is its diversified membership: engineers, architects, designers, educators, students, contractors, distributors, utility

personnel, manufacturers, and scientists, all contributing to the mission of the Society: to advance knowledge and disseminate information for the improvement of the lighted environment to the benefit of society.

The IESNA Lighting Handbook represents the most important reference document in the lighting profession. It is one means by which the Society accomplishes its mission: to advance knowledge and disseminate information for the improvement of the lighted environment to the benefit of society.

2.1.2.1 IMPORTANCE OF OFFICE LIGHTING

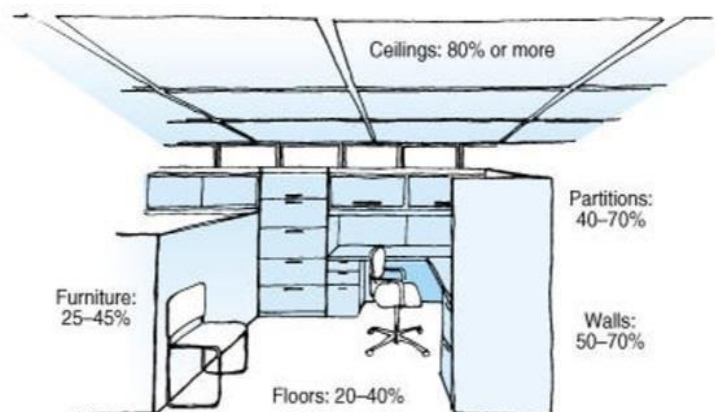
Offices are designed to house working people engaged in thought and in a number of forms of communication (written, visual, telephone, computer, and face to face). Office lighting should enable workers to perform these tasks effectively. Office lighting affects the appearance of the space and its occupants, and therefore their mood and productivity. Feelings of well-being, interest, and enthusiasm are affected by the environment, thus consideration should be given to the design of office interiors in an effort to achieve a stimulating work place. Naturally, lighting should provide good visibility for the visual tasks. It is important to consider the *luminous environment* and the *lighting of visual tasks* separately, but these aspects must work together. Energy-efficient lighting is critical to office lighting design. Good lighting design and applications go hand in hand with energy-efficient technologies to reduce operating costs and environmental pollution.

2.1.2.2 THE LUMINOUS ENVIRONMENT

The visual effect of an office space depends on variations in perceived brightness and color. The effects can be achieved by varying surface reflectance and illuminance.

A. Color: Both *surface reflectance* and light source *spectral power distribution* (SPD) play important roles in the color of the office lighting environment. High color rendering by the light source is critical if fine color discriminations are being performed. The spectral composition of the light source determine the general overall appearance of a space, particularly the furnishings, room surfaces, and people in that space, and so should be considered when selecting a light source.

- (a) **Surface Reflectances:** Office workers are exposed to the same environment for long periods of time, the color in that environment can affect performance positively or negatively, even if workers are not aware of this effect. Touches of accent color give vitality and dramatic interest to any office area. Color contrast, through the use of more colorful surfaces, may also make interior spaces appear brighter at low light levels. Colors selected for large surface areas should have reflectances as recommended in figure 2.3.



Reflectances recommended for room and furniture surfaces in offices.

Fig. 2.5

(b) Light Source Spectral Power Distribution :

There are two distinct application considerations with respect to light source SPD. These are the chromaticity (correlated color temperature, or CCT) and the color rendering properties of the light source.

- (i) CCT: Chromaticity refers to the color appearance of the lighted source and is designated by its CCT in kelvin (K). In interior spaces such as offices, a source will create a "warm" environment if its CCT is about 3000 K or lower, and a "cool" environment if it is 5000 K or higher. A CCT between these two is considered neutral.
- (ii) CRI: The color rendering index (CRI) is a measure of the color shift induced by a given lamp relative to a standard lamp of the same CCT. The maximum CRI value is 100. The perceived color of an object is affected by the color rendering properties of the lamp. Two lamps with the same chromaticity may have different color rendering characteristics. Thus it is important that the sources be viewed in a similar space before being specified.

B. Luminance:

Luminous differences and color contrast are necessary for vision. An interior space is visible because of the brightness differences of the surfaces. Brightness variations are a function of the absolute and spectral reflectance of the surfaces and of the distribution of light on those surfaces. An interior space is visible because of the brightness differences of the surfaces. Brightness variations are a function of the absolute and spectral reflectance of the surfaces and of the distribution of light on those surfaces. Office interiors should be lighted to provide for good visibility with no distracting glare. Direct and reflected glare should be avoided; however, it is important to provide enough variation in luminance or color to contribute to a stimulating, attractive environment.

- (a) Luminance ratio: For an office environment, luminances near each task and in other parts of the office interior within the field of view should be balanced with the task luminance. Two separate phenomena are influenced by the luminance ratios within the field of view: dark and light adaptation and disability glare. . To limit the effects of these phenomena, the luminance ratios generally should not exceed the following:

Between paper task and adjacent VDT screen: 3:1 or 1:3
Between task and adjacent dark surroundings: 3:1 or 1:3
Between task and remote (nonadjacent) surfaces: 10:1 or 1:10

- (b) Disability Glare: Glare sources within the field of view may cause stray light within the ocular media of the eye. This light is in turn superimposed on the retinal image. This reduces the contrast of the image and can reduce visibility and performance.
- (c) Reflectance and Finishes: The brightness's of objects depend on illuminance as well as surface reflectance. For example, reading 80%-reflectance white paper on an evenly illuminated desk top requires that the desk top have a reflectance of at least 27% (one-third of 80%) in order to comply with the 3:1 guideline for the ratio between the luminance of the task and its immediate surrounding. Dark wood or veneer work surfaces often have lower reflectance values and exceed the recommended value. Thus, reflectance as well as illuminance levels are important in office lighting design. Surface specularity, or gloss, must also be considered. Glossy surfaces are mirror-like and can produce images of the luminaires that can result in reflected glare, a patch of very high brightness. Glossy horizontal work surfaces are particularly troublesome. For this reason, shiny work surfaces should be avoided.

- (d) **Visual Comfort:** Discomfort glare is a sensation of annoyance produced by brightness in the visual field that are significantly higher than the brightness of the surrounding areas. The magnitude of the sensation depends on the size, position, relative brightness, and number of sources in the field of view.

A comparison of glare control from various luminaires can be made from photometric reports by comparing the average luminance values produced at 0° (vertical), 45°, 55°, 65°, 75°, and 85° in the lengthwise, crosswise, and (sometimes) diagonal planes.

Another comparison can be made by using the visual comfort probability (VCP) calculation. It is recommended that office lighting systems should have a VCP of 70 or greater. Since the operation of a visual display terminal (VDT) requires a heads-up, near-horizontal viewing position, several luminaires may be in view behind the VDT. To minimize discomfort glare for VDT tasks, a VCP of 80 or greater is recommended.

2.1.2.3 LIGHTING OF VISUAL TASKS

Office work entails a variety of visual tasks. The visibility of task details is determined by their size and contrast with the background, the absolute luminance of the background, and the viewing duration. The visual performance follows a law of diminishing returns, the greater the contrast and size of the task details, the higher the background luminance, the longer the viewing duration, and the higher the level of visual performance.

- **Illuminance Selection**

The general illumination level of an office facility should be determined by several factors. The reflectance values of surfaces surrounding the task area should be considered to create a visually comfortable environment. Luminance levels surrounding the task should not be greater than three times the luminance value of the task, or less than one-third the luminance value of the task. If the offices contain VDTs, the general illumination should meet the guidelines established for that specific type of task. Additionally, the general illumination should meet the psychological need for light of the occupants of the space. It should be remembered that room reflectance values and the distribution characteristics of the luminaire may be as important as illuminance level.

In determining an appropriate illuminance level, the designer must also consider how the illuminance is to be delivered, and to what locations. It is essential to differentiate between general lighting for the space and the illuminance specifically on the task or at the task location. In open plan offices, providing task level illumination only at specific task locations and at a lower illuminance level throughout the space is typically appropriate. In private offices with free standing desks, it is more likely that the general illumination of the room provides the task level illumination. The illumination requirements of different tasks may be satisfied by providing different task lights. A flexible lighting system, individual dimming controls, and multilevel switching are other available alternatives, depending on furniture layout and architecture. For locations with multiple tasks, designers can design for the task requiring the highest level of illumination and provide dimming capabilities that allow the user to adjust the lighting level in various areas to suit different tasks.

- **Quality of Lighting**

It should be remembered that task visibility can be affected by the quality of light. Poor lighting quality can provide veiling reflections, reflected glare, and shadows, resulting in reduced visibility. The angle at which light strikes the task, the location of the luminaires relative to the task, the distribution of the light emitted from the luminaires, the location of luminaires in the office, and the specific properties of the task and work surface all affect lighting quality.

- (a) **Veiling Reflections:** The contrast of a visual task depends on the glossiness of the task surface and on the geometric relationships between the light sources, the task, and the eyes. If the visual task produces a mirror angle between the eye and the luminaire or another bright object, contrast is reduced. This effect is called veiling reflections. The area from which a luminaire or bright object can reflect light off the task and into the viewer's eyes is termed the offending zone. This may be a specific area of the ceiling or, often in open-plan workstations, the area directly in front and above the occupant, which is a common area for placement of task-light luminaires. The designer should always consider multiple working areas within the space. In open office areas, for example, one luminaire placed outside the offending zone for one worker may be in the offending zone for another. Luminaire light output should be limited at angles greater than 55° from vertical in order to prevent veiling reflections and to reduce discomfort glare.
- (b) **Reflected Glare:** Reflected glare is usually caused by a mirror image of the light source in the offending zone reflected to the worker's eyes from VDTs or highly polished wood or glass-covered desk tops. It can be reduced by the use of matte surfaces and by carrying out the procedures for reducing veiling reflections on the task. Additionally, large-area low-luminance luminaires or indirect luminaires can be used when specular surfaces cannot be avoided.
- (c) **Shadows:** Shadows reduce the illuminance on the task and, if sharply defined, can be distracting and cause excessively high luminance ratios on desk tops. Shadows are minimized if the light arrives at the task from many directions, helped by high-reflectance matte finishes on room surfaces. Large area luminaires can also reduce shadows.
- (d) **Color Appearance:** People's preferences for warm or cool light sources are often cultural or climate related, so it is difficult to recommend color temperatures appropriate for office spaces. However, the color rendering ability of the lamp is important if food, faces, or fine architectural finishes are involved. In general, choose lamps of 70 CRI or greater, or 85 CRI or above if color critical tasks are being performed.
- (e) **Flicker:** Perceived flicker can cause headaches. Electronic ballasts can eliminate flicker for fluorescent lamps, and magnetically ballasted HID lamps can be wired to alternate phases of a three-phase system to reduce flicker.

2.1.2.4 LIGHTING METHODS

There are basically two methods for lighting office tasks (i) General Lighting & (ii) Localized Lighting. One is to design the general lighting so that required illuminances are provided at all task locations. This is most appropriate for private offices or special situations where task lighting is inappropriate. The other is to supply localized lighting from task-lighting luminaires in conjunction with a low level of general illumination. In open-plan arrangements where vertical partitions or storage cabinets over work surfaces because shadows, localized lighting becomes essential for adequate task illumination and shadow reduction. When localized lighting is used, the general illumination should be designed with a low illuminance appropriate for circulation, for casual viewing of tasks, and to provide the recommended luminance ratios between the task and other areas within the field of view. The design of the general illumination can also be better coordinated with the interior design and the architecture.

2.1.2.5 CIE Standard

CIE Standards are therefore a primary source of internationally accepted and agreed data, which can be taken, essentially unaltered, into universal standard systems. This International Standard was prepared jointly by CIE-TC 3-21 and ISO/TC 159/SC 5. It replaces publication CIE 29.2-1986 and deals with Lighting Requirements for Indoor Work Places CIE S 008/E-2001.

CIE S 008/E-2001 - LIGHTING OF INDOOR WORK PLACES

Good lighting will create a visual environment that enables people to see, to move about safely and to perform visual tasks efficiently, accurately and safely without causing undue visual fatigue and

discomfort. Good lighting requires equal attention to the quantity and quality of the lighting. Good lighting requires equal attention to the quantity and quality of the lighting. While the provision of sufficient illuminance on the task is necessary, in many instances the visibility depends on the way in which the light is delivered, the colour characteristics of the light source and surfaces together with the level of glare from the system.

In general the terms used in this standard are defined in the CIE Lighting Vocabulary (CIE 17.4 – 1987), but there are few more terms that are defined below:

- 1 Visual task: The visual elements of the task to be carried out.
- 2 Task area: The partial area in the work place in which the visual task is located and carried out.
- 3 Immediate surrounding: A zone of at least 0,5 m width surrounding the task area within the field of vision.
- 4 Maintained illuminance ($m E$): Value below which the average illuminance on the specified surface should not fall.
- 5 Unified glare rating (UGR): The CIE discomfort glare measure.
- 6 Limiting unified glare rating (UGRL): The maximum allowable design UGR value for the lighting installation.
- 7 Shielding angle: the angle measured from the horizontal, down to which the lamp(s) is screened by the luminaire from direct view by an observer.
- 8 Working plane: the reference surface defined as the plane at which work is usually done.

1. Lighting Design Criteria

(a) Luminous Environment

Good lighting practice for work places is more than just providing good task visibility. It is essential that tasks are performed easily and in comfort. Thus the lighting must satisfy the quantitative and qualitative aspects demanded by the environment. In general lighting is to ensure:

- visual comfort, where the workers have a feeling of well-being,
- visual performance, where the workers are able to perform their visual tasks, speedily and accurately even under difficult circumstances and during long periods,
- visual safety, to see one's way around and detect hazards.

To satisfy these, attention to all parameters contributing to the luminous environment is required.

The main parameters are:

- i. luminance distribution,
- ii. illuminance,
- iii. glare,
- iv. directionality of light,
- v. colour aspect of the light and surfaces,
- vi. flicker,
- vii. daylight,
- viii. maintenance.

(b) Luminance distribution

The luminance distribution in the field of view controls the adaptation level of the eyes, which affects task visibility.

A well balanced adaptation luminance is needed to increase:

- visual acuity (sharpness of vision),
- contrast sensitivity (discrimination of relatively small luminance differences)
- efficiency of the ocular functions (such as accommodation, convergence, pupillary contraction, eye movements, etc.).

Diverse luminance distribution in the field of view also affects visual comfort and should be avoided:

- too high luminances can give rise to glare.
- too high luminance contrasts will cause visual fatigue due to continuous readaptation of the eyes.
- too low luminances and too low luminance contrasts result in a dull and non stimulating working environment.
- attention should be given to adaptation in moving from zone to zone within a building.

The luminances of all surfaces are important and will be determined by the reflectance of and the illuminance on the surfaces. The range of useful reflectances for the major interior surfaces are:

- ceiling: 0.6 – 0.9
- walls: 0.3 – 0.8
- working planes: 0.2 – 0.6
- floor: 0.1 – 0.5

(c) Illuminance

The illuminance and its distribution on the task areas and the surrounding area have a major impact on how quickly, safely and comfortably a person perceives and carries out the visual task. For spaces where the specific area is unknown the area where the task may occur is taken as the task area.

All values of illuminances specified in this standard are maintained illuminances and will provide for visual safety at work and visual performance needs.

The value of illuminance may be adjusted, by at least one step on the scale of illuminance, if the visual conditions differ from the normal assumptions.

The illuminance should be increased when:

- unusually low contrasts are present in the task,
- visual work is critical, - errors are costly to rectify,
- accuracy or higher productivity is of great importance,
- the visual capacity of the worker is below normal.

The required maintained illuminance may be decreased when:

- the details are of an unusually large size or high contrast,
- the task is undertaken for an unusually short time

The illuminance of immediate surrounding areas shall be related to the illuminance of the task area and should provide a well-balanced luminance distribution in the field of view. The maintained illuminance of the immediate surrounding areas may be lower than the task illuminance but shall not be less than the values given in the table below.

Task illuminance lux	Illuminance of immediate surroundings lux
> 750	500
500	300
300	200
<200	Same as task illuminance

Table 2.4. Standard Illuminance for Task Area and Surroundings

(d) Uniformity

The uniformity of the illuminance is the ratio of the minimum to average value. The illuminance shall change gradually. The task area shall be illuminated as uniformly as possible. The uniformity of the task illuminance shall not be less than 0,7. The uniformity of the illuminance of the immediate surrounding areas shall be not less than 0,5.

(e) Glare

Glare is the visual sensation produced by bright areas within the field of view and may be experienced either as discomfort glare or disability glare. Glare may also be caused by reflections in specular surfaces usually known as veiling reflections or reflected glare.

It is important to limit the glare to avoid errors, fatigue and accidents.

Disability glare is more common in exterior lighting but may also be experienced from spotlights or large bright sources such as a window in a relatively poorly lit space.

In interior workplaces discomfort glare usually arises directly from bright luminaires or windows. If the discomfort glare limits are met then disability glare is not usually a major problem.

The discomfort glare rating of the lighting installation shall be determined by the CIE Unified Glare Rating (UGR) tabular method, based on formula:

$$UGR = 8 \cdot \log \left[\frac{0.25 \sum \frac{L_{i,p}^2 \cdot \omega_i}{L_{a,p}^2} \right]$$

where

- $L_{a,p}$ is the background luminance (cd/m^2), - $L_{i,p}$ is the luminance of the luminous parts of each luminaire in the direction of the observer's eye (cd/m^2), - ω_i is the solid angle of the luminous parts of each luminaire at the observer's eye (steradian), - p is the Guth position index for each individual luminaire which relates to its displacement from the line of sight.

The UGR scale is: 13 - 16 - 19 - 22 - 25 - 28

Details of the UGR method are given in CIE 117 - 1995.

In this standard all UGR values in clause 5 are based on the standard observer's position which have been validated by the UGR tabular method at a 1:1 spacing to height ratio. The UGR data shall be corrected for the initial luminous flux of the lamps used. If the lighting installation is composed of different types of luminaires with different photometry and/or lamps, the determination of the UGR value shall be applied to every lamp/luminaire combination in the installation. The highest UGR value thus obtained shall be taken as typical value of the entire installation and shall conform to the UGR limit. All assumptions made in the determination of UGR shall be stated in the scheme documentation.

(f) Directionality

Directional lighting may be used to highlight objects, to reveal texture and improve appearance of people within the space. This is described by the term "modelling". Directional lighting of a visual task may also enhance its visibility.

i. **Modelling** :Modelling refers to the balance between diffuse and directional light. It is a valid criterion of lighting quality in virtually all types of interiors. The general appearance of an interior is enhanced when its structural features, the people and objects within it are lit so that form and texture are revealed clearly and pleasingly. This occurs when the light comes noticeably from one direction; the shadows formed are essential to good modelling and are formed without confusion.

ii. **Directional lighting of visual tasks**: Lighting from a specific direction can reveal details within a visual task, increasing their visibility and making the task easier to perform. Particularly important for fine textured tasks and scribes/grooves.

(g) Colour Aspects

The colour qualities of a near-white lamp are characterised by two attributes:

- the colour appearance of the lamp itself,
- its colour rendering capabilities, which affect the colour appearance of objects and persons illuminated by the lamp.

These two attributes must be considered separately.

- i. The “colour appearance” of a lamp refers to the apparent colour (lamp chromaticity) of the light it emits. It may be described by its correlated colour temperature. Lamps are usually divided into three groups according to their correlated colour temperature (T_{cp}).

Colour Appearance	Co-related Colour Temperature
Warm	Below 3300K
Intermediate	3300K to 5300K
Cool	5300K

Table 2.5. Colour Corrected Temperature

- ii. **Colour Rendering**
It is important for both visual performance and the feeling of comfort and well being that colours in the environment of objects and human skin are rendered naturally, correctly and in a way that makes people look attractive and healthy. To provide an objective indication of the colour rendering properties of a light source the general colour rendering index Ra has been introduced. The maximum value of Ra is 100. This figure decreases with decreasing colour rendering quality.

(h) Maintenance

The recommended lighting levels for each task are provided as maintained illuminance. Maintained illuminance depends on the maintenance characteristic of the lamp, the luminaire, the environment and maintenance programme.

The lighting scheme should be designed with overall maintenance factor calculated for the selected lighting equipment, space environment and specified maintenance schedule. The calculated maintenance factor should not be less than 0.70.

(i) Lighting of workstations with visual display terminals VDT

The lighting for the VDT work stations shall be appropriate for all tasks performed at the work station, e.g. reading from screen, printed text, writing on paper, keyboard work, etc.

For these areas therefore the lighting criteria and systems shall be chosen in accordance with activity area, task type and type of interior. The VDT screens and in some circumstances the keyboard can suffer from reflections causing disability and discomfort glare. It is therefore necessary to select, locate and manage the luminaires to avoid disturbing high brightness reflections.

The designer shall determine the offending mounting zone and shall choose suitable luminance controlled equipment and plan mounting positions which will cause no disturbing reflections.

The luminance limits for downward flux of luminaires which maybe reflected in the VDT screens for normal viewing directions are shown in the table below. The limits of the average luminaire luminance are given at elevation angles of 65° and above from the downward vertical radially around the luminaires for work places where display screens which are vertical or inclined up to 15° tilt angle are used.

Screen classes see ISO 9241-7	I	II	III
Screen quality	Good	medium	Poor
Limit of average luminance of luminaires	$\leq 1000 \text{ cd}/\square^2$		$\leq 200\text{cd}/\square^2$

Table 2.6. Limit of average luminance of luminaires

(j) Flicker and stroboscopic effect

Flicker causes distraction and may give rise to physiological effects such as headaches. The lighting system should be designed to avoid flicker and stroboscopic effects. Stroboscopic effects can lead to dangerous situations by changing the perceived motion of rotating or reciprocating machinery.

Table 2.7 THE SCHEDULE OF INTERIORS (AREAS) TASKS AND ACTIVITIES WITH SPECIFICATION OF ILLUMINANCE, GLARE LIMITATION AND COLOUR QUALITY

Type of interior, task or activity	□□ lux	UG□ □	□□	Remarks
1. General building areas				
Entrance halls	100	22	60	
Lounges	200	22	80	
Circulation areas and corridors	100	28	40	At exits and entrances provide a transition zone and avoid sudden changes.
Stairs, escalators, travellers	150	25	40	
Loading ramps/bays	150	25	40	
Canteens	200	22	80	
Rest rooms	100	22	80	
Rooms for physical exercise	300	22	80	
Cloakrooms, washrooms, bathrooms, toilets	200	25	80	
Sick bay	500	19	80	
Rooms for medical attention	500	16	90	□□□ at least 4000 K
K Plant rooms, switch gear rooms	200	25	60	
Post room, switchboard	500	19	80	
Store, stockrooms, cold store	100	25	60	200 lux if continuously occupied
Dispatch packing handling areas	300	25	60	
Control station	150	22	60	200 lux if continuously occupied
2. Offices				
Filing, copying, circulation, etc	300	19	80	
Writing, typing, reading, data processing	500	19	80	
Technical drawing	750	16	80	
CAD workstation	500	19	80	
Conference and meeting rooms	500	19	80	Lighting should be controllable.
Reception desk	300	22	80	

2.1.3 ECBC – Energy Conservation Building Code 2017

The installed interior lighting power for a building or a separately metered or permitted portion of a building shall be calculated all power used by the luminaires, including lamps, ballasts, current regulators, and control devices and shall not exceed the interior lighting power allowance. Trade-offs of interior lighting power allowance among portions of the building for which a different method of calculation has been used are not permitted.

The following lighting equipment and applications shall not be considered when determining the interior lighting power allowance, nor shall the wattage for such lighting be included in the installed interior lighting power.

- (a) Display or accent lighting that is an essential element for the function performed in galleries, museums, and monuments,
- (b) Lighting that is integral to equipment or instrumentation and is installed by its manufacturer,
- (c) Lighting specifically designed for medical or dental procedures and lighting integral to medical equipment,
- (d) Lighting integral to food warming and food preparation equipment,
- (e) Lighting for plant growth or maintenance,
- (f) Lighting in spaces specifically designed for use by the visually impaired, (g) Lighting in retail display windows, provided the display area is enclosed by ceilingheight partitions,
- (h) Lighting in interior spaces that have been specifically designated as a registered interior historic landmark,
- (i) Lighting that is an integral part of advertising or directional signage,
- (j) Exit signs,
- (k) Lighting that is for sale or lighting educational demonstration systems, (l) Lighting for theatrical purposes, including performance, stage, and film or video production, and
- (m) Athletic playing areas with permanent facilities for television broadcasting.

Interior Lighting Power allowance (watts) can be calculated by

- a. Building Area Method
- b. Space Function Method

A. Building Area Method

Determination of interior lighting power allowance (watts) by the building area method shall be in accordance with the following:-

- i. Determine the allowed lighting power density for each appropriate building area type.
- ii. Calculate the gross lighted carpet area for each building area type.
- iii. The interior lighting power allowance is the sum of the products of the gross lighted floor area of each building area times the allowed lighting power density for that building area type.

Office Building (ECBC Buildings) – LPD is 9.50 W/

B. Space Function Method

Determination of interior lighting power allowance (watts) by the space function method shall be in accordance with the following:

- (a) Determine the appropriate building type and the allowed lighting power density from Table for ECBC Buildings. In cases where both a common space type and building specific space type are listed, building specific space type LPD shall apply.

(b) For each space, enclosed by partitions 80% or greater than ceiling height, determine the gross carpet area by measuring to the face of the partition wall. Include the area of balconies or other projections. Retail spaces do not have to comply with the 80% partition height requirements.

(c) The interior lighting power allowance is the sum of the lighting power allowances for all spaces. The lighting power allowance for a space is the product of the gross lighted carpet area of the space times the allowed lighting power density for that space.

Category	LPD (W/□ ²)	Category (Common Space Type)	LPD (W/□ ²)
Conference/ Meeting	11.5	Enclosed	10.0
Corridor/Transition	7.10	Banking Activity Area	12.6
Lobby	9.10	Open Plan	10.0
Storage	6.80	Service/Repair	6.8
Electrical/Mechanical	7.10	Food Preparation	12.1
Stairway	5.50	Hotel Dining	7.30

Table 2.8. Interior Lighting Power for ECBC Buildings – Space Function Method

**CHAPTER 3
LIGHTING DESIGN &
CALCULATIONS**

3.1 Powerful Tool for Lighting Design: Co-efficient of Utilization

The average illuminance in a space, E_{av} , is equal to the luminous flux per unit area,

$$E_{av} = \frac{\Phi}{A}$$

where Flux is expressed in lumens, and the area may be in square meters. If the SI system is used, the area will be in square meters and the unit of illuminance is the Lux.

A more practical approach recognizes that not all of the lumens produced by a lamp will reach the workplane. In design calculations, since the number of luminaires is determined to produce a specified illuminance, the percentage of lamp lumens which actually reach the workplane (CU) must be factored into the calculation.

Co-efficient of Utilization is the percentage of lamp lumens which reach the workplane, and are used to determine the number of luminaires required to light the room. The CU of a fixture is specified to that fixture, and will vary as a function of three factors: the physical characteristics of the luminaire, the room proportions (ratio of vertical wall surface area to horizontal surface area), and the percentage of light which is reflected by room surfaces.

3.1.1 Steps to Compute Coefficient of Utilization

1. Tables of COU are developed using candela distribution data obtained from photometric tests. These data are then mathematically reduced to tabular form.
2. The calculation consists of two basic parts:
 - a. The determination of percentage of lamp lumens which travel directly downward to the work plane
 - b. The determination of percentage of lumens which will be reflected to the workplane by the room surface.
3. For a symmetrical distribution fixture, to determine the CU, two things are mandatory:-
 - a. Candela at various angles since coefficient of utilization represents percentage of lamp lumens reaching the workplane.
 - b. Angles at which the lumens are emitted, because light at high angles has a higher probability of striking a wall than light which travels more nearly downward.
4. In practical viewport, it is not possible to determine the flux at each angle surrounding the luminaire and converting to lumens, so the area surrounding the luminaire is divided into series of conic solid angles.
5. Each solid angle creates a band with its mid-point corresponding to the angle. The flux contained within each band can be determined using

$$\Phi = 2\pi I (\cos \alpha_1 - \cos \alpha_2)$$
 Where α_1 and α_2 are the angles which define the zone and I is the mid zone intensity.
6. This $2\pi I (\cos \alpha_1 - \cos \alpha_2)$ is known as zonal constants which when multiplied by mid zone intensity yield lumens contained in the zone.

$$\Phi_{zone} = I_{zone} \cdot (\text{Zonal Constant})$$

Where,

- Φ = zonal lumens
- I = mid-zone intensity
- N = zone

7. This mid zone intensity or average intensity for each vertical angle can be found from :

$$I_{av} = \frac{I_0 + 2I_{22.5} + 2I_{45} + 2I_{67.5} + I_{90}}{8}$$

The value of I in the equation is obtained by averaging the intensities for all planes in which measurements are taken. For example, assume that a fluorescent luminaire was photometered in 0°, 22.5°, 45°, 67.5°, 90° planes. For purpose of calculation the luminaire is assumed to have both X- axis symmetry and Y-axis symmetry, so the intensity at 0° will equal the intensity at 180°. The intensity at 22.5° will be same at 112.5°, 202.5° and 292.5°. The intensity at 45° and 67.5° will have similar symmetry at corresponding angles at other three quadrants.

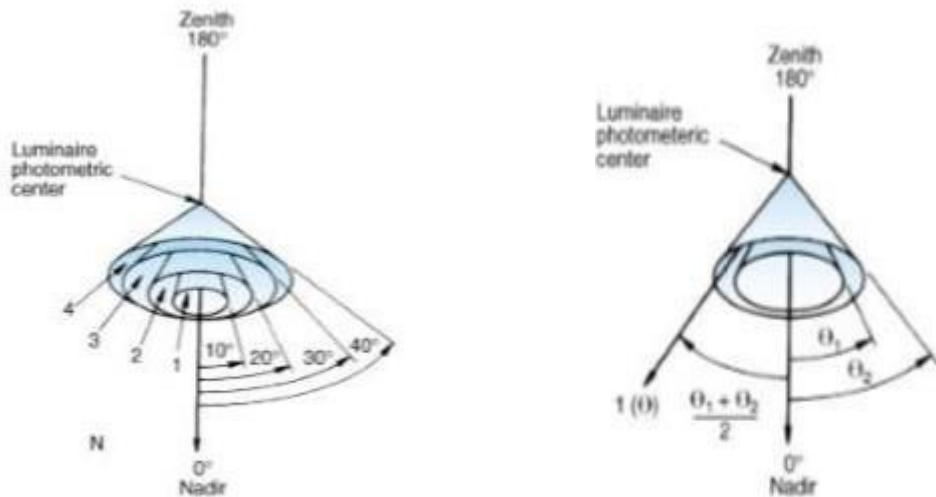


Fig 3.1 Conic solid angle zones of 10° width for use in calculating zonal flux.

8. Downward flux , upward flux and the total flux from the luminaire can be found from:

$$\text{Downward flux} = \sum_{\theta=1}^9 2\pi I (\cos \theta_1 - \cos \theta_2)$$

Or more simply stated,

$$\text{Downward flux} = \sum_{\theta=1}^9 I_{\theta} \cdot (\cos \theta_1 - \cos \theta_2)$$

And,

$$\text{Upward flux} = \sum_{\theta=10}^{18} 2\pi I (\cos \theta_1 - \cos \theta_2)$$

Or more simply stated,

$$\text{Upward flux} = \sum_{\theta=10}^{18} I_{\theta} \cdot (\cos \theta_1 - \cos \theta_2)$$

(Considering 10° lumens)

The total luminaire lumens is the sum of downward and upward lumens.
The fixture efficiency may be calculated from

$$\text{Efficiency} = \frac{(\text{Downward flux} + \text{Upward flux})}{\text{Total lumens}}$$

9. Computation of fractional downward flux (\square_{\square}) and fractional upward flux (\square_{\square})

$$\begin{aligned} \phi_{\square} &= \frac{1}{\phi} \sum_{\square=1}^9 \phi_{\square} \\ &= \frac{1}{\phi} \sum_{\square=10}^{18} \phi_{\square} \end{aligned}$$

Where ϕ_{\square} is zonal lumens for \square^{th} Capital Zone
 ϕ is the total lamp lumens installed in the luminaire

$$\begin{aligned} \phi_{\square} &= (\text{Total downward lumens}) / (\text{Total lamp lumens}) \\ \phi_{\square} &= (\text{Total upward lumens}) / (\text{Total lamp lumens}) \end{aligned}$$

10. Computation of Direct Ratio

Some percentage of lamp lumens from each fixture travels directly to the workplane. This is called direct ratio.

$$\phi = \frac{1}{\phi} \sum_{\square=1}^9 \phi_{\square}$$

Where,

- ϕ_{\square} = fractional downward flux
- ϕ = total lamp lumens
- G = room cavity ratio
- ϕ_{\square} = zonal multiplier

The Zonal multiplier (ϕ_{\square}) represents the flux contained in each zoneN i.e. directly incident on the work plane. It depends on RCR (Room Cavity Ratio) and can be calculated from $\phi_{\square} = A \cdot B^{\square}$. A, B are the zonal multiplier constants which depend on the zone number N.

This completes the basis for calculating the direct component of the coefficient of Utilization.

11. The Reflected component is based on the flux transfer theory to determine the percentages of the flux which will reach the workplane from the walls, ceiling and floor. This ratios are called ϕ_1 , ϕ_2 and ϕ_3 respectively, and are functions of the surface reflectances, Room Cavity Ratio and the Form Factor $\phi_{2 \rightarrow 3}$. They are calculated from

$$\phi_1 = \frac{(1-\rho_1)(1-\rho_{2 \rightarrow 3}^2)\phi}{2.5\rho_1(1-\rho_{2 \rightarrow 3}^2) + \rho_{2 \rightarrow 3}(1-\rho_1)}$$

$$\phi_2 = \frac{(1-\rho_2)(1+\rho_{2 \rightarrow 3}^2)}{1+\rho_2\rho_{2 \rightarrow 3}}$$

$$\phi_3 = \frac{(1-\rho_3)(1+\rho_{2 \rightarrow 3}^2)}{1+\rho_3\rho_{2 \rightarrow 3}}$$

$$\phi_0 = \phi_1 + \phi_2 + \phi_3$$

Where,

$\square_{2 \rightarrow 3}$ is approximated from:

$$\square_{2 \rightarrow 3} = 0.026 + 0.503 \square^{(-0.270 \square \square \square)} + 0.470 \square^{(-0.119 \square \square \square)}$$

The coefficient of utilization can then be calculated from:

$$CU = \frac{2.5\rho_1\rho_1\rho_3(1-\rho_0)\rho_0}{\rho_0(1-\rho_1)(1-\rho_3)\rho_0} + \frac{\rho_2\rho_2\rho_3\rho_0}{(1-\rho_2)(1-\rho_3)\rho_0} + \left[1 - \frac{\rho_3\rho_3(\rho_1+\rho_2)}{(1-\rho_3)\rho_0}\right] \frac{\rho_0\rho_0}{1-\rho_3}$$

Where ρ_1 , ρ_2 and ρ_3 are the reflectances of the walls, floor, and ceiling, respectively.

RCR	$\rho_{\text{floor}} = 20$							
	$\rho_{\text{ceiling}} = 80$			70			50	
	$\rho_{\text{wall}} = 70$	50	30	70	50	30	50	30
0	75	75	75	73	73	73	70	70
1	71	69	68	70	68	66	65	64
2	67	64	61	66	63	61	61	59
3	64	59	56	62	58	55	57	54
4	60	55	51	59	54	51	53	50
5	56	50	46	55	50	46	49	45
6	53	47	43	52	46	42	45	42
7	50	43	39	49	43	39	42	38
8	46	39	35	45	39	35	38	35
9	43	36	32	42	36	32	35	31
10	40	33	29	39	33	29	32	28

3.2 POINT CALCULATION METHOD

Point calculation methods are used to predict the illuminance at a specific location. This information may be required for a variety of reasons :- (a) to assure that sufficient illuminance has been provided at a specific point in the space; (b) to evaluate uniformity of illumination or luminance ratios; or in the illumination of vertical surfaces such as warehouse stacks where average illuminance calculation methods do not apply.

Point calculation methods may be used for both indoor and outdoor lighting.

For indoor applications the illuminance at a point consists of two components: light that travels directly from the luminaire to the point, called the direct component and the light that is reflected to the point by room surfaces, called the reflected component.

3.2.1 Direct Component

When the illuminance is desired at only a few points, and the number of luminaires which contribute to the illuminance at that point is small, the calculations may be done manually using the Inverse Square Law. If the illuminance at an array of points is desired or the number of luminaires is large, the calculations are best performed by computer because a large number of reductant calculations is required.

Inverse Square Law

The inverse square law is the most widely used method of calculating the illuminance at a point. The horizontal illuminance at a point which is normal to the source as in fig.

$$E = \frac{\phi}{\pi^2} \text{ or } \frac{\phi \cos^3 \theta}{\pi^2 r^2}$$

The illuminance must frequently be calculated on a plane which is not normal to the source. In these cases the use of the inverse square law would yield an erroneous illuminance because the area which the flux is distributed is greater than one square meter and a correction must be made.

Points at which the illuminance is to be calculated are not always in a plane which is normal to the light source. When the point at which the illuminance is to be calculated is not in a plane normal to the source the flux spreads out to cover a wider area.

The area of plane B is trigonometrically related to the area of plane A, which is normal to the source, by

$$\text{Area of Plane B} = \frac{\text{Area of Plane A}}{\cos \theta}$$

And the illuminance is found from:

$$E = \frac{I \cos \theta}{D^2}$$

This is called the “Cosine Law.”

When the illuminance at a point in a horizontal plane is to be determined, angle β is equal to angle θ , and the equation takes the form:

$$E = \frac{I \cos \theta}{D^2}$$

By the application of basic trigonometry, value of D from the source to the point can be determined.

$$D = \frac{H}{\cos \theta}$$

Where, D= distance from source to point

H= height of fixture above a horizontal plane containing the point.

And by substitution,

$$E = \frac{I \cos \theta}{(\frac{H}{\cos \theta})^2}$$

which, when simplified, yields a form which is much easier to use in practical applications:

$$E = \frac{I \cos^3 \theta}{H^2}$$

Note that the inverse square law assumes a point source: a source so infinitesimally small that it has no dimension. This does not exist in the real world, by the equation will produce acceptable accuracy as long as the maximum luminous dimension of the source does not exceed 1/5th of the distance from the luminaires to the point at which the illuminance is to be calculated .

a. Linear Sources

For linear sources with uniform luminance, such as bare fluorescent lamps, the illuminance at a point on a point on a line which is directly below the lamp,

$$E = \frac{L \cdot W}{2D}$$

Where,

- E = illuminance at the point in lux.
- M = exitance of the source in lm/sq. m
- W = width of the source
- D = distance from the source to the point

b. Circular Sources

The illuminance produced at a point directly below the centre of a Lambertian circular source, can be found from

$$E = M \frac{W^2}{4D^2}$$

If the point is not on the axis i.e. $\theta > 0$, the equation becomes

$$E = \frac{M(1 - \cos \theta)}{2}$$

3.2.2 Reflected Component

For interior lighting applications the component of illuminance that is reflected from room surfaces must be added to the direct component to determine the total illuminance. The calculation method is similar to the method used to determine average illuminance, except that the reflected radiation co-efficient (RRC) is substituted for the co-efficient of utilization used in horizontal illuminance calculations, and the wall reflected radiation co-efficient (WRRC) is used in place of the co-efficient of utilization for vertical surface calculations.

For horizontal surfaces the reflected illuminance is calculated from:

$$E = \frac{(\text{lumens per luminaire}) (\text{RRC}) (\text{LLF})}{\text{Area per luminaire}}$$

Where,

- RRC = WEC + RPM (CCEC – WEC)
- WEC = Wall Exitance co-efficient
- RPM = Room Position Multiplier
- CCEC = Ceiling Cavity Exitance Co-efficient

For vertical surfaces the reflected illuminance is calculated from:

$$E = \frac{(\text{lumens/ luminaire}) (\text{WRRC})}{\text{Area of Luminaire}}$$

Where,

$$\text{WRRC} = \frac{\rho_w}{1 - \rho_w} \text{WDRC}$$

Where,

ρ_w = wall reflectance,

WDRC = Wall Direct Radiation Co-efficient

CHAPTER 4
OFFICE LIGHTING DESIGN

The best lighting is integrated into the architecture of the space: enhancing the architect's conception of the space, reinforcing the activity occurring in the space, and highlighting prominent areas. When lighting commercial spaces, a "one size fits all" approach is unsuccessful, as different areas require different lighting needs. It is important to work on a space-by-space basis to determine specific lighting design criteria with enough flexibility for personal touch. The needs to be kept simple to avoid visual clutter; use a family of luminaires for cohesiveness in the design.

It is important to layer the light, ambient (general), task and accent to get the best balance of light in the space. Lighting uses about 30% of the electricity used in an office space. Dimming controls can also reduce energy costs by lowering light levels to conserve energy and increase lamp life and alter the intensity of light to suit particular tasks and activities.

4.1 Layers of Lighting

Layers of Lighting can be divided into following sections:

4.1.1 General Lighting

General lighting is the main source of illumination in a space. This uniform, base level of lighting can easily become the focus of energy reduction, as the light levels from other fixtures can be lowered, especially when using LED sources. It should provide the area with overall illumination; more specifically for orientation, general tasks, and to control contrast ratios. Diffused general lighting ensures a sense of well-being, which makes employees feel comfortable.

A simple way to achieve this is by arranging recessed fixtures using reflectors, baffles, and lensed trims in overlapping positions.

4.1.2 Task Lighting

Task lighting is most effective when used as a supplement to general lighting in workspaces, conference areas and on counter tops. Effective task lighting should eliminate shadows on the specific illuminated area, while preventing glare from the lamp or off surfaces. Glare impedes office work, and is easy to control by increasing the brightness of surrounding areas, decreasing the brightness of the glare source, or both.

A 3:1 ratio of task lighting to general illumination provides a nice contrast. The amount of light needed on the task, or luminance, is usually the most flexible variable of task lighting, and can be increased to compensate for low contrast levels. For office spaces, utilizing a generally low level of ambient light with strategically placed task luminaires is an ideal solution. Using this combination, the optimal seeing conditions in the work environment are met, and energy is conserved since the high-level illumination is provided only where it is needed.

4.1.3 Accent Lighting

Accent lighting reinforces design aesthetics and creates a dramatic emphasis on shapes, textures, finishes, and colors using a focused, or point, light source or sources.

The key is to make this illumination more precise and of higher intensity than the surrounding ambient light. Track fixtures, recessed housings with adjustable trims and concealed adjustable illumination with point source lamps provide directional

control and are especially effective for accent lighting. The IESNA recommends a 5:1 ratio of accent lighting to ambient light to make objects stand out and create a significant visual effect.

4.1.4 Decorative Lighting

Decorative lighting serves a dual purpose: not only to contribute to the lighting layers in a commercial environment, but also to enhance the look of the space as a design element.

Decorative lighting includes pendants, sconces, chandeliers, table and floor lamps, and cylinders. Decorative lighting should complement and add visual interest to the interior, as well as provide or contribute to the overall lighting plan.

A typical office has reception area, corridors, private offices, open office area, board room, emergency & exit area. Etc.

4.2 Considerations for Office Lighting

- Size and shape of the space
- Traffic patterns through the space; there is almost always some type of task involved in each space and some tasks require more light than others.
- The ceiling height and shape: if light will be reflected off these surfaces and contribute to the ambient light level in the room.
- Color of the walls: darker walls absorb more light and may require higher levels of illumination. A light, bright office will reflect a better image of a company than a dull one.
- Art work and highlight areas: determining the pieces and places to be highlighted helps determine the number of accent lights needed.

4.3 Lighting of different areas of office

4.3.1 Reception area

The first impression of your business is often formed when visitors and potential customers enter your space. Lighting needs to compliment the architecture, provide a safe exterior- to-interior transition, and convey a strong corporate image. This area usually requires lighting two separate conditions: a task area for the receptionist as well as an area for waiting visitors.

Care should be taken to light the receptionist's face so they appear approachable. Lighting in the waiting area should be restful, but provide sufficient illuminance for simple tasks.

4.3.2 Corridors

The corridors throughout the office must remain illuminated for long, if not continuous, periods of time. To conserve energy, provide at least one-fifth the illuminance level of the surrounding areas. This is a safe, navigational level, and will not affect eye adaptation when moving in and out of the hallways. If the walls and ceilings are lit, the area will feel larger and more open. All corridors must have emergency lighting, as they are paths of egress.

4.3.3 Conference Rooms

The conference room serves many different functions: from video and power point presentations to brainstorming sessions, the lighting design needs to accommodate the range of activity occurring in the space. It is vital that the lighting in these spaces is designed for maximum flexibility and visual comfort. Appropriate task lighting needs to be provided for reading and writing at the table, and ample illumination on the people seated at the table also needs to be provided.

4.3.4 Open Plan Office Space

Open plan office space is a dynamic space where a wide variety of different tasks are carried out. The ambient light level in the open plan office needs to provide a comfortable, functional light and be lit consistently with the overall lighting plan. The furniture used in the space will have a major impact on the distribution characteristics and general luminance of the ambient lighting. Therefore, the task lighting in the space will provide the higher illuminance levels that are needed at task locations. The lighting should be distributed uniformly, avoiding hot spots and glare.

4.3.5 Private Office Space

Private offices are used for individual work as well as group meeting space. The ambient light in the room should be sufficient for navigation and conversation with adequate task lighting over the desk and

other work surfaces. Accent lighting can provide variety and interest, and serve a dual purpose by creating simple light patterns on the wall while highlighting artwork or other work-related material. This can be achieved with adjustable recessed housings or track heads.

4.3.6 Emergency & Exit Lighting

When general lighting systems fail, exit and emergency lighting direct the safe exit of the building's occupants. If no exit is required, the lighting should provide security and comfort until the general lighting can be restored.

CHAPTER 5
DESCRIPTION OF LUMINAIRE USED IN DESIGN

5.1 Luminaire Selection

For designing with Luminaires, the following criteria need to be considered.

- (i) Efficacy (lm/W)
- (ii) Wattage of Lamp
- (iii) Type of Lamp
- (iv) Luminous Flux coming from Lamp
- (v) Luminous Flux coming from Luminaire
- (vi) CRI
- (vii) CCT
- (viii) IP Rating
- (ix) Electrical Characteristics
- (x) Physical Characteristics
- (xi) Intensity Distribution of luminaire
- (xii) Housing material
- (xiii) Optic/Lens Material
- (xiv) Gear
- (xv) Weightage of Lamp
- (xvi) Mechanical Strength
- (xvii) Lamp Life (avg)

5.2 Technical Details of Conventional Luminaire Used:

I. Name of Lamp: Lineco TMS022-1x36W

- 1) Wattage: 36W
- 2) Ingress Protection Code: IP20
- 3) Mech. Impact Protection Code: IK02
- 4) Gear: HFS
- 5) Fixation point length Distance: 1500mm
- 6) Safety Class: Class I
- 7) System Lumen O/P: 2756lm
- 8) Weight: 1.077 kg
- 9) Rated Voltage: 230-240V

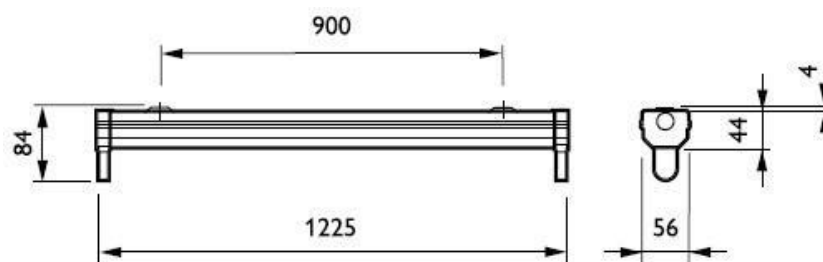


Fig. 5.1. Dimension Drawing of TMS022 1x36W



Fig.5.2 Image of TMS022-1x36W

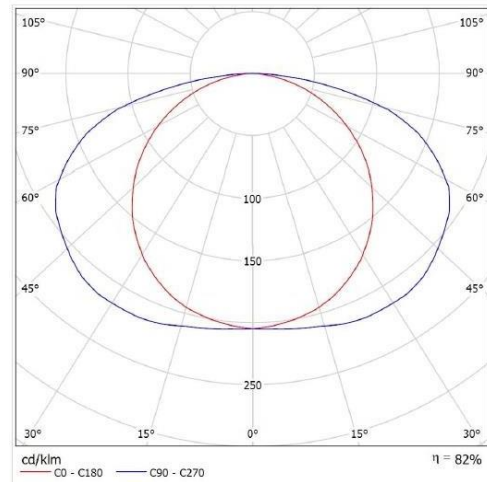


Fig. 5.3 Intensity Distribution Curve

II. Name of Lamp: CFL Downlighter NLP72340

- 1) Wattage: 19W
- 2) Ingress Protection Code: IP20
- 3) Base: E27
- 4) Cut Out Diameter: 125mm
- 5) Safety Class: Class I
- 6) System Lumen O/P: 441lm
- 7) Weight: 0.3 kg
- 8) Rated Voltage: 230- 240 V AC

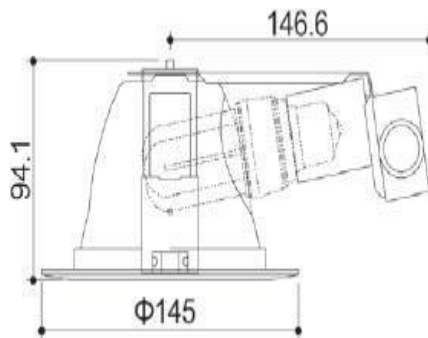


Fig. 5.4 Dimension Drawing of NLP73240

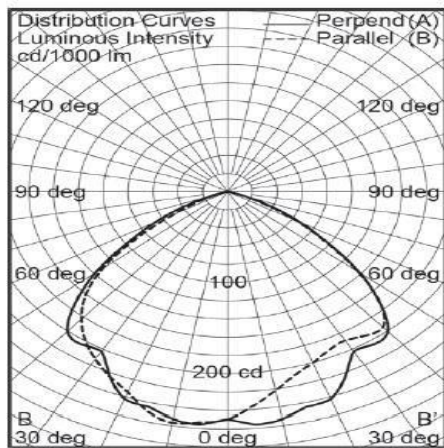


Fig. 5.5 Intensity Dimension Curve



Fig. 5.6 Image of NLP72340

III. Name of Lamp: CFL Downlighter NLP72432

- 1) Wattage: 25W
- 2) Ingress Protection Code: IP20
- 3) Base: E27
- 4) Cut Out Diameter: 150mm
- 5) Safety Class: Class I
- 6) System Lumen O/P: 410lm
- 7) Weight: 0.3 kg
- 8) Input Voltage: 220- 240 V AC



Fig. 5.7 Image of NLP72432

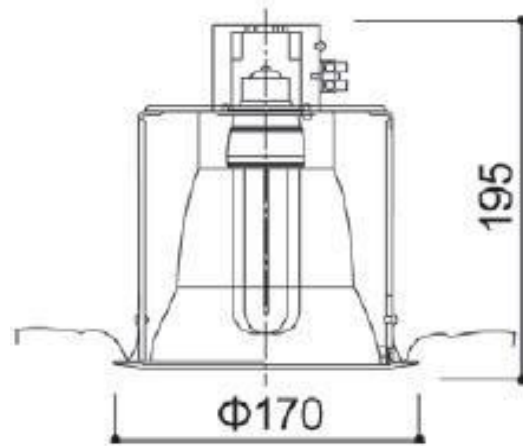


Fig. 5.8 Dimension Drawing of NLP72432

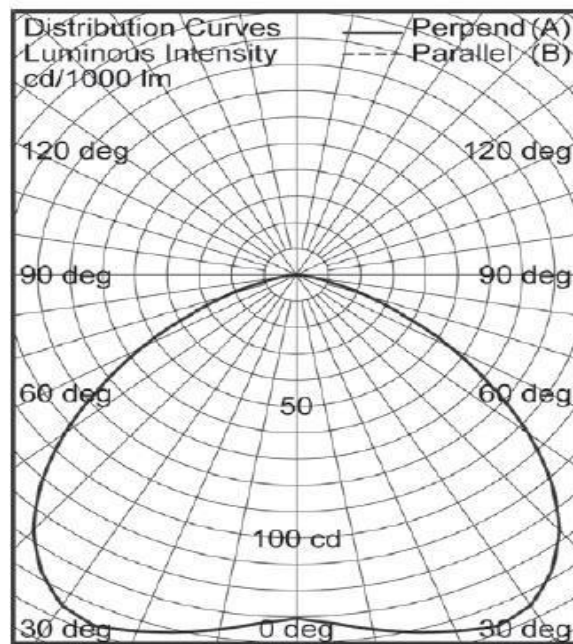


Fig. 5.9. Intensity Distribution Curve

IV. Name of Lamp: CFL Downlighter NLP72443

- 1) Wattage: 25W
- 2) Ingress Protection Code: IP20
- 3) Base: E27
- 4) Cut Out Diameter: 150mm
- 5) Safety Class: Class I
- 6) System Lumen O/P: 480lm

- 7) Weight: 0.4 kg
- 8) Input Voltage: 220- 240 V AC



Fig. 5.10 Image of NLP72443

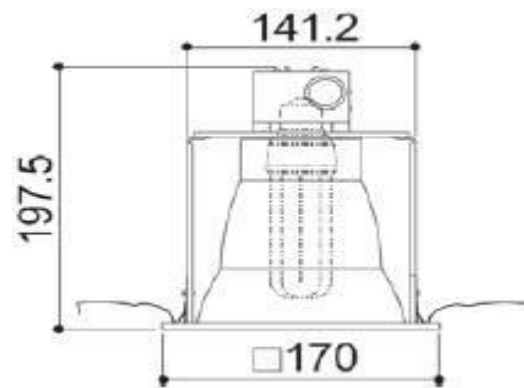


Fig. 5.11 Dimension Drawing of NLP72443

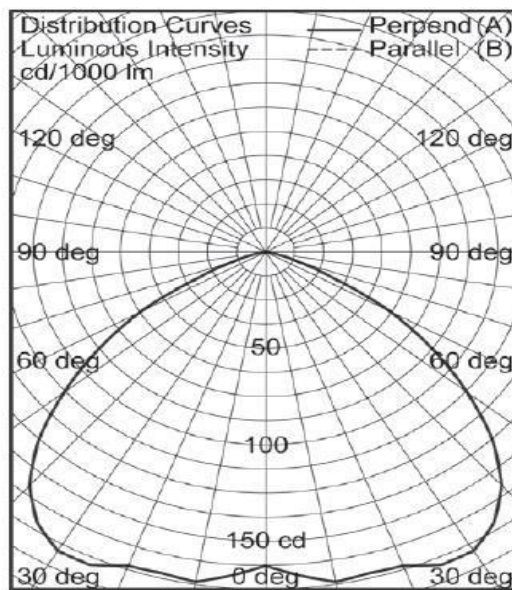


Fig 5.12 Intensity Distribution Curve of NLP2443

V. Name of Lamp: Lineco TMS022xTL-D18W HFS

- 1) Wattage: 18W
- 2) Ingress Protection Code: IP20
- 3) Gear: HFS
- 4) Fixation Point Length Distance : 900mm
- 5) Safety Class: Class I
- 6) System Lumen O/P: 1110lm
- 7) Weight: 0.645 kg
- 8) Input Voltage: 220- 240 V AC



Fig. 5.13 Image of TMS022

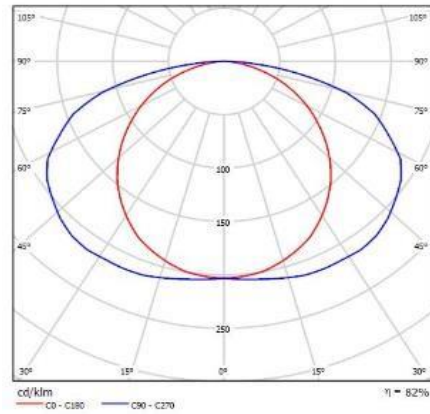


Fig. 5.14 Intensity Distribution Curve of Lineco TMS022

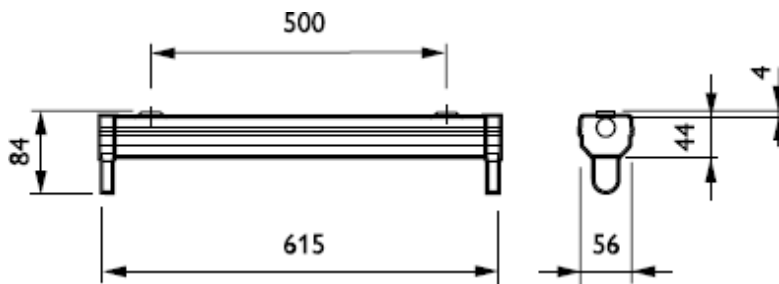


Fig 5.15 Dimension Drawing of Lineco TMS022xTL-D18W HFS

VI. Name of Lamp: CFL Ceiling Light NLP52603

- 1) Wattage: 22W
- 2) Ingress Protection Code: IP20
- 3) Cut Out Diameter : 300mm
- 4) Base Type: E27
- 5) Safety Class: Class I
- 6) System Lumen O/P: 1110lm
- 7) Weight: 0.5 kg
- 8) Input Voltage: 220- 240 V AC
- 9) CCT: 6500K
- 10) Lamp Life Average: 10000h



Fig. 5.16 Image of NLP52603

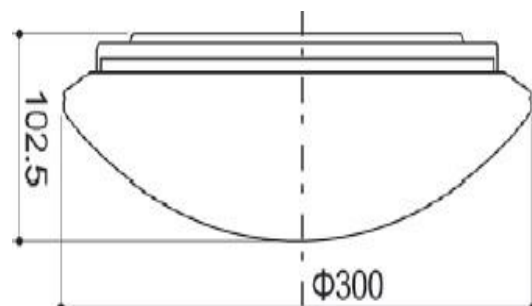


Fig.5.17 Dimension Drawing of NLP52603

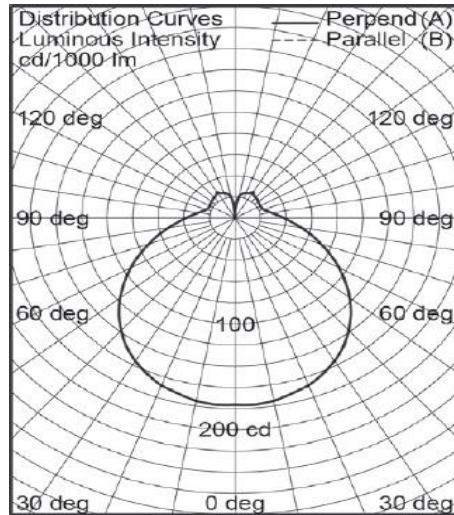


Fig. 5.18 Intensity Distribution Curve of NLP52603

5.3 Technical Details of LED Luminaire Used:

I. Name of Lamp: Luxspace2 Compact Low Height DN570B LED20S/830 PSED-VLC-E M WH

- 1) Wattage: 19W
- 2) Type of Fitting: Recessed Mounted
- 3) Ingress Protection Code: IP20
- 4) Mech. Impact Protection Code: IK02
- 5) CCT: 3000K
- 6) CRI: >80
- 7) Safety Class: Class II
- 8) System Lumen O/P: 1850lm
- 9) Weight: 1.080 kg
- 10) Rated Voltage: 220-240V
- 11) Luminaire efficacy: 97lm/W
- 12) Unified Glare Rating: 22
- 13) Inrush current (A): 20.4 A
- 14) Housing Material: Aluminium die cast
- 15) Reflector material: Polycarbonate aluminium coated
- 16) Optic material: Polycarbonate

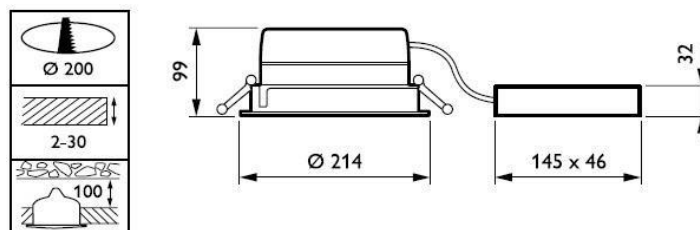


Fig. 5.19 Dimension Drawing of Luxspace2 Compact Low Height

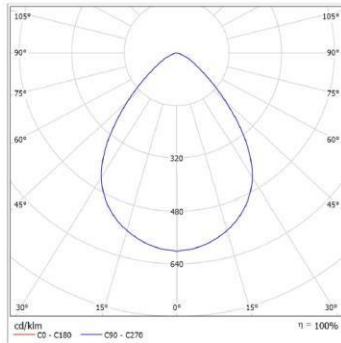


Fig. 5.20 Intensity Distribution Curve



Fig. 5.21 Image of Luxspace2 Compact Low Height DN570B

II. Name of Lamp: LUXSPACE 2 COMPACT LOW HEIGHT]DN570B LED12S/830 PSE-E C WH1

- 1) Wattage: 11W
- 2) Type of Fitting: Recessed Mounted
- 3) Ingress Protection Code: IP20
- 4) Mech. Impact Protection Code: IK02
- 5) CCT: 3000K
- 6) CRI: >80
- 7) Safety Class: Class II
- 8) System Lumen O/P: 1350lm
- 9) Weight: 1.080 kg
- 10) Rated Voltage: 220-240V
- 11) Luminaire efficacy: 123 lm/W
- 12) Unified Glare Rating: 22
- 13) Inrush current (A): 18 A
- 14) Housing Material: Aluminium die cast
- 15) Reflector material: Polycarbonate aluminium coated
- 16) Optic material: Polycarbonate

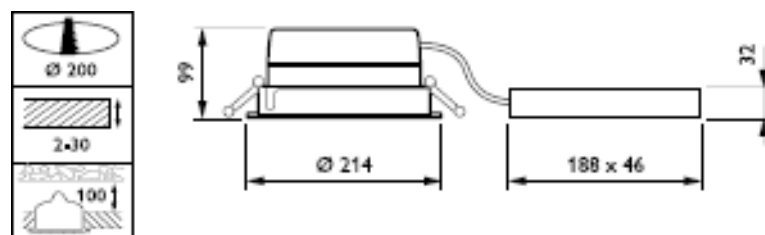


Fig 5.22 Dimension Drawing of Luxspace 2 Compact LED12S/830



Fig 5.23 Image of Luxspace 2 Compact

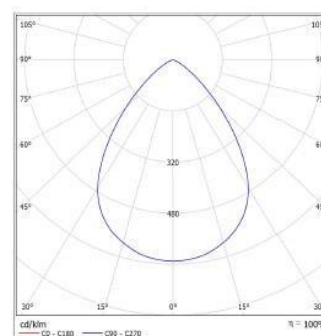


Fig 5.24 Intensity Distribution Curve

III. Name of Lamp: PowerBalance Gen2 RC461B G2 LED40S/840 PSD W60L60 VPC W

- 1) Wattage: 29W
- 2) Type of Fitting: Recessed Mounted Square Fitting (0.6 X 0.6)m
- 3) Ingress Protection Code: IP20
- 4) Mech. Impact Protection Code: IK02
- 5) CCT: 4000K
- 6) CRI: ≥ 80
- 7) Safety Class: Class I
- 8) System Lumen O/P: 4000lm
- 9) Weight: 4.7 kg
- 10) Rated Voltage: 220-240V
- 11) Luminaire efficacy: 140 lm/W
- 12) Unified Glare Rating: 16
- 13) Inrush current (A): 5 A
- 14) Housing Material: Steel
- 15) Reflector material: Polycarbonate
- 16) Lens material: Polycarbonate



Fig 5.25 Image of PowerBalance Gen2 LED40S/840

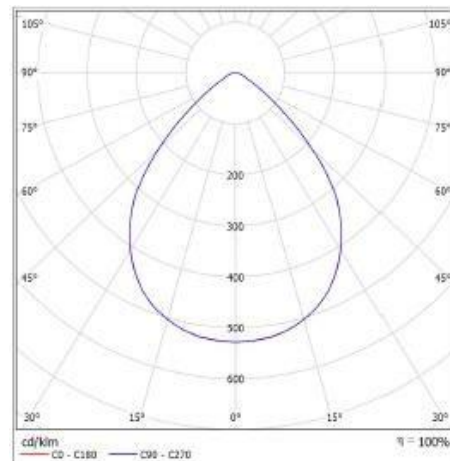


Fig 5.26 Intensity Distribution Curve

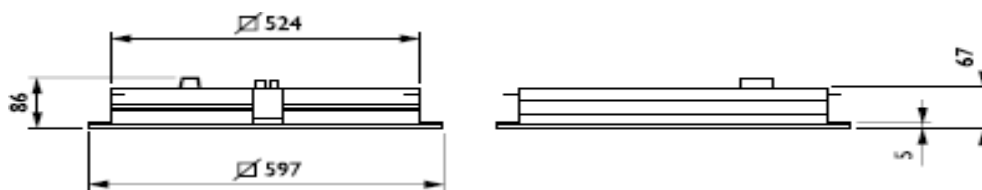


Fig 5.27 Dimension Drawing of PowerBalance Gen2 LED40S/840

VI. Name of Lamp: PowerBalance Gen2 RC461B G2 LED34S/840 PSD W60L60 VPC W

- 1) Wattage: 24W
- 2) Type of Fitting: Recessed Mounted Square Fitting (0.6 X 0.6)m
- 3) Ingress Protection Code: IP20
- 4) Mech. Impact Protection Code: IK02
- 5) CCT: 4000K
- 6) CRI: ≥ 80
- 7) Safety Class: Class I
- 8) System Lumen O/P: 3400lm
- 9) Weight: 4.7 kg
- 10) Rated Voltage: 220-240V

- 11) Luminaire efficacy: 142 lm/W
- 12) Unified Glare Rating: 16
- 13) Inrush current (A): 5 A
- 14) Housing Material: Steel
- 15) Reflector material: Polycarbonate
- 16) Lens material: Polycarbonate



Fig 5.28 Image of PowerBalance Gen2 LED34S/840

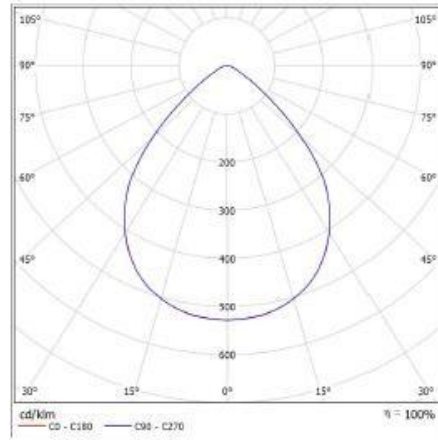


Fig 5.29 Intensity Distribution Curve

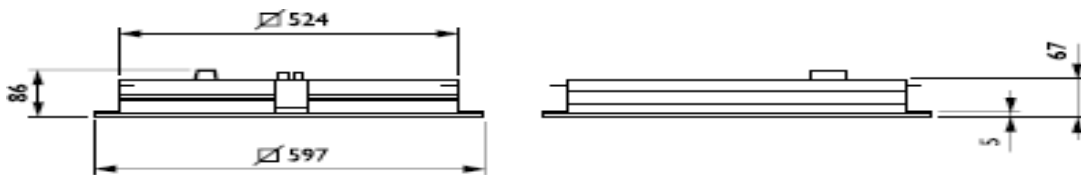


Fig 5.30 Dimension Drawing of PowerBalance Gen2 LED34S/840

V. Name of Lamp: Trueline Suspended SP530P LED40S/840 PSD PI5 SM2 L1130 ALU1)

- 1) Wattage: 29W
- 2) Type of Fitting: Linear Suspended Fitting (1130mm)
- 3) Ingress Protection Code: IP20
- 4) Mech. Impact Protection Code: IK02
- 5) CCT: 4000K
- 6) CRI: >=80
- 7) Safety Class: Class I
- 8) System Lumen O/P: 4000lm
- 9) Weight: 3.2 kg
- 10) Rated Voltage: 220-240V
- 11) Luminaire efficacy: 138 lm/W
- 12) Unified Glare Rating: 19
- 13) Inrush current (A): 0.19 A
- 14) Housing Material: Aluminium
- 15) Reflector material: Polycarbonate
- 16) Lens material: Polymethyl methacrylate

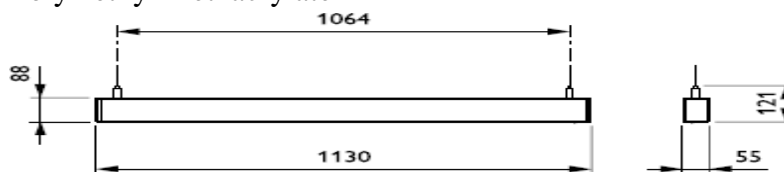


Fig 5.31 Image of Trueline Suspended



Fig 5.32 Dimension Drawing of Trueline Suspended

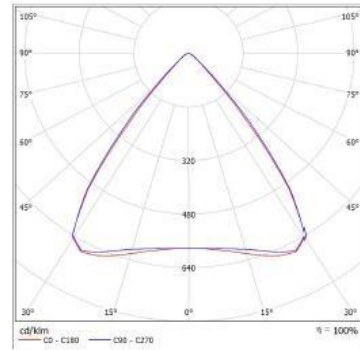


Fig 5.33 Intensity Distribution Curve

VI. Name of Lamp: CoreLine Batten BN124C LED21S/840 PSU TW1 L600)

- 1) Wattage: 19W
- 2) Type of Fitting: Linear LED Batten (600mm)
- 3) Ingress Protection Code: IP20
- 4) Mech. Impact Protection Code: IK02
- 5) CCT: 4000K
- 6) CRI: ≥ 80
- 7) Safety Class: Class I
- 8) System Lumen O/P: 2100 lm
- 9) Weight: 0.7 kg
- 10) Rated Voltage: 220-240V
- 11) Luminaire efficacy: 110 lm/W
- 12) Unified Glare Rating: 19
- 13) Inrush current (A): 0.29 A
- 14) Housing Material: Metal
- 15) Optical cover: Frosted
- 16) Lens material: Polycarbonate



Fig 5.34 Dimension Drawing of CoreLine Batten

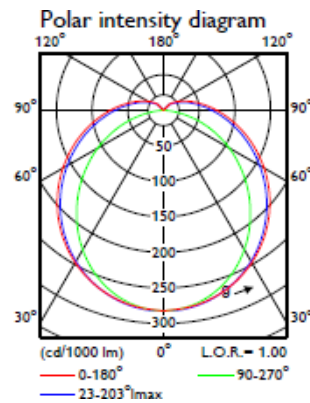


Fig 5.35 Intensity Distribution Curve

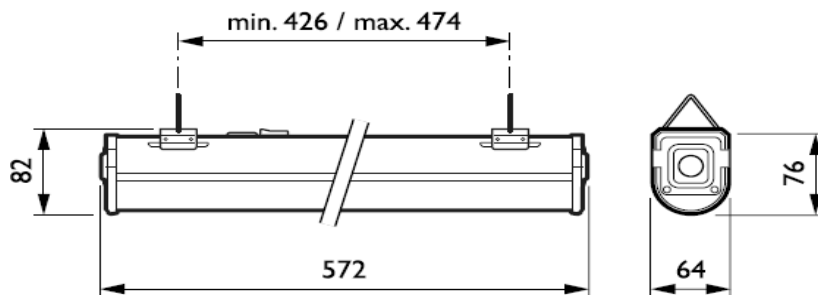


Fig 5.36 Image of CoreLine Batten

CHAPTER 6
INTRODUCTION TO DIALux 4.13

6.1 INTRODUCTION TO LIGHTING DESIGN SOFTWARE

There is a long list of Lighting design software DIALux, AGi 32, Lighting Reality pro, Relux, CGLux, Calculux, Photolux, Sunlux, Lumen Micro, Lumen Designer etc. All the lighting software is different, but the aim is same. The software is typically used by importing the structural design via CAD files. Then lighting elements are inserted. And finally, the lighting objects are associated with a photometry via IES files. The photometry of a light fixture describes the way it distributes its light into space. Once this process is completed, the illuminance and luminance produced by each fixture in the space can be calculated.

In Wipro lighting mostly DIALux software has been used for lighting design.

6.2 DIALux 4.13

DIALux is a 3D graphics software developed and distributed by DIAL GmbH in Lüdenscheid for indoor and outdoor lighting design. The software is available free of charge from the manufacturer's website. While designing, DIALux determines the energy of your light solution requires and supports you in complying with the respective national and international regulations. DIALux supports the luminaires of the world's leading manufacturers and therefore have the greatest possible freedom in the design process.

Benefits of DIALux:

- Simple, effective and professional light planning
- Support any photometric data file in required format(.ies)
- Latest photometric data files of the world's leading manufacturers
- Results can be compared with international standard result
- Dynamic light scenes with LED or other color changing luminaires
- Planning 3D model and simulate photometric data to any buildings, landscape, façade or roadway model
- CAD file can be imported or exported

6.3 AUTOCAD 2016

AutoCAD is a commercial computer-aided design (CAD) and drafting software application.

Developed and marketed by Autodesk, AutoCAD was first released in December 1982 as a desktop app running on microcomputers with internal graphics controllers

AutoCAD is used in the industry, by architects, project managers, engineers, graphic designers, city planners and other professionals.

Chapter 7
Comparative Case Studies of Different Offices with
Conventional & LED Luminaires

7.1 Introduction

In this project we will study about the lighting systems of 10 different office layouts with arrangements of conventional luminaires and LED luminaires. A typical office interior consists of reception, meeting rooms, conference rooms, board meeting rooms, cabins, cafeterias, pantry, toilets etc.

7.2 Case Study –I : Lighting design of Office A Ahmedabad

This office A_Ahmedabad is a small office of floor area 211.47m^2 having a reception area followed by a corridor. There is a meeting room beside the reception. On the right side of the entrance there is a conference room. Then comes a technical workstation straight from the main entrance. There are all total six cabins. There are pantry, gents & ladies toilet. The fig. 6.1 shows the layout of office A_Ahmedabad.

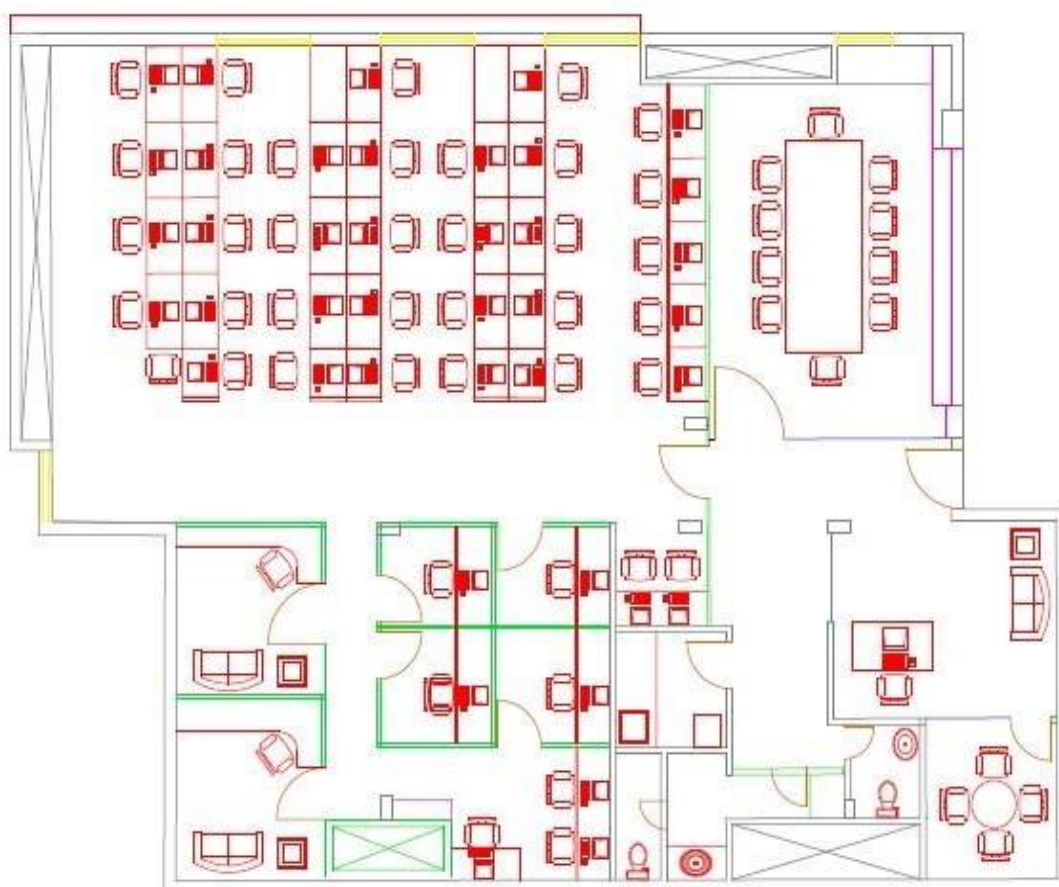


Fig. 7.1 Typical Layout of Office A_Ahmedabad

7.2.1 Lighting Design with Conventional Luminaires

- a. Input Design parameters are considered according to the Standards.
 - Ceiling Reflectance = 80%
 - Wall Reflectance = 50%
 - Floor Reflectance = 20%
 - Light Loss Factor = 0.8
 - Workplane Height = 0.76 m

b. Conventional Luminaires used are as follows:-

- a. Linear Surface Mounted Batten of 36W- Lineco TMS022-1x36W
- b. CFL down lighters of 19 W
- c. CFL downlighters of 25W of higher lumen package
- d. CFL downlighters of 25W of lower lumen package

Conventional Lighting Design of Office A_Ahmedabad are as follows:

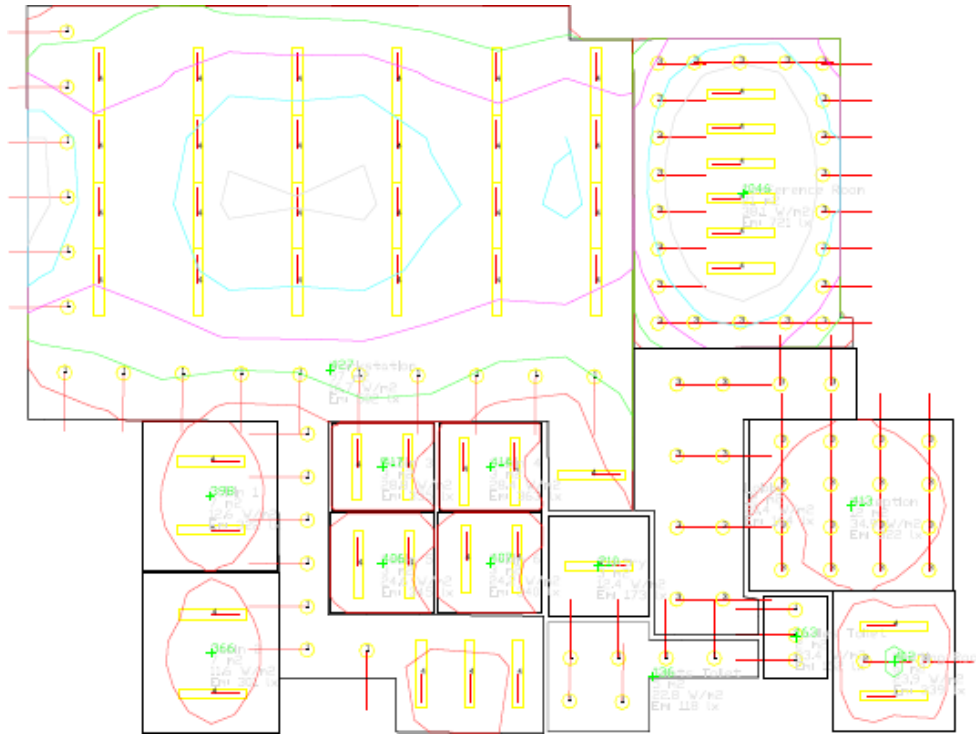


Fig 7.2 Conventional Luminaire Layout of Office A_Ahmedabad

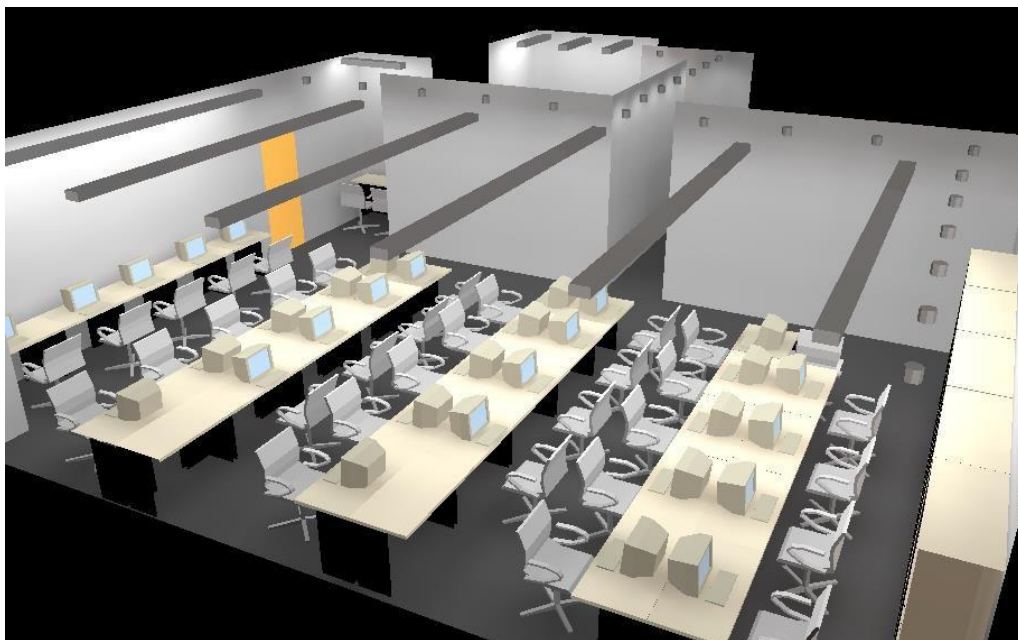


Fig 7.3 Image of the Workstation of Office A_Ahmedabad in Dialux

➤ Cabin 1

Floor Area : 6.65 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.5 m

Luminaire Used: Lineco TMS022 TMS022 1x36W +GMS022 R TL-D HFS (1.000)

No. of Luminaires used: 2

The lighting arrangement Followed : General Lighting

The design outputs are as follows:

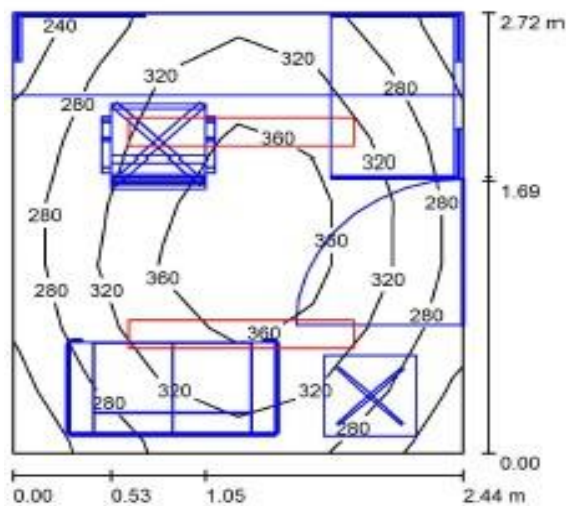
The lux level obtained after calculation is 322 lux.

Uniformity obtained : 0.742

Specific Connected Load: 12.63W/m²

The Technical Report of Cabin 1

Cabin 1 / Summary



Height of Room: 2.800 m, Mounting Height: 2.500 m, Light loss factor: 0.80 Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	322	239	393	0.742
Floor	20	122	10	234	0.085
Ceiling	80	94	69	112	0.730
Walls (4)	50	195	2.61	590	/

Workplane:

Height: 0.760 m
Grid: 6 x 7 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.768, Ceiling / Working Plane: 0.299.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 5512	Total: 6700	84.0

Specific connected load: 12.63 W/m² = 3.92 W/m²/100 lx (Ground area: 6.65 m²)

➤ **Cabin 2**

Floor Area : 7.26 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.5 m

Luminaire Used: Lineco TMS022 TMS022 1x36W +GMS022 R TL-D HFS (1.000)

No. of Luminaires used: 2

Lighting Arrangement Followed: General Lighting

The design outputs are as follows:

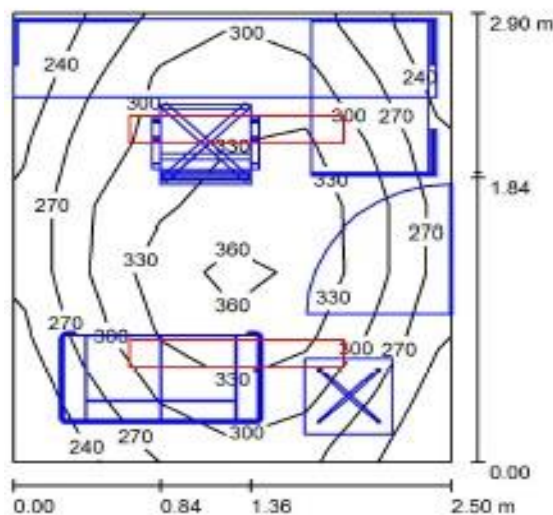
The lux level obtained after calculation is 301 lux.

Uniformity obtained : 0.738

Specific Connected Load: 11.57W/m²

The Technical report of Cabin 2

Cabin 2 / Summary



Height of Room: 2.800 m, Mounting Height: 2.500 m, Light loss factor: 0.80

Values in Lux, Scale 1:38

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	301	222	371	0.738
Floor	20	117	13	226	0.108
Ceiling	80	90	62	104	0.688
Walls (4)	50	187	4.88	585	/

Workplane:

Height: 0.760 m
 Grid: 7 x 8 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.766, Ceiling / Working Plane: 0.302.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 5512	Total: 6700	84.0

Specific connected load: 11.57 W/m² = 3.85 W/m²/100 lx (Ground area: 7.26 m²)

➤ **Workstation**

Floor Area: 96.62 m²

Height: 3 m

Mounting Height of the luminaire: 3 m

Luminaire Used:

a. Luminaire Used: Lineco TMS022 TMS022 1x36W +GMS022 R TL-DHFS

b. NLP72340 NLP72340 (1.000) (23 Nos.)

No. of Luminaires used: 51

Lighting Arrangement Followed : Localized General Lighting (IS-3646)

The design outputs are as follows:

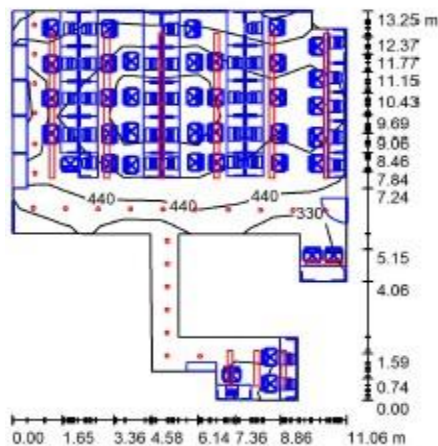
The lux level obtained after calculation is 502 lux.

Uniformity obtained : 0.489

Specific Connected Load: 16.74 W/m²

Technical Report of Workstation

Workstation / Summary



Height of Room: 3.000 m, Mounting Height: 3.000 m, Light loss factor: 0.80 Values in Lux, Scale 1:171

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	502	246	755	0.489
Floor	20	231	21	502	0.090
Ceiling	80	152	74	292	0.488
Walls (16)	50	259	16	1146	/

Workplane:

Height: 0.760 m
 Grid: 9 x 11 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.606, Ceiling / Working Plane: 0.306.

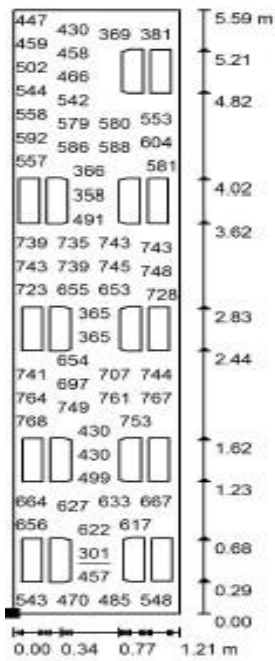
Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	23	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
2	28	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			87317	111280	1617.8

Specific connected load: 16.74 W/m² = 3.33 W/m²/100 lx (Ground area: 96.62 m²)

Since the localized general lighting arrangement is done, the uniformity cannot be achieved according to Standards. This is a technical workstation thus illuminance level has to be maintained as 500 lux. The task illuminance on workstation table top is achieved as 577 lux with uniformity of 0.521.

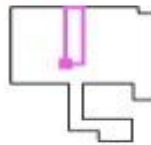
The technical report of the workstation table top is as follows:-



Values in Lux, Scale 1 : 44

Not all calculated values could be displayed.

Position of surface in room:
Marked point:
(2.430 m, 7.732 m, 0.760 m)



Grid: 32 x 128 Points

E_{av} [lx]
577

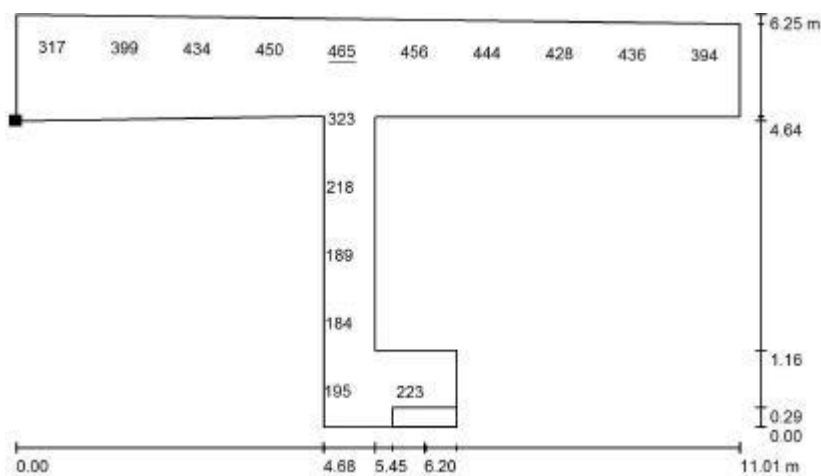
E_{min} [lx]
301

E_{max} [lx]
775

u_0
0.521

E_{min} / E_{max}
0.388

The lux level obtained from the passage area is 309 lux.



➤ **Pantry**

Floor Area : 3.38 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used: Lineco TMS022 TMS022 1x36W +GMS022 R TL-DHFS

No. of Luminaires used: 1

Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:

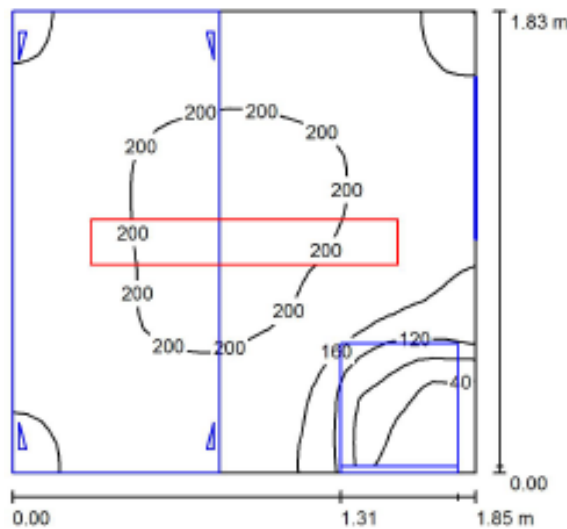
The lux level obtained after calculation is 173 lux.

Uniformity obtained : 0.12

Specific Connected Load: 7.17 W/m²

Technical Report of Pantry

Pantry / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:24

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	173	21	213	0.120
Floor	20	56	7.08	113	0.128
Ceiling	80	96	53	128	0.553
Walls (4)	50	156	1.77	411	/

Workplane:

Height: 0.760 m
 Grid: 32 x 32 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 1.197, Ceiling / Working Plane: 0.555.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 2756	Total: 3350	42.0

Specific connected load: 12.42 W/m² = 7.17 W/m²/100 lx (Ground area: 3.38 m²)

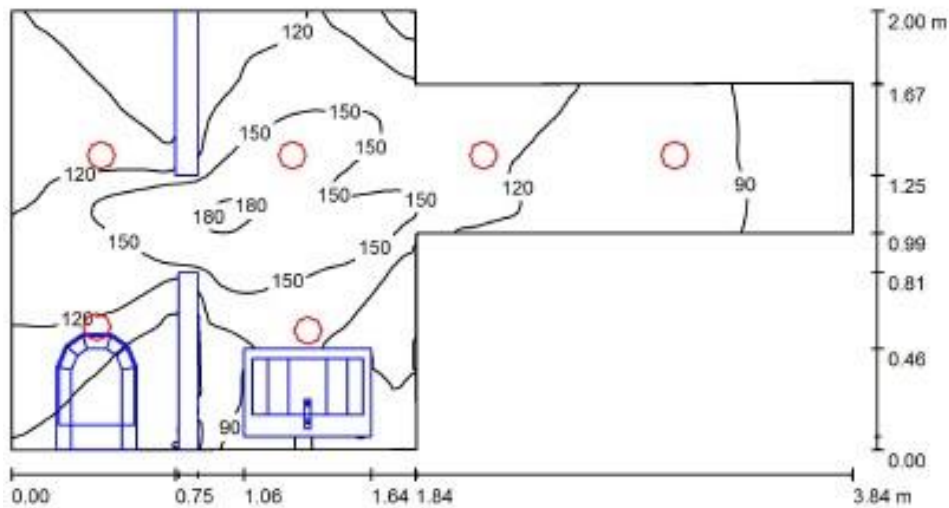
➤ **Gents Toilet**

Floor Area : 5.05 m²
 Height : 2.8 m
 Mounting Height of the luminaire: 2.8 m
 Luminaire Used: NLP72340 (1.000) (6 Nos.)
 No. of Luminaires used: 6
 Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:
 The lux level obtained after calculation is 118 lux.
 Uniformity obtained : 0.488
 Specific Connected Load: 22.83 W/m²

Technical Report of Gents Toilet

Gents Toilet / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80 Values in Lux, Scale 1:28

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0
Workplane	/	118	57	190	0.488
Floor	20	70	10	120	0.145
Ceiling	80	41	13	83	0.324
Walls (8)	50	75	8.00	430	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.791, Ceiling / Working Plane: 0.348.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	6	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
			Total: 2646	Total: 4560	115.2

Specific connected load: 22.83 W/m² = 19.40 W/m²/100 lx (Ground area: 5.05 m²)

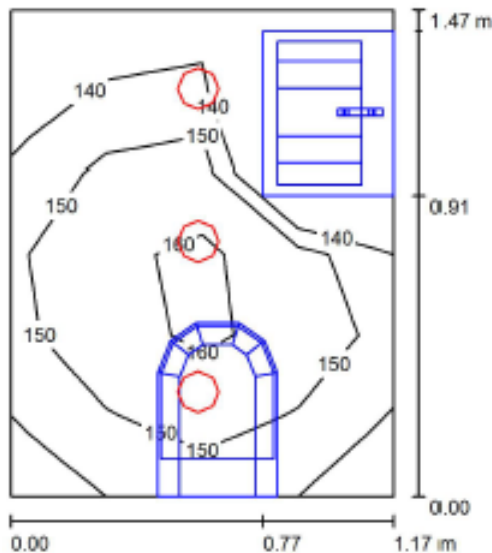
➤ **Ladies Toilet**

Floor Area : 1.73 m²
 Height : 2.8 m
 Mounting Height of the luminaire: 2.8 m
 Luminaire Used: NLP72340 (1.000) (3 Nos.)
 No. of Luminaires used: 3
 Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:
 The lux level obtained after calculation is 152 lux.
 Uniformity obtained : 0.877
 Specific Connected Load: 33.38 W/m²

Technical Report of Ladies Toilet

Ladies Toilet / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80 Values in Lux, Scale 1:19

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	152	133	164	0.877
Floor	20	71	22	91	0.307
Ceiling	80	72	49	94	0.681
Walls (4)	50	121	8.20	720	/

Workplane:

Height: 0.760 m
 Grid: 6 x 4 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 1.023, Ceiling / Working Plane: 0.483.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	3	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
Total:			1323	2280	57.6

Specific connected load: 33.38 W/m² = 21.98 W/m²/100 lx (Ground area: 1.73 m²)

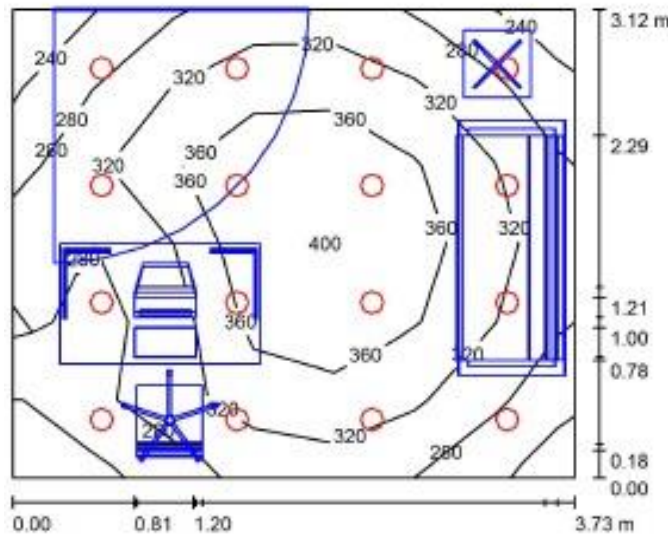
➤ **Reception**

Floor Area :11.63 m²
 Height : 2.8 m
 Mounting Height of the luminaire: 2.8 m
 Luminaire Used: NLP72443 (1.000) (3 Nos.)
 No. of Luminaires used: 16
 Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:
 The lux level obtained after calculation is 322 lux.
 Uniformity obtained :0.657
 Specific Connected Load: 34.94 W/m²

Technical Report of Reception

Reception / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:41

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	322	212	410	0.657
Floor	20	178	21	289	0.120
Ceiling	80	82	69	111	0.840
Walls (4)	50	174	19	361	/

Workplane:

Height: 0.760 m
 Grid: 7 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.620, Ceiling / Working Plane: 0.256.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	16	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
			Total: 7680	Total: 16000	406.4

Specific connected load: 34.94 W/m² = 10.84 W/m²/100 lx (Ground area: 11.63 m²)

➤ **Meeting Room**

Floor Area : 5.64 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

a. Lineco TMS022 TMS022 1x36W +GMS022 R TL-DHFS

b. NLP72340 NLP72340 (1.000) (2Nos.)

No. of Luminaires used: 4

Lighting Arrangement Followed : Localized General Lighting (IS-3646)

The design outputs are as follows:

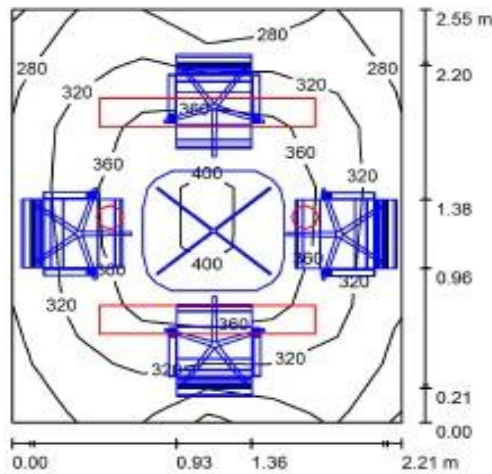
The lux level obtained after calculation is 339 lux.

Uniformity obtained : 0.646

Specific Connected Load: 23.90 W/m²

Technical Report of Meeting Room

Meeting Room / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:33

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	339	219	408	0.646
Floor	20	146	46	220	0.332
Ceiling	80	127	92	177	0.721
Walls (4)	50	267	35	736	/

Workplane:

Height: 0.760 m
 Grid: 7 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.973, Ceiling / Working Plane: 0.377.

Luminaire Parts List

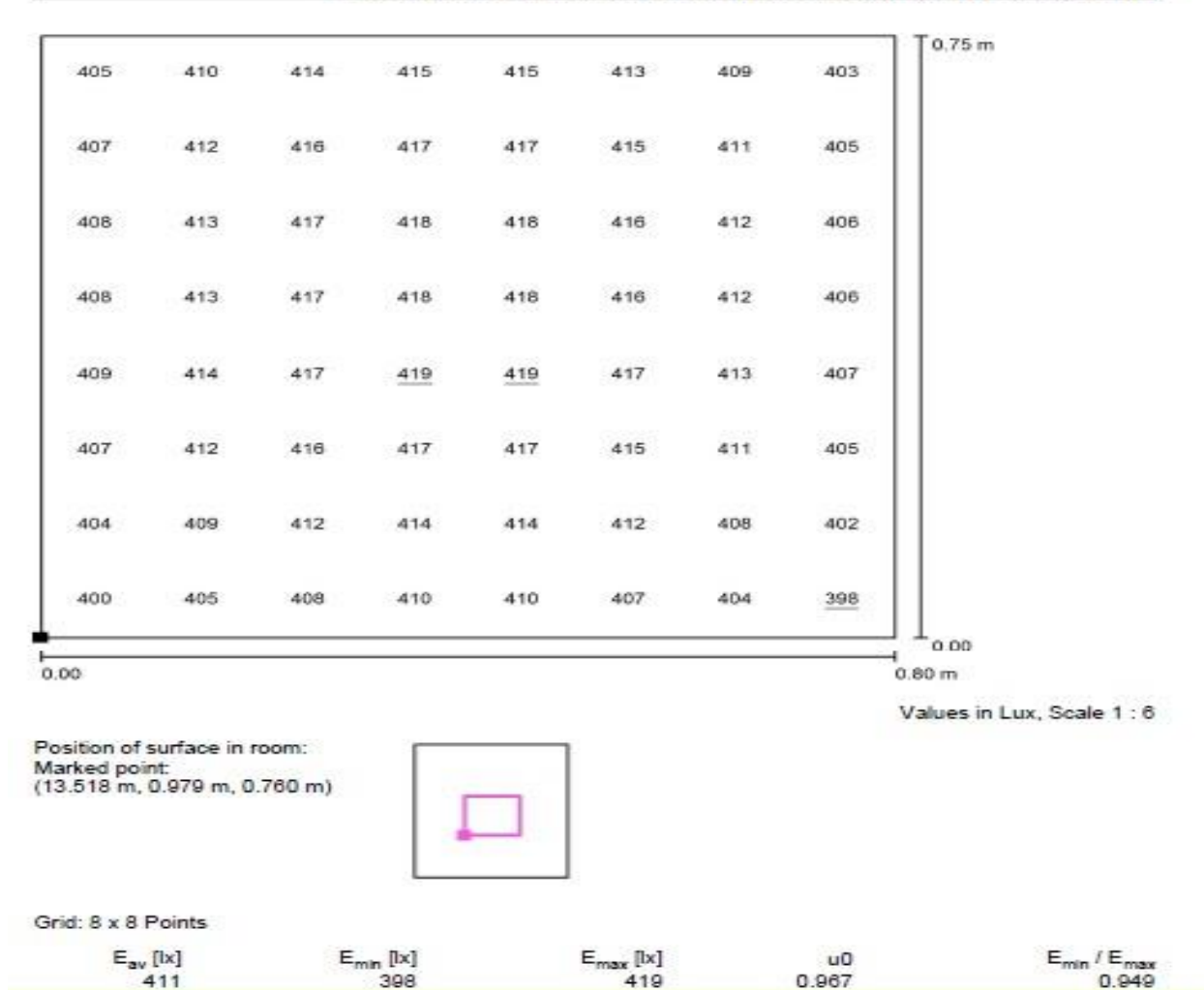
No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PANASONIC NLP72432 NLP72432 (1.000)	410	1000	25.4
2	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2766	3350	42.0
Total:			6333	8700	134.8

Specific connected load: 23.90 W/m² = 7.06 W/m²/100 lx (Ground area: 5.64 m²)

The Task illuminance of Table top of meeting room is obtained as 411 Lux and uniformity is 0.967.

Technical Report of Meeting Room(Table Top)

Meeting Room / Table Top / Value Chart (E, Perpendicular)



➤ **Conference Room**

Floor Area : 21.27 m²

Height : 2.8 m

Mounting Height of the luminaire:

The linear lights are suspended from the ceiling at a height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

- a. Lineco TMS022 TMS022 1x36W +GMS022 R TL-DHFS
- b. NLP72340 NLP72443

No. of Luminaires used: 28

Lighting Arrangement Followed : Localized General Lighting (IS-3646)

The design outputs are as follows:

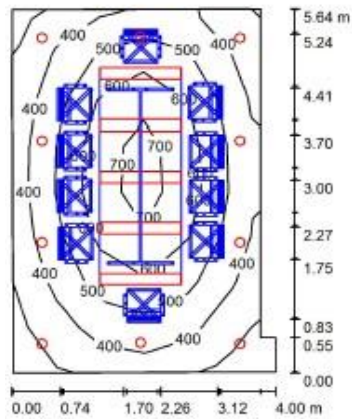
The lux level obtained after calculation is 721 lux.

Uniformity obtained : 0.576

Specific Connected Load: 38.12 W/m²

Technical Report of Conference Room

Conference Room / Summary



Height of Room: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:73

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	504	271	762	0.538
Floor	20	179	43	323	0.238
Ceiling	80	127	83	157	0.649
Walls (6)	50	267	72	607	/

Workplane:

Height: 0.760 m
 Grid: 6 x 8 Points
 Boundary Zone: 0.000 m

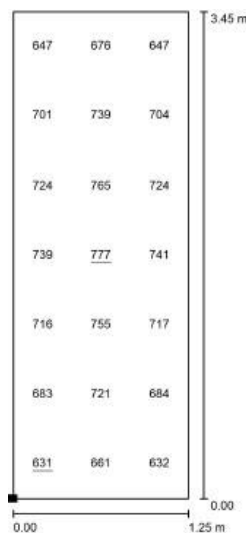
Illuminance Quotient (according to LG7): Walls / Working Plane: 0.597, Ceiling / Working Plane: 0.261.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	10	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	5	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			18585	26750	464.0

Specific connected load: $21.81 \text{ W/m}^2 = 4.33 \text{ W/m}^2/100 \text{ lx}$ (Ground area: 21.27 m^2)

The task illuminance achieved on the table top of Conference Room is 704 lux and the uniformity is 0.897.



Values in Lux, Scale 1 : 27

Position of surface in room:
 Marked point:
 (10.469 m, 8.471 m, 0.760 m)



Grid: 3 x 7 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$	E_{min} / E_{max}
704	631	777	0.897	0.813

➤ **Lobby**

Floor Area : 12.44 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8m

The downlighters are recessed mounted.

Luminaire Used: NLP72443 (1.000) (10Nos.)

No. of Luminaires used: 10

Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:

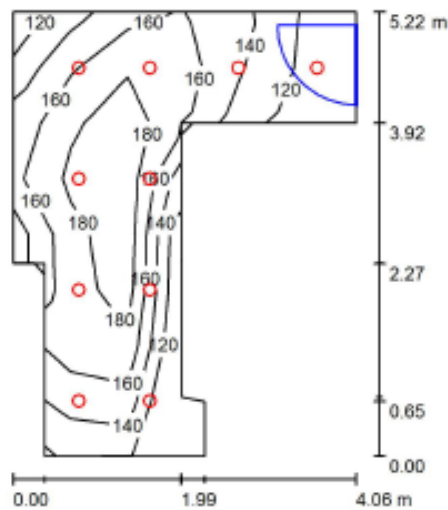
The lux level obtained after calculation is 164 lux.

Uniformity obtained : 0.65

Specific Connected Load: 20.42 W/m²

Technical Report of Lobby

Lobby / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:88

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	164	107	199	0.650
Floor	20	121	57	153	0.473
Ceiling	80	43	31	58	0.723
Walls (10)	50	94	31	338	/

Workplane:

Height: 0.760 m
 Grid: 8 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.653, Ceiling / Working Plane: 0.265.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	10	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
Total:			4804	10000	254.0

Specific connected load: 20.42 W/m² = 12.44 W/m²/100 lx (Ground area: 12.44 m²)

➤ **Cabin 3**

Floor Area : 2.92 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

a. Lineco TMS022 TMS022 1x36W +GMS022 R TL-DHFS

No. of Luminaires used: 2

Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:

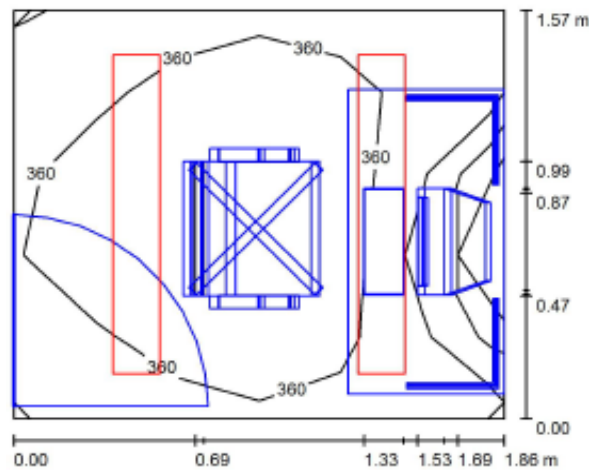
The lux level obtained after calculation is 355 lux.

Uniformity obtained : 0.354

Specific Connected Load: 28.81 W/m²

Technical Report of Cabin 3

Cabin 3 / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80 Values in Lux, Scale 1:21

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	355	126	421	0.354
Floor	20	140	26	221	0.182
Ceiling	80	180	116	243	0.646
Walls (4)	50	372	5.05	1108	/

Workplane:

Height: 0.760 m
Grid: 6 x 5 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 1.333, Ceiling / Working Plane: 0.507.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 5512	Total: 6700	84.0

Specific connected load: 28.81 W/m² = 8.11 W/m²/100 lx (Ground area: 2.92 m²)

The Task illuminance of Worktable of Cabin 3 is 321 lux and the uniformity is 0.394 since the computer is present on the worktable.

E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0	E _{min} / E _{max}
321	126	397	0.394	0.318

➤ **Cabin 4**

Floor Area : 2.96 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used: Lineco TMS022 TMS022 1x36W +GMS022 R TL-DHFS

No. of Luminaires used: 2

Lighting Arrangement Followed: General Lighting (IS-3646)

The design outputs are as follows:

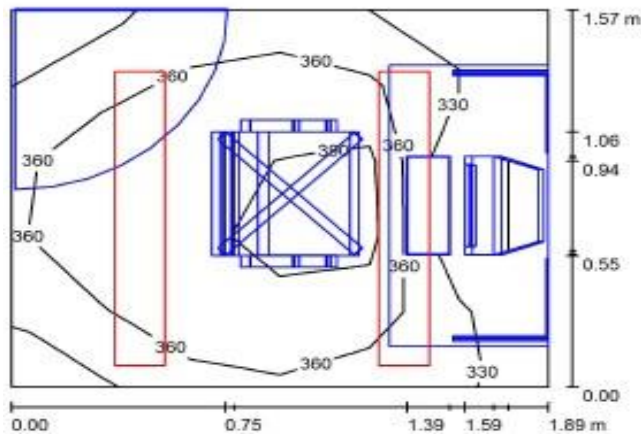
The lux level obtained after calculation is 363 lux.

Uniformity obtained: 0.844

Specific Connected Load: 28.37 W/m²

Technical Report of Cabin 4

Cabin 4 / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:21

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	363	308	412	0.844
Floor	20	147	31	227	0.211
Ceiling	80	182	74	319	0.404
Walls (4)	50	362	6.42	1291	/

Workplane:

Height: 0.760 m
Grid: 6 x 5 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 1.314, Ceiling / Working Plane: 0.511.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 5512	Total: 6700	84.0

Specific connected load: 28.37 W/m² = 7.82 W/m²/100 lx (Ground area: 2.96 m²)

The Task illuminance of Worktable of Cabin 4 is 317 lux and the uniformity is 0.348 since the computer is present on the worktable.

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$	E_{min} / E_{max}
317	109	414	0.342	0.263

➤ **Cabin 5**

Floor Area : 3.42 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

a. Lineco TMS022 TMS022 1x36W +GMS022 R TL-DHFS

No. of Luminaires used: 2

Lighting Arrangement Followed: General Lighting (IS-3646)

The design outputs are as follows:

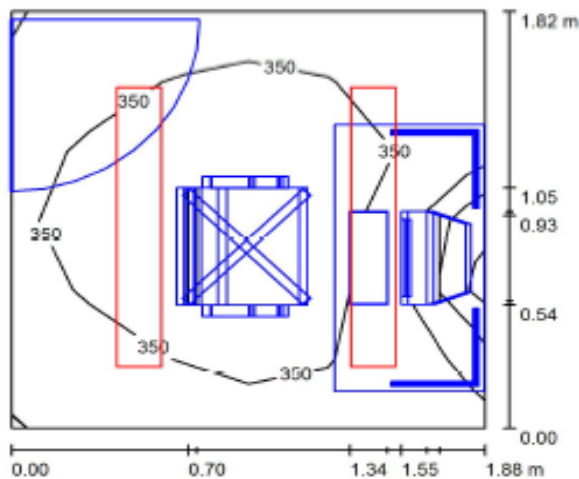
The lux level obtained after calculation is 345 lux.

Uniformity obtained : 0.221

Specific Connected Load: 24.56 W/m²

Technical Report of Cabin 5

Cabin 5 / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80 Values in Lux, Scale 1:24

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	345	76	403	0.221
Floor	20	148	26	222	0.173
Ceiling	80	169	92	265	0.546
Walls (4)	50	336	6.50	1147	/

Workplane:

Height: 0.760 m
 Grid: 6 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 1.250, Ceiling / Working Plane: 0.491.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [mm]	ϕ (Lamps) [mm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 5512	Total: 6700	84.0

Specific connected load: 24.56 W/m² = 7.11 W/m²/100 lx (Ground area: 3.42 m²)

The Task illuminance of Worktable of Cabin 5 is 310 lux and the uniformity is 0.334 since the computer is present on the worktable.

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$	E_{min} / E_{max}
317	111	416	0.348	0.268

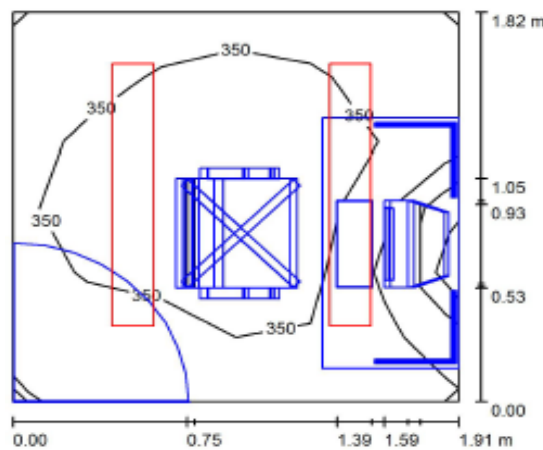
➤ **Cabin 6**

Floor Area : 3.47 m²
 Height : 2.8 m
 Mounting Height of the luminaire: 2.8 m
 Luminaire Used:
 a. Lineco TMS022 TMS022 1x36W +GMS022 R TL-DHFS
 No. of Luminaires used: 2
 Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:
 The lux level obtained after calculation is 340 lux.
 Uniformity obtained : 0.224
 Specific Connected Load: 24.19 W/m²

Technical Report of Cabin 6

Cabin 6 / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80 Values in Lux, Scale 1:24

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	340	76	404	0.224
Floor	20	151	28	223	0.184
Ceiling	80	167	89	257	0.534
Walls (4)	50	328	5.40	1087	/

Workplane:
 Height: 0.760 m
 Grid: 6 x 6 Points
 Boundary Zone: 0.000 m
 Illuminance Quotient (according to LG7): Walls / Working Plane: 1.239, Ceiling / Working Plane: 0.487.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 5512	Total: 6700	84.0

Specific connected load: 24.19 W/m² = 7.12 W/m²/100 lx (Ground area: 3.47 m²)

The Task illuminance of Worktable of Cabin 6 is 310 lux and the uniformity is 0.334 since the computer is present on the worktable.

E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0	E _{min} / E _{max}
310	104	381	0.334	0.272

7.2.2 Lighting Design of Office A Amhedabad with LED Luminaires

- a. Input Design parameters like Surface Reflectances, Light Loss factor etc are considered according to the Standards.
 - Ceiling Reflectance = 80%
 - Wall Reflectance = 50%
 - Floor Reflectance = 20%
 - Light Loss Factor = 0.8
 - Workplane Height = 0.76 m

- b. Details of LED Luminaires used are as follows:-
 - i) Linear Suspended LED Luminaire of 29W
 - ii) Recessed Mounted LED Downlighters of 19W
 - iii) Recessed Mounted LED Downlighters of 11W
 - iv) Recessed Mounted (2 X 2) LED Square Panel of 29W
 - v) Recessed Mounted (2 X 2) LED Square Panel of 24W



Fig 7.4 shows the conference room with LED Lighting design

LED Lighting Design of Office A_Ahmedabad are as follows:

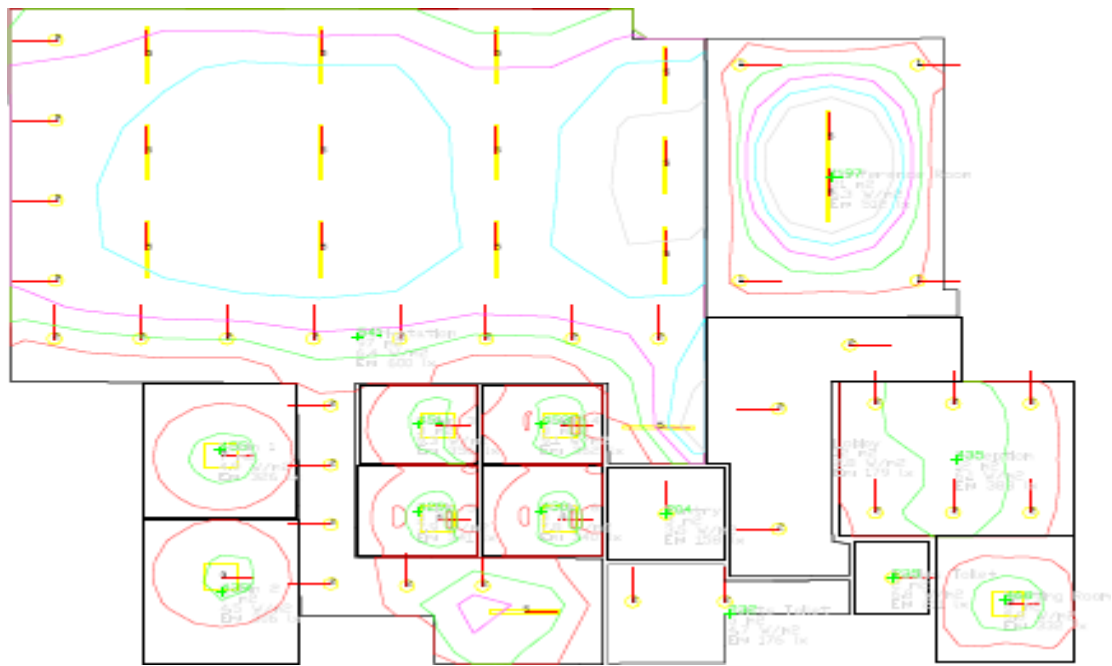


Fig. 7.5 LED Luminaire Arrangement of Office A_Ahmedabad

➤ **Cabin 1**

Floor Area : 6.65 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

- a. PowerBalance2 RC461B G2 LED34S/840 PSD W60L60 VPC W

No. of Luminaires used: 1

The lighting arrangement Followed : General Lighting

The design outputs are as follows:

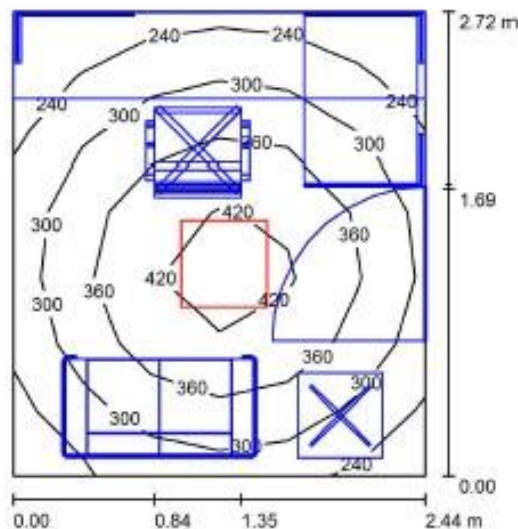
The lux level obtained after calculation is 326 lux.

Uniformity obtained : 0.606

Specific Connected Load: 4.89W/m²

Technical Report of Cabin 1

Cabin 1 / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	326	197	458	0.606
Floor	20	141	6.33	269	0.045
Ceiling	80	61	27	74	0.439
Walls (4)	50	117	2.45	239	/

Workplane:

Height: 0.760 m
 Grid: 6 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.418, Ceiling / Working Plane: 0.190.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS RC461B G2 PSD W60L60 (1.000)	3996	4000	32.5
Total:			3996	4000	32.5

Specific connected load: 4.89 W/m² = 1.50 W/m²/100 lx (Ground area: 6.65 m²)

➤ **Cabin 2**

Floor Area : 7.26 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

a. PowerBalance2 RC461B G2 LED34S/840 PSD W60L60 VPC W

No. of Luminaires used: 1

Lighting Arrangement Followed: General Lighting

The design outputs are as follows:

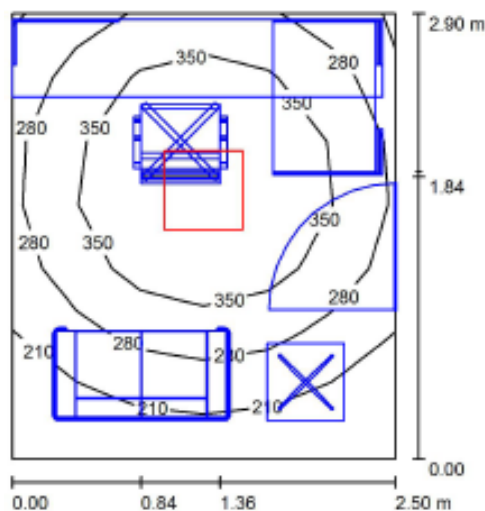
The lux level obtained after calculation is 306 lux.

Uniformity obtained :0.496

Specific Connected Load: 4.48W/m²

The Technical report of Cabin 2

Cabin 2 / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:38

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	306	151	456	0.496
Floor	20	128	8.15	257	0.064
Ceiling	80	62	31	81	0.508
Walls (4)	50	114	3.78	282	/

Workplane:

Height: 0.760 m
 Grid: 7 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.425, Ceiling / Working Plane: 0.201.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS RC461B G2 PSD W60L60 (1.000)	3996	4000	32.5
			Total: 3996	Total: 4000	32.5

Specific connected load: 4.48 W/m² = 1.47 W/m²/100 lx (Ground area: 7.26 m²)

➤ **Workstation**

Floor Area : 96.62 m²

Height : 3 m

Mounting Height of the luminaire:

The linear suspended luminaire is suspended from ceiling at a suspension of 0.03m

Luminaire Used:

- a. Trueline Suspended SP530P LED40S/840 PSD PI5 SM2 L1130 ALU1)
- b. LUXSPACE 2 COMPACT LOW HEIGHT]DN570B LED12S/830 PSE-E C WH1

No. of Luminaires used: 32

Lighting Arrangement Followed : Localized General Lighting (IS-3646)

The design outputs are as follows:

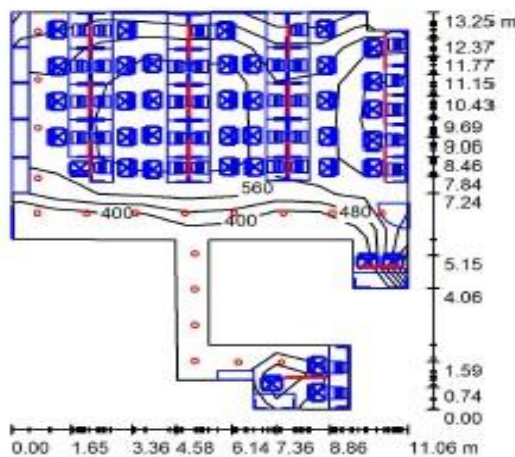
The lux level obtained after calculation is 600 lux.

Uniformity obtained :0.633

Specific Connected Load: 6.40 W/m²

Technical Report of Workstation

Workstation / Summary



Height of Room: 3.000 m, Light loss factor: 0.80

Values in Lux, Scale 1:171

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	600	380	779	0.633
Floor	20	286	16	721	0.054
Ceiling	80	150	78	223	0.523
Walls (16)	50	200	20	972	/

Workplane:

Height: 0.760 m
 Grid: 9 x 11 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.396, Ceiling / Working Plane: 0.260.

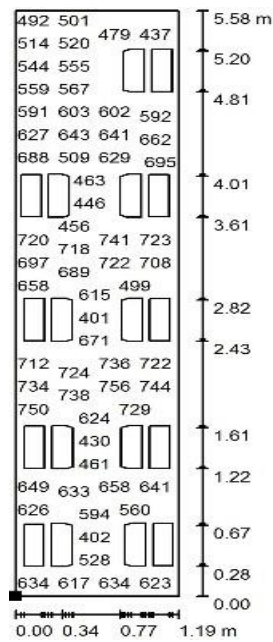
Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	⌀ (Luminaire) [lm]	⌀ (Lamps) [lm]	P [W]
1	18	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	14	PHILIPS SP530P L1130 OC LED40S/840 NO (1.000)	3995	4000	29.0
Total:			80225	80300	618.4

Specific connected load: 6.40 W/m² = 1.07 W/m²/100 lx (Ground area: 96.62 m²)

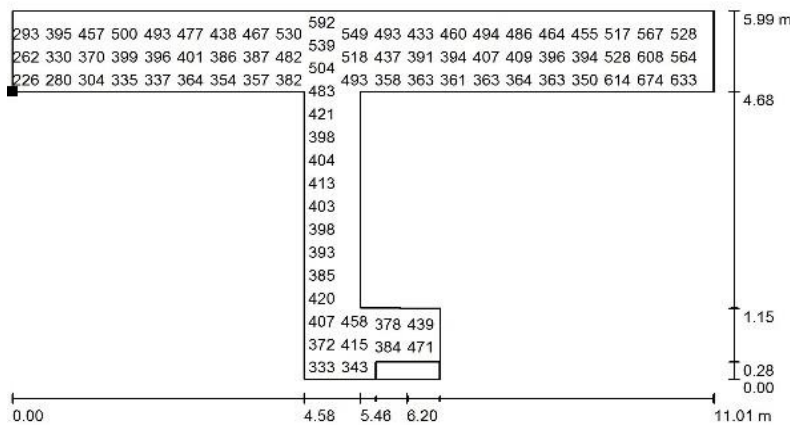
Since the localized general lighting arrangement is done, the uniformity cannot be achieved according to Standards. This is a technical workstation thus illuminance level has to be maintained as 500 lux. The task illuminance on workstation table top is achieved as 598 lux with uniformity of 0.296.

The value chart of the workstation table top is as follows:-



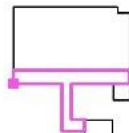
The lux level obtained from the passage area is 442 lux and the technical report is given:-

Workstation / Corridor / Value Chart (E, Perpendicular)



Not all calculated values could be displayed.

Position of surface in room:
Marked point: (-1.882 m, 5.817 m, 0.760 m)



Values in Lux, Scale 1 : 79

➤ **Pantry**

Floor Area : 3.38 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

- a. LUXSPACE 2 COMPACT LOW HEIGHT] DN570B LED12S/830 PSE-E C WH1

No. of Luminaires used: 1

Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:

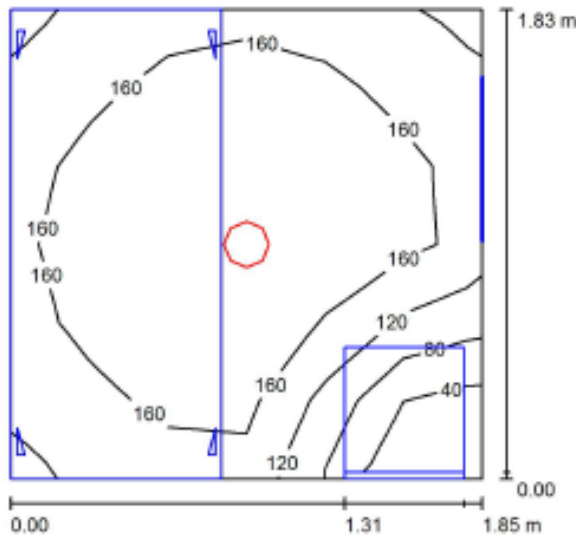
The lux level obtained after calculation is 158 lux.

Uniformity obtained :0.077

Specific Connected Load: 3.49 W/m²

Technical Report of Pantry

Pantry / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:24

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	158	12	202	0.077
Floor	20	54	2.32	111	0.043
Ceiling	80	36	24	41	0.674
Walls (4)	50	62	1.33	152	/

Workplane:

Height: 0.760 m
 Grid: 6 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.485, Ceiling / Working Plane: 0.227.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
Total:			1350	1350	11.8

Specific connected load: 3.49 W/m² = 2.22 W/m²/100 lx (Ground area: 3.38 m²)

➤ **Gents Toilet**

Floor Area : 5.05 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

a. LUXSPACE 2 COMPACT LOW HEIGHT]DN570B LED12S/830 PSE-E C WH1

No. of Luminaires used: 2

Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:

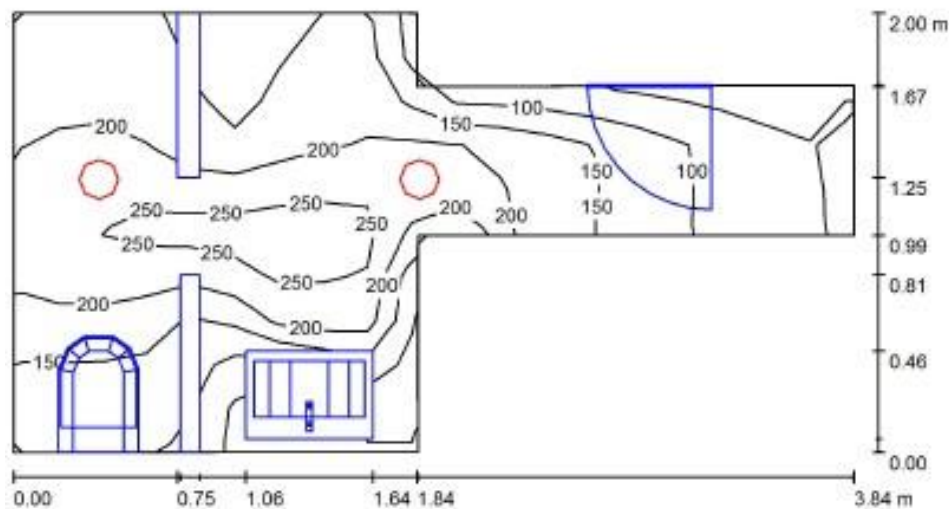
The lux level obtained after calculation is 176lux.

Uniformity obtained :0.258

Specific Connected Load: 4.68W/m²

Technical Report of Gents Toilet

Gents Toilet / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:28

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	176	45	279	0.258
Floor	20	107	12	177	0.113
Ceiling	80	35	13	84	0.383
Walls (8)	50	70	0.06	1400	/

Workplane:

Height: 0.760 m
 Grid: 19 x 10 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.478, Ceiling / Working Plane: 0.201.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
			Total: 2700	Total: 2700	23.6

Specific connected load: 4.68 W/m² = 2.66 W/m²/100 lx (Ground area: 5.05 m²)

➤ **Ladies Toilet**

Floor Area : 1.73 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

- a. LUXSPACE 2 COMPACT LOW HEIGHT] DN570B LED12S/830 PSE-E C WH1

No. of Luminaires used: 1

Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:

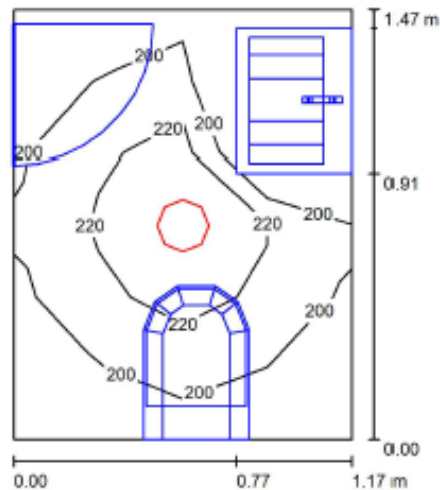
The lux level obtained after calculation is 211 lux.

Uniformity obtained :0.857

Specific Connected Load: 6.84 W/m²

Technical Report of Ladies Toilet

Ladies Toilet / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80 Values in Lux, Scale 1:19

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	211	181	233	0.857
Floor	20	101	23	132	0.225
Ceiling	80	60	42	68	0.699
Walls (4)	50	121	7.21	333	/

Workplane:

Height: 0.760 m
 Grid: 6 x 4 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.699, Ceiling / Working Plane: 0.286.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
			Total: 1350	Total: 1350	11.8

Specific connected load: 6.84 W/m² = 3.24 W/m²/100 lx (Ground area: 1.73 m²)

➤ **Reception**

Floor Area : 11.63 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

a. LUXSPACE 2 COMPACT LOW HEIGHT] DN570B LED12S/830 PSE-E C WH1

No. of Luminaires used: 6

Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:

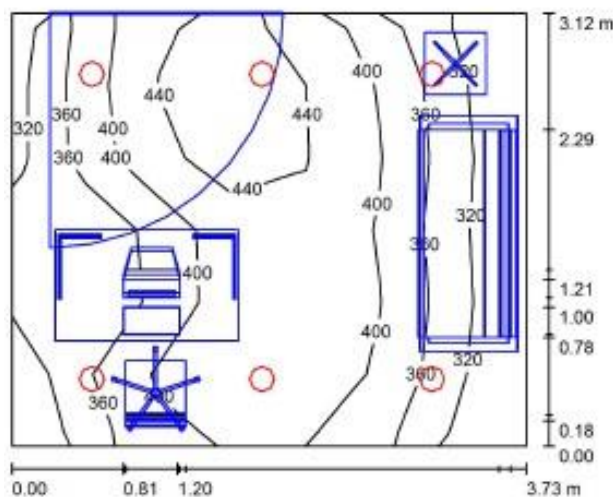
The lux level obtained after calculation is 383 lux.

Uniformity obtained :0.753

Specific Connected Load: 6.09 W/m²

Technical Report of Reception

Reception / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:41

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	383	288	463	0.753
Floor	20	234	19	382	0.079
Ceiling	80	94	58	118	0.617
Walls (4)	50	179	17	557	/

Workplane:

Height: 0.760 m
 Grid: 7 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.532, Ceiling / Working Plane: 0.247.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	6	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
			Total: 8100	Total: 8100	70.8

Specific connected load: 6.09 W/m² = 1.59 W/m²/100 lx (Ground area: 11.63 m²)

➤ **Meeting Room**

Floor Area : 5.64 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

a. PowerBalance2 RC461B G2 LED34S/840 PSD W60L60 VPC W

No. of Luminaires used: 1

Lighting Arrangement Followed : Localized General Lighting (IS-3646)

The design outputs are as follows:

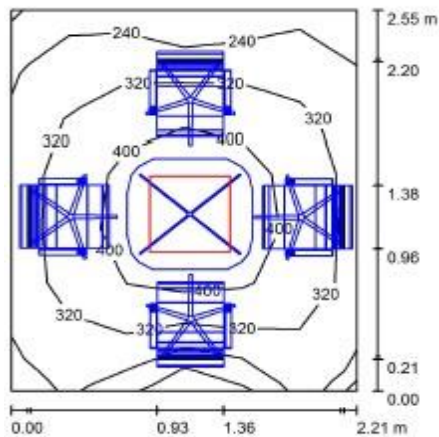
The lux level obtained after calculation is 332 lux.

Uniformity obtained :0.205

Specific Connected Load: 5.76 W/m²

Technical Report of Meeting Room

Meeting Room / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:33

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	332	68	465	0.205
Floor	20	141	32	243	0.227
Ceiling	80	66	28	77	0.432
Walls (4)	50	144	24	316	/

Workplane:

Height: 0.760 m
Grid: 7 x 6 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.471, Ceiling / Working Plane: 0.196.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS RC461B G2 PSD W60L60 (1.000)	3996	4000	32.5
Total:			3996	4000	32.5

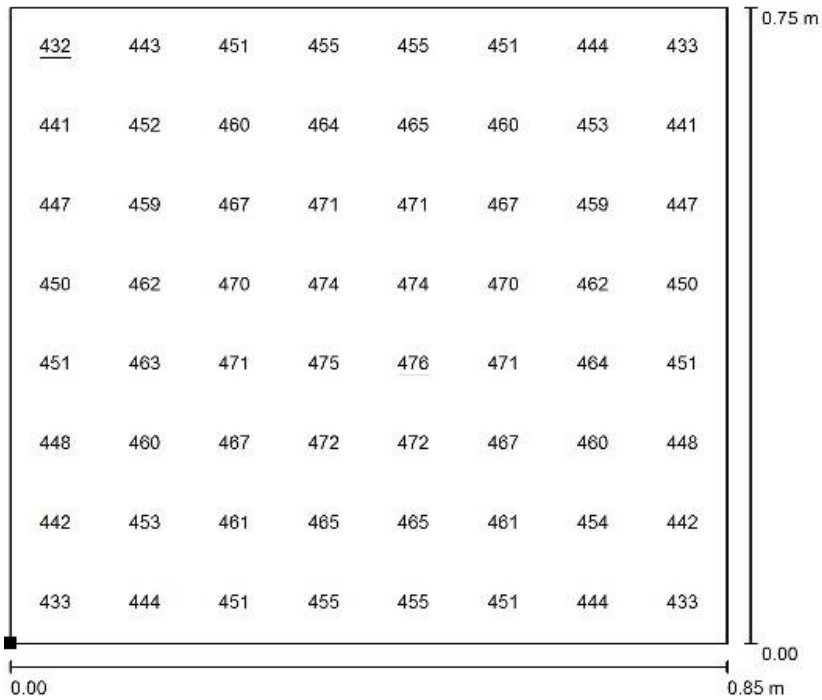
Specific connected load: 5.76 W/m² = 1.74 W/m²/100 lx (Ground area: 5.64 m²)

The Task illuminance of Table top of meeting room is obtained as 457 Lux and uniformity is 0.947.

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0	E_{min} / E_{max}
459	441	476	0.962	0.927

Value Chart of Meeting Room(Table Top)

Meeting Room / Table Top / Value Chart (E, Perpendicular)



➤ **Conference Room**

Floor Area : 21.27 m²

Height : 2.8 m

Mounting Height of the luminaire:

The linear lights are suspended from the ceiling at a height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

- a. Trueline Suspended SP530P L1130 OC LED40S/840 NO
- b. Luxspace 2 Compact Low Height DN570B LED20S/830 PSED-VLC-E M WH

No. of Luminaires used: 6

Lighting Arrangement Followed : Localized General Lighting (IS-3646)

The design outputs are as follows:

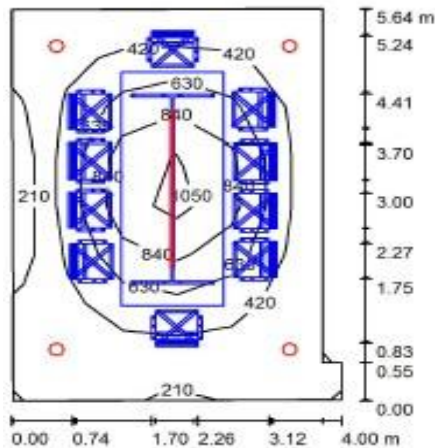
The lux level obtained after calculation is 512 lux.

Uniformity obtained : 0.4

Specific Connected Load: 6.30 W/m²

Technical Report of Conference Room

Conference Room / Summary



Height of Room: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:73

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	512	204	1205	0.399
Floor	20	175	31	417	0.177
Ceiling	80	122	69	164	0.568
Walls (6)	50	171	45	860	/

Workplane:

Height: 0.760 m
 Grid: 6 x 8 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.379, Ceiling / Working Plane: 0.244.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS DN570B PSED-E M (1.000)	1850	1850	19.0
2	2	PHILIPS SP530P L1130 OC LED40S/840 NO (1.000)	3995	4000	29.0
Total:			15389	Total: 15400	134.0

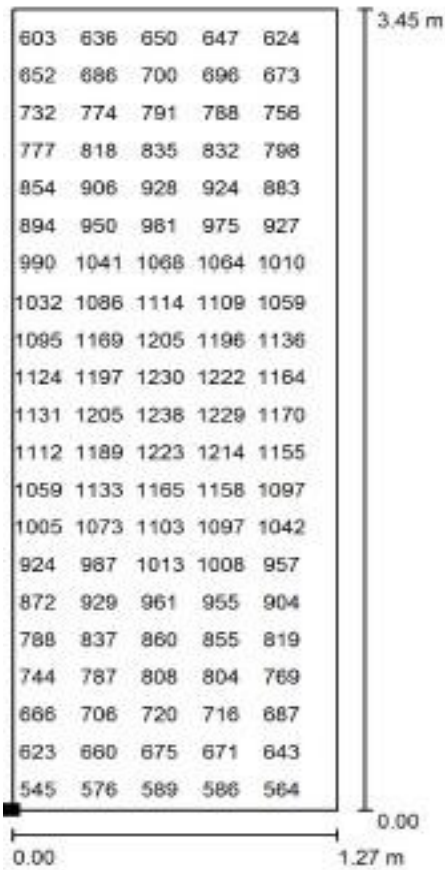
Specific connected load: 6.30 W/m² = 1.23 W/m²/100 lx (Ground area: 21.27 m²)

The task illuminance achieved on the table top of Conference Room is 905 lux and the uniformity is 0.58

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$	E_{min} / E_{max}
905	524	1246	0.580	0.421

Value Chart of Conference Room(Table Top)

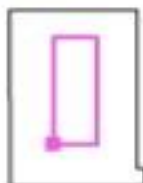
Conference Room / Conference Table Top / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 27

Not all calculated values could be displayed.

Position of surface in room:
Marked point:
(10.442 m, 8.471 m, 0.760 m)



➤ **Lobby**

Floor Area : 12.44 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8m

The downlighters are recessed mounted.

Luminaire Used:

a. LUXSPACE 2 COMPACT LOW HEIGHT] DN570B LED12S/830 PSE-E C WH1

No. of Luminaires used: 3

Lighting Arrangement Followed :Localized Lighting (IS-3646)

The design outputs are as follows:

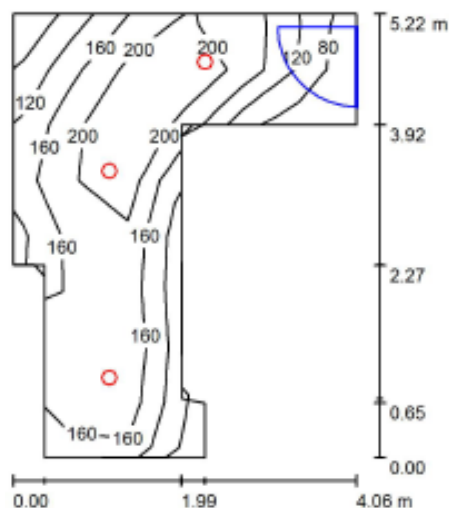
The lux level obtained after calculation is 179 lux.

Uniformity obtained :0.426

Specific Connected Load: 2.85 W/m²

Technical Report of Lobby

Lobby / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:68

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	179	76	258	0.426
Floor	20	136	48	185	0.350
Ceiling	80	30	17	38	0.579
Walls (10)	50	67	18	314	/

Workplane:

Height: 0.760 m
 Grid: 8 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.402, Ceiling / Working Plane: 0.172.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	3	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
			Total: 4050	Total: 4050	35.4

Specific connected load: 2.85 W/m² = 1.59 W/m²/100 lx (Ground area: 12.44 m²)

➤ **Cabin 3**

Floor Area : 2.92 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

a. PowerBalance Gen2 RC461B G2 LED34S/840 PSD W60L60 VPC W

No. of Luminaires used: 1

Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:

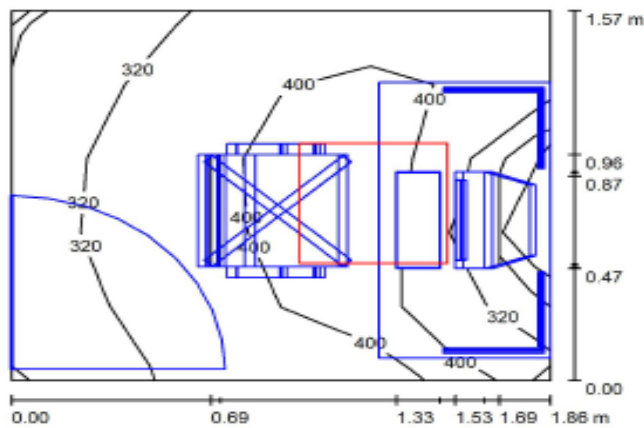
The lux level obtained after calculation is 356 lux.

Uniformity obtained :0.230

Specific Connected Load: 9.26 W/m²

Technical Report of Cabin 3

Cabin 3 / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:21

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	356	82	458	0.230
Floor	20	132	16	236	0.125
Ceiling	80	97	26	130	0.272
Walls (4)	50	207	2.73	700	/

Workplane:

Height: 0.760 m
Grid: 6 x 5 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.709, Ceiling / Working Plane: 0.269.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS RC461B G2 PSD W60L60 (1.000)	3397	3400	27.0
			Total: 3397	Total: 3400	27.0

Specific connected load: $9.26 \text{ W/m}^2 = 2.60 \text{ W/m}^2/100 \text{ lx}$ (Ground area: 2.92 m²)

The Task illuminance of Worktable of Cabin 3 is 365 lux and the uniformity is 0.198 since the computer is present on the worktable.

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$	E_{min} / E_{max}
365	72	483	0.198	0.149

➤ **Cabin 4**

Floor Area : 2.96 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminare Used:

- a. PowerBalance Gen2 RC461B G2 LED34S/840 PSD W60L60 VPC W

No. of Luminaires used: 1

Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:

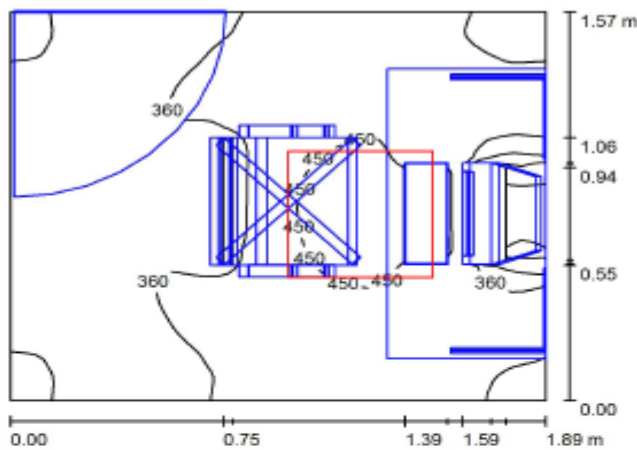
The lux level obtained after calculation is 362 lux.

Uniformity obtained :0.159

Specific Connected Load: 9.12 W/m²

Technical Report of Cabin 4

Cabin 4 / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80 Values in Lux, Scale 1:21

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	362	58	489	0.159
Floor	20	136	20	238	0.147
Ceiling	80	95	24	124	0.251
Walls (4)	50	209	3.18	624	/

Workplane:

Height: 0.760 m
 Grid: 64 x 64 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.695, Ceiling / Working Plane: 0.262.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS RC461B G2 PSD W60L60 (1.000)	3397	3400	27.0
Total:			3397	Total: 3400	27.0

Specific connected load: 9.12 W/m² = 2.52 W/m²/100 lx (Ground area: 2.96 m²)

The Task illuminance of Worktable of Cabin 4 is 366 lux and the uniformity is 0.167 since the computer is present on the worktable.

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$	E_{min} / E_{max}
366	61	480	0.167	0.128

➤ **Cabin 5**

Floor Area : 3.42 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

a. PowerBalance Gen2 RC461B G2 LED34S/840 PSD W60L60 VPC W

No. of Luminaires used: 1

Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:

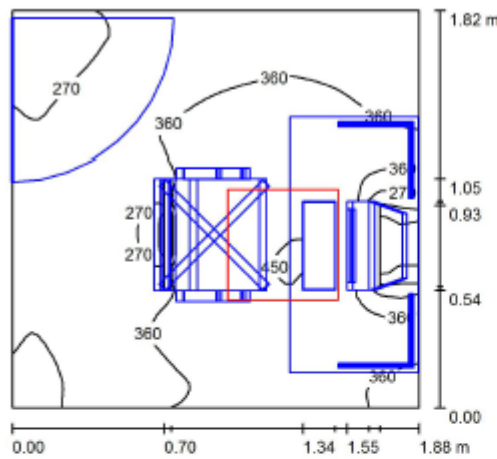
The lux level obtained after calculation is 341 lux.

Uniformity obtained : 0.141

Specific Connected Load: 7.89 W/m²

Technical Report of Cabin 5

Cabin 5 / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:24

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	341	48	455	0.141
Floor	20	136	16	231	0.118
Ceiling	80	87	19	120	0.218
Walls (4)	50	187	4.96	647	/

Workplane:

Height: 0.760 m
Grid: 64 x 64 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.659, Ceiling / Working Plane: 0.254.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	1	PHILIPS RC461B G2 PSD W60L60 (1.000)	3397	3400	27.0
Total:			3397	3400	27.0

Specific connected load: 7.89 W/m² = 2.31 W/m²/100 lx (Ground area: 3.42 m²)

The Task illuminance of Worktable of Cabin 5 is 349 lux and the uniformity is 0.170 since the computer is present on the worktable.

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$	E_{min} / E_{max}
349	59	432	0.170	0.137

➤ **Cabin 6**

Floor Area : 3.47 m²

Height : 2.8 m

Mounting Height of the luminaire: 2.8 m

Luminaire Used:

a. PowerBalance Gen2 RC461B G2 LED34S/840 PSD W60L60 VPC W

No. of Luminaires used: 1

Lighting Arrangement Followed : General Lighting (IS-3646)

The design outputs are as follows:

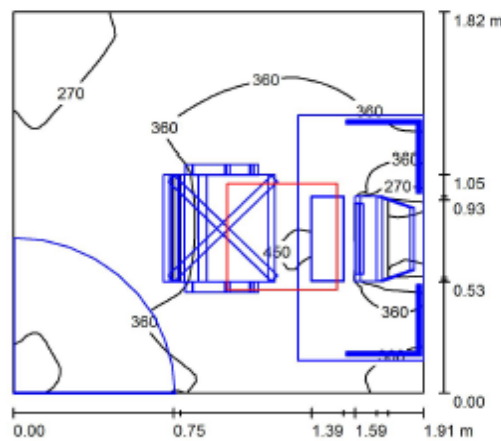
The lux level obtained after calculation is 340 lux.

Uniformity obtained : 0.152

Specific Connected Load: 7.77 W/m²

Technical Report of Cabin 6

Cabin 6 / Summary



Height of Room: 2.800 m, Mounting Height: 2.800 m, Light loss factor: 0.80

Values in Lux, Scale 1:24

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0
Workplane	/	340	51	455	0.152
Floor	20	140	17	233	0.123
Ceiling	80	85	18	115	0.211
Walls (4)	50	187	3.78	603	/

Workplane:

Height: 0.760 m
Grid: 64 x 64 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.648, Ceiling / Working Plane: 0.250.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS RC461B G2 PSD W60L60 (1.000)	3397	3400	27.0
Total:			3397	Total: 3400	27.0

Specific connected load: 7.77 W/m² = 2.29 W/m²/100 lx (Ground area: 3.47 m²)

The Task illuminance of Worktable of Cabin 6 is 347 lux and the uniformity is 0.173 since the computer is present on the worktable.

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0	E_{min} / E_{max}
347	60	436	0.173	0.137

Office A_Ahmedabad				Reflectances	80/50/20	LLF	0.8
Room Name	Area (sq. m)	Height	Conventional				
			Mounting Height	Lux Level	Uniformity	LPD	Qty.
Cabin 1	6.65	2.8m	2.5m	322	0.742	12.63	2
Cabin 2	7.26	2.8m	2.5m	301	0.738	11.57	2
Workstation	96.62	3m	3m	496	0.422	12.17	51
Pantry	3.38	2.8m	2.8m	173	0.12	12.42	1
Gents Toilet	5.05	2.8m	2.8m	118	0.488	22.83	6
Ladies Toilet	1.73	2.8m	2.8m	152	0.877	33.38	3
Reception	11.63	2.8m	2.8m	322	0.657	34.94	16
Meeting Room	5.64	2.8m	2.8m	339	0.646	23.9	4
Conference Room	21.27	2.8m	2.8m, 2.5m	721	0.576	38.12	28
Lobby	12.44	2.8m	2.8m	164	0.65	20.42	10
Cabin 3	2.92	2.8m	2.8m	355	0.354	28.81	2
Cabin 4	2.96	2.8m	2.8m	363	0.844	28.37	2
Cabin 5	3.42	2.8m	2.8m	345	0.221	24.56	2
Cabin 6	3.47	2.8m	2.8m	340	0.224	24.19	2

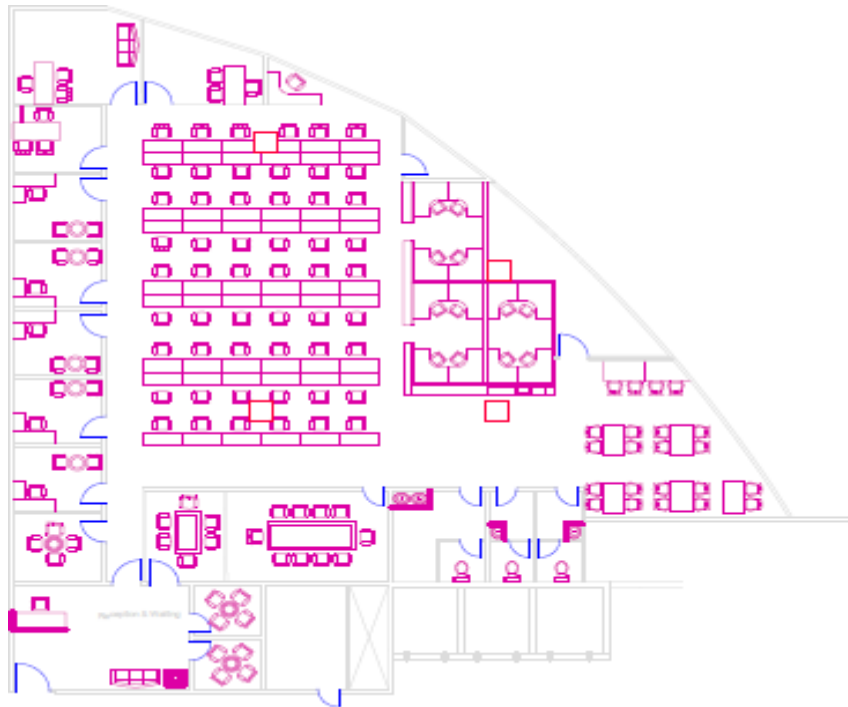
Table 7.1 Design Output Parameters of Office_A_Ahmedabad with Conventional Luminaire

Office A_Ahmedabad							
Room Name	Area (sq. m)	Height	LED				
			Mounting Height	Lux Level	Uniformity	LPD	Qty.
Cabin 1	6.65	2.8m	2.8m	326	0.606	4.89	1
Cabin 2	7.26	2.8m	2.8m	306	0.496	4.48	1
Workstation	96.62	3m	3m ,2.8m	600	0.633	6.4	32
Pantry	3.38	2.8m	2.8m	158	0.077	2.22	1
Gents Toilet	5.05	2.8m	2.8m	176	0.258	4.68	2
Ladies Toilet	1.73	2.8m	2.8m	211	0.857	6.84	1
Reception	11.63	2.8m	2.8m	383	0.753	6.09	6
Meeting Room	5.64	2.8m	2.8m	332	0.205	5.76	1
Conference Room	21.27	2.8m	2.8m	768	0.517	9.03	8
Lobby	12.44	2.8m	2.8m	223	0.734	3.79	4
Cabin 3	2.92	2.8m	2.8m	356	0.23	9.26	1
Cabin 4	2.96	2.8m	2.8m	362	0.159	9.12	1
Cabin 5	3.42	2.8m	2.8m	341	0.141	7.89	1
Cabin 6	3.47	2.8m	2.8m	340	0.152	7.77	1

Table 7.2 Design Output Parameters of Office_A_Ahmedabad with LED Luminaire

7.3 Case Study –II : Office B_Bangalore

This floor area of office B_Bangalore is 362.14 m² having a reception area followed by a corridor. There are two 4S meeting rooms and one 6S Meeting rooms beside the reception. There are 8 cabins including CEO's Cabin, Manager's Cabin. There is an open workstation sharing same ceiling of cafeteria. Conference room is beside the 6S meeting room. The fig. 7.6 shows the layout of office B_Bangalore.



7.3.1 Lighting design of Office B Bangalore with Conventional Luminaires

- a. Input Design parameters like Surface Reflectances, Light Loss factor etc are considered according to the Standards.
 - Ceiling Reflectance = 80%
 - Wall Reflectance = 50%
 - Floor Reflectance = 20%
 - Light Loss Factor = 0.8
 - Workplane Height = 0.76 m
- b. Conventional Luminaire Used:
 - i) Linear Surface Mounted Batten of 36W
 - ii) Linear Surface Mounted Batten of 18W
 - iii) CFL down lighters of 19 W
 - iv) CFL downlighters of 25W of higher lumen package

The Lighting plan of Office B_Bangalore with Conventional Luminaires:-

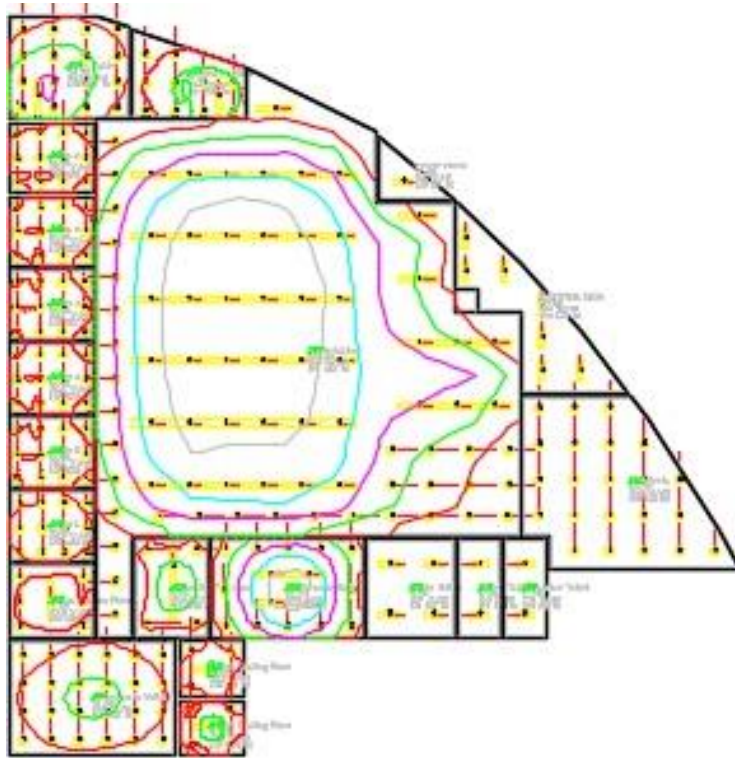


Fig. 7.7 Lighting plan of Office B_bangalore with Conventional Layout

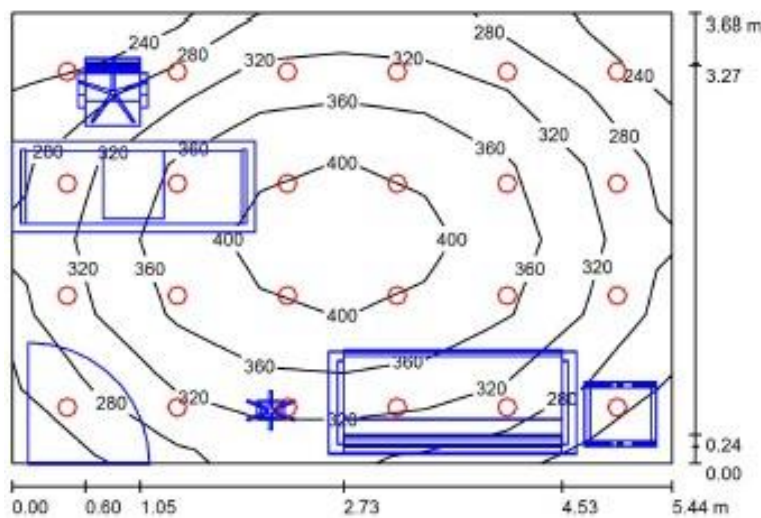
➤ **Reception & Waiting**

Floor Area 20.02 m²
 Height : 2.750 m
 Mounting Height of the luminaire: 2.750 m
 Luminaire Used:
 a. NLP72443 (1.000)
 No. of Luminaires used: 24
 The lighting arrangement Followed : General Lighting

The design outputs are as follows:
 The lux level obtained after calculation is 336 lux.
 Uniformity obtained : 0.642
 Specific Connected Load: 30.45W/m²

Technical Report of Reception & Waiting

Reception & Waiting / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:48

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	336	226	421	0.672
Floor	20	206	9.89	336	0.048
Ceiling	80	74	61	97	0.830
Walls (4)	50	165	20	287	/

Workplane:

Height: 0.760 m
 Grid: 8 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.550, Ceiling / Working Plane: 0.223.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	24	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
Total:			11529	24000	609.6

Specific connected load: 30.45 W/m² = 9.07 W/m²/100 lx (Ground area: 20.02 m²)

➤ **4 Pax Meeting Room**

Floor Area :6.61 m²

Height : 2.750 m

Mounting Height of the luminaire:

The Linear Luminaire are suspended at a suspension height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

a. NLP72340 (1.000)

b. Lineco TMS022 TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 7

The lighting arrangement Followed : Localized General Lighting

The design outputs are as follows:

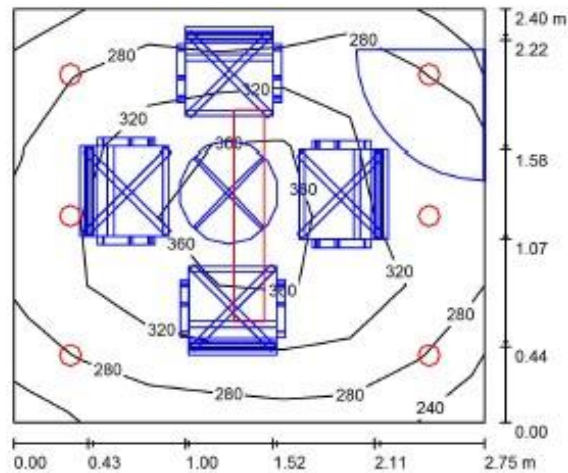
The lux level obtained after calculation is 315 lux.

Uniformity obtained : 0.709

Specific Connected Load: 23.77W/m²

Technical Report of 4Pax Meeting Room

4 Pax Meeting Room / Summary



Height of Room: 2.750 m, Light loss factor: 0.80 Values in Lux, Scale 1:31

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0
Workplane	/	315	223	381	0.709
Floor	20	145	37	217	0.258
Ceiling	80	88	74	116	0.834
Walls (4)	50	196	35	444	/

Workplane:
 Height: 0.760 m
 Grid: 7 x 6 Points
 Boundary Zone: 0.000 m
 Illuminance Quotient (according to LG7): Walls / Working Plane: 0.728, Ceiling / Working Plane: 0.286.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	6	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
2	1	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			5402	7910	157.2

Specific connected load: 23.77 W/m² = 7.54 W/m²/100 lx (Ground area: 8.61 m²)

The Task illuminance of Worktable of 4Pax Meeting Room is 384 lux and the uniformity is 0.966.

E_{av} [lx]
384

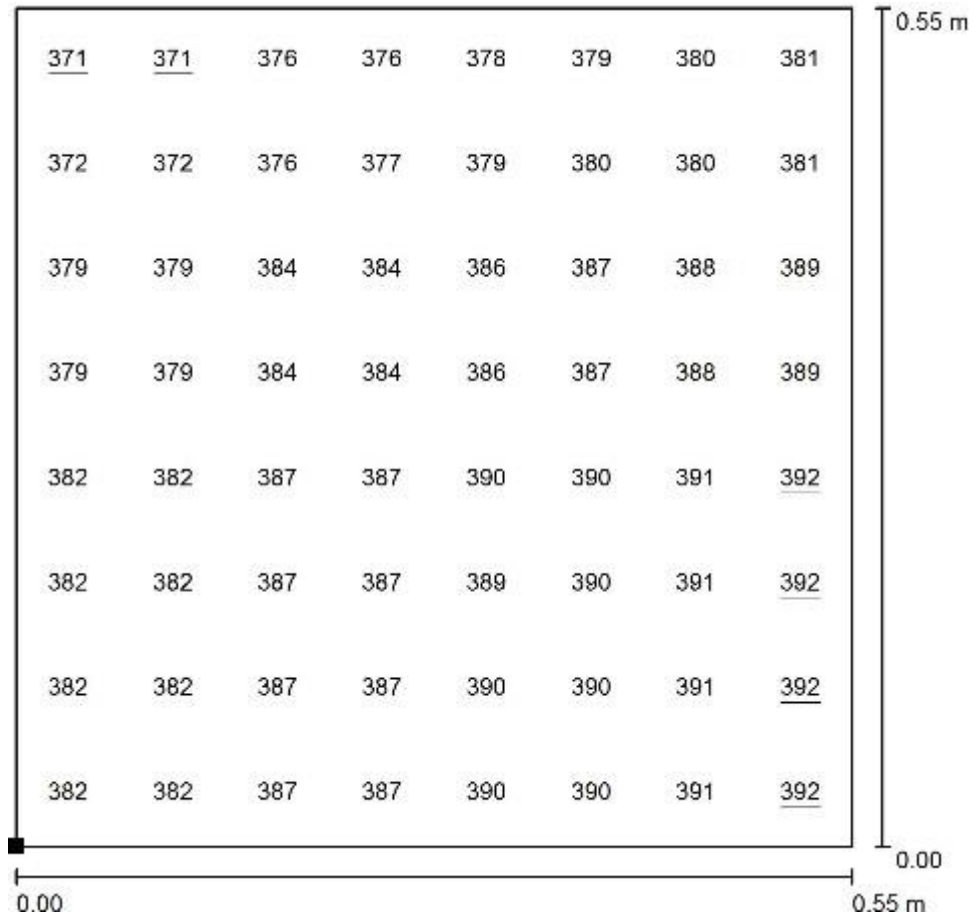
E_{min} [lx]
371

E_{max} [lx]
392

u_0
0.966

E_{min} / E_{max}
0.947

The Value Chart of Table Top of 4 Pax Meeting Room is given :-



➤ 6 Pax Meeting Room

Floor Area :7.79 m²

Height : 2.750 m

Mounting Height of the luminaire:

The Linear Luminaire are suspended at a suspension height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

a. NLP72340 (1.000)

b. Lineco TMS022 TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 6

The lighting arrangement Followed : Localized General Lighting

The design outputs are as follows:

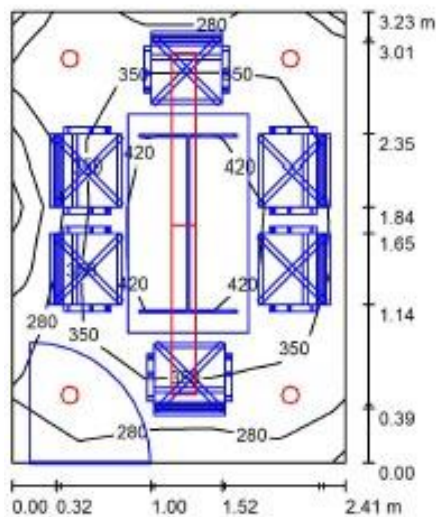
The lux level obtained after calculation is 355 lux.

Uniformity obtained : 0.378

Specific Connected Load: 20.63W/m²

Technical Report of 6 Pax Meeting Room

6 Pax Meeting room / Summary



Height of Room: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:42

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	355	134	468	0.378
Floor	20	109	22	230	0.204
Ceiling	80	102	79	121	0.776
Walls (4)	50	224	27	483	/

Workplane:

Height: 0.760 m
Grid: 5 x 7 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.744, Ceiling / Working Plane: 0.286.

Luminaire Parts List

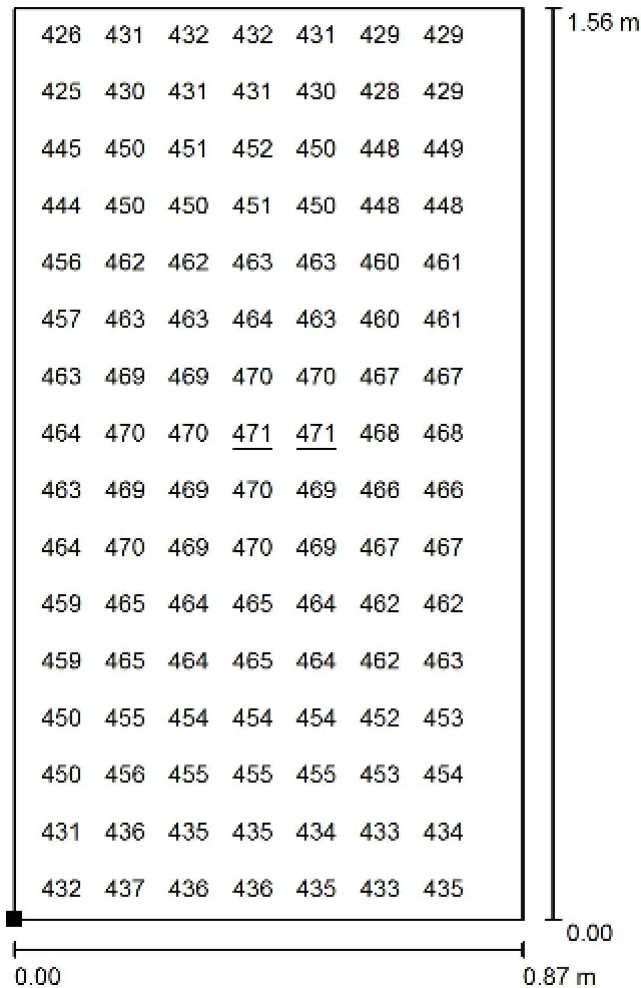
No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
2	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			7276	9740	160.8

Specific connected load: 20.63 W/m² = 5.81 W/m²/100 lx (Ground area: 7.79 m²)

The Task illuminance of Worktable of 6 Pax Meeting Room is 452 lux and the uniformity is 0.934.

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0	E_{min} / E_{max}
452	422	471	0.934	0.896

Value Chart of Table Top of 6 Pax Meeting Room



➤ 4 Pax Meeting Room

Floor Area :3.71 m²

Height : 2.750 m

Mounting Height of the luminaire:

The Linear Luminaire are suspended at a suspension height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

a. NLP72340 (1.000)

b. Lineco TMS022 TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 5

The lighting arrangement Followed : Localized General Lighting

The design outputs are as follows:

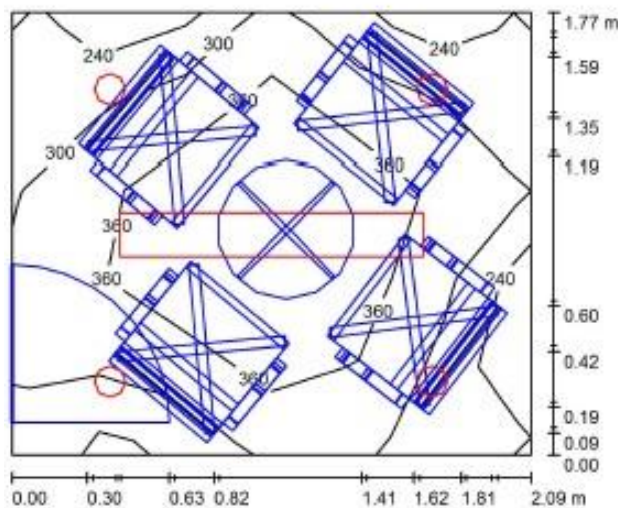
The lux level obtained after calculation is 331 lux.

Uniformity obtained : 0.387

Specific Connected Load: 32.06W/m²

Technical Report of 4 Pax Meeting Room

4 Pax Meeting Room / Summary



Height of Room: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:23

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	331	128	408	0.387
Floor	20	97	31	228	0.322
Ceiling	80	115	93	155	0.812
Walls (4)	50	238	33	545	/

Workplane:

Height: 0.760 m
Grid: 6 x 5 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.878, Ceiling / Working Plane: 0.346.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
2	1	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 4520	Total: 6390	118.8

Specific connected load: 32.06 W/m² = 9.68 W/m²/100 lx (Ground area: 3.71 m²)

The Task illuminance of Worktable of 4 Pax Meeting Room is 415 lux and the uniformity is 0.982.

E_{av} [lx]
415

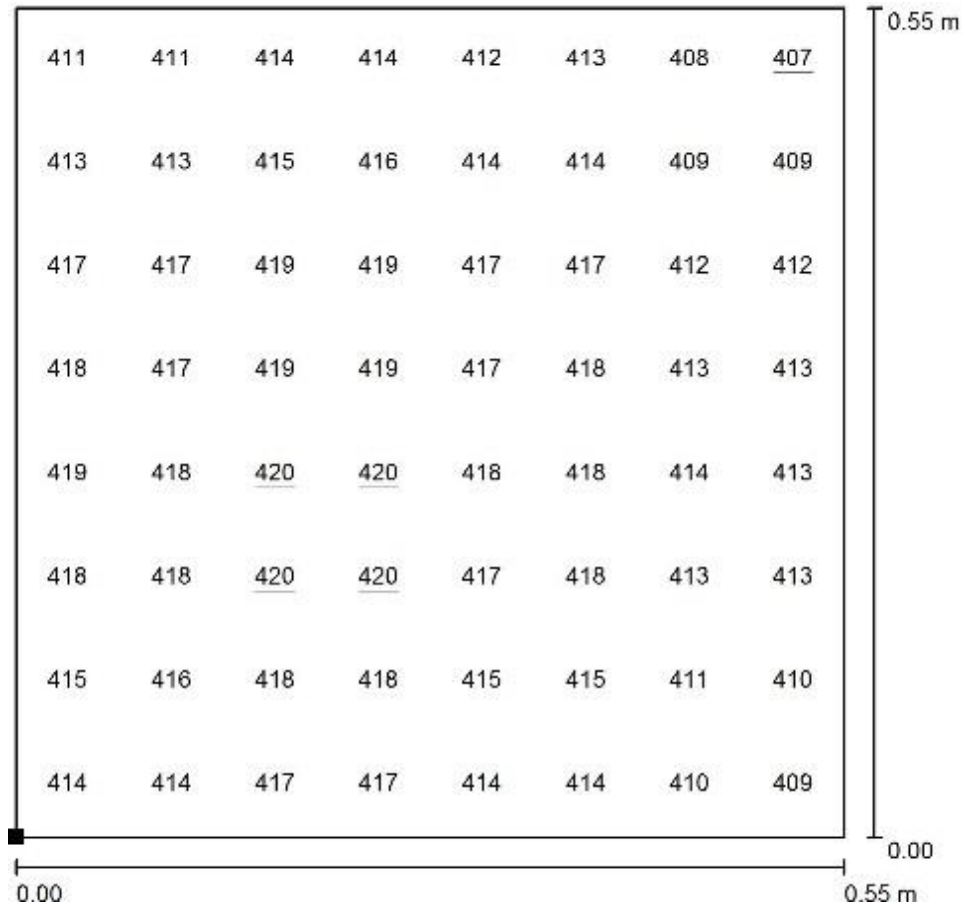
E_{min} [lx]
407

E_{max} [lx]
420

u_0
0.982

E_{min} / E_{max}
0.970

Value Chart of Table Top of 4 Pax Meeting Room



➤ **Conference Room**

Floor Area :16.04m²

Height : 2.750 m

Mounting Height of the luminaire:

The Linear Luminaire are suspended at a suspension height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

a. NLP72443

b. Lineco TMS022 TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 20

The lighting arrangement Followed : Localized General Lighting

The design outputs are as follows:

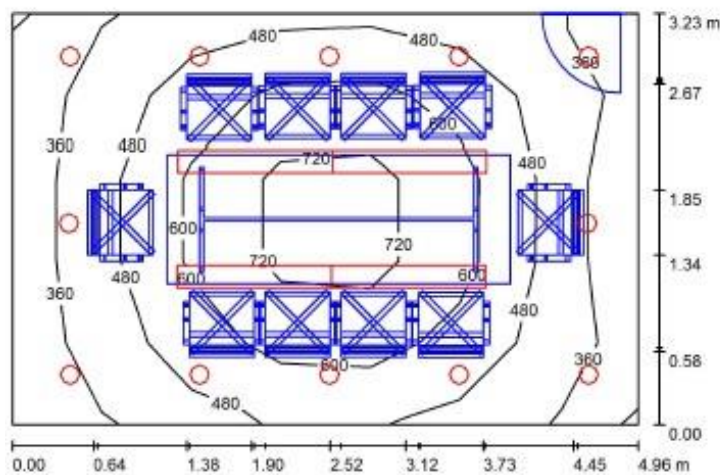
The lux level obtained after calculation is 525 lux.

Uniformity obtained : 0.452

Specific Connected Load: 29.45W/m²

Technical Report of Conference Room

Conference Room / **Summary**



Height of Room: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:42

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	525	237	823	0.452
Floor	20	175	47	314	0.289
Ceiling	80	128	93	156	0.723
Walls (4)	50	292	102	642	/

Workplane:

Height: 0.760 m
 Grid: 7 x 5 Points
 Boundary Zone: 0.000 m

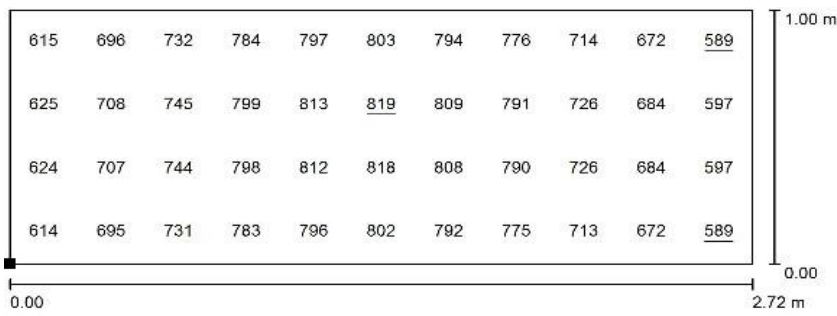
Illuminance Quotient (according to LG7): Walls / Working Plane: 0.627, Ceiling / Working Plane: 0.248.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	12	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	4	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 16789	Total: 25400	472.8

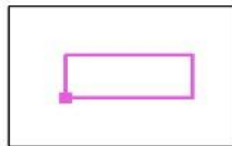
Specific connected load: 29.48 W/m² = 5.61 W/m²/100 lx (Ground area: 16.04 m²)

The Task illuminance of Worktable of Conference Room Meeting Room is 731 lux and the uniformity is 0.805.



Values in Lux, Scale 1 : 20

Position of surface in room:
Marked point: (11.165 m, 8.324 m, 0.760 m)



Grid: 11 x 4 Points

E_{av} [lx]
731

E_{min} [lx]
589

E_{max} [lx]
819

u_0
0.805

E_{min} / E_{max}
0.718

➤ **4 Pax Meeting Room**

Floor Area :3.70m²

Height : 2.750 m

Mounting Height of the luminaire:

The Linear Luminaire are suspended at a suspension height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

a. NLP72340

b. Lineco TMS022 TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 5

The lighting arrangement Followed : Localized General Lighting

The design outputs are as follows:

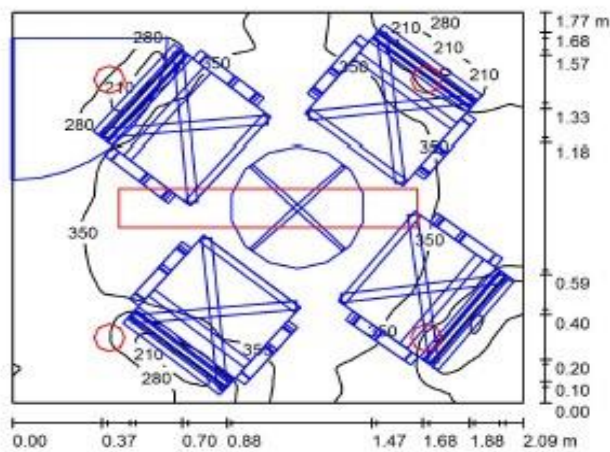
The lux level obtained after calculation is 334 lux.

Uniformity obtained : 0.293

Specific Connected Load: 32.08W/m²

Technical Report of 4 Pax Meeting Room

4 Pax Meeting Room / Summary



Height of Room: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:23

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	334	98	412	0.293
Floor	20	97	29	205	0.303
Ceiling	80	115	95	154	0.825
Walls (4)	50	238	29	539	/

Workplane:

Height: 0.760 m
Grid: 128 x 128 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.875, Ceiling / Working Plane: 0.344.

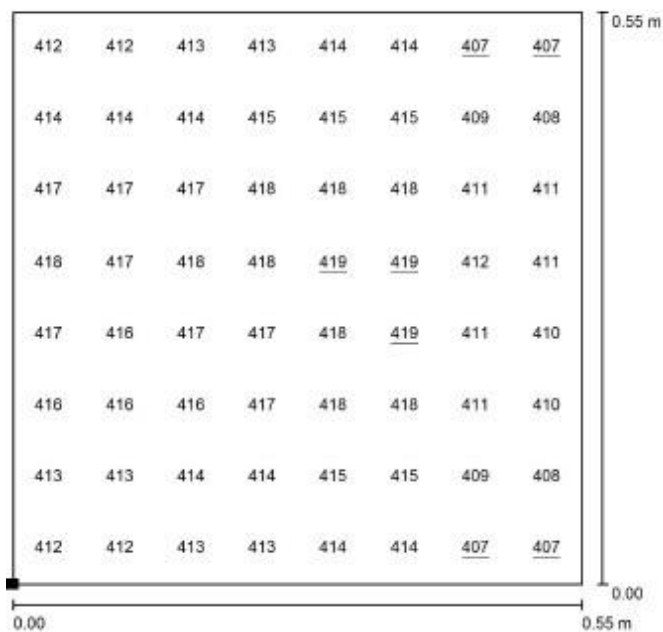
Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	⌀ (Luminaire) [lm]	⌀ (Lamps) [lm]	P [W]
1	4	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
2	1	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			4520	6390	118.8

Specific connected load: 32.08 W/m² = 9.59 W/m²/100 lx (Ground area: 3.70 m²)

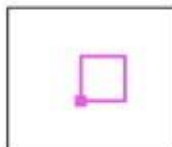
The Task illuminance of Worktable of 4 Pax Meeting Room is 414 lux and the uniformity is 0.982. The value chart of Table Top of 4 Pax Meeting Room is given.

4 Pax Meeting Room / Table Top / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 5

Position of surface in room:
Marked point:
(9.804 m, 4.039 m, 0.760 m)



Grid: 8 x 8 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$	E_{min} / E_{max}
414	407	419	0.982	0.971

➤ **Cabin 1**

Floor Area : 6.33m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750m.

Luminaire Used:

a. NLP72340

No. of Luminaires used: 12

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

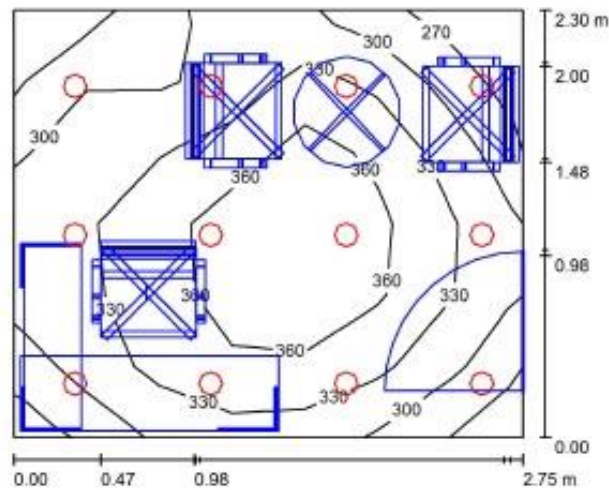
The lux level obtained after calculation is 330 lux.

Uniformity obtained : 0.762

Specific Connected Load: 36.37W/m²

Technical Report of Cabin 1

Cabin 1 / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:30

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	330	252	390	0.762
Floor	20	156	22	256	0.143
Ceiling	80	99	75	138	0.753
Walls (4)	50	193	12	842	/

Workplane:

Height: 0.760 m
 Gnd: 7 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.705, Ceiling / Working Plane: 0.301.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	12	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
			Total: 5292	Total: 9120	230.4

Specific connected load: 36.37 W/m² = 11.01 W/m²/100 lx (Ground area: 6.33 m²)

➤ **Cabin 2**

Floor Area : 6.33m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750m.

Luminaire Used:

a. NLP72340

No. of Luminaires used: 12

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

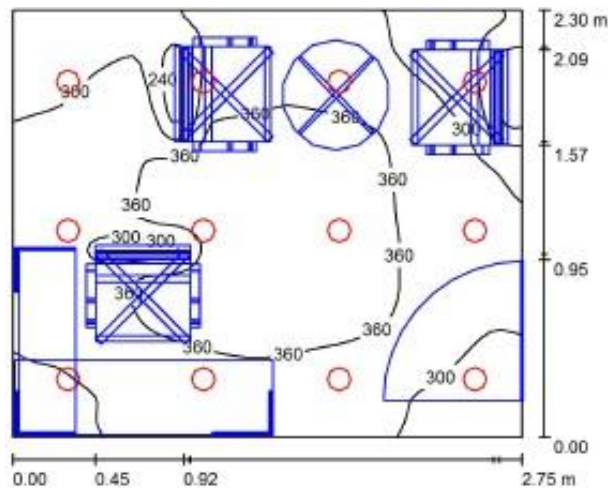
The lux level obtained after calculation is 329 lux.

Uniformity obtained : 0.329

Specific Connected Load: 36.37W/m²

Technical Report of Cabin 2

Cabin 2 / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:30

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	329	129	393	0.392
Floor	20	159	23	258	0.145
Ceiling	80	98	71	130	0.717
Walls (4)	50	192	9.80	661	/

Workplane:

Height: 0.760 m
 Grid: 64 x 64 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.705, Ceiling / Working Plane: 0.300.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	12	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
Total:			5292	9120	230.4

Specific connected load: 36.37 W/m² = 11.07 W/m²/100 lx (Ground area: 6.33 m²)

➤ **Cabin 3**

Floor Area : 6.33m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750m.

Luminaire Used:

a. NLP72340

No. of Luminaires used: 12

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

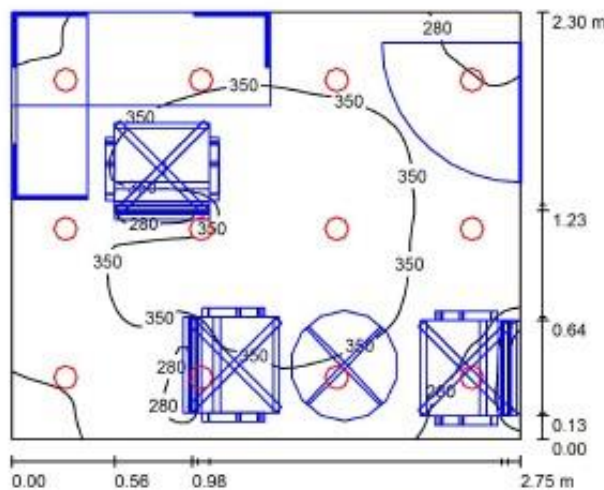
The lux level obtained after calculation is 328 lux.

Uniformity obtained : 0.254

Specific Connected Load: 36.37W/m²

Technical Report of Cabin 3

Cabin 3 / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:30

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	328	83	392	0.254
Floor	20	157	19	258	0.119
Ceiling	80	100	74	137	0.745
Walls (4)	50	191	5.55	638	/

Workplane:

Height: 0.760 m
 Grid: 64 x 64 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.705, Ceiling / Working Plane: 0.304.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	12	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
Total:			5292	9120	230.4

Specific connected load: 36.37 W/m² = 11.08 W/m²/100 lx (Ground area: 6.33 m²)

➤ **Cabin 4**

Floor Area : 6.33m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750.

Luminaire Used:

a. NLP72340

No. of Luminaires used: 12

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

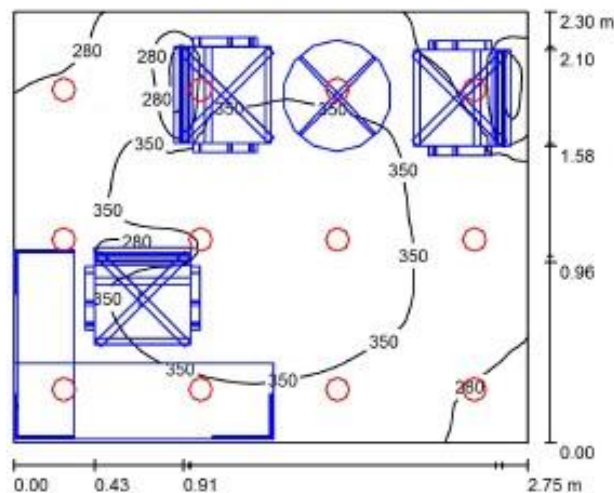
The lux level obtained after calculation is 327 lux.

Uniformity obtained : 0.225

Specific Connected Load: 36.37W/m²

Technical Report of Cabin 4

Cabin 4 / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:30

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	327	74	393	0.225
Floor	20	158	23	256	0.149
Ceiling	80	98	75	143	0.759
Walls (4)	50	190	9.60	614	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.702, Ceiling / Working Plane: 0.301.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	12	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
Total:			5292	9120	230.4

Specific connected load: 36.37 W/m² = 11.12 W/m²/100 lx (Ground area: 6.33 m²)

➤ **Cabin 5**

Floor Area : 6.33m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750.

Luminaire Used:

a. NLP72340

No. of Luminaires used: 12

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

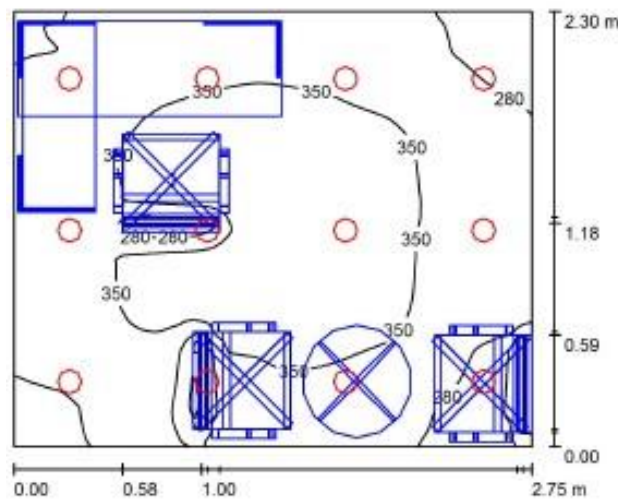
The lux level obtained after calculation is 328 lux.

Uniformity obtained : 0.204

Specific Connected Load: 36.37W/m²

Technical Report of Cabin 5

Cabin 5 / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:30

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	328	67	393	0.204
Floor	20	154	19	253	0.122
Ceiling	80	99	72	134	0.723
Walls (4)	50	190	9.90	650	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.703, Ceiling / Working Plane: 0.303.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	⊙ (Luminaire) [lm]	⊙ (Lamps) [lm]	P [W]
1	12	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
Total:			5292	9120	230.4

Specific connected load: 36.37 W/m² = 11.10 W/m²/100 lx (Ground area: 6.33 m²)

➤ **Cabin 6**

Floor Area : 6.33m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750.

Luminaire Used:

a. NLP72340

No. of Luminaires used: 12

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

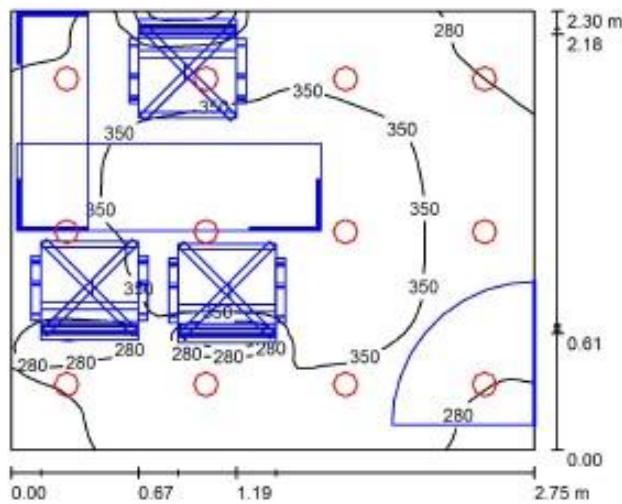
The lux level obtained after calculation is 326 lux.

Uniformity obtained : 0.267

Specific Connected Load: 36.37W/m²

Technical Report of Cabin 6

Cabin 6 / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:30

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	326	87	392	0.267
Floor	20	148	21	245	0.140
Ceiling	80	99	70	135	0.704
Walls (4)	50	196	9.74	635	/

Workplane:

Height: 0.760 m
 Grid: 64 x 64 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.711, Ceiling / Working Plane: 0.304.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	12	PANASONIC NLP72340 NLP72340 (1.000)	441	760	19.2
			Total: 5292	Total: 9120	230.4

Specific connected load: 36.37 W/m² = 11.15 W/m²/100 lx (Ground area: 6.33 m²)

➤ **CEO's Cabin**

Floor Area : 12.89m²

Height : 2.750 m

Mounting Height of the luminaire:

The Linear Luminaire are suspended at a suspension height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

a. NLP72443

b. Lineco TMS022 TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 17

The lighting arrangement Followed :Localized General Lighting

The design outputs are as follows:

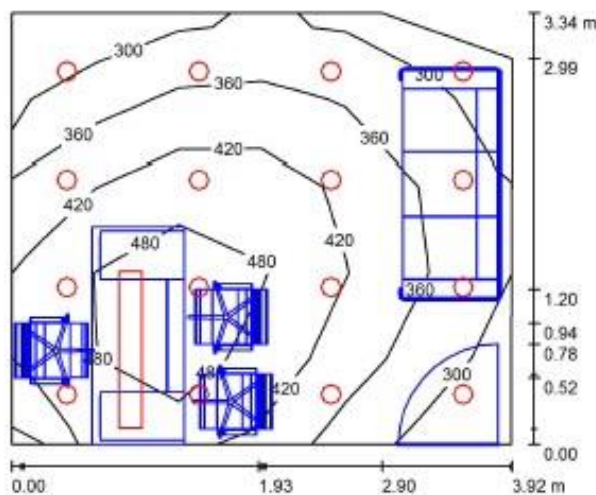
The lux level obtained after calculation is 396 lux.

Uniformity obtained : 0.682

Specific Connected Load: 34.78W/m²

Technical Report of CEO's Cabin

CEO's Cabin / Summary



Height of Room: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:43

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	396	270	541	0.682
Floor	20	201	22	353	0.108
Ceiling	80	97	72	165	0.736
Walls (5)	50	224	31	1004	/

Workplane:

Height: 0.760 m
 Grid: 6 x 5 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.656, Ceiling / Working Plane: 0.248.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	16	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	1	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 10442	Total: 19350	448.4

Specific connected load: 34.78 W/m² = 8.78 W/m²/100 lx (Ground area: 12.89 m²)

➤ **Manager's Cabin**

Floor Area : 8.65m²

Height : 2.750 m

Mounting Height of the luminaire:

The Linear Luminaire are suspended at a suspension height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

a. NLP72443

b. Lineco TMS022 TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 11

The lighting arrangement Followed :Localized General Lighting

The design outputs are as follows:

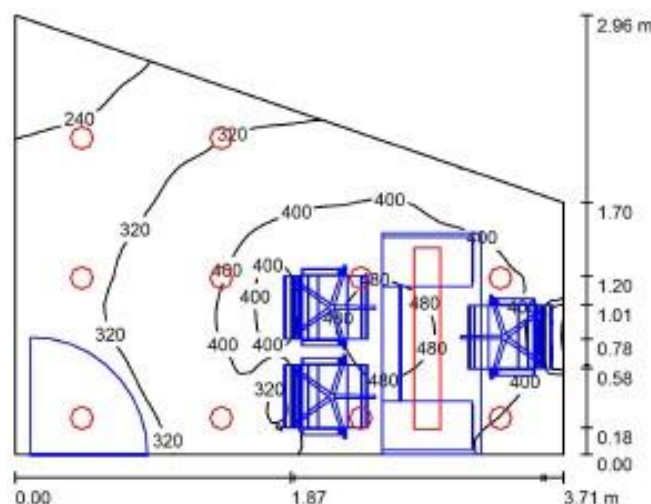
The lux level obtained after calculation is 357 lux.

Uniformity obtained : 0.405

Specific Connected Load: 34.22W/m²

Technical Report of Manager's Cabin

Manager's cabin / Summary



Height of Room: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:39

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	357	145	499	0.405
Floor	20	184	23	287	0.125
Ceiling	80	104	65	153	0.628
Walls (4)	50	227	26	840	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.728, Ceiling / Working Plane: 0.292.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	⌀ (Luminaire) [mm]	⌀ (Lamps) [mm]	P [W]
1	10	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	1	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			7560	Total: 13350	296.0

Specific connected load: 34.22 W/m² = 9.57 W/m²/100 lx (Ground area: 8.65 m²)

➤ **Workstation**

Floor Area : 173.48m²

Height : 2.950 m

Mounting Height of the luminaire:

The Linear Luminaire are suspended at a suspension height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

a. NLP72443

b. Lineco TMS022 TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 78

The lighting arrangement Followed :Localized General Lighting

The design outputs are as follows:

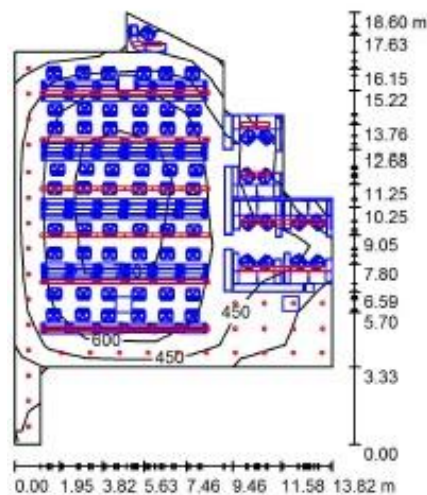
The lux level obtained after calculation is 544 lux.

Uniformity obtained : 0.204

Specific Connected Load: 15.73W/m²

Technical Report of Workstation

Workstation / Summary



Height of Room: 2.950 m, Light loss factor: 0.80

Values in Lux, Scale 1:239

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	544	111	850	0.204
Floor	20	245	26	500	0.105
Ceiling	80	133	46	184	0.348
Walls (13)	50	251	24	1127	/

Workplane:

Height: 0.760 m
 Grid: 13 x 9 Points
 Boundary Zone: 0.000 m

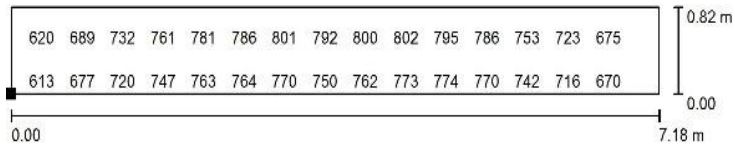
Illuminance Quotient (according to LG7): Walls / Working Plane: 0.485, Ceiling / Working Plane: 0.242.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	33	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	45	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 139882	Total: 183750	2728.2

Specific connected load: 15.73 W/m² = 2.89 W/m²/100 lx (Ground area: 173.48 m²)

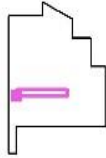
The Task illuminance of Worktable of is 740 lux and the uniformity is 0.794.



Values in Lux, Scale 1 : 52

Not all calculated values could be displayed.

Position of surface in room:
Marked point: (7.399 m, 14.231 m, 0.760 m)



Grid: 32 x 4 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$	E_{min} / E_{max}
740	588	813	0.794	0.723

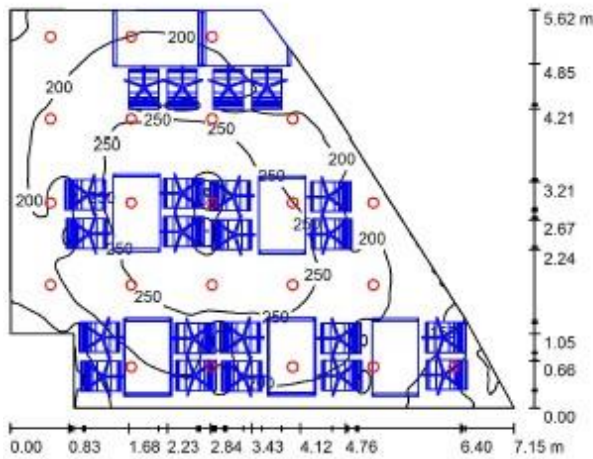
➤ **Cafeteria**

Floor Area : 29.56m²
 Height : 2.950 m
 Mounting Height of the luminaire:2.950
 Luminaire Used:
 a. NLP72443
 No. of Luminaires used: 22
 The lighting arrangement Followed :General Lighting

The design outputs are as follows:
 The lux level obtained after calculation is 210 lux.
 Uniformity obtained : 0.303
 Specific Connected Load: 18.90W/m²

Technical Report of Cafeteria

Cafeteria / Summary



Height of Room: 2.950 m, Mounting Height: 2.950 m, Light loss factor: 0.80 Values in Lux, Scale 1:73

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u
Workplane	/	210	64	277	0.303
Floor	20	105	17	203	0.164
Ceiling	80	50	37	139	0.738
Walls (9)	50	102	18	968	/

Workplane:
 Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m
 Illuminance Quotient (according to LG7): Walls / Working Plane: 0.546, Ceiling / Working Plane: 0.240.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	22	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
Total:			10560	22000	558.8

Specific connected load: 18.90 W/m² = 9.02 W/m²/100 lx (Ground area: 29.56 m²)

➤ **Gents Toilet**

Floor Area : 9.38m²

Height : 2.450 m

Mounting Height of the luminaire:2.450

Luminaire Used:

a. Lineco TMS022 TMS022 1x18W +GMS022 R TL-D

No. of Luminaires used: 4

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

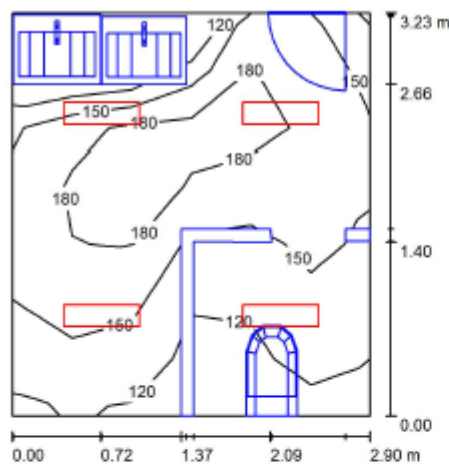
The lux level obtained after calculation is 157 lux.

Uniformity obtained : 0.613

Specific Connected Load: 10.66W/m²

Technical Report of Gents Toilet

Gents Toilet / Summary



Height of Room: 2.450 m, Mounting Height: 2.450 m, Light loss factor: 0.80 Values in Lux, Scale 1:42

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	157	96	201	0.613
Floor	20	96	13	135	0.131
Ceiling	80	52	24	78	0.464
Walls (4)	50	115	8.86	267	/

Workplane:

Height: 0.760 m
Grid: 6 x 7 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.898, Ceiling / Working Plane: 0.331.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS TMS022 1x18W +GMS022 R TL-D HFS (1.000)	1110	1350	25.0
Total:			4440	5400	100.0

Specific connected load: 10.66 W/m² = 8.81 W/m²/100 lx (Ground area: 9.38 m²)

➤ **Ladies Toilet**

Floor Area : 4.33m²

Height : 2.450 m

Mounting Height of the luminaire:2.450

Luminaire Used:

a. Lineco TMS022 TMS022 1x18W +GMS022 R TL-D

No. of Luminaires used: 2

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

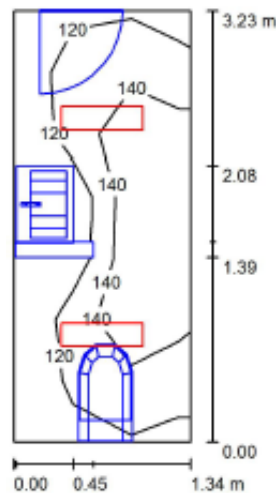
The lux level obtained after calculation is 138 lux.

Uniformity obtained : 0.781

Specific Connected Load: 11.54W/m²

Technical Report of Ladies Toilet

Ladies Toilet / Summary



Height of Room: 2.450 m, Mounting Height: 2.450 m, Light loss factor: 0.80

Values in Lux, Scale 1:42

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	138	108	169	0.781
Floor	20	74	16	105	0.212
Ceiling	80	55	30	74	0.534
Walls (4)	50	106	12	250	/

Workplane:

Height: 0.760 m
 Grid: 3 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.982, Ceiling / Working Plane: 0.412.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x18W +GMS022 R TL-D HFS (1.000)	1110	1350	25.0
Total:			2220	2700	50.0

Specific connected load: 11.54 W/m² = 8.34 W/m²/100 lx (Ground area: 4.33 m²)

➤ **Executive Toilet**

Floor Area : 4.53m²

Height : 2.450 m

Mounting Height of the luminaire:2.450

Luminaire Used:

a. Lineco TMS022 TMS022 1x18W +GMS022 R TL-D

No. of Luminaires used: 2

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

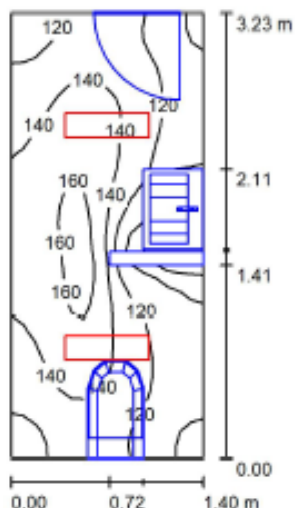
The lux level obtained after calculation is 131 lux.

Uniformity obtained : 0.585

Specific Connected Load: 11.54W/m²

Technical Report of Executive Toilet

Executive Toilet / Summary



Height of Room: 2.450 m, Mounting Height: 2.450 m, Light loss factor: 0.80

Values in Lux, Scale 1:42

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	131	78	168	0.585
Floor	20	72	15	104	0.203
Ceiling	80	53	29	69	0.544
Walls (4)	50	102	9.71	244	/

Workplane:

Height: 0.760 m
 Grid: 16 x 32 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.971, Ceiling / Working Plane: 0.404.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x18W +GMS022 R TL-D HFS (1.000)	1110	1350	25.0
Total:			2220	2700	50.0

Specific connected load: 11.04 W/m² = 8.45 W/m²/100 lx (Ground area: 4.53 m²)

➤ **Electrical room**

Floor Area : 4.53m²

Height : 3 m

Mounting Height of the luminaire:3

Luminaire Used:

a. Lineco TMS022 TMS022 1x18W +GMS022 R TL-D

No. of Luminaires used: 7

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

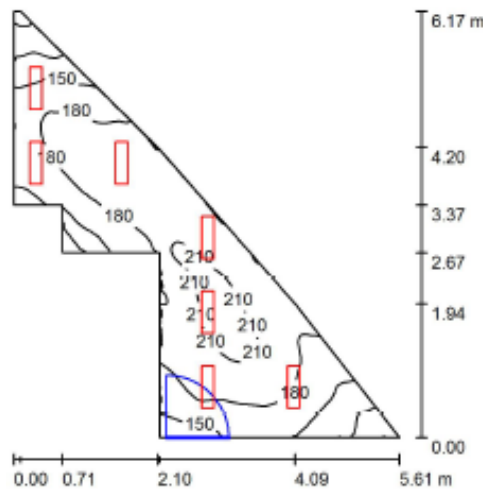
The lux level obtained after calculation is 178 lux.

Uniformity obtained : 0.463

Specific Connected Load: 12.39W/m²

Technical Report of Electrical Room

Electrical Room / Summary



Height of Room: 3.000 m, Mounting Height: 3.000 m, Light loss factor: 0.80 Values in Lux, Scale 1:80

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	178	83	218	0.463
Floor	20	135	88	189	0.647
Ceiling	80	75	38	230	0.499
Walls (10)	50	151	45	1502	/

Workplane:

Height: 0.760 m
 Grid: 128 x 64 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.996, Ceiling / Working Plane: 0.421.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	7	PHILIPS TMS022 1x18W +GMS022 R TL-D HFS (1.000)	1110	1350	25.0
Total:			7770	9450	175.0

Specific connected load: 14.12 W/m² = 7.91 W/m²/100 lx (Ground area: 12.39 m²)

➤ **Phone Booth**

Floor Area : 2.66m²

Height : 3 m

Mounting Height of the luminaire:3m

Luminaire Used:

a. Lineco TMS022 TMS022 1x18W +GMS022 R TL-D

No. of Luminaires used: 1

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

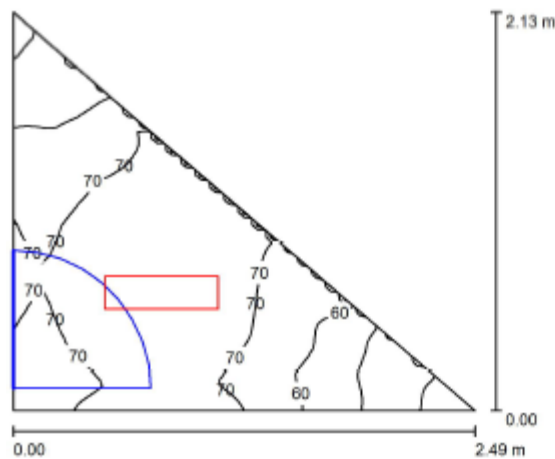
The lux level obtained after calculation is 67lux.

Uniformity obtained : 0.543

Specific Connected Load: 9.39W/m²

Technical Report of Phone Booth

Phone Booth / Summary



Height of Room: 3.000 m, Mounting Height: 3.000 m, Light loss factor: 0.80

Values in Lux, Scale 1:28

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	67	36	79	0.543
Floor	20	42	29	47	0.701
Ceiling	80	46	18	77	0.382
Walls (3)	50	66	10	359	/

Workplane:

Height: 0.760 m
 Grid: 64 x 64 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 1.204, Ceiling / Working Plane: 0.687.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS TMS022 1x18W +GMS022 R TL-D HFS (1.000)	1110	1350	25.0
Total:			1110	1350	25.0

Specific connected load: $9.39 \text{ W/m}^2 = 13.97 \text{ W/m}^2/100 \text{ lx}$ (Ground area: 2.66 m²)

7.3.2 Lighting design of Office B Bangalore with LED Luminaires

- a. Input Design parameters like Surface Reflectances, Light Loss factor etc are considered according to the Standards.

Ceiling Reflectance = 80%

Wall Reflectance = 50%

Floor Reflectance = 20%

Light Loss Factor = 0.8

Workplane Height = 0.76 m

- b. LED Luminaire Used:

- i) Linear LED Batten of 19W
- ii) Recessed mounted LED down lighters of 11 W
- iii) Recessed mounted LED down lighters of 19 W
- iv) Recessed mounted LED Panel of 27W
- v) Linear Surface mounted LED Luminaire of 29W

The Lighting plan of Office B_Bangalore with LED Luminaires Layout:



Fig. 7.8 LED Luminaire Layout of Office B Bangalore

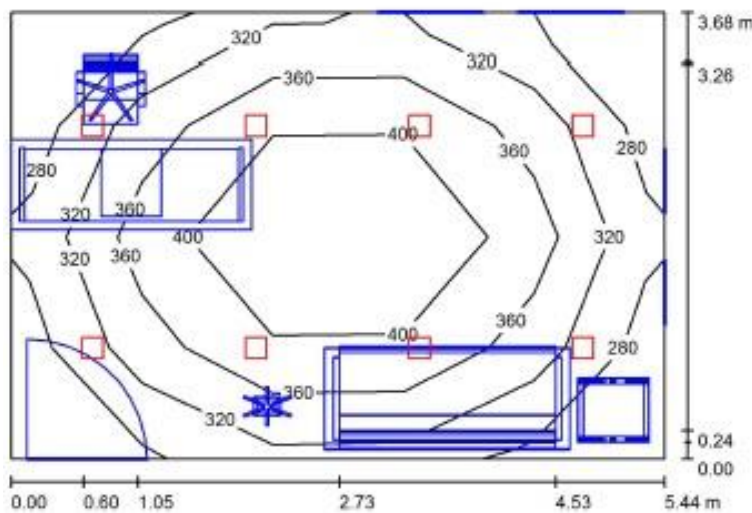
➤ **Reception & Waiting**

Floor Area 20.02 m²
 Height : 2.750 m
 Mounting Height of the luminaire: 2.750 m
 Luminaire Used:
 a. DN572B PSE-E F
 The lighting arrangement Followed : General Lighting

The design outputs are as follows:
 The lux level obtained after calculation is 357 lux.
 Uniformity obtained : 0.750
 Specific Connected Load: 4.32W/m²

Technical Report of Reception & Waiting

Reception & Waiting / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80 Values in Lux, Scale 1:48

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	357	268	449	0.750
Floor	20	236	6.97	423	0.030
Ceiling	80	59	40	74	0.680
Walls (4)	50	106	12	222	/

Workplane:

Height: 0.760 m
 Grid: 5 x 4 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.308, Ceiling / Working Plane: 0.169.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	8	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
			Total: 9999	Total: 10000	86.4

Specific connected load: 4.32 W/m² = 1.21 W/m²/100 lx (Ground area: 20.02 m²)

➤ **4 Pax Meeting Room**

Floor Area : 6.61 m²

Height : 2.750 m

Mounting Height of the luminaire: The Linear Luminaire are suspended at a suspension height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

a. DN570B PSE-E C PG (1.000)

b. RC461B G2 PSD W60L60 (1.000)

No. of Luminaires used: 2

The lighting arrangement Followed : Localized General Lighting

The design outputs are as follows:

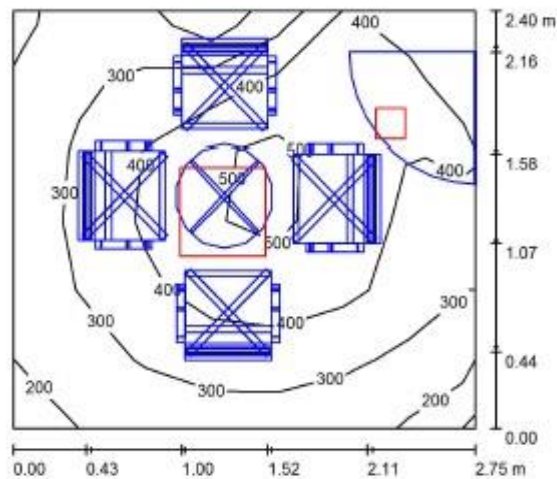
The lux level obtained after calculation is 315 lux.

Uniformity obtained : 0.709

Specific Connected Load: 23.77W/m²

Technical Report of 4Pax Meeting Room

4 Pax Meeting Room / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:31

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	354	60	537	0.170
Floor	20	167	32	313	0.194
Ceiling	80	66	43	85	0.656
Walls (4)	50	141	33	370	/

Workplane:

Height: 0.760 m
Grid: 7 x 6 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.399, Ceiling / Working Plane: 0.182.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
2	1	PHILIPS RC461B G2 PSD W60L60 (1.000)	3397	3400	27.0
Total:			4647	4650	37.8

Specific connected load: 5.72 W/m² = 1.61 W/m²/100 lx (Ground area: 6.61 m²)

The Task illuminance of Worktable of 4Pax Meeting Room is 518 lux and the uniformity is 0.924

E_{av} [lx]
518

E_{min} [lx]
479

E_{max} [lx]
546

u_0
0.924

E_{min} / E_{max}
0.877

The value chart of table top of 4 pax meeting room is given where distribution of light level are shown on table top.

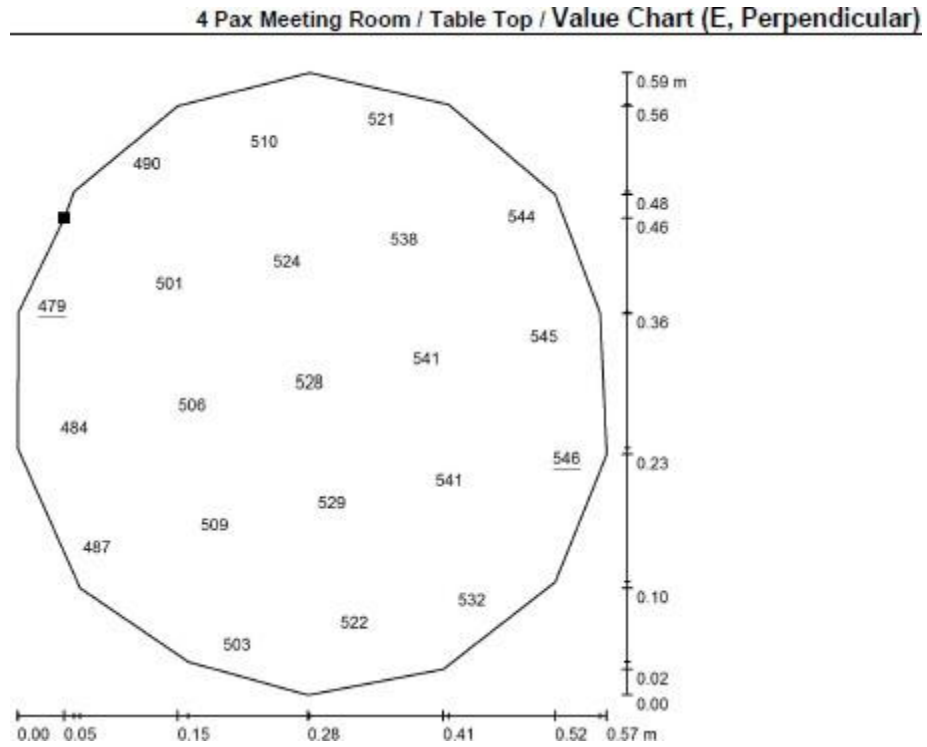


Fig. 7.9 Value Chart of Table Top of 4Pax Meeting Room

➤ 6 Pax Meeting Room

Floor Area :7.79 m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750 m

Luminaire Used:

- a. DN570B PSE-E C PG (1.000)
- b. RC461B G2 PSD W60L60 (1.000)

No. of Luminaires used: 2

The lighting arrangement Followed : Localized General Lighting

The design outputs are as follows:

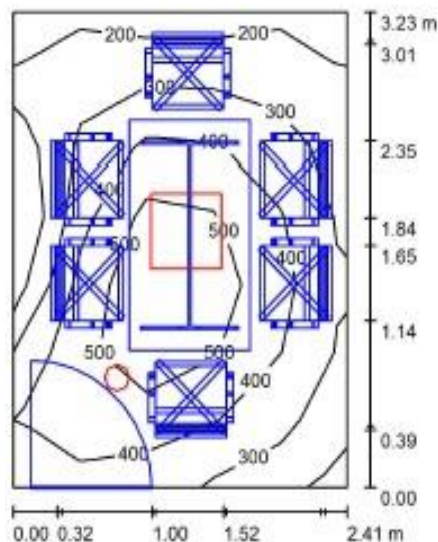
The lux level obtained after calculation is 377 lux.

Uniformity obtained : 0.303

Specific Connected Load: 5.90W/m²

Technical Report of 6 Pax Meeting Room

6 Pax Meeting room / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:42

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	377	114	593	0.303
Floor	20	116	17	343	0.150
Ceiling	80	78	47	97	0.618
Walls (4)	50	141	17	384	/

Workplane:

Height: 0.760 m
Grid: 5 x 7 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.393, Ceiling / Working Plane: 0.197.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C PG (1.000)	2100	2100	19.0
2	1	PHILIPS RC461B G2 PSD W60L60 (1.000)	3397	3400	27.0
			Total: 5497	Total: 5500	46.0

Specific connected load: 5.90 W/m² = 1.56 W/m²/100 lx (Ground area: 7.79 m²)

The Task illuminance of Worktable of 6 Pax Meeting Room is 452 lux and the uniformity is 0.934.

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0	E_{min} / E_{max}
524	369	612	0.704	0.603

The value chart of table top of 6 pax meeting room is given where distribution of light level are shown on table top.

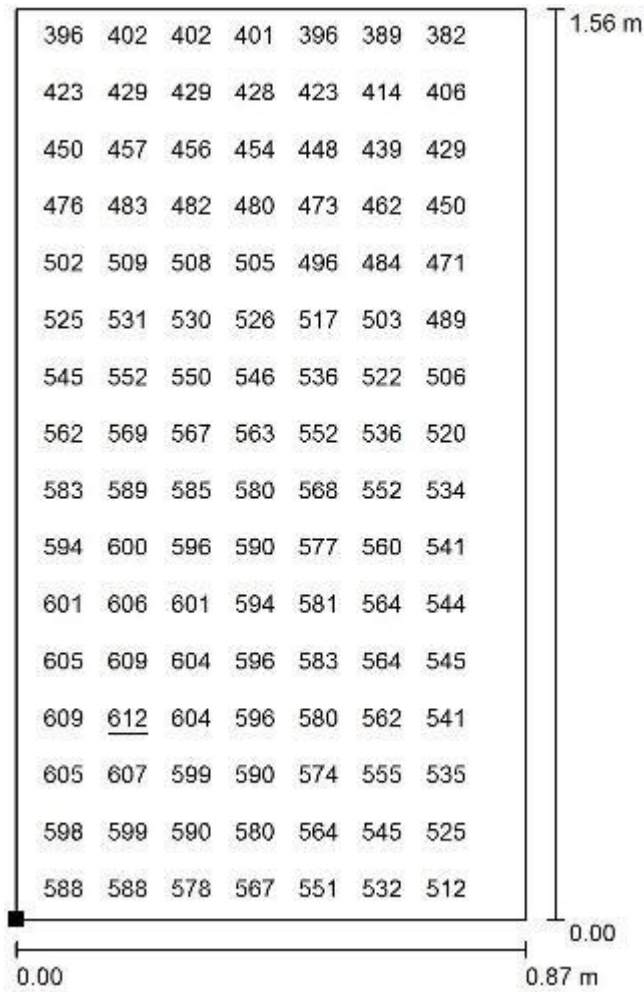


Fig. Value Chart of Table Top of 6Pax Meeting Room

➤ **4 Pax Meeting Room**

Floor Area :3.71 m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750 m

Luminaire Used:

a. RC461B G2 PSD W60L60 (1.000)

No. of Luminaires used: 2

The lighting arrangement Followed : Localized General Lighting

The design outputs are as follows:

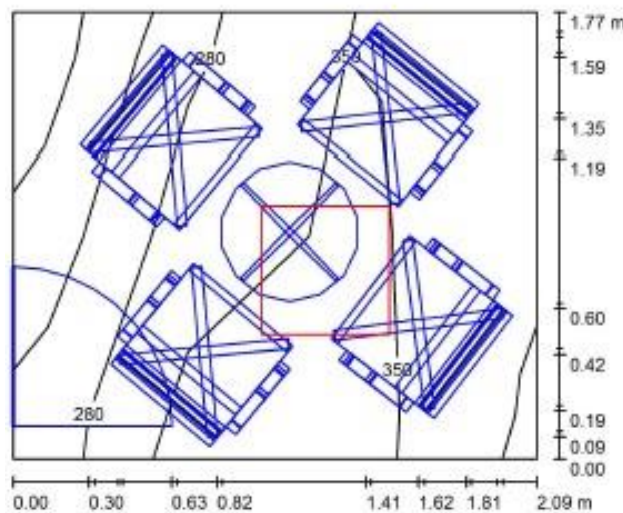
The lux level obtained after calculation is 345 lux.

Uniformity obtained : 0.397

Specific Connected Load: 7.29W/m²

Technical Report of 4 Pax Meeting Room

4 Pax Meeting Room / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:23

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	345	137	443	0.397
Floor	20	91	27	224	0.294
Ceiling	80	81	52	104	0.643
Walls (4)	50	166	26	489	/

Workplane:

Height: 0.760 m
 Grid: 3 x 2 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.573, Ceiling / Working Plane: 0.240.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS RC461B G2 PSD W60L60 (1.000)	3397	3400	27.0
Total:			3397	3400	27.0

Specific connected load: 7.29 W/m² = 2.11 W/m²/100 lx (Ground area: 3.71 m²)

The Task illuminance of Worktable of 4 Pax Meeting Room is 442 lux and the uniformity is 0.939

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$	E_{min} / E_{max}
442	415	460	0.939	0.903

The value chart of table top of 4 pax meeting room is given where distribution of light level are shown on table top.

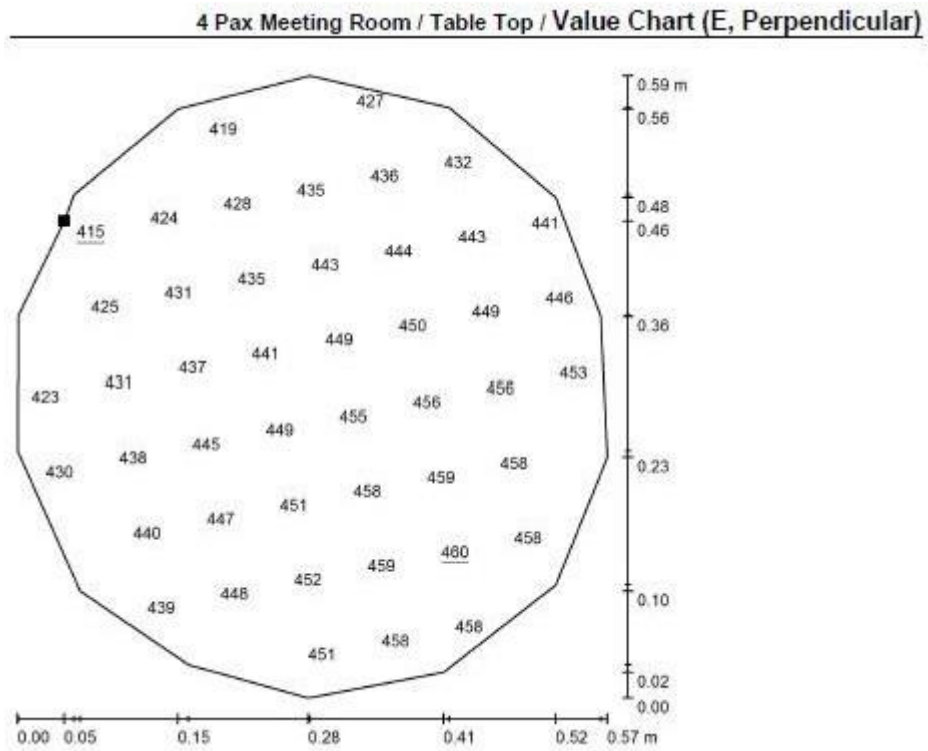


Fig. 7.10 Value Chart of Table Top of 4Pax Meeting Room

➤ **Conference Room**

Floor Area :16.04m²

Height : 2.750 m

Mounting Height of the luminaire:

The Linear Luminaire are suspended at a suspension height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

a. DN570B PSE-E C PG (1.000)

b. BN124C L600 LED21S/857 NO

No. of Luminaires used: 15

The lighting arrangement Followed : Localized General Lighting

The design outputs are as follows:

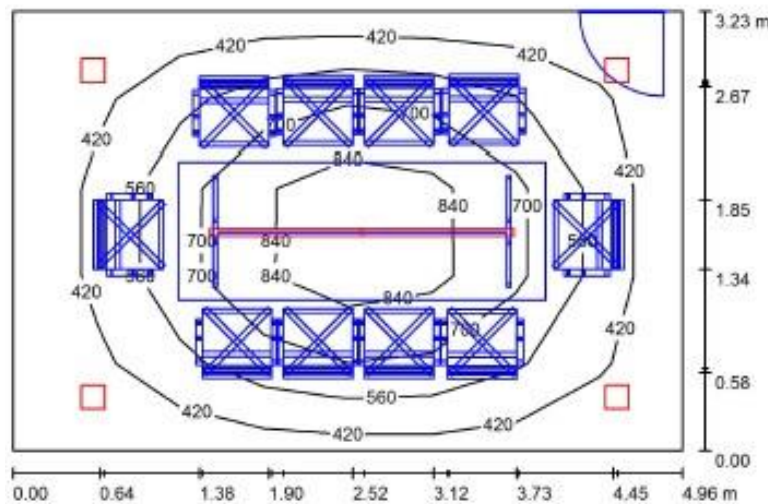
The lux level obtained after calculation is 577 lux.

Uniformity obtained : 0.510

Specific Connected Load: 6.31W/m²

Technical Report of Conference Room

Conference Room / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:42

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	577	294	982	0.510
Floor	20	186	30	454	0.162
Ceiling	80	106	70	132	0.659
Walls (4)	50	169	73	543	/

Workplane:

Height: 0.760 m
 Grid: 8 x 5 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.312, Ceiling / Working Plane: 0.193.

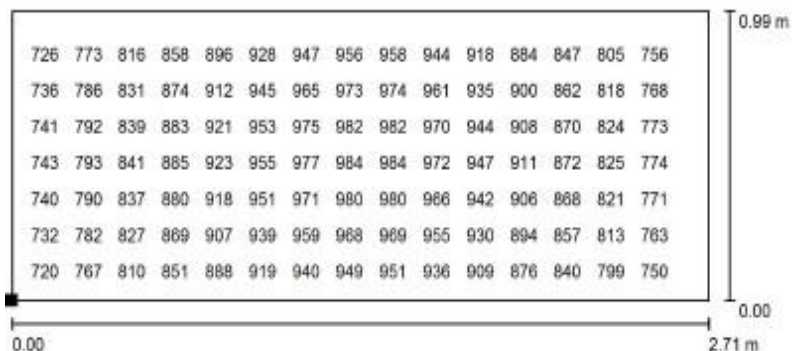
Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
2	2	PHILIPS SM530C L1130 OC LED40S/840 NO (1.000)	3995	4000	29.0
Total:			12989	13000	101.2

Specific connected load: 6.31 W/m² = 1.09 W/m²/100 lx (Ground area: 16.04 m²)

The Task illuminance of Worktable of Conference Room Meeting Room Is 865 lux and the uniformity is 0.792. The value chart of table top of 4 pax meeting room is given where distribution of light level are shown on table top.

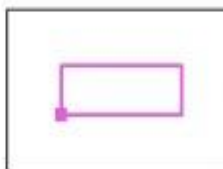
Conference Room / Table Top / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 20

Not all calculated values could be displayed.

Position of surface in room:
Marked point:
(11.185 m, 8.330 m, 0.760 m)



Grid: 32 x 16 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$	E_{min} / E_{max}
865	885	987	0.792	0.894

➤ **4 Pax Meeting Room**

Floor Area :3.70m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750m

Luminaire Used:

a. RC461B G2 PSD W60L60 (1.000)

No. of Luminaires used: 1

The lighting arrangement Followed : Localized General Lighting

The design outputs are as follows:

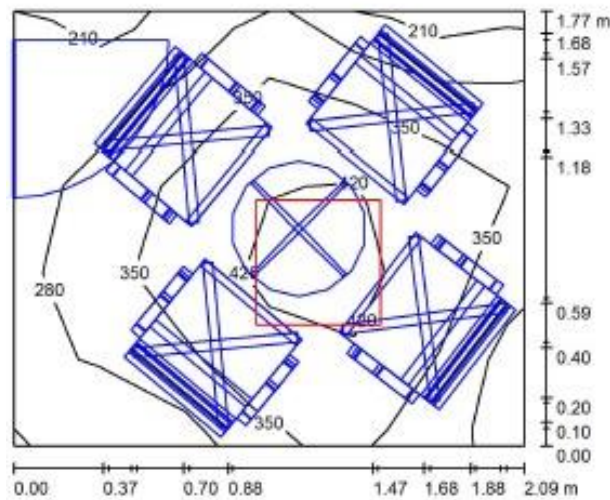
The lux level obtained after calculation is 346 lux.

Uniformity obtained : 0.407

Specific Connected Load: 7.29W/m²

Technical Report of 4 Pax Meeting Room

4 Pax Meeting Room / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:23

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	346	141	447	0.407
Floor	20	90	25	221	0.280
Ceiling	80	81	52	104	0.642
Walls (4)	50	167	23	491	/

Workplane:

Height: 0.760 m
 Grid: 6 x 5 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.575, Ceiling / Working Plane: 0.239.

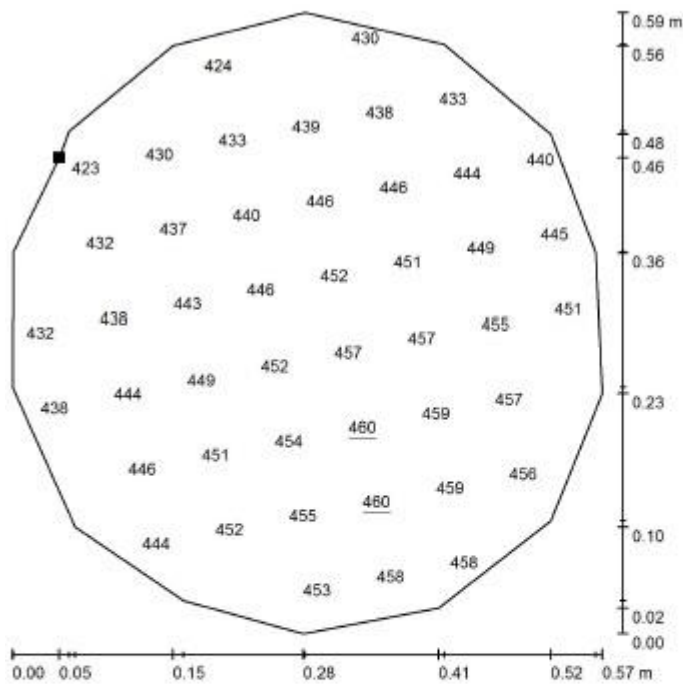
Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS RC461B G2 PSD W60L60 (1.000)	3397	3400	27.0
Total:			3397	3400	27.0

Specific connected load: 7.29 W/m² = 2.11 W/m²/100 lx (Ground area: 3.70 m²)

The Task illuminance of Worktable of 4 Pax Meeting Room is 445 lux and the uniformity is 0.948. The value chart of table top of 4 pax meeting room is given where distribution of light level are shown on table top.

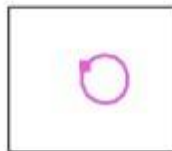
4 Pax Meeting Room / Table Top / Value Chart (E, Perpendicular)



Values in Lux, Scale 1 : 5

Not all calculated values could be displayed.

Position of surface in room:
Marked point:
(9.835 m, 4.473 m, 0.760 m)



Grid: 8 x 8 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0	E_{min} / E_{max}
445	422	460	0.948	0.918

➤ **Cabin 1**

Floor Area : 6.33m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750.

Luminaire Used:

- a. DN572B PSE-E F

No. of Luminaires used: 4

The lighting arrangement Followed : General Lighting

The design outputs are as follows:

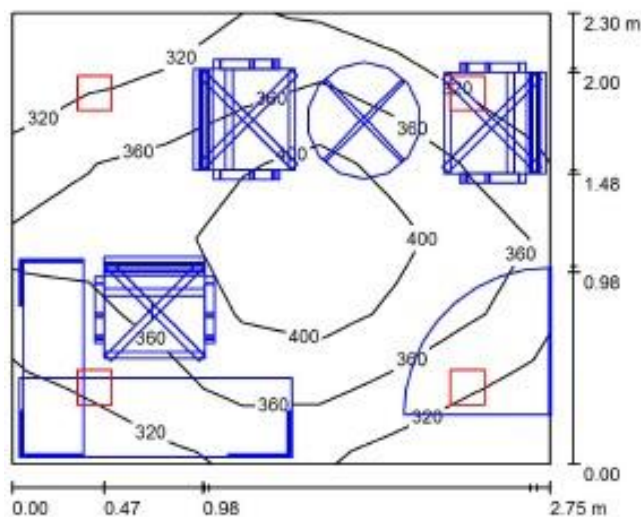
The lux level obtained after calculation is 358 lux.

Uniformity obtained : 0.791

Specific Connected Load: 6.82W/m²

Technical Report of Cabin 1

Cabin 1 / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:30

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0
Workplane	/	358	284	446	0.791
Floor	20	186	19	342	0.102
Ceiling	80	90	67	106	0.744
Walls (4)	50	168	11	552	/

Workplane:

Height: 0.760 m
 Grid: 7 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.563, Ceiling / Working Plane: 0.254.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
Total:			4999	5000	43.2

Specific connected load: 6.82 W/m² = 1.90 W/m²/100 lx (Ground area: 6.33 m²)

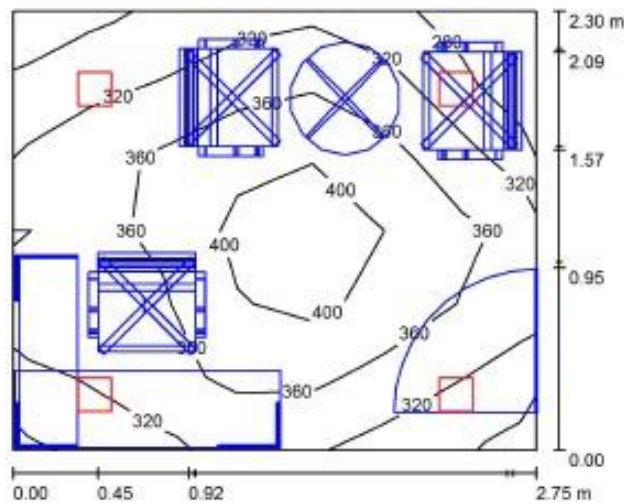
➤ **Cabin 2**

Floor Area : 6.33m²
 Height : 2.750 m
 Mounting Height of the luminaire: 2.750.
 Luminaire Used:
 a. DN572B PSE-E F
 No. of Luminaires used: 4
 The lighting arrangement Followed :General Lighting

The design outputs are as follows:
 The lux level obtained after calculation is 350 lux.
 Uniformity obtained : 0.783
 Specific Connected Load: 6.82W/m²

Technical Report of Cabin 2

Cabin 2 / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:30

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	350	274	437	0.783
Floor	20	187	18	338	0.104
Ceiling	80	92	67	121	0.722
Walls (4)	50	169	8.80	910	/

Workplane:

Height: 0.760 m
 Grid: 7 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.584, Ceiling / Working Plane: 0.265.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
			Total: 4999	Total: 5000	43.2

Specific connected load: 6.82 W/m² = 1.95 W/m²/100 lx (Ground area: 6.33 m²)

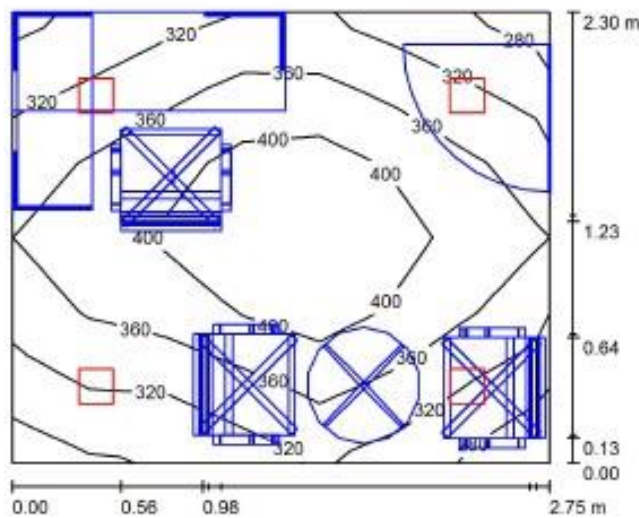
➤ **Cabin 3**

Floor Area : 6.33m²
 Height : 2.750 m
 Mounting Height of the luminaire: 2.750m
 Luminaire Used:
 a. DN572B PSE-E F
 No. of Luminaires used: 4
 The lighting arrangement Followed :General Lighting

The design outputs are as follows:
 The lux level obtained after calculation is 362 lux.
 Uniformity obtained : 0.772
 Specific Connected Load: 6.82W/m²

Technical Report of Cabin 3

Cabin 3 / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:30

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	362	280	450	0.772
Floor	20	187	13	345	0.089
Ceiling	80	91	69	106	0.754
Walls (4)	50	166	5.48	552	/

Workplane:

Height: 0.760 m
 Grid: 7 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.557, Ceiling / Working Plane: 0.255.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
			Total: 4999	Total: 5000	43.2

Specific connected load: 6.82 W/m² = 1.88 W/m²/100 lx (Ground area: 6.33 m²)

➤ **Cabin 4**

Floor Area : 6.33m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750.

Luminaire Used:

- a. DN572B PSE-E F

No. of Luminaires used: 4

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

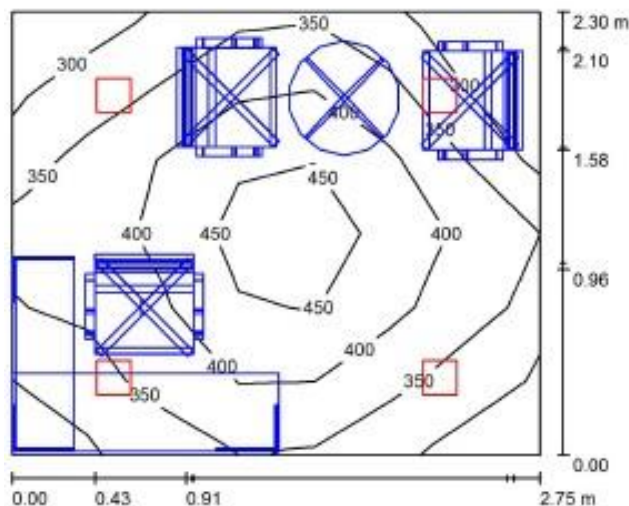
The lux level obtained after calculation is 375 lux.

Uniformity obtained : 0.745

Specific Connected Load: 6.82W/m²

Technical Report of Cabin 4

Cabin 4 / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:30

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	375	279	492	0.745
Floor	20	197	18	357	0.091
Ceiling	80	86	64	99	0.746
Walls (4)	50	162	8.99	516	/

Workplane:

Height: 0.760 m
 Grid: 7 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.512, Ceiling / Working Plane: 0.230.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
			Total: 4999	Total: 5000	43.2

Specific connected load: 6.82 W/m² = 1.82 W/m²/100 lx (Ground area: 6.33 m²)

➤ **Cabin 5**

Floor Area : 6.33m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750.

Luminaire Used:

a. DN572B PSE-E F

No. of Luminaires used: 4

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

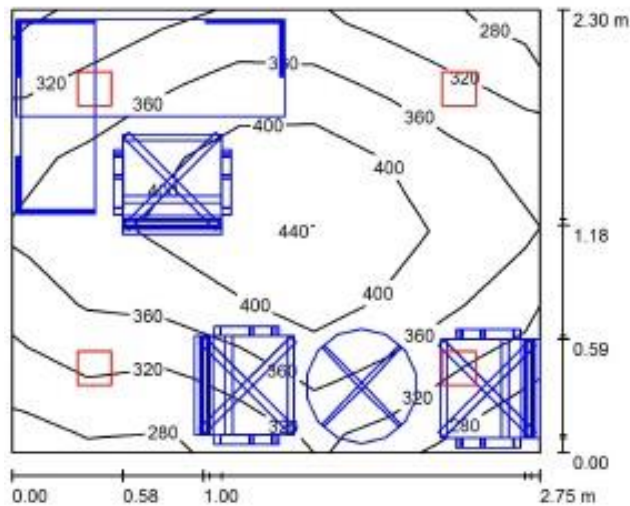
The lux level obtained after calculation is 360 lux.

Uniformity obtained : 0.713

Specific Connected Load: 6.82 W/m²

Technical Report of Cabin 5

Cabin 5 / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:30

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	360	257	454	0.713
Floor	20	186	15	343	0.080
Ceiling	80	90	66	106	0.736
Walls (4)	50	165	9.44	507	/

Workplane:

Height: 0.760 m
 Grid: 7 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.552, Ceiling / Working Plane: 0.249.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
Total:			4999	5000	43.2

Specific connected load: 6.82 W/m² = 1.89 W/m²/100 lx (Ground area: 6.33 m²)

➤ **Cabin 6**

Floor Area : 6.33m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750.

Luminaire Used:

a. DN572B PSE-E F

No. of Luminaires used: 4

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

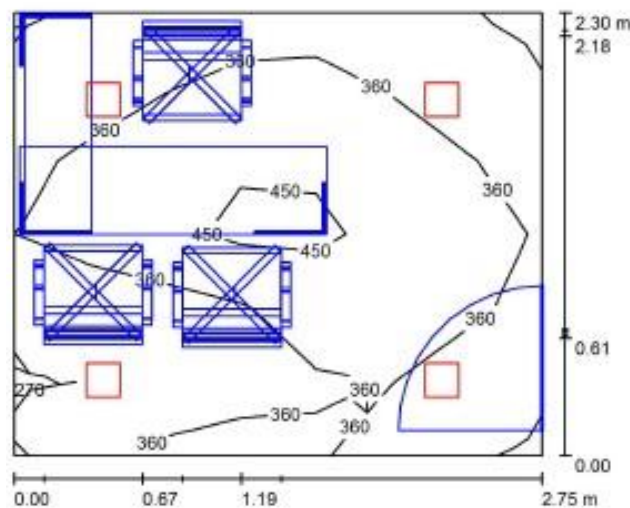
The lux level obtained after calculation is 354 lux.

Uniformity obtained : 0.226

Specific Connected Load: 6.82 W/m²

Technical Report of Cabin 6

Cabin 6 / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:30

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	354	80	481	0.226
Floor	20	181	14	328	0.075
Ceiling	80	89	64	103	0.720
Walls (4)	50	166	9.74	550	/

Workplane:

Height: 0.760 m
 Grid: 7 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.525, Ceiling / Working Plane: 0.242.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
Total:			4999	5000	43.2

Specific connected load: 6.82 W/m² = 1.93 W/m²/100 lx (Ground area: 6.33 m²)

➤ **CEO's Cabin**

Floor Area : 12.89m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750 m

Luminaire Used:

a. DN572B PSE-E F

No. of Luminaires used: 6

The lighting arrangement Followed :Localized General Lighting

The design outputs are as follows:

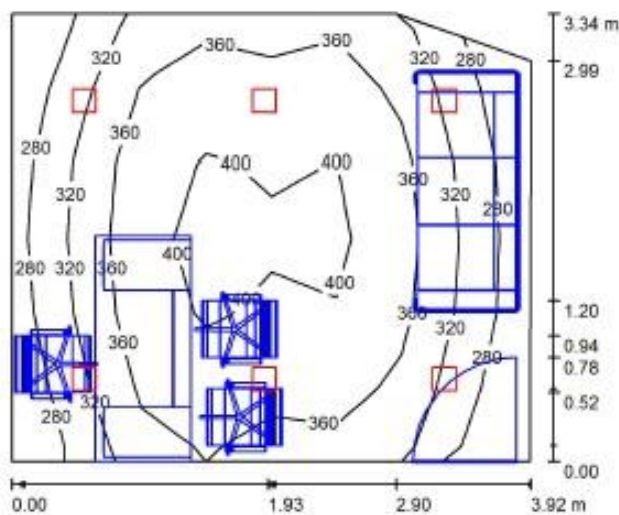
The lux level obtained after calculation is 351 lux.

Uniformity obtained : 0.733

Specific Connected Load: 5.03 W/m²

Technical Report of CEO's Cabin

CEO's Cabin / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:43

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	351	257	420	0.733
Floor	20	204	12	392	0.061
Ceiling	80	66	45	82	0.686
Walls (5)	50	132	14	389	/

Workplane:

Height: 0.760 m
 Grid: 8 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.419, Ceiling / Working Plane: 0.190.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	6	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
Total:			7499	7500	64.8

Specific connected load: 5.03 W/m² = 1.43 W/m²/100 lx (Ground area: 12.89 m²)

➤ **Manager's Cabin**

Floor Area : 8.65m²

Height : 2.750 m

Mounting Height of the luminaire: 2.750m

Luminaire Used:

a. DN572B PSE-E F

No. of Luminaires used: 4

The lighting arrangement Followed :Localized General Lighting

The design outputs are as follows:

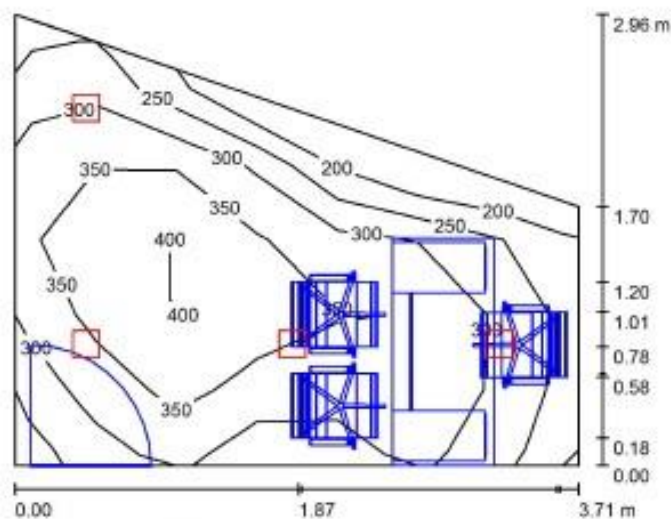
The lux level obtained after calculation is 315 lux.

Uniformity obtained : 0.58

Specific Connected Load: 4.99 W/m²

Technical Report of Manager's Cabin

Manager's cabin / Summary



Height of Room: 2.750 m, Mounting Height: 2.750 m, Light loss factor: 0.80

Values in Lux, Scale 1:39

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	315	183	419	0.580
Floor	20	193	13	315	0.085
Ceiling	80	64	46	79	0.709
Walls (4)	50	126	15	509	/

Workplane:

Height: 0.760 m
 Grid: 6 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.429, Ceiling / Working Plane: 0.202.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
Total:			4999	5000	43.2

in Specific connected load: 4.99 W/m² = 1.58 W/m²/100 lx (Ground area: 8.65 m²)

➤ **Workstation**

Floor Area : 173.48m²

Height : 2.950 m

Mounting Height of the luminaire: The Linear Luminaire are suspended at a suspension height of 0.3m and the downlighters are recessed mounted.

Luminaire Used:

a. DN572B PSE-E F

b. SM530C L1130 OC LED40S/840

No. of Luminaires used: 38

The lighting arrangement Followed :Localized General Lighting

The design outputs are as follows:

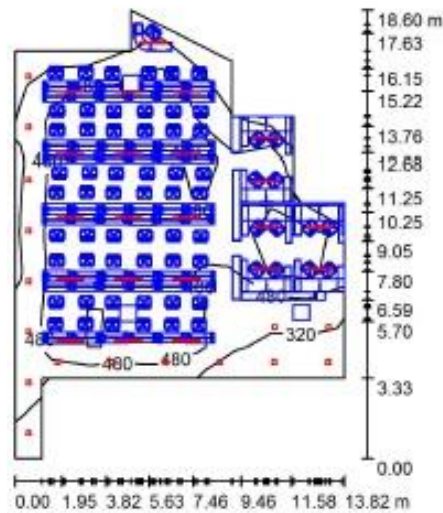
The lux level obtained after calculation is 502 lux.

Uniformity obtained : 0.398

Specific Connected Load: 4.67W/m²

Technical Report of Workstation

Workstation / Summary



Height of Room: 2.950 m, Light loss factor: 0.80

Values in Lux, Scale 1:230

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	502	200	966	0.398
Floor	20	246	16	745	0.064
Ceiling	80	117	46	275	0.397
Walls (13)	50	150	21	507	/

Workplane:

Height: 0.760 m
 Grid: 12 x 9 Points
 Boundary Zone: 0.000 m

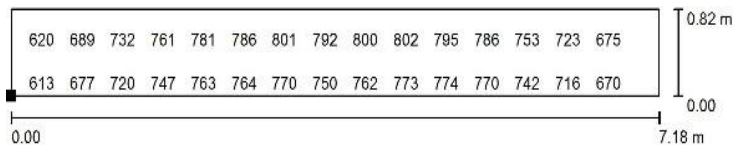
Illuminance Quotient (according to LG7): Walls / Working Plane: 0.313, Ceiling / Working Plane: 0.233.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	16	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
2	22	PHILIPS SM530C L1130 OC LED40S/840 NO (1.000)	3995	4000	29.0
Total:			107880	108000	810.8

Specific connected load: 4.67 W/m² = 0.93 W/m²/100 lx (Ground area: 173.48 m²)

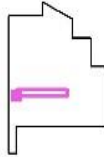
The Task illuminance of Worktable of is 740 lux and the uniformity is 0.794. . The value chart of table top of 4 pax meeting room is given where distribution of light level are shown on table top.



Values in Lux, Scale 1 : 52

Not all calculated values could be displayed.

Position of surface in room:
Marked point: (7.399 m, 14.231 m, 0.760 m)



Grid: 32 x 4 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
740	588	813	0.794	0.723

➤ **Cafeteria**

Floor Area : 29.56m²

Height : 2.950 m

Mounting Height of the luminaire: 2.950m

Luminaire Used:

a. DN572B PSE-E F

No. of Luminaires used: 11

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

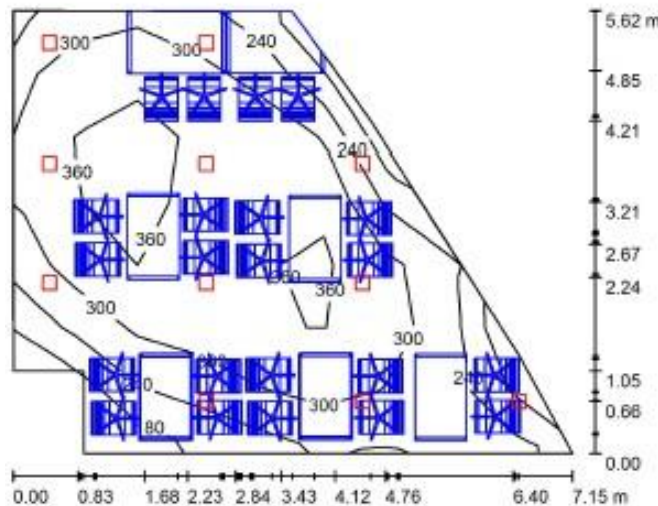
The lux level obtained after calculation is 302 lux.

Uniformity obtained : 0.438

Specific Connected Load: 4.02 W/m²

Technical Report of Cafeteria

Cafeteria / Summary



Height of Room: 2.950 m, Mounting Height: 2.950 m, Light loss factor: 0.80

Values in Lux, Scale 1:73

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	302	132	405	0.438
Floor	20	166	14	350	0.087
Ceiling	80	64	44	124	0.695
Walls (9)	50	113	19	1122	/

Workplane:

Height: 0.760 m
 Grid: 9 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.413, Ceiling / Working Plane: 0.209.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	11	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
Total:			13748	13750	118.8

Specific connected load: 4.02 W/m² = 1.33 W/m²/100 lx (Ground area: 29.56 m²)

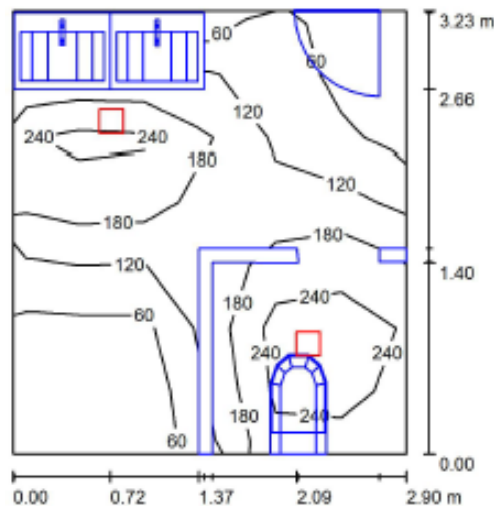
➤ **Gents Toilet**

Floor Area : 9.38m²
 Height : 2.450 m
 Mounting Height of the luminaire: 2.450
 Luminaire Used:
 a. DN572B PSE-E F
 No. of Luminaires used: 2
 The lighting arrangement Followed :General Lighting

The design outputs are as follows:
 The lux level obtained after calculation is 148 lux.
 Uniformity obtained : 0.079
 Specific Connected Load: 2.30 W/m²

Technical Report of Gents Toilet

Gents Toilet / Summary



Height of Room: 2.450 m, Mounting Height: 2.450 m, Light loss factor: 0.80 Values in Lux, Scale 1:42

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	148	12	283	0.079
Floor	20	90	8.22	174	0.082
Ceiling	80	24	9.50	40	0.385
Walls (4)	50	49	6.77	183	/

Workplane:

Height: 0.760 m
 Grid: 6 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.382, Ceiling / Working Plane: 0.167.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
Total:			2500	2500	21.6

Specific connected load: 2.30 W/m² = 1.56 W/m²/100 lx (Ground area: 9.38 m²)

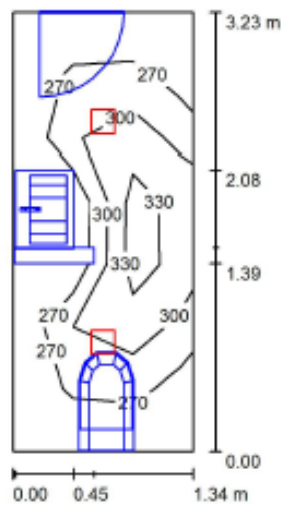
➤ **Ladies Toilet**

Floor Area : 4.33m²
 Height : 2.450 m
 Mounting Height of the luminaire: 2.450
 Luminaire Used:
 a. DN572B PSE-E F
 No. of Luminaires used: 2
 The lighting arrangement Followed :General Lighting

The design outputs are as follows:
 The lux level obtained after calculation is 293 lux.
 Uniformity obtained : 0.827
 Specific Connected Load: 4.99 W/m²

Technical Report of Ladies Toilet

Ladies Toilet / Summary



Height of Room: 2.450 m, Mounting Height: 2.450 m, Light loss factor: 0.80 Values in Lux, Scale 1:42

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	293	243	377	0.827
Floor	20	164	17	252	0.102
Ceiling	80	43	24	51	0.568
Walls (4)	50	100	15	212	/

Workplane:
 Height: 0.760 m
 Grid: 3 x 7 Points
 Boundary Zone: 0.000 m
 Illuminance Quotient (according to LG7): Walls / Working Plane: 0.370, Ceiling / Working Plane: 0.149.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	2	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
			Total: 2500	Total: 2500	21.6

Specific connected load: 4.99 W/m² = 1.70 W/m²/100 lx (Ground area: 4.33 m²)

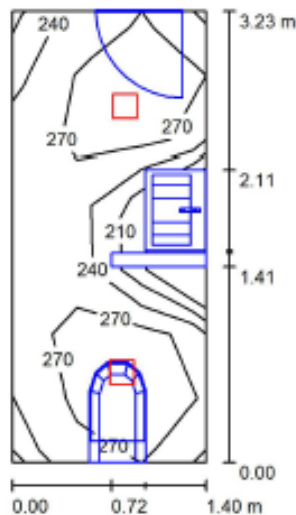
➤ **Executive Toilet**

Floor Area : 4.53m²
 Height : 2.450 m
 Mounting Height of the luminaire: 2.450
 Luminaire Used:
 a. DN572B PSE-E F
 No. of Luminaires used: 2
 The lighting arrangement Followed :General Lighting

The design outputs are as follows:
 The lux level obtained after calculation is 268 lux.
 Uniformity obtained : 0.663
 Specific Connected Load: 4.77 W/m²

Technical Report of Executive Toilet

Executive Toilet / Summary



Height of Room: 2.450 m, Mounting Height: 2.450 m, Light loss factor: 0.80 Values in Lux, Scale 1:42

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	268	177	303	0.663
Floor	20	153	15	233	0.099
Ceiling	80	42	23	49	0.541
Walls (4)	50	99	13	251	/

Workplane:

Height: 0.760 m
 Grid: 3 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.393, Ceiling / Working Plane: 0.156.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS DN572B PSE-E F (1.000)	1250	1250	10.8
			Total: 2500	Total: 2500	21.6

Specific connected load: 4.77 W/m² = 1.78 W/m²/100 lx (Ground area: 4.53 m²)

➤ **Electrical room**

Floor Area : 4.53m²

Height : 3 m

Mounting Height of the luminaire: 3

Luminaire Used:

a. BN124C L600 LED21S/857

No. of Luminaires used: 7

The lighting arrangement Followed :General Lighting

The design outputs are as follows:

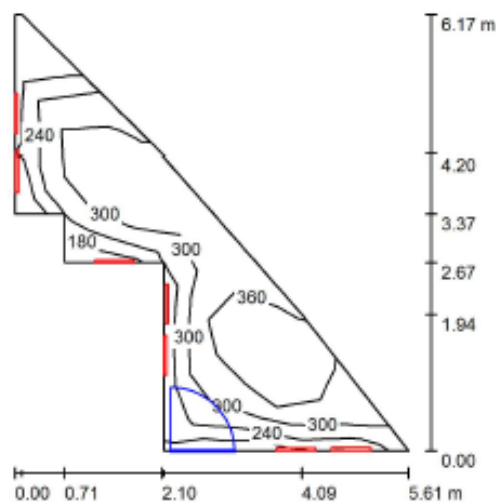
The lux level obtained after calculation is 312 lux.

Uniformity obtained : 0.434

Specific Connected Load: 10.73 W/m²

Technical Report of Electrical Room

Electrical Room / Summary



Height of Room: 3.000 m, Light loss factor: 0.80

Values in Lux, Scale 1:80

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	312	135	403	0.434
Floor	20	235	140	294	0.598
Ceiling	80	437	120	808	0.274
Walls (10)	50	289	78	3104	/

Workplane:

Height: 0.760 m
 Grid: 15 x 5 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 1.077, Ceiling / Working Plane: 1.388.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	⊕ (Luminaire) [lm]	⊕ (Lamps) [lm]	P [W]
1	7	PHILIPS BN124C L600 LED21S/857 NO (1.000)	2119	2200	19.0
			Total: 14835	Total: 15400	133.0

Specific connected load: 10.73 W/m² = 3.44 W/m²/100 lx (Ground area: 12.39 m²)

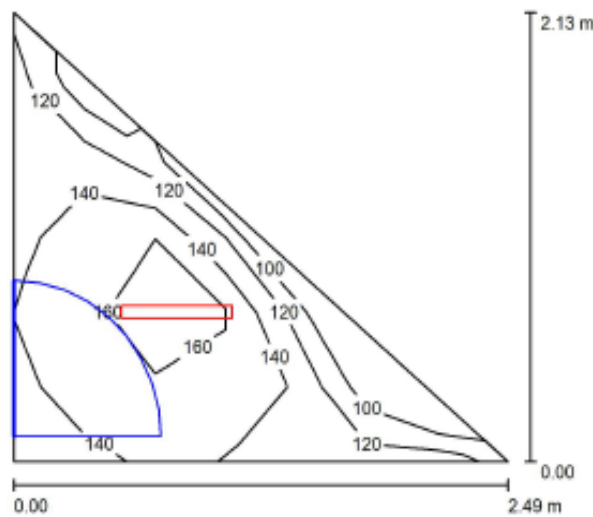
➤ **Phone Booth**

Floor Area : 2.66m²
 Height : 3 m
 Mounting Height of the luminaire: 3m
 Luminaire Used:
 a. BN124C L600 LED21S/857
 No. of Luminaires used: 1
 The lighting arrangement Followed :General Lighting

The design outputs are as follows:
 The lux level obtained after calculation is 144 lux.
 Uniformity obtained : 0.656
 Specific Connected Load: 7.14 W/m²

Technical Report of Phone Booth

Phone Booth / Summary



Height of Room: 3.000 m, Mounting Height: 3.000 m, Light loss factor: 0.80 Values in Lux, Scale 1:28

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	144	94	170	0.656
Floor	20	90	62	102	0.687
Ceiling	80	149	33	2178	0.224
Walls (3)	50	122	21	675	/

Workplane:

Height: 0.760 m
 Grid: 7 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 1.036, Ceiling / Working Plane: 1.051.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS BN124C L600 LED21S/857 NO (1.000)	2119	2200	19.0
Total:			2119	2200	19.0

Specific connected load: 7.14 W/m² = 4.96 W/m²/100 lx (Ground area: 2.66 m²)

Office B_Bangalore		LLF	0.8	Reflectances	80/50/20		
Room Name	Area (sq. m)	Height	Conventional				
			Mounting Height	Lux Level	Uniformity	LPD	Qty.
Reception & Waiting	20.02	2.75	2.75	336	0.672	30.45	7
4 PaxMeeting Room	6.61	2.75	2.75, 2.45	315	0.709	23.77	6
6 PaxMeeting Room	7.79	2.75	2.75, 2.45	355	0.378	20.63	5
4 PaxMeeting Room	3.71	2.75	2.75, 2.45	331	0.387	32.06	20
Conference Room	16.04	2.75	2.75, 2.45	525	0.452	37.88	16
4 PaxMeeting Room	3.7	2.75	2.75, 2.45	334	0.293	32.08	12
Cabin 1	6.33	2.75	2.75, 2.45	330	0.762	36.37	12
Cabin 2	6.33	2.75	2.75, 2.45	329	0.392	36.37	12
Cabin 3	6.33	2.75	2.75, 2.45	328	0.254	36.37	12
Cabin 4	6.33	2.75	2.75, 2.45	327	0.225	36.37	12
Cabin 5	6.33	2.75	2.75, 2.45	328	0.204	36.37	12
Cabin 6	6.33	2.75	2.75, 2.45	326	0.267	36.37	12
Cafeteria	29.56	2.95	2.95	210	0.303	18.9	22
G Toilet'	9.38	2.45	2.45	156	0.172	10.66	4
L Toilet'	4.33	2.45	2.45	134	0.148	11.54	2
Executive Toilet	4.53	2.45	2.45	131	0.585	11.04	2
Electrical Room	12.39	3	3	178	0.463	14.12	7
Phone Booth	2.66	3	3	67	0.543	9.39	1
CEO's Cabin	12.89	2.75	2.75, 2.45	396	0.682	34.78	17
Manager	8.65	2.75	2.75, 2.45	357	0.405	34.22	11
Workstation	173.48	2.95	2.95, 2.65	544	0.204	15.73	78

Table 7.3 Design Parameters of Office_B_Bangalore with Conventional Luminaire

Room Name	Area (sq. m)	Height	LED				
			Mounting Height	Lux Level	Uniformity	LPD	Qty.
Reception & Waiting	20.02	2.75	2.75	357	0.75	4.32	8
4 Pax Meeting Room	6.61	2.75	2.75	354	0.17	5.72	2
6 Pax Meeting Room	7.79	2.75	2.75	377	0.303	5.9	2
4 Pax Meeting Room	3.71	2.75	2.75	345	0.397	7.29	1
Conference Room	16.04	2.75	2.75	534	0.582	12.66	10
4 Pax Meeting Room	3.7	2.75	2.75	346	0.407	7.29	1
Cabin 1	6.33	2.75	2.75	358	0.791	6.82	4
Cabin 2	6.33	2.75	2.75	350	0.783	6.82	4
Cabin 3	6.33	2.75	2.75	362	0.772	6.82	4
Cabin 4	6.33	2.75	2.75	375	0.745	6.82	4
Cabin 5	6.33	2.75	2.75	360	0.713	6.82	4
Cabin 6	6.33	2.75	2.75	354	0.226	6.82	4
Cafeteria	29.56	2.95	2.95	302	0.438	4.02	11
G Toilet'	9.38	2.45	2.45	143	0.082	2.3	2
L Toilet'	4.33	2.45	2.45	293	0.827	4.99	2
Executive Toilet	4.53	2.45	2.45	268	0.663	4.77	2
Electrical Room	12.39	3	3	312	0.434	10.73	7
Phone Booth	2.66	3	3	144	0.656	7.14	1
CEO's Cabin	12.89	2.75	2.75	351	0.733	5.03	6
Manager	8.65	2.75	2.75	315	0.58	4.99	4
Workstation	173.48	2.95	2.95	502	0.398	4.67	38

Table 7.4 Design Parameters of Office_B_Bangalore with LED Luminaire

7.4 Case Study –III : Lighting design of Office C_Cuttack

This floor area of office D_Delhi is 436.9 m². This office contains 13 cabins or private offices including MD's cabin. There are meeting rooms of 4 seater, 6 seater and one conference room is also present. There is a big workstation of 68 person capacity. Gents and ladies toilets are there.

The fig7.8 shows the office layout of Office C_Cuttack.

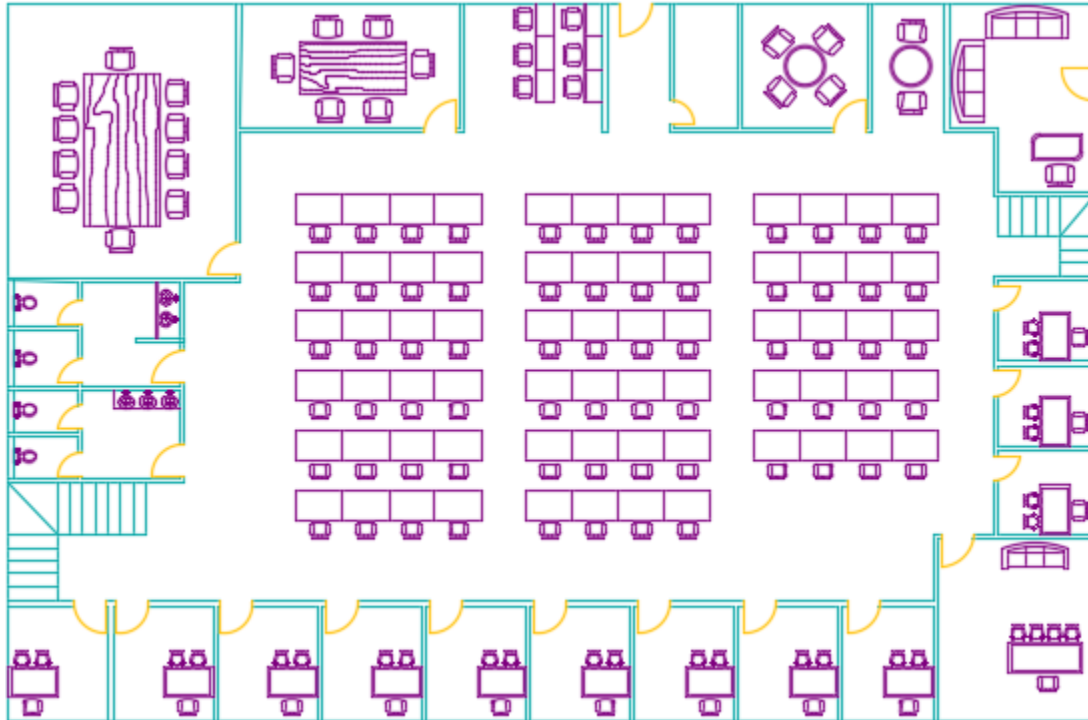


Fig. 7.8 Office Plan of Office C_Cuttack

7.4.1 Lighting design of Office C_Cuttack with Conventional Luminaires

- b. Input Design parameters like Surface Reflectances, Light Loss factor etc are considered according to the Standards.

Ceiling Reflectance = 80%

Wall Reflectance = 50%

Floor Reflectance = 20%

Light Loss Factor = 0.8

Workplane Height = 0.76 m

- c. Conventional Luminaire Used:

- Linear Surface Mounted Batten of 36W
- Linear Surface Mounted Batten of 18W
- CFL downlighters of 25W of higher lumen package

The Lighting Layout of Office C_Cuttack with Conventional Luminaire is as follows:

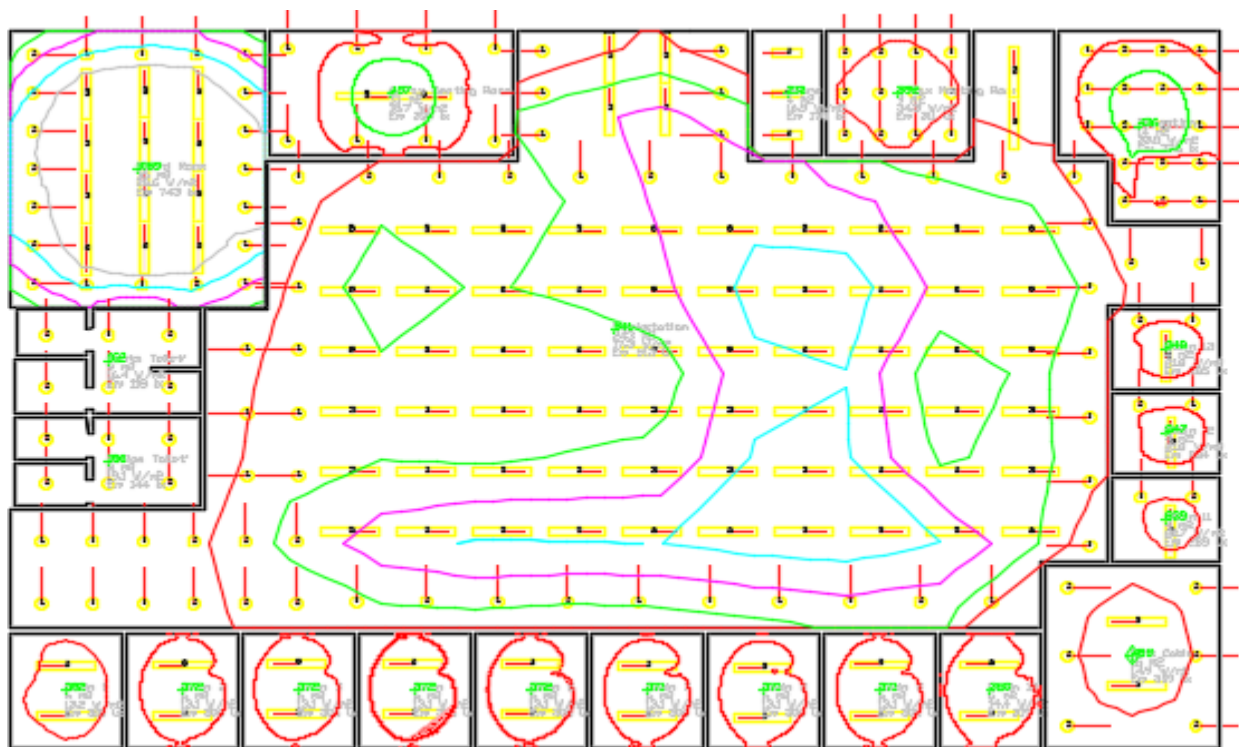


Fig7.9 The layout of Office D_Delhi with Conventional Luminaire Layout

➤ **Cabin 1**

Floor Area : 6.38 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

- a. TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

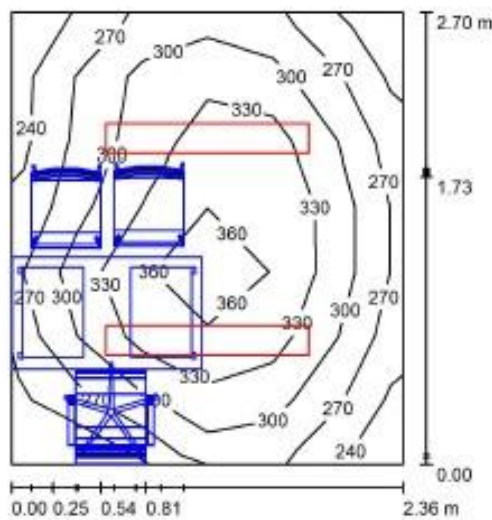
The lux level obtained after calculation is 310lux.

Uniformity obtained : 0.767

Specific Connected Load: 13.17W/m²

Technical Report of Cabin 1

Cabin 1 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	310	238	377	0.767
Floor	20	157	24	235	0.152
Ceiling	80	103	50	138	0.573
Walls (4)	50	228	12	580	/

Workplane:

Height: 0.760 m
 Grid: 6 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.808, Ceiling / Working Plane: 0.336.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 5512	Total: 6700	84.0

Specific connected load: 13.17 W/m² = 4.24 W/m²/100 lx (Ground area: 6.38 m²)

➤ **Cabin 2**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

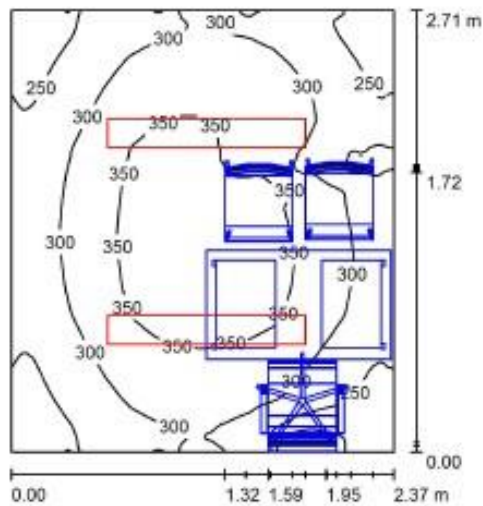
The lux level obtained after calculation is 306lux.

Uniformity obtained : 0.523

Specific Connected Load: 13.06W/m²

Technical Report of Cabin 2

Cabin 2 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	306	160	382	0.523
Floor	20	156	26	235	0.170
Ceiling	80	102	60	143	0.586
Walls (4)	50	224	14	583	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.895, Ceiling / Working Plane: 0.335.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 5512	Total: 6700	84.0

Specific connected load: 13.06 W/m² = 4.27 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 3**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

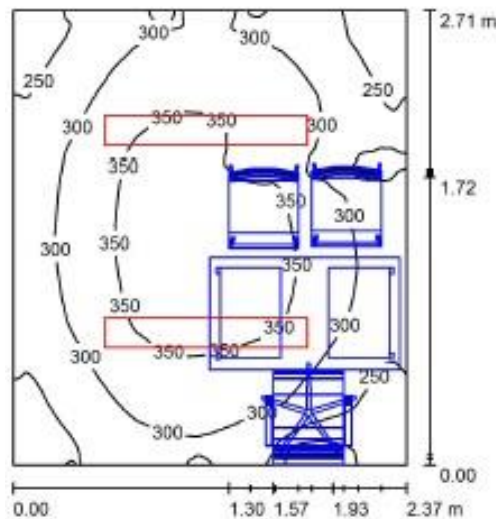
The lux level obtained after calculation is 306lux.

Uniformity obtained : 0.517

Specific Connected Load: 13.06W/m²

Technical Report of Cabin 3

Cabin 3 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	306	158	383	0.517
Floor	20	156	28	236	0.178
Ceiling	80	104	63	142	0.609
Walls (4)	50	225	18	608	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.896, Ceiling / Working Plane: 0.341.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 5512	Total: 6700	84.0

Specific connected load: 13.06 W/m² = 4.27 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 4**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

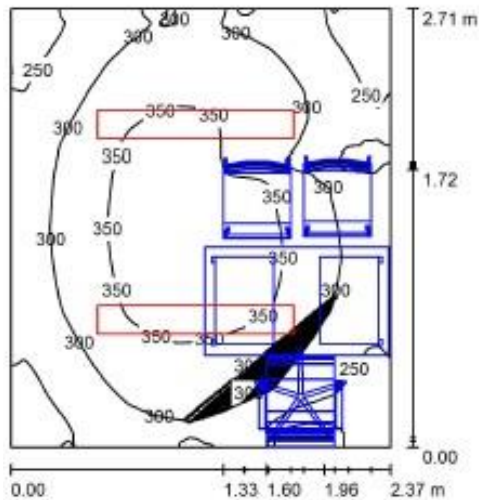
The lux level obtained after calculation is 306lux.

Uniformity obtained : 0.511

Specific Connected Load: 13.06W/m²

Technical Report of Cabin 4

Cabin 4 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	306	156	383	0.511
Floor	20	158	26	236	0.163
Ceiling	80	104	63	142	0.607
Walls (4)	50	225	13	608	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.896, Ceiling / Working Plane: 0.341.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			5512	6700	84.0

Specific connected load: 13.06 W/m² = 4.27 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 5**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

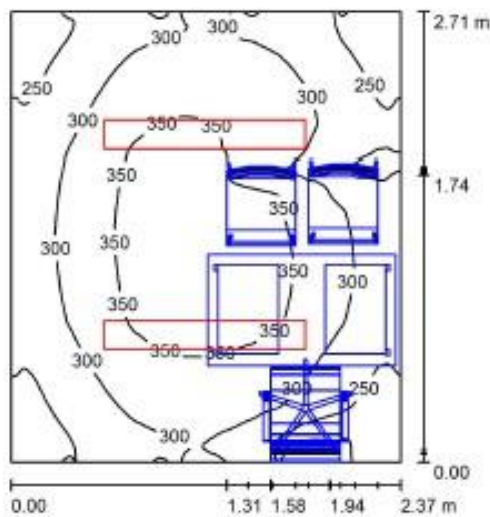
The lux level obtained after calculation is 306lux.

Uniformity obtained : 0.524

Specific Connected Load: 13.06W/m²

Technical Report of Cabin 5

Cabin 5 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	306	160	382	0.524
Floor	20	156	26	235	0.166
Ceiling	80	102	61	139	0.595
Walls (4)	50	225	16	585	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.895, Ceiling / Working Plane: 0.333.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			5512	6700	84.0

Specific connected load: 13.06 W/m² = 4.27 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 6**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

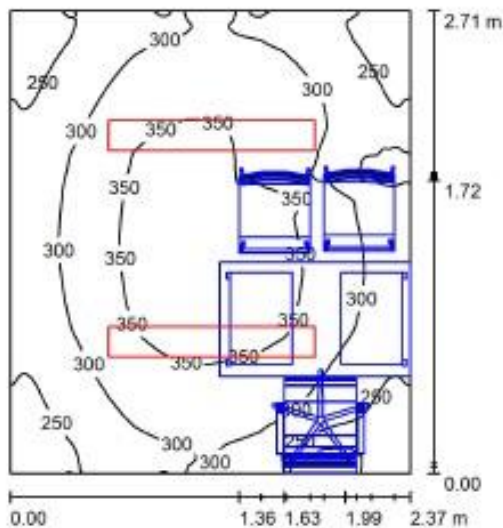
The lux level obtained after calculation is 306lux.

Uniformity obtained : 0.515

Specific Connected Load: 13.06W/m²

Technical Report of Cabin 6

Cabin 6 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	306	157	382	0.515
Floor	20	158	25	236	0.156
Ceiling	80	104	63	139	0.606
Walls (4)	50	224	9.26	592	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.895, Ceiling / Working Plane: 0.339.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			5512	6700	84.0

Specific connected load: 13.06 W/m² = 4.27 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 7**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

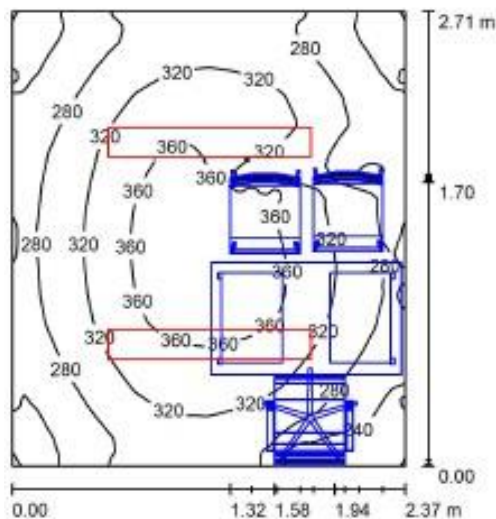
The lux level obtained after calculation is 306lux.

Uniformity obtained : 0.670

Specific Connected Load: 13.06W/m²

Technical Report of Cabin 7

Cabin 7 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	306	205	382	0.670
Floor	20	156	26	236	0.164
Ceiling	80	104	66	141	0.640
Walls (4)	50	225	15	603	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.895, Ceiling / Working Plane: 0.338.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			5512	6700	84.0

Specific connected load: 13.06 W/m² = 4.27 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 8**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

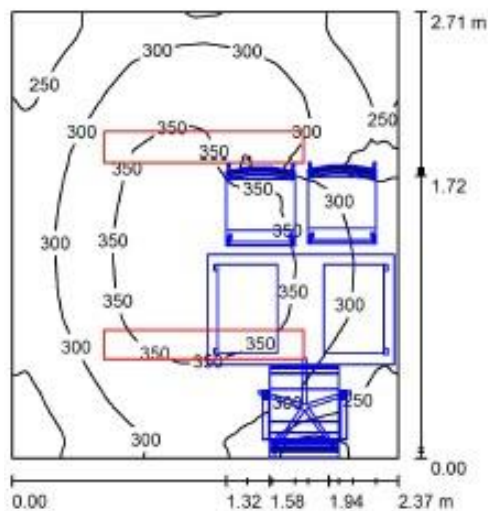
The lux level obtained after calculation is 306lux.

Uniformity obtained : 0.528

Specific Connected Load: 13.06W/m²

Technical Report of Cabin 8

Cabin 8 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	306	161	384	0.528
Floor	20	156	26	234	0.165
Ceiling	80	103	56	146	0.542
Walls (4)	50	225	15	638	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.896, Ceiling / Working Plane: 0.336.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			5512	6700	84.0

Specific connected load: 13.06 W/m² = 4.27 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 9**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used: TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

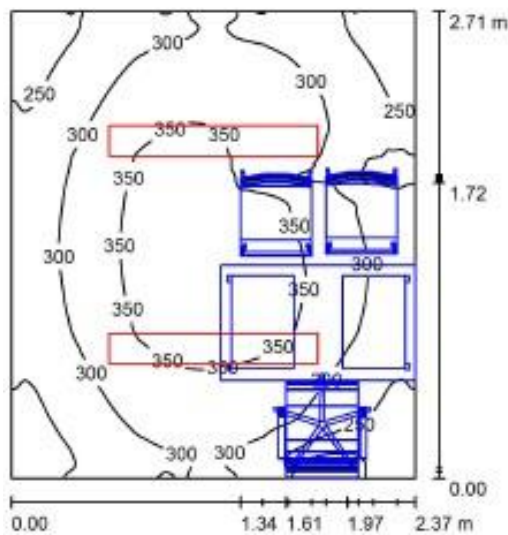
The lux level obtained after calculation is 306lux.

Uniformity obtained : 0.516

Specific Connected Load: 13.06W/m²

Technical Report of Cabin 9

Cabin 9 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	305	158	382	0.516
Floor	20	157	25	236	0.159
Ceiling	80	101	61	139	0.597
Walls (4)	50	224	9.72	579	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.895, Ceiling / Working Plane: 0.332.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			5512	6700	84.0

Specific connected load: 13.06 W/m² = 4.28 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 10**

Floor Area : 5.84 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. TMS022 1x36W +GMS022 R TL-D

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

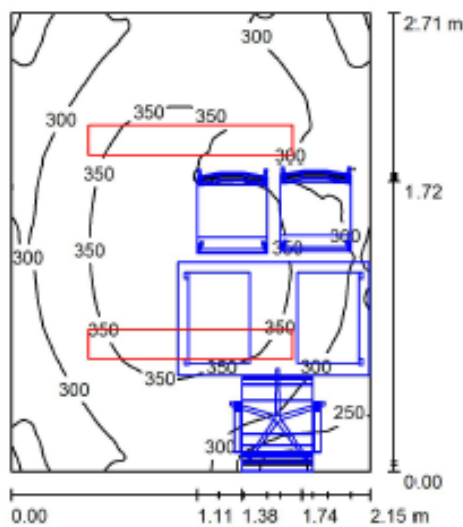
The lux level obtained after calculation is 319lux.

Uniformity obtained : 0.530

Specific Connected Load: 14.39W/m²

Technical Report of Cabin 10

Cabin 10 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	319	169	392	0.530
Floor	20	154	25	235	0.164
Ceiling	80	111	65	151	0.587
Walls (4)	50	240	13	591	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.925, Ceiling / Working Plane: 0.350.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			5512	6700	84.0

Specific connected load: 14.39 W/m² = 4.52 W/m²/100 lx (Ground area: 5.84 m²)

➤ **MD's Cabin**

Floor Area : 15.85 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. TMS022 1x36W +GMS022 R TL-D

b. NLP72443 NLP72443

No. of Luminaires used: 8

The lighting arrangement followed : General Lighting

The design outputs are as follows:

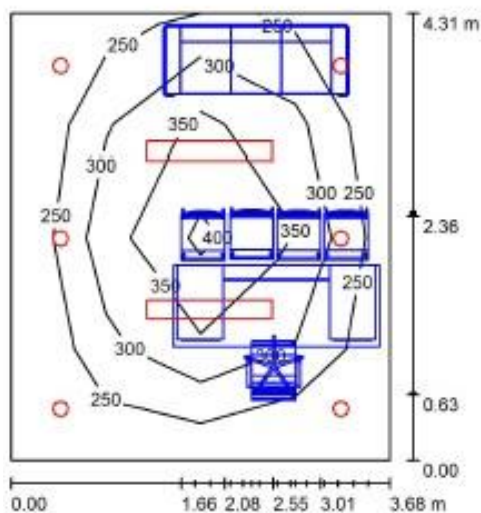
The lux level obtained after calculation is 309lux.

Uniformity obtained : 0.702

Specific Connected Load: 14.91W/m²

Technical Report of MD's Cabin

MD's Cabin / Summary



Height of Room: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:56

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	309	217	429	0.702
Floor	20	152	14	280	0.089
Ceiling	80	69	54	79	0.785
Walls (4)	50	157	22	291	/

Workplane:

Height: 0.760 m
 Grid: 4 x 4 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.595, Ceiling / Working Plane: 0.234.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	6	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 8395	Total: 12700	236.4

Specific connected load: 14.91 W/m² = 4.82 W/m²/100 lx (Ground area: 15.85 m²)

➤ **Cabin 11**

Floor Area : 4.47 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

- a. TMS022 1x36W +GMS022 R TL-D
- b. NLP72443

No. of Luminaires used: 3

The lighting arrangement followed : General Lighting

The design outputs are as follows:

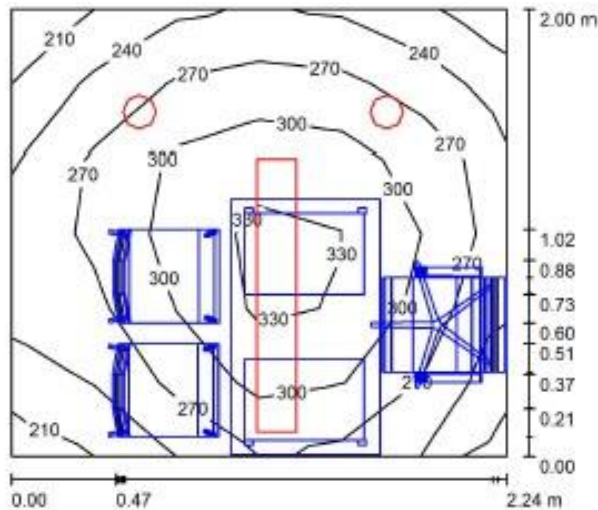
The lux level obtained after calculation is 289lux.

Uniformity obtained : 0.726

Specific Connected Load: 20.75W/m²

Technical Report of Cabin 11

Cabin 11 / Summary



Height of Room: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:26

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	289	210	346	0.726
Floor	20	107	23	181	0.217
Ceiling	80	90	67	109	0.742
Walls (4)	50	188	8.49	982	/

Workplane:

Height: 0.760 m
 Grid: 6 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.828, Ceiling / Working Plane: 0.323.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	1	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
			Total: 3717	Total: 5350	92.8

Specific connected load: 20.75 W/m² = 7.19 W/m²/100 lx (Ground area: 4.47 m²)

➤ **Cabin 12**

Floor Area : 4.25 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

- a. TMS022 1x36W +GMS022 R TL-D
- b. NLP72443

No. of Luminaires used: 3

The lighting arrangement followed : General Lighting

The design outputs are as follows:

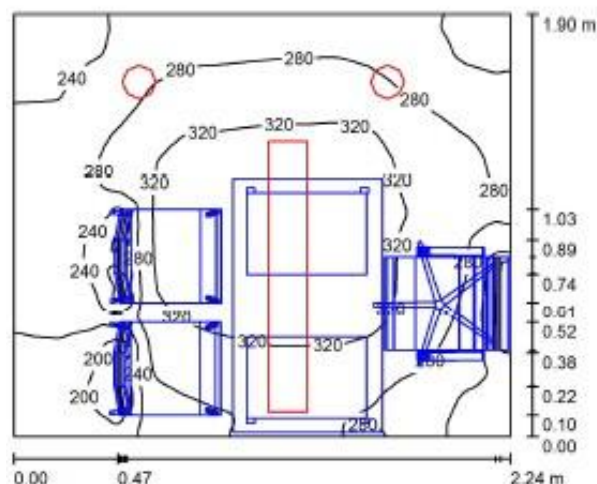
The lux level obtained after calculation is 284lux.

Uniformity obtained : 0.585

Specific Connected Load: 21.84W/m²

Technical Report of Cabin 12

Cabin 12 / Summary



Height of Room: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:25

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	284	166	351	0.585
Floor	20	104	23	179	0.224
Ceiling	80	96	65	113	0.677
Walls (4)	50	195	12	982	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.850, Ceiling / Working Plane: 0.339.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	1	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			3717	5350	92.8

Specific connected load: 21.84 W/m² = 7.69 W/m²/100 lx (Ground area: 4.25 m²)

➤ Cabin 13

Floor Area : 4.25 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

- a. TMS022 1x36W +GMS022 R TL-D
- b. NLP72443

No. of Luminaires used: 3

The lighting arrangement followed : General Lighting

The design outputs are as follows:

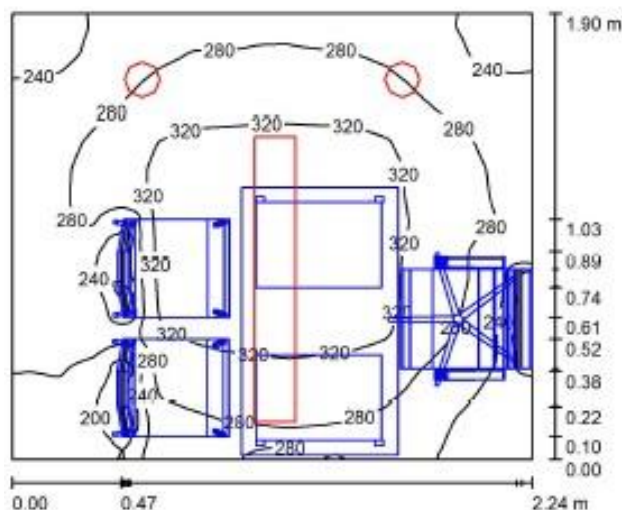
The lux level obtained after calculation is 285lux.

Uniformity obtained : 0.557

Specific Connected Load: 21.84W/m²

Technical Report of Cabin 13

Cabin 13 / Summary



Height of Room: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:25

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	285	159	350	0.557
Floor	20	106	23	181	0.218
Ceiling	80	96	67	115	0.698
Walls (4)	50	195	13	703	/

Workplane:

Height: 0.760 m
Grid: 128 x 128 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.848, Ceiling / Working Plane: 0.336.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [mm]	ϕ (Lamps) [mm]	P [W]
1	2	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	1	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			3717	5350	92.8

Specific connected load: 21.84 W/m² = 7.67 W/m²/100 lx (Ground area: 4.25 m²)

➤ **Reception**

Floor Area : 13.54 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. NLP72443 NLP72443

No. of Luminaires used: 18

The lighting arrangement followed : General Lighting

The design outputs are as follows:

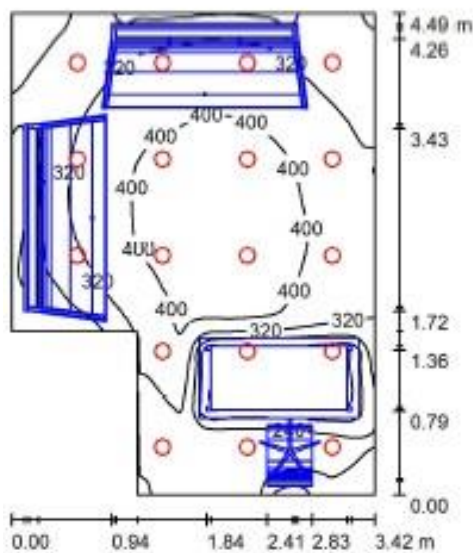
The lux level obtained after calculation is 326lux.

Uniformity obtained : 0.557

Specific Connected Load: 33.77W/m²

Technical Report of Reception

Reception / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:58

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0
Workplane	/	326	50	446	0.152
Floor	20	171	17	329	0.101
Ceiling	80	85	62	173	0.729
Walls (6)	50	169	21	819	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.609, Ceiling / Working Plane: 0.260.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	18	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
			Total: 8647	Total: 18000	457.2

Specific connected load: 33.77 W/m² = 10.35 W/m²/100 lx (Ground area: 13.54 m²)

➤ **4 Pax Meeting Room**

Floor Area : 8.87 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. NLP72443 NLP72443

No. of Luminaires used: 12

The lighting arrangement followed : General Lighting

The design outputs are as follows:

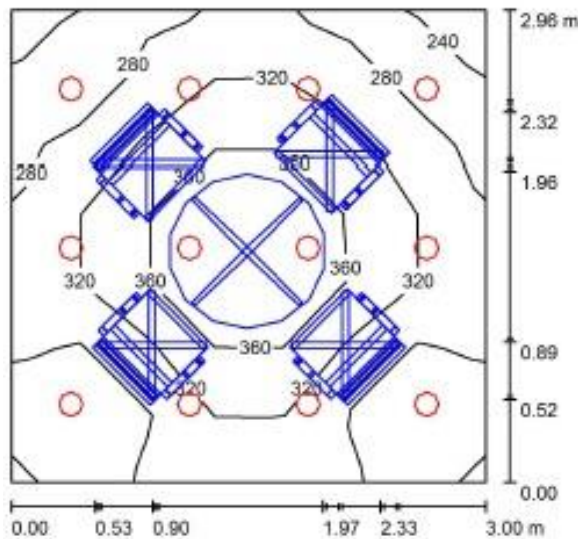
The lux level obtained after calculation is 311lux.

Uniformity obtained : 0.750

Specific Connected Load: 34.35W/m²

Technical Report of 4 Pax Meeting Room

4 Pax Meeting Room / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:38

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	311	233	397	0.750
Floor	20	154	43	226	0.277
Ceiling	80	85	71	98	0.835
Walls (4)	50	177	78	379	/

Workplane:

Height: 0.760 m
 Grid: 7 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.650, Ceiling / Working Plane: 0.275.

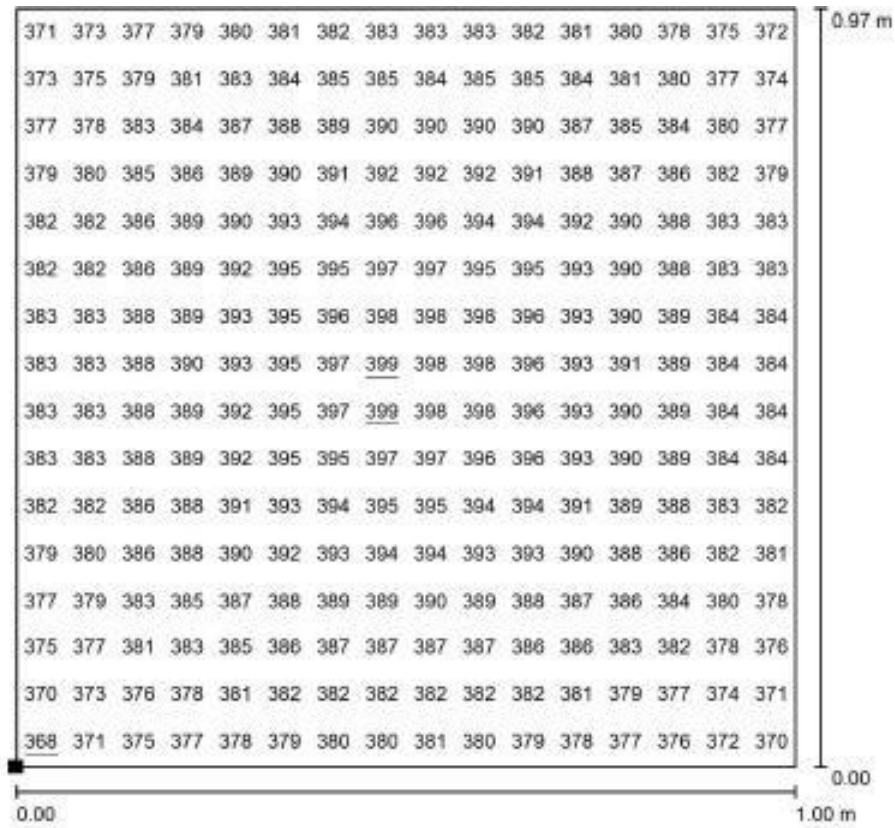
Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	12	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
Total:			5765	12000	304.8

Specific connected load: 34.35 W/m² = 11.05 W/m²/100 lx (Ground area: 8.87 m²)

The task illuminance value is 386 Lux and the uniformity is 0.954.

E_{av} [lx] 386
 E_{min} [lx] 368
 E_{max} [lx] 399
 u_0 0.954
 E_{min} / E_{max} 0.922



➤ 6 Pax Meeting Room

Floor Area : 15.32 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. NLP72443 NLP72443

b. TMS022 1x36W +GMS022 R TL-D HFS

No. of Luminaires used: 10

The lighting arrangement followed : General Lighting

The design outputs are as follows:

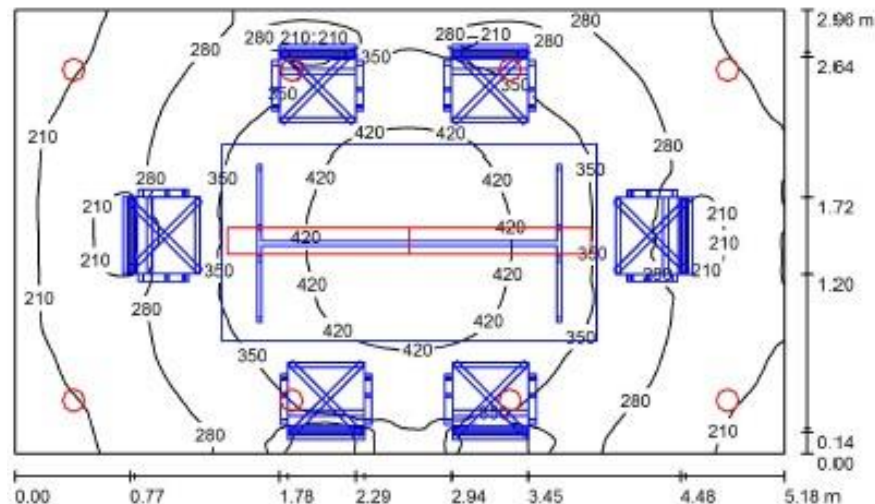
The lux level obtained after calculation is 308lux.

Uniformity obtained : 0.407

Specific Connected Load: 18.75W/m²

Technical Report of 6 Pax Meeting Room

6 Pax Meeting Room / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:38

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	308	126	459	0.407
Floor	20	125	37	213	0.297
Ceiling	80	96	58	123	0.601
Walls (4)	50	191	39	560	/

Workplane:

Height: 0.760 m
Grid: 128 x 128 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.724, Ceiling / Working Plane: 0.312.

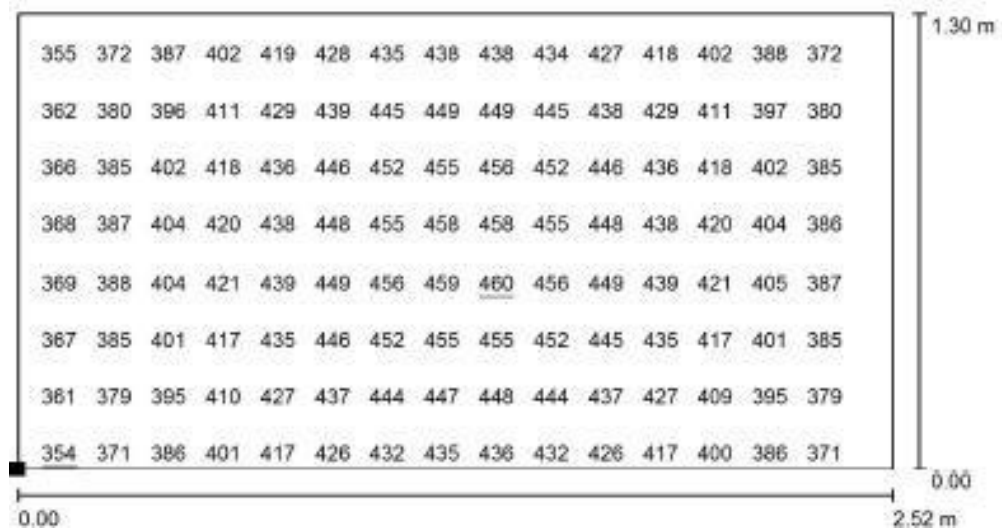
Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	8	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	2	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			9356	14700	287.2

Specific connected load: 18.75 W/m² = 6.08 W/m²/100 lx (Ground area: 15.32 m²)

The task illuminance value is 415 Lux and the uniformity is 0.853.

E_{av} [lx] E_{min} [lx] E_{max} [lx] u_0 E_{min} / E_{max}
 415 354 460 0.853 0.769



➤ **Board Room**

Floor Area : 35.36 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. NLP72443 NLP72443

b. TMS022 1x36W +GMS022 R TL-D HFS

No. of Luminaires used: 32

The lighting arrangement followed : General Lighting

The design outputs are as follows:

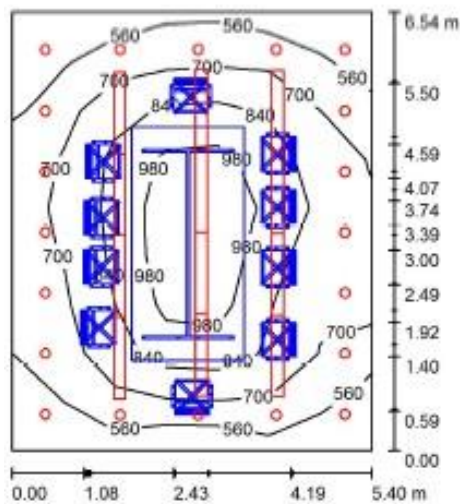
The lux level obtained after calculation is 743lux.

Uniformity obtained : 0.569

Specific Connected Load: 28.62W/m²

Technical Report of Board Room

Board Room / Summary



Height of Room: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:85

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	743	423	1089	0.569
Floor	20	387	89	603	0.178
Ceiling	80	191	127	271	0.664
Walls (4)	50	417	157	709	/

Workplane:

Height: 0.760 m
 Grid: 7 x 9 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.579, Ceiling / Working Plane: 0.252.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	20	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	12	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			42682	60200	1012.0

Specific connected load: 28.62 W/m² = 3.85 W/m²/100 lx (Ground area: 35.36 m²)

The task illuminance value is 1033 Lux and the uniformity is 0.843.

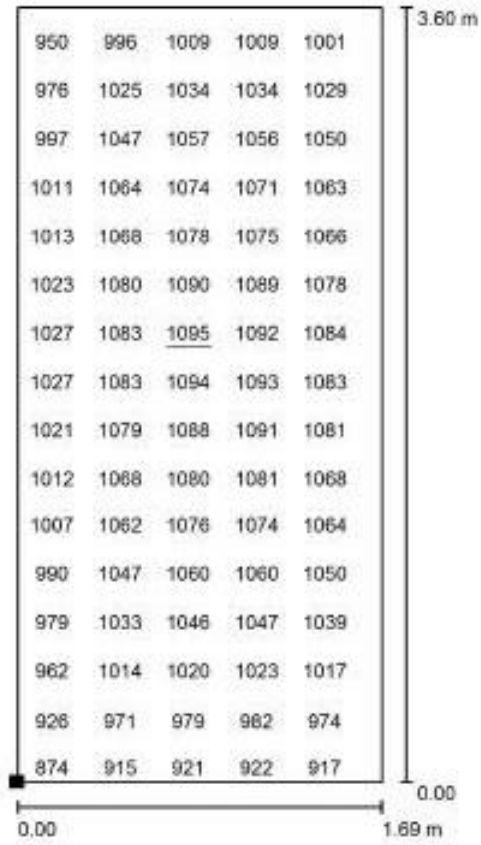
E_{av} [lx]
1033

E_{min} [lx]
871

E_{max} [lx]
1095

u_0
0.843

E_{min} / E_{max}
0.795



➤ **Gents Toilet**

Floor Area : 9.29 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. NLP72443

No. of Luminaires used: 6

The lighting arrangement followed : General Lighting

The design outputs are as follows:

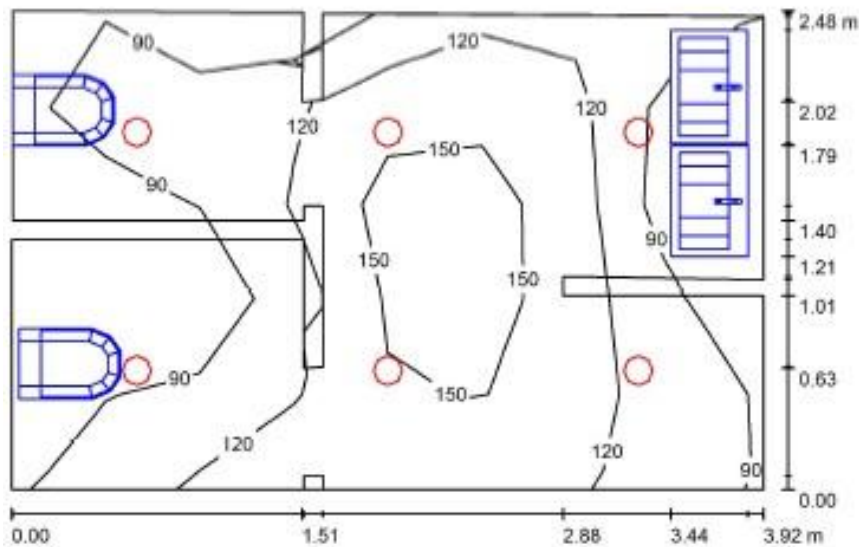
The lux level obtained after calculation is 118lux.

Uniformity obtained : 0.561

Specific Connected Load: 16.40W/m²

Technical Report of Gents Toilet

Gents Toilet' / Summary



Height of Room: 2.400 m, Mounting Height: 2.400 m, Light loss factor: 0.80 Values in Lux, Scale 1:32

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0
Workplane	/	118	68	178	0.561
Floor	20	75	18	124	0.208
Ceiling	80	32	21	57	0.648
Walls (24)	50	65	11	379	/

Workplane:

Height: 0.760 m
 Grid: 5 x 8 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.688, Ceiling / Working Plane: 0.273.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	6	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
Total:			2882	6000	152.4

Specific connected load: 16.40 W/m² = 13.87 W/m²/100 lx (Ground area: 9.29 m²)

➤ **Ladies Toilet**

Floor Area : 7.99 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. NLP72443

No. of Luminaires used: 6

The lighting arrangement followed : General Lighting

The design outputs are as follows:

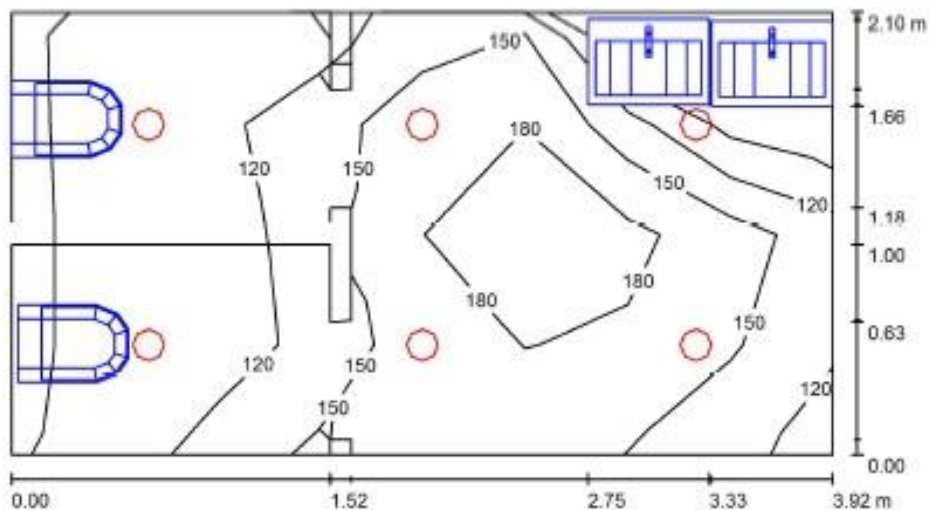
The lux level obtained after calculation is 144lux.

Uniformity obtained : 0.546

Specific Connected Load: 19.07W/m²

Technical Report of Ladies Room

Ladies Toilet' / Summary



Height of Room: 2.400 m, Mounting Height: 2.400 m, Light loss factor: 0.80

Values in Lux, Scale 1:29

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	144	79	199	0.546
Floor	20	93	16	137	0.174
Ceiling	80	39	28	53	0.716
Walls (20)	50	77	12	332	/

Workplane:

Height: 0.760 m
 Grid: 4 x 8 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.644, Ceiling / Working Plane: 0.277.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	6	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
Total:			2882	6000	152.4

Specific connected load: 19.07 W/m² = 13.23 W/m²/100 lx (Ground area: 7.99 m²)

➤ **Workstation**

Floor Area : 243.05 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. NLP72443

b. TMS022 1x36W +GMS022 R TL-D HFS

No. of Luminaires used: 122

The lighting arrangement followed : General Lighting

The design outputs are as follows:

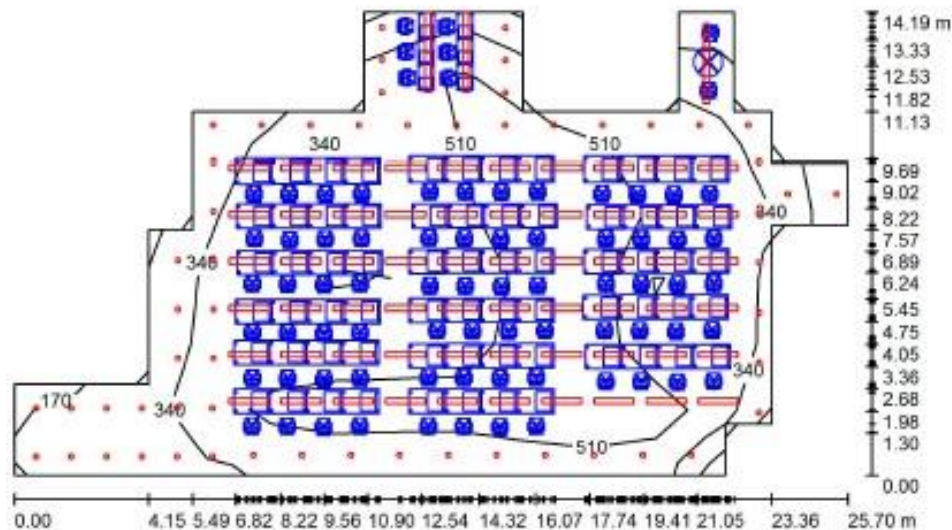
The lux level obtained after calculation is 513lux.

Uniformity obtained : 0.145

Specific Connected Load: 17.26W/m²

Technical Report of Workstation

Workstation / Summary



Height of Room: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:184

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	513	74	893	0.145
Floor	20	319	92	642	0.290
Ceiling	80	167	50	314	0.298
Walls (23)	50	297	56	3346	/

Workplane:

Height: 0.760 m
 Grid: 13 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.615, Ceiling / Working Plane: 0.344.

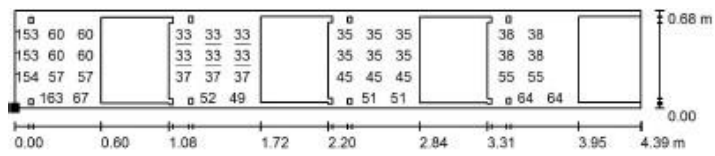
Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [mm]	ϕ (Lamps) [mm]	P [W]
1	56	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	66	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0

Total: 208811 Total: 277100 4194.4

Specific connected load: 17.26 W/m² = 3.36 W/m²/100 lx (Ground area: 243.05 m²)

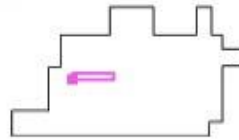
The task illuminance of the Worktable top is



Values in Lux, Scale 1 : 32

Not all calculated values could be displayed.

Position of surface in room:
Marked point:
(8.819 m, 9.027 m, 0.760 m)



Grid: 128 x 64 Points

E_{av} [lx]
86

E_{min} [lx]
33

E_{max} [lx]
183

$u0$
0.489

E_{min} / E_{max}
0.177

➤ **Store**

Floor Area : 4.44 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

d. TMS022 1x18W +GMS022 R TL-D HFS

No. of Luminaires used: 3

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

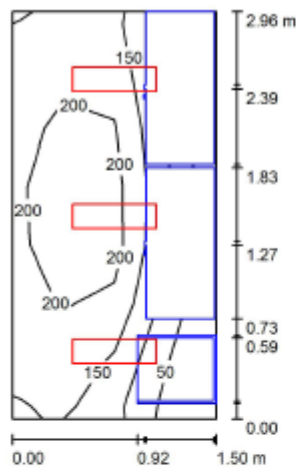
The lux level obtained after calculation is 178lux.

Uniformity obtained : 0.053

Specific Connected Load: 16.90W/m²

Technical Report of Store

Store / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:38

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	178	9.40	233	0.053
Floor	20	80	5.00	141	0.062
Ceiling	80	111	44	159	0.394
Walls (4)	50	134	0.83	574	/

Workplane:

Height: 0.760 m
Grid: 4 x 7 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 1.009, Ceiling / Working Plane: 0.637.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	3	PHILIPS TMS022 1x18W +GMS022 R TL-D HFS (1.000)	1110	1350	25.0
			Total: 3330	Total: 4050	75.0

Specific connected load: 16.90 W/m² = 9.49 W/m²/100 lx (Ground area: 4.44 m²)

7.4.2 Lighting design of Office C_Cuttack with LED Luminaires

- a. Input Design parameters like Surface Reflectances, Light Loss factor etc are considered according to the Standards.
Ceiling Reflectance = 80%
Wall Reflectance = 50%
Floor Reflectance = 20%
Light Loss Factor = 0.8
Workplane Height = 0.76 m
- b. LED Luminaire Used:
 - i) Recessed Mounted LED Downlighter of 11W
 - ii) Recessed Mounted LED Downlighter of 19W
 - iii) Linear Suspended LED Luminaire of 37W
 - iv) Linear Suspended LED Luminaire of 39W

The Luminaire layout of Office C_Cuttack with LED Luminaire is as follows:

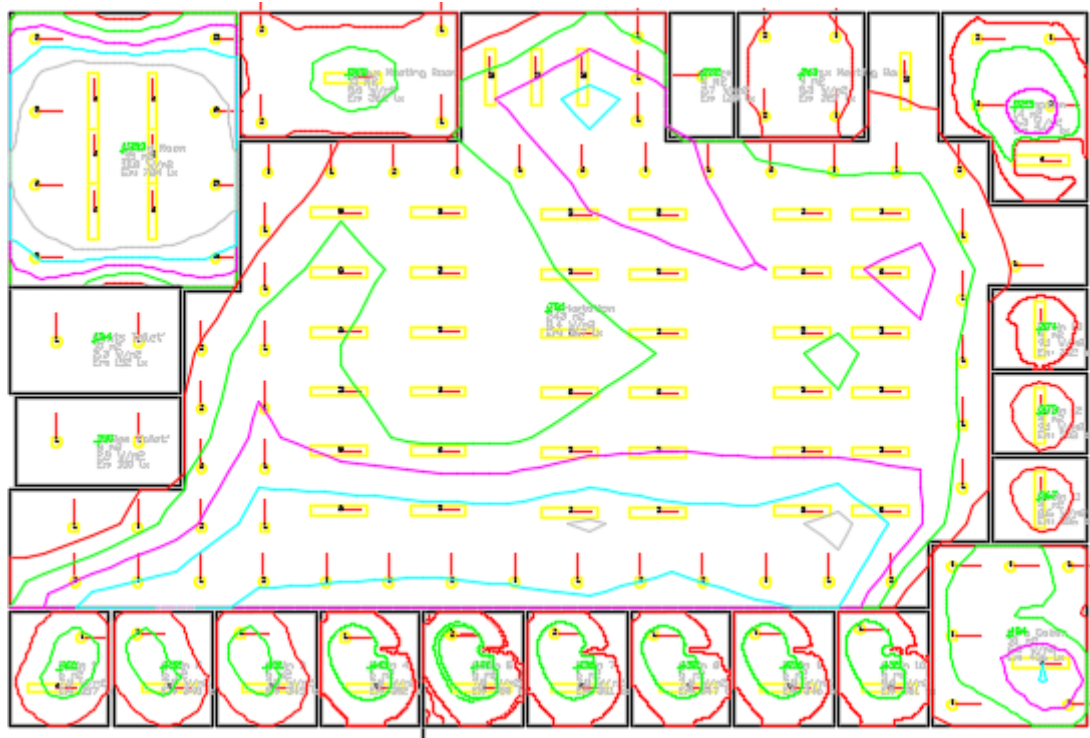


Fig 7.10 LED Luminaire Layout of Office C_Cuttack

➤ **Cabin 1**

Floor Area : 6.38 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. SP482P W24L134 ACC-MLO LED40S/840 NO

b. DN570B PSE-E C

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

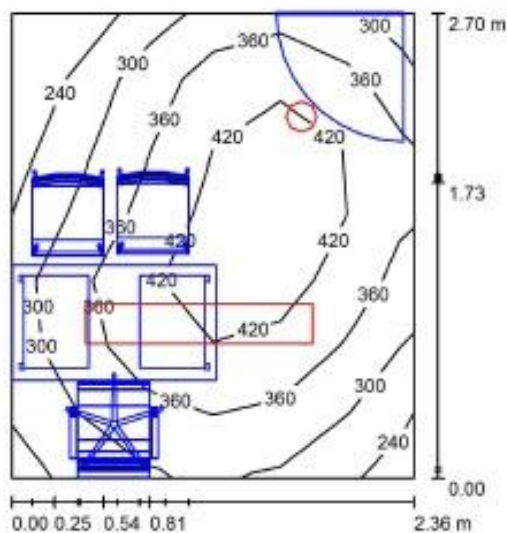
The lux level obtained after calculation is 357lux.

Uniformity obtained : 0.523

Specific Connected Load: 7.88W/m²

Technical Report of Cabin 1

Cabin 1 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	357	186	466	0.523
Floor	20	188	23	297	0.125
Ceiling	80	76	41	102	0.540
Walls (4)	50	162	12	373	/

Workplane:

Height: 0.760 m
 Grid: 6 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.506, Ceiling / Working Plane: 0.212.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4099	4100	38.5
			Total: 5449	Total: 5450	50.3

Specific connected load: 7.88 W/m² = 2.21 W/m²/100 lx (Ground area: 6.38 m²)

➤ **Cabin 2**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. SP482P W24L134 ACC-MLO LED40S/840 NO

b. DN570B PSE-E C

No. of Luminaires used: 2

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

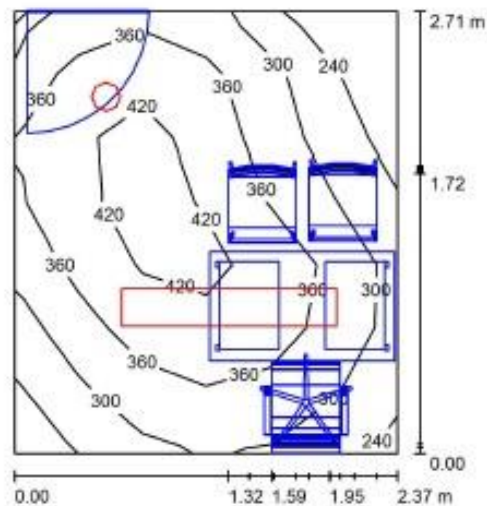
The lux level obtained after calculation is 348 lux.

Uniformity obtained : 0.520

Specific Connected Load: 7.82W/m²

Technical Report of Cabin 2

Cabin 2 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	348	181	451	0.520
Floor	20	187	26	291	0.137
Ceiling	80	76	43	104	0.565
Walls (4)	50	162	14	418	/

Workplane:

Height: 0.760 m
 Grid: 6 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.521, Ceiling / Working Plane: 0.218.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4096	4100	38.5
			Total: 5449	Total: 5450	50.3

Specific connected load: 7.82 W/m² = 2.24 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 3**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

- a. SP482P W24L134 ACC-MLO LED40S/840 NO
- b. DN570B PSE-E C

No. of Luminaires used: 2

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

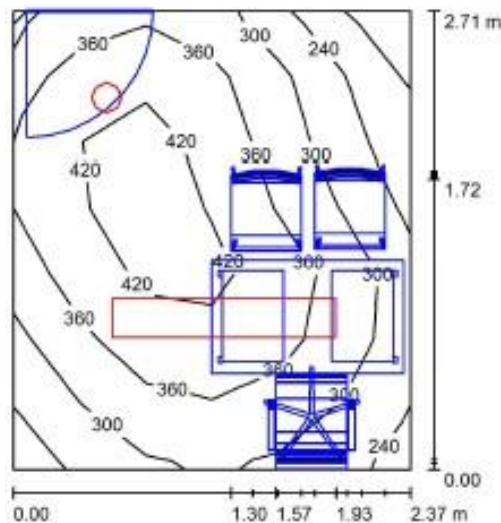
The lux level obtained after calculation is 349lux.

Uniformity obtained : 0.502

Specific Connected Load: 7.82W/m²

Technical Report of Cabin 3

Cabin 3 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80 Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	349	175	455	0.502
Floor	20	187	27	292	0.143
Ceiling	80	76	41	99	0.536
Walls (4)	50	162	17	436	/

Workplane:

Height: 0.760 m
 Grid: 6 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.521, Ceiling / Working Plane: 0.219.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4099	4100	38.5
Total:			5449	Total: 5450	50.3

Specific connected load: 7.82 W/m² = 0.24 W/m²/100 lx (Cabinet area: 6.43 m²)

➤ **Cabin 4**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

- a. SP482P W24L134 ACC-MLO LED40S/840 NO
- b. DN570B PSE-E C

No. of Luminaires used: 2

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

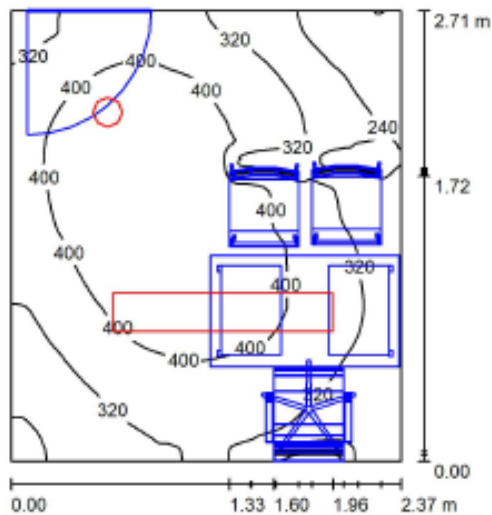
The lux level obtained after calculation is 352lux.

Uniformity obtained : 0.319

Specific Connected Load: 7.82W/m²

Technical Report of Cabin 4

Cabin 4 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	352	112	469	0.319
Floor	20	190	25	295	0.130
Ceiling	80	75	42	102	0.561
Walls (4)	50	161	13	372	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.509, Ceiling / Working Plane: 0.213.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4098	4100	38.5
			Total: 5448	Total: 5450	50.3

Specific connected load: 7.82 W/m² = 2.22 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 5**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. SP482P W24L134 ACC-MLO LED40S/840 NO

b. DN570B PSE-E C

No. of Luminaires used: 2

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

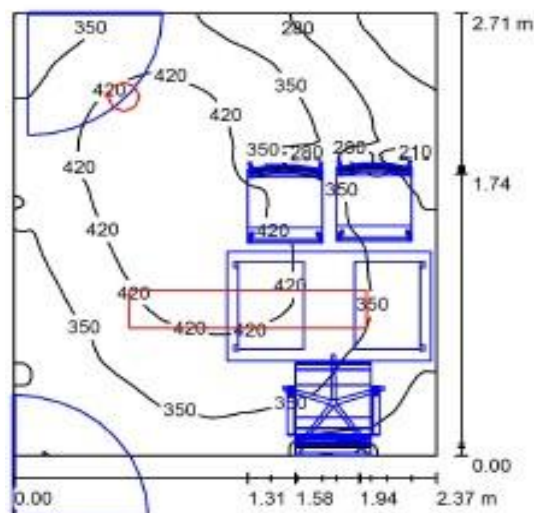
The lux level obtained after calculation is 357lux.

Uniformity obtained : 0.335

Specific Connected Load: 7.82W/m²

Technical Report of Cabin 5

Cabin 5 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	357	120	465	0.335
Floor	20	193	27	296	0.142
Ceiling	80	81	46	109	0.566
Walls (4)	50	168	17	439	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.528, Ceiling / Working Plane: 0.227.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4096	4100	38.5
			Total: 5449	Total: 5450	50.3

Specific connected load: 7.82 W/m² = 2.19 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 6**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

- a. SP482P W24L134 ACC-MLO LED40S/840 NO
- b. DN570B PSE-E C

No. of Luminaires used: 2

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

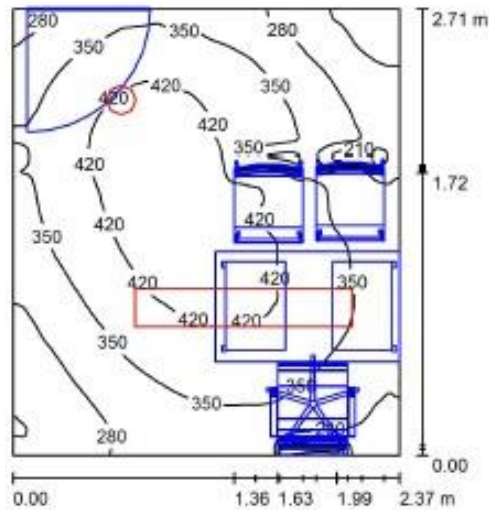
The lux level obtained after calculation is 350lux.

Uniformity obtained : 0.328

Specific Connected Load: 7.82W/m²

Technical Report of Cabin 6

Cabin 6 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	350	115	457	0.328
Floor	20	187	24	289	0.127
Ceiling	80	75	42	105	0.557
Walls (4)	50	162	8.52	427	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.516, Ceiling / Working Plane: 0.216.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4090	4100	38.5
Total:			5449	5450	50.3

Specific connected load: 7.82 W/m² = 2.23 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 7**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

- a. SP482P W24L134 ACC-MLO LED40S/840 NO
- b. DN570B PSE-E C

No. of Luminaires used: 2

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

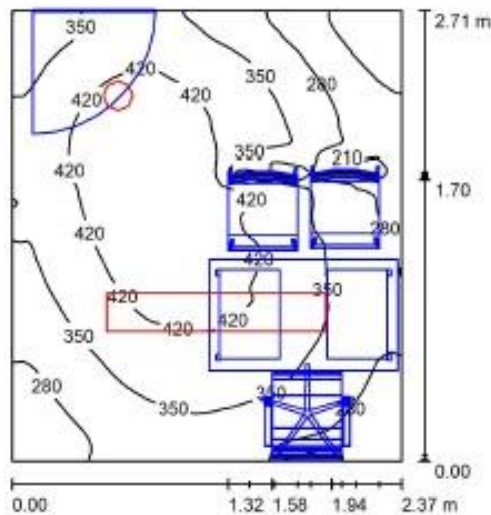
The lux level obtained after calculation is 351lux.

Uniformity obtained : 0.461

Specific Connected Load: 7.82W/m²

Technical Report of Cabin 7

Cabin 7 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	351	162	466	0.461
Floor	20	190	24	294	0.126
Ceiling	80	75	40	98	0.533
Walls (4)	50	162	15	435	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.512, Ceiling / Working Plane: 0.215.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4096	4100	38.5
			Total: 5449	Total: 5450	50.3

Specific connected load: 7.82 W/m² = 2.22 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 8**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

- a. SP482P W24L134 ACC-MLO LED40S/840 NO
- b. DN570B PSE-E C

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

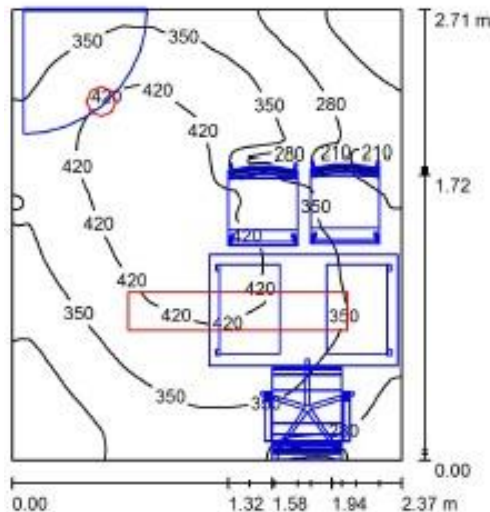
The lux level obtained after calculation is 347lux.

Uniformity obtained : 0.338

Specific Connected Load: 7.82W/m²

Technical Report of Cabin 8

Cabin 8 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80 Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	347	117	456	0.338
Floor	20	184	25	287	0.138
Ceiling	80	78	41	109	0.545
Walls (4)	50	162	15	407	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.523, Ceiling / Working Plane: 0.219.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4096	4100	38.5
			Total: 5449	Total: 5450	50.3

Specific connected load: 7.82 W/m² = 2.25 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 9**

Floor Area : 6.43 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

- a. SP482P W24L134 ACC-MLO LED40S/840 NO
- b. DN570B PSE-E C

No. of Luminaires used: 2

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

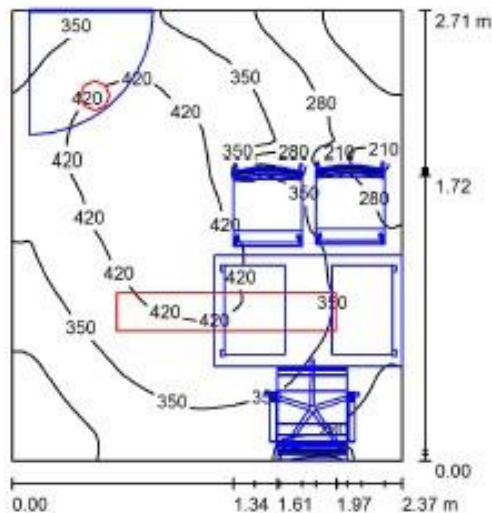
The lux level obtained after calculation is 346lux.

Uniformity obtained : 0.324

Specific Connected Load: 7.82W/m²

Technical Report of Cabin 9

Cabin 9 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	346	112	458	0.324
Floor	20	188	24	290	0.127
Ceiling	80	77	42	103	0.545
Walls (4)	50	162	13	456	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.526, Ceiling / Working Plane: 0.221.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4096	4100	38.5
			Total: 5449	Total: 5450	50.3

Specific connected load: 7.82 W/m² = 2.26 W/m²/100 lx (Ground area: 6.43 m²)

➤ **Cabin 10**

Floor Area : 5.84 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

- a. SP482P W24L134 ACC-MLO LED40S/840 NO
- b. DN570B PSE-E C

No. of Luminaires used: 2

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

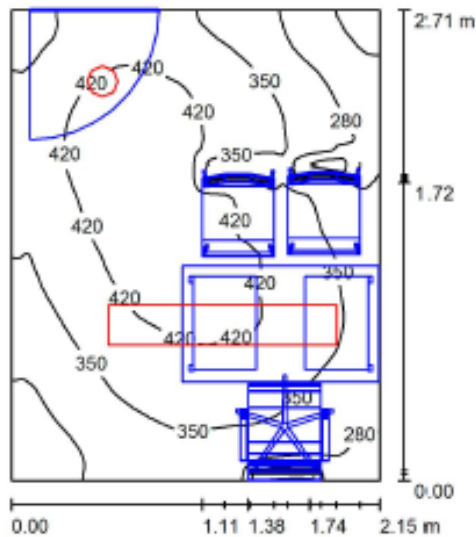
The lux level obtained after calculation is 361lux.

Uniformity obtained : 0.346

Specific Connected Load: 8.62W/m²

Technical Report of Cabin 10

Cabin 10 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:35

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	361	125	458	0.346
Floor	20	183	25	290	0.135
Ceiling	80	84	46	112	0.543
Walls (4)	50	176	13	625	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.557, Ceiling / Working Plane: 0.232.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4099	4100	38.5
Total:			5449	5450	50.3

Specific connected load: 8.62 W/m² = 2.39 W/m²/100 lx (Ground area: 5.84 m²)

➤ **MD's Cabin**

Floor Area : 15.85 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. SP482P W24L134 ACC-MLO LED40S/840 NO

b. DN570B PSE-E C

No. of Luminaires used: 7

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

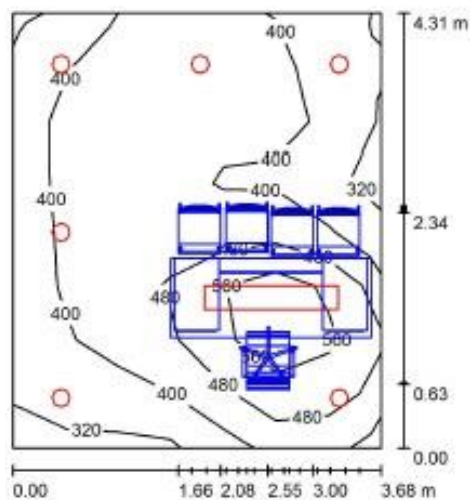
The lux level obtained after calculation is 436lux.

Uniformity obtained : 0.596

Specific Connected Load: 6.80W/m²

Technical Report of MD's Cabin

MD's Cabin / Summary



Height of Room: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:56

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0
Workplane	/	436	260	633	0.596
Floor	20	276	16	417	0.060
Ceiling	80	89	69	106	0.769
Walls (4)	50	197	31	624	/

Workplane:

Height: 0.760 m
 Grid: 7 x 8 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.499, Ceiling / Working Plane: 0.205.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	6	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP480P W24L134 ACC-MLO LED35S/830 NO (1.000)	3496	3500	37.0
Total:			11598	11600	107.8

Specific connected load: 6.80 W/m² = 1.56 W/m²/100 lx (Ground area: 15.85 m²)

➤ **Cabin 11**

Floor Area : 4.47 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. SP482P W24L134 ACC-MLO LED40S/840 NO

No. of Luminaires used: 1

The lighting arrangement followed : General Lighting

The design outputs are as follows:

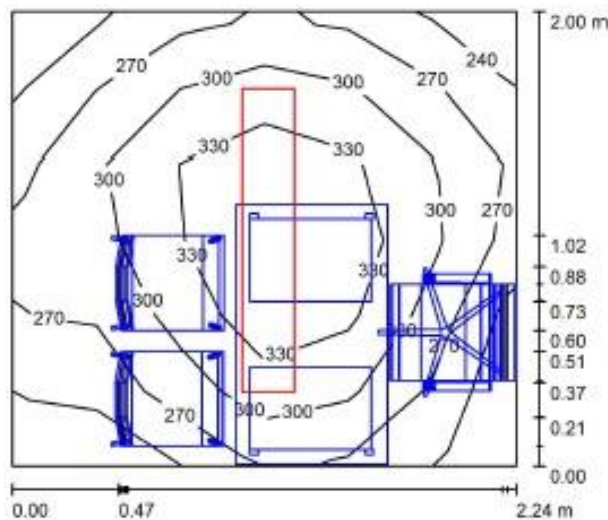
The lux level obtained after calculation is 306lux.

Uniformity obtained : 0.770

Specific Connected Load: 8.61W/m²

Technical Report of Cabin 11

Cabin 11 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:26

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	306	236	361	0.770
Floor	20	115	21	202	0.184
Ceiling	80	72	48	104	0.675
Walls (4)	50	155	9.44	380	/

Workplane:

Height: 0.760 m
 Grid: 6 x 6 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.619, Ceiling / Working Plane: 0.242.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4099	4100	38.5
			Total: 4099	Total: 4100	38.5

Specific connected load: 8.61 W/m² = 2.81 W/m²/100 lx (Ground area: 4.47 m²)

➤ **Cabin 12**

Floor Area : 4.25 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. SP482P W24L134 ACC-MLO LED40S/840 NO

No. of Luminaires used: 1

The lighting arrangement followed : General Lighting

The design outputs are as follows:

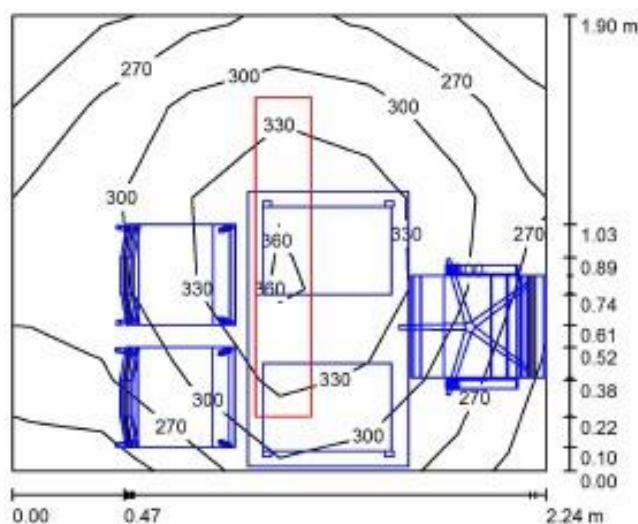
The lux level obtained after calculation is 308lux.

Uniformity obtained : 0.771

Specific Connected Load: 9.06W/m²

Technical Report of Cabin 12

Cabin 12 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:25

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	308	238	368	0.771
Floor	20	110	21	197	0.195
Ceiling	80	75	54	117	0.723
Walls (4)	50	162	11	524	/

Workplane:

Height: 0.760 m
 Grid: 6 x 5 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.637, Ceiling / Working Plane: 0.250.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4099	4100	38.5
Total:			4099	4100	38.5

Specific connected load: $9.06 \text{ W/m}^2 = 2.94 \text{ W/m}^2/100 \text{ lx}$ (Ground area: 4.25 m^2)

➤ **Cabin 13**

Floor Area : 4.25 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. SP482P W24L134 ACC-MLO LED40S/840 NO

No. of Luminaires used: 1

The lighting arrangement followed : General Lighting

The design outputs are as follows:

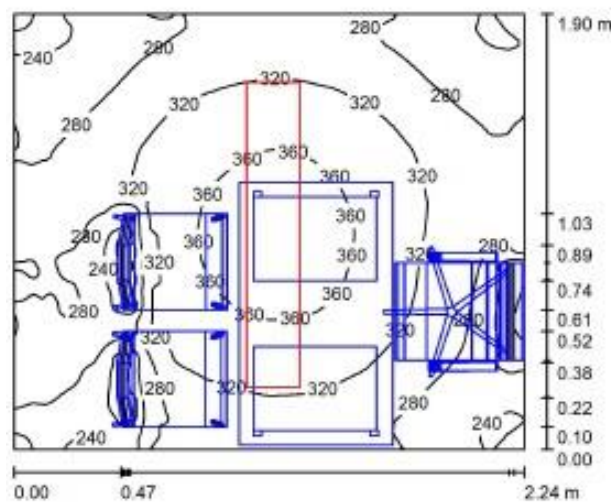
The lux level obtained after calculation is 302lux.

Uniformity obtained : 0.586

Specific Connected Load: 9.06W/m²

Technical Report of Cabin 13

Cabin 13 / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:25

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	302	177	375	0.586
Floor	20	111	22	199	0.196
Ceiling	80	75	54	111	0.716
Walls (4)	50	162	11	451	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.636, Ceiling / Working Plane: 0.249.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4099	4100	38.5
Total:			4099	4100	38.5

Specific connected load: 9.06 W/m² = 3.00 W/m²/100 lx (Ground area: 4.25 m²)

➤ **Reception**

Floor Area : 13.54 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

- a. SP482P W24L134 ACC-MLO LED40S/840 NO
- b. DN570B PSE-E C

No. of Luminaires used: 5

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

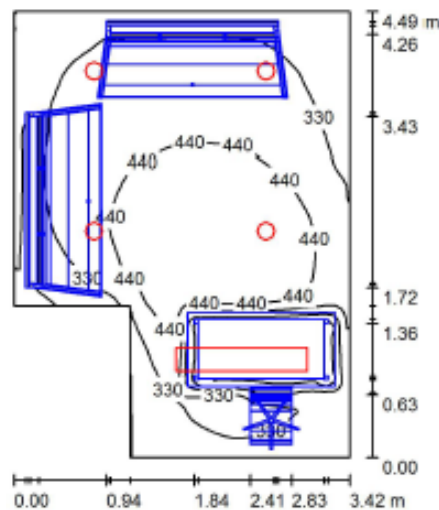
The lux level obtained after calculation is 367lux.

Uniformity obtained : 0.109

Specific Connected Load: 6.33W/m²

Technical Report of Reception

Reception / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:58

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	367	40	541	0.109
Floor	20	199	16	410	0.081
Ceiling	80	79	55	107	0.693
Walls (6)	50	152	16	339	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.467, Ceiling / Working Plane: 0.215.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4099	4100	38.5
			Total: 9499	Total: 9500	85.7

Specific connected load: 6.33 W/m² = 1.72 W/m²/100 lx (Ground area: 13.54 m²)

➤ **4 Pax Meeting Room**

Floor Area : 8.87 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. DN570B PSE-E C

No. of Luminaires used: 4

The lighting arrangement followed : General Lighting

The design outputs are as follows:

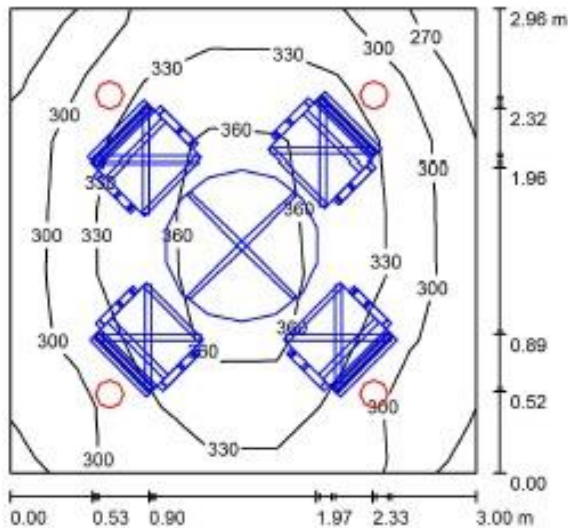
The lux level obtained after calculation is 327lux.

Uniformity obtained : 0.805

Specific Connected Load: 5.32W/m²

Technical Report of 4 Pax Meeting Room

4 Pax Meeting Room / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:38

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	327	263	371	0.805
Floor	20	183	36	266	0.196
Ceiling	80	74	52	87	0.693
Walls (4)	50	150	56	420	/

Workplane:

Height: 0.760 m
 Grid: 7 x 7 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.521, Ceiling / Working Plane: 0.230.

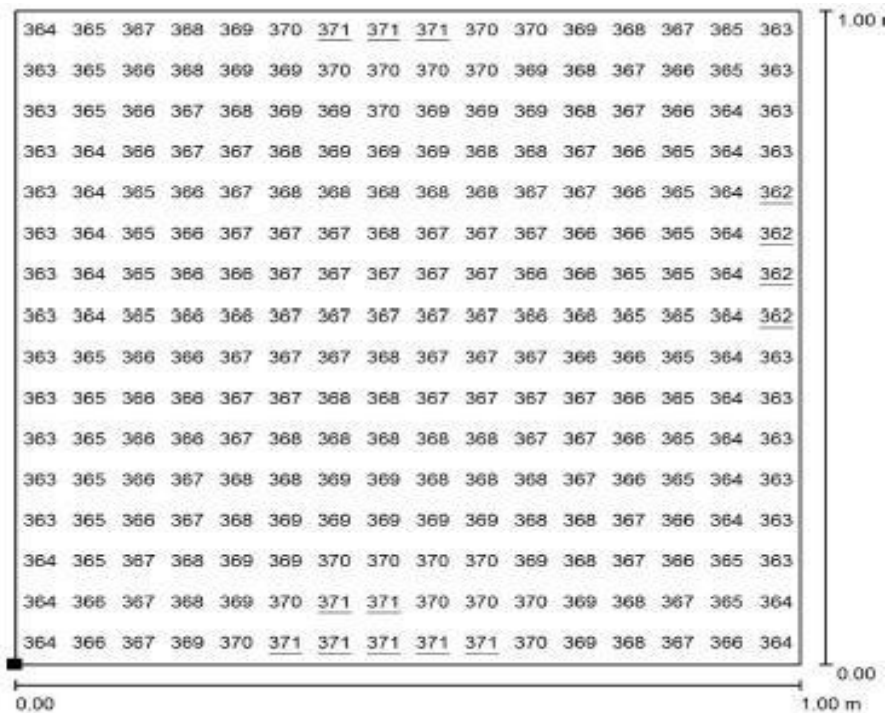
Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
			Total: 5400	Total: 5400	47.2

Specific connected load: 5.32 W/m² = 1.62 W/m²/100 lx (Ground area: 8.87 m²)

The task illuminance value is 367 Lux and the uniformity is 0.988.

E_{av} [lx] E_{min} [lx] E_{max} [lx] u_0 E_{min} / E_{max}
 367 362 371 0.988 0.975



➤ **6 Pax Meeting Room**

Floor Area : 15.32 m²

Height : 2.6m

Mounting Height of the luminaire: The linear LED luminaire is suspended from the ceiling at a height of 0.3m. and the downlighters are recessed mounted in the ceiling.

Luminaire Used:

a. DN570B PSE-E C

b. SP482P W24L134 ACC-MLO LED40S/840 NO

No. of Luminaires used: 5

The lighting arrangement followed : Localized General Lighting

The design outputs are as follows:

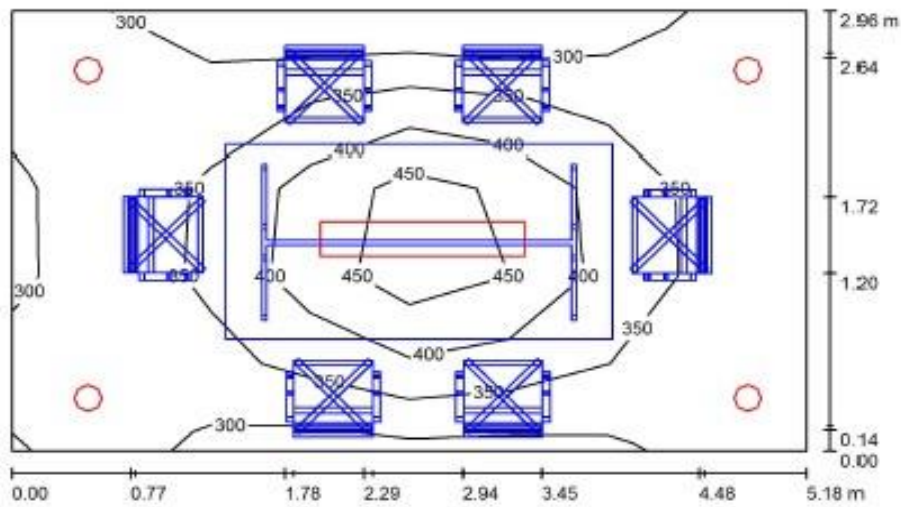
The lux level obtained after calculation is 362lux.

Uniformity obtained : 0.817

Specific Connected Load: 5.59W/m²

Technical Report of 6 Pax Meeting Room

6 Pax Meeting Room / Summary



Height of Room: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:38

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	362	296	522	0.817
Floor	20	158	38	271	0.242
Ceiling	80	136	72	1032	0.531
Walls (4)	50	170	48	802	/

Workplane:

Height: 0.760 m
 Grid: 8 x 5 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.562, Ceiling / Working Plane: 0.393.

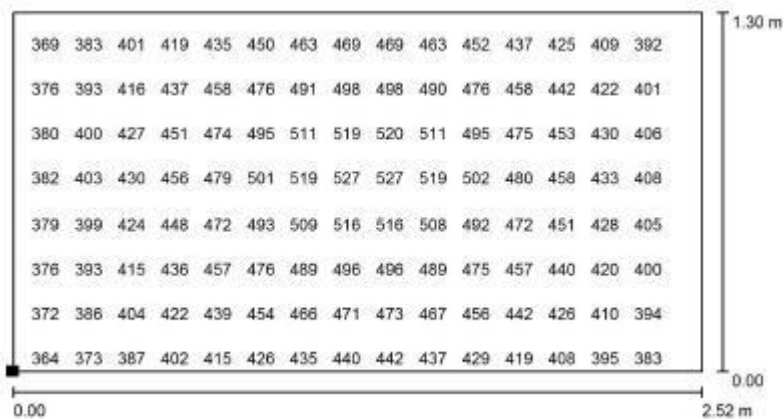
Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
2	1	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO(1.000)	4090	4100	38.5
			Total: 9499	Total: 9500	85.7

Specific connected load: $5.59 \text{ W/m}^2 = 1.55 \text{ W/m}^2/100 \text{ lx}$ (Ground area: 15.32 m^2)

The task illuminance value is 441 Lux and the uniformity is 0.816.

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$	E_{min} / E_{max}
441	360	528	0.816	0.682



➤ Board Room

Floor Area : 35.36 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. DN570B PSE-E C PG

b. SP482P W24L134 ACC-MLO LED40S/840 NO

No. of Luminaires used: 14

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

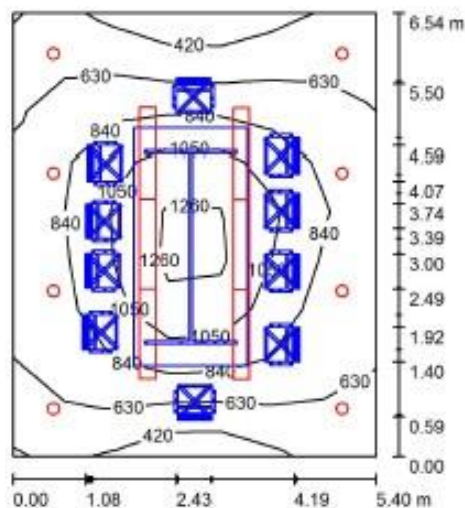
The lux level obtained after calculation is 784lux.

Uniformity obtained : 0.450

Specific Connected Load: 10.83W/m²

Technical Report of Board Room

Board Room / Summary



Height of Room: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:85

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	784	353	1353	0.450
Floor	20	427	66	717	0.155
Ceiling	80	303	121	1201	0.398
Walls (4)	50	320	147	777	/

Workplane:

Height: 0.760 m
 Grid: 7 x 9 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.413, Ceiling / Working Plane: 0.378.

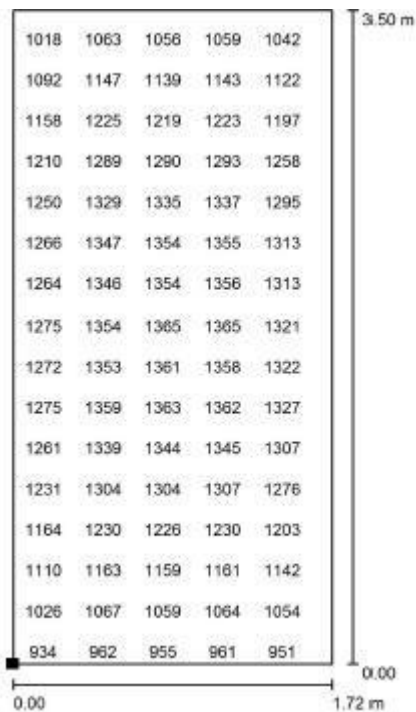
Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	∅ (Luminaire) [lm]	∅ (Lamps) [lm]	P [W]
1	8	PHILIPS DN570B PSE-E C PG (1.000)	2100	2100	19.0
2	6	PHILIPS SP482P W24L134 ACC-MLO LED40S/840 NO (1.000)	4096	4100	38.5
			Total: 41393	Total: 41400	383.0

Specific connected load: 10.83 W/m² = 1.38 W/m²/100 lx (Ground area: 35.36 m²)

The task illuminance value is 1219 Lux and the uniformity is 0.757.

E_{av} [lx] E_{min} [lx] E_{max} [lx] u_0 E_{min} / E_{max}
 1219 923 1370 0.757 0.674



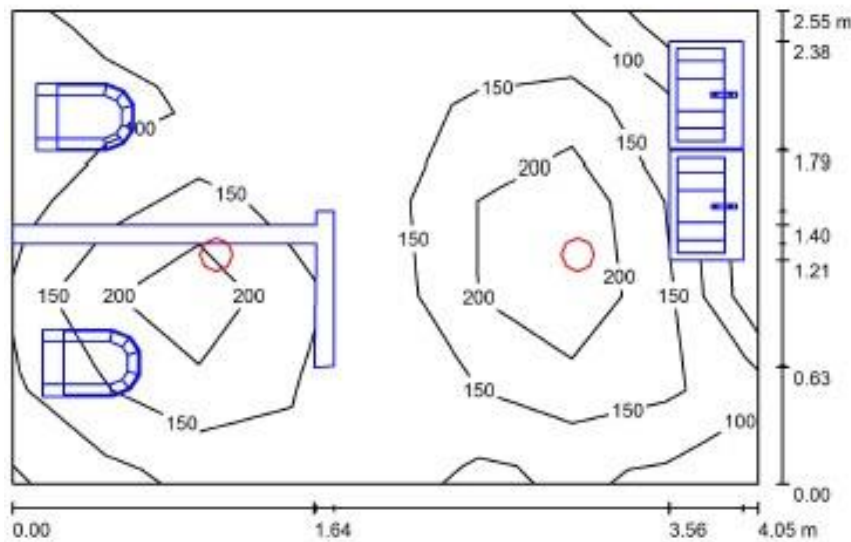
➤ **Gents Toilet**

Floor Area : 10.31 m²
 Height : 2.4m
 Mounting Height of the luminaire: 2.4m
 Luminaire Used: DN570B PSE-E C
 No. of Luminaires used: 2
 The lighting arrangement followed : General Lighting

The design outputs are as follows:
 The lux level obtained after calculation is 152lux.
 Uniformity obtained : 0.295
 Specific Connected Load: 2.29W/m²

Technical Report of Gents Room

Gents Toilet' / Summary



Height of Room: 2.400 m, Mounting Height: 2.400 m, Light loss factor: 0.80 Values in Lux, Scale 1:33

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	152	45	264	0.295
Floor	20	95	8.27	161	0.087
Ceiling	80	26	12	92	0.453
Walls (4)	50	48	8.08	134	/

Workplane:
 Height: 0.760 m
 Grid: 8 x 5 Points
 Boundary Zone: 0.000 m
 Illuminance Quotient (according to LG7): Walls / Working Plane: 0.307, Ceiling / Working Plane: 0.180.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
			Total: 2700	Total: 2700	23.6

Specific connected load: 2.29 W/m² = 1.50 W/m²/100 lx (Ground area: 10.31 m²)

➤ **Ladies Toilet**

Floor Area : 8.24 m²

Height : 2.4m

Mounting Height of the luminaire: 2.4m

Luminaire Used: DN570B PSE-E C

No. of Luminaires used: 2

The lighting arrangement followed : General Lighting

The design outputs are as follows:

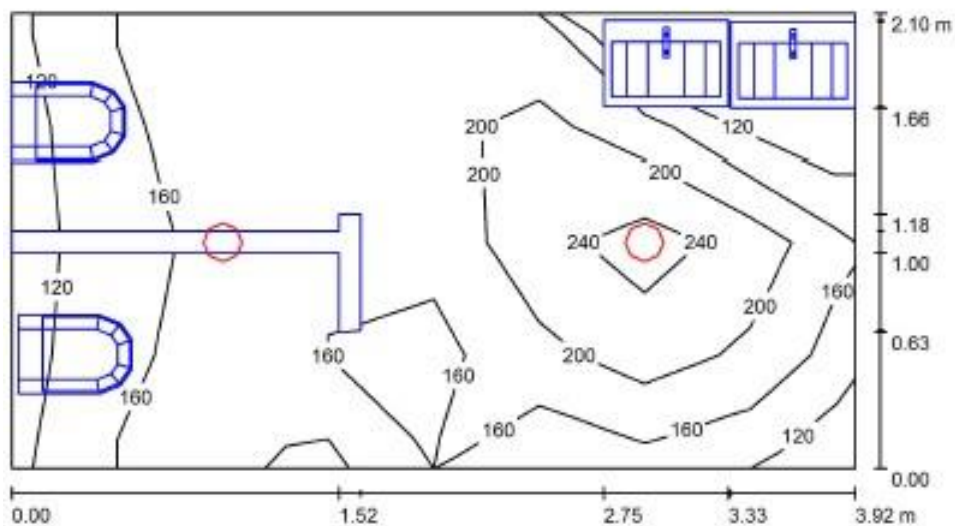
The lux level obtained after calculation is 180lux.

Uniformity obtained : 0.549

Specific Connected Load: 2.86W/m²

Technical Report of Ladies Room

Ladies Toilet' / Summary



Height of Room: 2.400 m, Mounting Height: 2.400 m, Light loss factor: 0.80

Values in Lux, Scale 1:20

Surface	ρ [%]	E _{av} [lx]	E _{min} [lx]	E _{max} [lx]	u0
Workplane	/	180	99	260	0.549
Floor	20	114	11	176	0.092
Ceiling	80	33	16	94	0.488
Walls (4)	50	61	8.04	145	/

Workplane:

Height: 0.760 m
 Grid: 8 x 4 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.335, Ceiling / Working Plane: 0.181.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
			Total: 2700	Total: 2700	23.6

Specific connected load: 2.86 W/m² = 1.59 W/m²/100 lx (Ground area: 8.24 m²)

➤ **Workstation**

Floor Area : 243.05 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. DN570B PSE-E C

b. SP480P W24L134 ACC-MLO LED35S/830 NO

No. of Luminaires used: 87

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

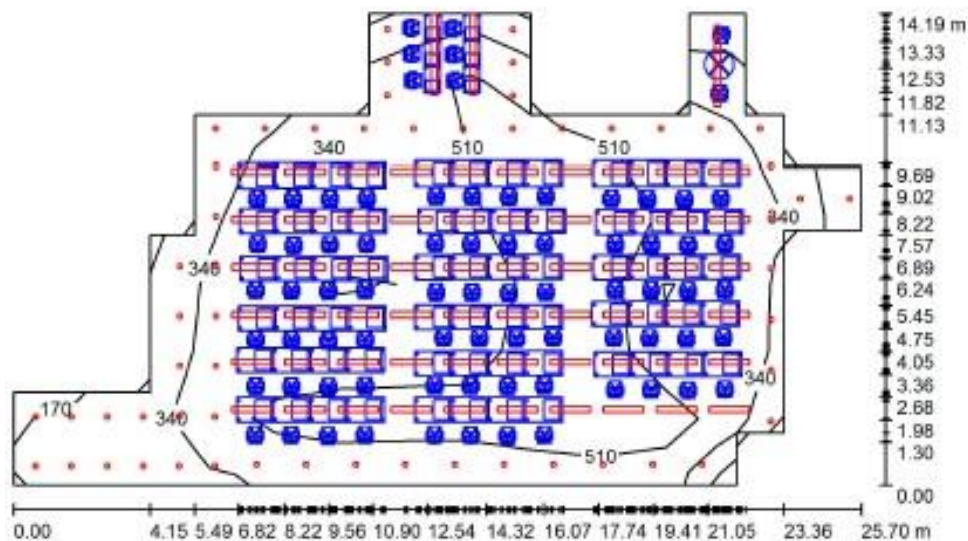
The lux level obtained after calculation is 513lux.

Uniformity obtained : 0.145

Specific Connected Load: 17.26W/m²

Technical Report of Workstation

Workstation / Summary



Height of Room: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:184

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	$u0$
Workplane	/	513	74	893	0.145
Floor	20	319	92	642	0.290
Ceiling	80	167	50	314	0.298
Walls (23)	50	297	56	3346	/

Workplane:

Height: 0.760 m
 Grid: 13 x 7 Points
 Boundary Zone: 0.000 m

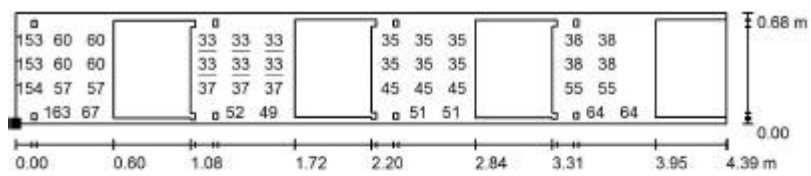
Illuminance Quotient (according to LG7): Walls / Working Plane: 0.615, Ceiling / Working Plane: 0.344.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	ϕ (Luminaire) [lm]	ϕ (Lamps) [lm]	P [W]
1	56	PANASONIC NLP72443 NLP72443 (1.000)	480	1000	25.4
2	66	PHILIPS TMS022 1x36W +GMS022 R TL-D HFS (1.000)	2756	3350	42.0
Total:			208811	277100	4194.4

Specific connected load: 17.26 W/m² = 3.36 W/m²/100 lx (Ground area: 243.05 m²)

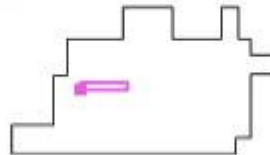
The task illuminance of the Worktable top is



Values in Lux, Scale 1 : 32

Not all calculated values could be displayed.

Position of surface in room:
Marked point:
(6.819 m, 0.027 m, 0.760 m)



Grid: 128 x 64 Points

E_{av} [lx]
66

E_{min} [lx]
33

E_{max} [lx]
183

$u0$
0.489

E_{min} / E_{max}
0.177

➤ **Store**

Floor Area : 4.44 m²

Height : 2.6m

Mounting Height of the luminaire: 2.6m

Luminaire Used:

a. DN570B PSE-E C

No. of Luminaires used: 1

The lighting arrangement followed : Localized Lighting

The design outputs are as follows:

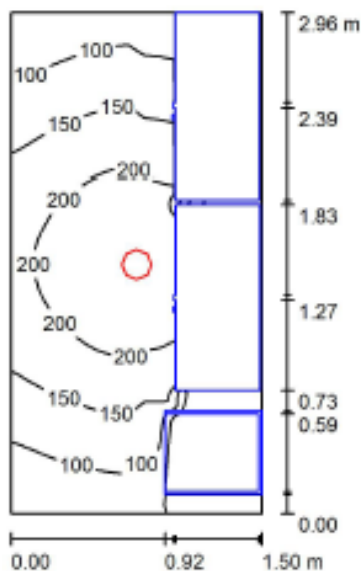
The lux level obtained after calculation is 138lux.

Uniformity obtained : 0.021

Specific Connected Load: 2.66W/m²

Technical Report of Store

Store / Summary



Height of Room: 2.600 m, Mounting Height: 2.600 m, Light loss factor: 0.80

Values in Lux, Scale 1:38

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u_0
Workplane	/	138	2.93	240	0.021
Floor	20	67	1.41	129	0.021
Ceiling	80	44	20	86	0.452
Walls (4)	50	40	0.51	245	/

Workplane:

Height: 0.760 m
 Grid: 128 x 128 Points
 Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.325, Ceiling / Working Plane: 0.317.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	PHILIPS DN570B PSE-E C (1.000)	1350	1350	11.8
			Total: 1350	Total: 1350	11.8

Specific connected load: 2.66 W/m² = 1.92 W/m²/100 lx (Ground area: 4.44 m²)

Office C_Cuttack		Reflectances	80/50/20	LLF	0.8		
Room Name	Area (sq. m)	Height	Conventional				
			Mounting Height	Lux Level	Uniformity	LPD	Qty.
Cabin 1	6.38	2.6	2.6	310	0.767	13.17	2
Cabin 2	6.43	2.6	2.6	306	0.523	13.06	2
Cabin 3	6.43	2.6	2.6	306	0.517	13.06	2
Cabin 4	6.43	2.6	2.6	306	0.511	13.06	2
Cabin 5	6.43	2.6	2.6	305	0.524	13.06	2
Cabin 6	6.43	2.6	2.6	306	0.515	13.06	2
Cabin 7	6.43	2.6	2.6	306	0.67	13.06	2
Cabin 8	6.43	2.6	2.6	306	0.523	13.06	2
Cabin 9	6.43	2.6	2.6	305	0.516	13.06	2
Cabin 10	6.43	2.6	2.6	319	0.53	13.06	2
MD Cabin	15.85	2.6	2.6m,2.4m	309	0.702	14.91	8
Cabin 11	4.47	2.6	2.6	289	0.726	20.75	3
Cabin 12	4.25	2.6	2.6m, 2.4m	284	0.585	21.84	3
Cabin 13	4.25	2.6	2.6m, 2.4m	285	0.557	21.84	3
Reception	13.54	2.6	2.6	326	0.152	33.77	18
4 Pax meeting Room	8.87	2.6	2.6	311	0.75	34.35	12
Store	4.44	2.6	2.6	178	0.053	16.9	3
6 Pax Meeting room	15.32	2.6	2.6	308	0.407	18.75	10
Board Room	35.36	2.6	2.6m, 2.4m	743	0.569	28.62	32
Gents Toilet	9.29	2.4	2.4	118	0.561	16.4	6
Ladies Toilet	7.99	2.4	2.4	144	0.546	19.07	6
Workstation	243.05	2.6	2.6m,2.4m	513	0.145	17.26	0.145

Table 7.5 Design Parameters of Office_C_Cuttack with Conventional Luminaire

Office C_Cuttack		Reflectance					
Room Name	Area (sq. m)	Height	LED				
			Mounting Height	Lux Level	Uniformity	LPD	Qty.
Cabin 1	6.38	2.6	2.6	357	0.523	7.88	2
Cabin 2	6.43	2.6	2.6	348	0.52	7.82	2
Cabin 3	6.43	2.6	2.6	349	0.502	7.82	2
Cabin 4	6.43	2.6	2.6	352	0.319	7.82	2
Cabin 5	6.43	2.6	2.6	357	0.335	7.82	2
Cabin 6	6.43	2.6	2.6	350	0.328	7.82	2
Cabin 7	6.43	2.6	2.6	351	0.461	7.82	2
Cabin 8	6.43	2.6	2.6	347	0.338	7.82	2
Cabin 9	6.43	2.6	2.6	346	0.324	7.82	2
Cabin 10	6.43	2.6	2.6	361	0.346	8.62	2
MD Cabin	15.85	2.6	2.6	436	0.596	6.8	7
Cabin 11	4.47	2.6	2.6	306	0.77	8.61	1
Cabin 12	4.25	2.6	2.6	308	0.771	9.06	1
Cabin 13	4.25	2.6	2.6	302	0.586	9.06	1
Reception	13.54	2.6	2.6	367	0.109	6.33	5
4 Pax meeting Room	8.87	2.6	2.6	327	0.805	5.32	4
Store	4.44	2.6	2.6	138	0.021	2.66	1
6 Pax Meeting room	15.32	2.6	2.6	362	0.817	5.59	5
Board Room	35.36	2.6	2.6m,2.4m	784	0.45	10.83	14
Gents Toilet	9.29	2.4	2.4	152	0.296	2.29	2
Ladies Toilet	7.99	2.4	2.4	180	0.549	2.86	2
Workstation	243.05	2.6	2.6m,2.4m574	574	0.277	8.37	70

Table 7.6 Design Parameters of Office_C_Cuttack with LED Luminaire

CHAPTER 8

CONCLUSION & FUTURE ASPECTS

8.1 CONCLUSION

In this project, three offices are chosen for the study of differences between LED and the Conventional luminaries. The office plan has been created in AutoCAD 2016 and then the plan is imported into the DIALux software for the design .

First the office is designed with conventional luminaries maintaining the lux levels as per Standards. For maintaining the standard lux levels, the LPD of the area is crossing the ECBC Standard. To maintain the uniformity above 0.6, general distribution of the luminaries with uniform spacing has been maintained. CFL downlighters of 11W, 19W, 25W and Fluorescent luminaries of 36W and 12W are used in conventional design. For reception area standard lux level , according to IS-3646 is 300 lux. In conventional luminaries design, for reception area, mostly CFL downlighters have been used . For cabin or private offices, linear fluorescent lamps of 36W is used on the table top. Otherwise CFL downlighters are used for general lighting. For workstation, fluorescent lamps of 36W has been used for the working area and CFL downlighters or fluorescent lamps of 18W are used in corridor lighting.

Then the office is designed with the LED luminaries maintaining the same lux level standards. It is seen that the LPD value of the area has drastically reduced. For maintaining the uniformity above 0.6, general distribution of luminaries is not needed always in case LED lighting. In LED Lighting design, recessed mounted downlighters, surface mounted downlighters, panel lights, spot lights, Linear LED luminaries (surface mounted or recessed mounted), circular diffuser lights has been used. For meeting rooms, recessed /surface mounted/ suspended luminaries are fitted over the meeting room table while the rest of the parts of the meeting room can be fitted with surface mounted/ recessed mounted downlighters. For workstation area, sometimes for general lighting , panel lights are used also along with the linear luminaries This gives better view with good uniformity ratio and energy efficient with least number of luminaire used.

From this study of the project, it is very clear that LED is much better option over conventional luminaires. The quality of the illumination, the uniformity ratio is better than Conventional Luminaire. Though the initial cost of the LED is much higher, but the quality of light is more appreciable. The lamp lumen output and the luminary lumen output in case of LED are almost same, whereas the luminaire lumen output of conventional luminaire is a certain percentage of lamp lumen output. Requirement of luminaire quantity is also reduced during LED lighting design. Since the wattage of the LED luminaires are lesser than the conventional luminaries, the per unit electrical cost, the lighting power density of the area considered have got reduced. The LED luminaires have longer life than the conventional luminaires. Thus design with LED luminaires is much more convenient and energy efficient than conventional luminaire.

8.2 FUTURE ASPECTS

In this project we have studied how to create an energy efficient lighting system with LED. Conventional Luminaires are becoming obsolete and LED is taking its' place there. Design with LED is not only energy efficient but it can represent itself in long run. In this project for designing an energy efficient lighting system in office building only LED is considered. By using lighting controls like PIR sensors and daylight integration along with LED a more energy efficient lighting system can be created which will help in reducing lighting cost in future.

9. Bibliography

1. IEA 4E SSL Performance Tiers, <http://ssl.iea-4e.org/product-performance/performance-tiers>, 2016.
2. Minergie Efficacy criteria, <http://www.minergie.ch/>
3. Minergie Produktreglement zu den Gebäudestandards, v. 2017.2, part 11.1, Switzerland.
4. Lys-Emitterende Dioder (in Danish), LED, Rune Søgaard Larsen, 2011.
5. Light! On light in life and life in light, Tor Nørretranders & Olafur Eliasson, 2012.
6. EU GPP Criteria for Indoor Lighting, EU JRC, http://ec.europa.eu/environment/gpp/pdf/-criteria/indoor_lighting.pdf, 2012.
7. How to complement efficient lighting with good lighting design to obtain best practice, Advice and comments provided by Danish Centre for Lighting (DCL), Anne Bay, 2017.
8. Lys i Læringsmiljø (Norwegian language), Lyskultur, 2015.
9. Code of Practice for the Application of LED Lighting Systems, IET, UK, 2014.
10. Smart Lighting impacting Energy Consumption, Casper Kofod, IEA 4E SSL Annex, Sep. 2016, <http://ssl.iea-4e.org/product-performance/new-product-features/standby-of-smart-lamps-first-report>.
11. Occupant Sensors, <http://www.qualitylight.com/techniques/sensors/sensors.html>
12. Human Centric Lighting, Stan Walerczyk, <http://humancentriclighting.com/wp-content/uploads/2012/07/Stan-Article-SSL1.pdf>, 2012.
13. https://www1.eere.energy.gov/buildings/publications/pdfs/ssl/opticalsafety_fact-sheet.pdf
14. http://en.licht.de/fileadmin/shop-downloads/1606_Reliable-Planning-with-LED-Lighting-2nd-Ed.pdf
15. <http://ieslightlogic.org/lighting-language/>
16. Light's Labour's Lost, Policies for Energy-efficient Lighting, IEA, 2006.
17. <http://www.allaboutvision.com/over60/vision-changes.htm>
18. The Use of the Internal Telephone Network for Control of Lighting in Large Office Buildings, <http://www.caddet-ee.org/register/data-ee/cce02091.htm>
19. <http://luxreview.com/article/2016/03/dubai-supermarket-is-first-in-middle-east-with-connected-lighting>
20. <http://luxreview.com/article/2015/04/exclusive-us-retail-giant-target-leads-the-way-in-lighting-based-in-store-navigation-systems>
21. Saving Energy with Efficient Lighting in Commercial Buildings, (only used information about lighting control), CADDET maxi Brochure 01, 1995.
22. Lamps and Lighting, (general lighting design), JR Coaton, AM marsden, Arnold, 1997.
23. Energy Efficient Lighting in Commercial Buildings, Stefan Aronsson, Per-Erik Nilsson, CADDET Analyses Series No. 6.
24. http://bygningsreglementet.dk/br15_02_id103/0/42, part 6.5.3 paragraph 2 (in Danish)
25. <http://ecodesign-lightingsystems.eu/documents>, 2016
26. Task and Building Lighting: the Link Between Lighting Quality and Energy Efficiency, David Loe, Right Light 4 p.11.
27. Strategies for Technologies Procurement in Creating Energy Efficient Lighting Installations, Arnold Buddenberg, Rienk Visser, Right Light 4.
28. Lighting Technology and maintenance, <http://www.facilitiesnet.com/NS/NS3mg6f.html>
29. Electric Lighting Controls – A Guide for Designers, Installers and Users, BRECSU, Good Practice Guide 160.
30. Daylight Performance of Buildings: 60 European Case Studies, m Fontoynt, Right Light 4 Vol.2 p.61.
31. A Study Performance of Light Pipes Under Cloudy and Sunny Conditions in UK, L Shao, SB Riffat, W Hicks, Right Light 4 Vol.1 p.155.

