APPLICATION OF LIGHTING AUTOMATION IN RESIDENTIAL SECTOR : A CASE STUDY

A dissertation submitted in partial fulfillment of the requirements for the degree of Master of Technology in Illumination Technology and Design

Submitted by

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It is my esteemed pleasure to present a project on " Application of Lighting Automation in Resiential Sector : A Case Study" to provide the know-how of Residential Lighting Automation as per modern industrial standard. My sole objective is to make a documentation on the implementation of lighting automation in today world. Any big or small achievement should have a catalyst and constant encouragement and advice of valuable and noble minds. The satisfaction that accompanies the succesful completion of any task would be incomplete without mentioning those who made it possible because success is the epitome of hard work, determination and dedication. I express my deep gratitude to my project guide, Dr. Biswanath Roy, who gave me inspiration to pursue this project and guided me in this endeavour. I also express my deep gratitude to the Director of SISED, Mr. Parthasarathi Satvaya for his support, constant encouragement and also for providing the necessary facilities to carry out project successfully. I would also like to thank our honourable Dean of FISLM for the smooth management of our course. I would also like to thank the colleagues of Marici Experience Center, where I have undergone internship without whose many critical concepts regarding the thesis cannot be understood by me. Last but not the least, I am thankful to all the faculty members and lab instructors without whose support at various stages, this project would not have materialized. Finally, I must express my very profound gratitude to my family members and friends for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this thesis.

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1 Introduction

Proper lighting adds dimension to any space. Obviously, lighting has the basic function to help us to see, though nowadays, lighting play different role in people's life. Lighting adds mood to a scene. To extract the beauty and functionality of a scene, we need to set the brightness level and CCT of a scene properly. For example, when a movie is playing in home theatre, the lights near the television should be off, all the curtains should be closed, the downlights on the backside of the sofa should be dimmed with a warm color or only the cove lights should be on. To properly set the mood of the scene in just one click, we need automation. Residential automation is mostly about creating drama with lighting, audio, curtain movement etc. Era of artificial light begin when ancient man discovered fire. Then candle, oil lamp , arc lamp, filament lamp, gas powered lamp etc. came into the scene gradually. Arc lamp is based on the arc produced by keeping the electrodes very close to each other. Russian physicist Vasilij Vladimirovič Petrov first tested the persistent arc lamp in 1802. Sir Humphrey Davy, in 1809, made first carbon arc lamp and was powered by early battery which was drained very quickly. A patent for incandescent lamp is issued in the name of Henry Woodward and Mathew Evens in 1874. Afterwards, they sell there patent to famous Thomas Alva Edison Group. Edison group made a bamboo filament which has a life of about 1200 hrs, for which they received the second patent. William D. Coolidge developed the tungsten filament lamp on 1911. Irving Longmuir discovered in 1931, that inert gas and twisted filament is increasing the life and performance of tungsten lamp. Then, the frosted incandescent lamp, a glareless diffused lighting is introduced by Marvin Pipkin at 1925. Till 1925, bulbs are made up of clear glass only. Though the original gas discharge tube was invented by Heinrich Geissler in 1857, but gas discharge lamp widely came into use in the early 20th century. French chemist George Claude made neon lamp from Geissler tube. This neon lamp is introduced in US in 1923 and became extremely popular for signage. At 1926, Edmund Germer patented the design for fluorescent lamp, which has a powder coating on the inside of glass that acts as a frequency converter producing a diffused light. GE took the patent of fluorescent tube in 1939 and started producing commercially after World War II. CFLs (Compact Fluorescent Lights) are introduced by Philips at 1980. Simultaneously, in 1927, the high pressure mercury vapour lamp was discovered by Hungarian physicist and engineer De'nes Gabor. HPMV was widely used as street lighting. Shortly after, low

pressure sodium vapour lamp replaced HPMV due to highest efficiency of 200lm/w, but the distinct yellow colour of LPSV restricted the use of it to the street light only. Then in the 1960s, Halogen technology came to prevent the evaporation of the filament within the bulb, where halogen materials are mixed with the gases inside. Then gradually, metal halide lamps are introduced, where metal is combined with halogen to produce more white light.

Years later, infrared LED is discovered accidentally by Garry Pittman and James R. Biard in 1961. In 1962, a GE researcher Nick Holonyak made the first commercially viable red LED, but this was very expensive for mass production. The cost of producing LED is dropped dramatically in 1970s and M. George Craford developed yellow LED in 1972. But, LED can not be used widely, because white light cannot be produced till then. After years, in 1989, Japanese researchers Isamu Akasaki, Hiroshi Amano and Shuji Nakamura developed the high-brightness blue LED, which was essential for making white LED and they got the Nobel Prize in 2014 for this breakthrough invention. LEDs are preferred for its efficient and cool light, its ability to fit in different type of lighting fixtures and long operational life. Modern indoor architectural lighting mostly consists of profile lighting, track lighting, round, square and linear laser downlights, recessed, semi-recessed and surface downlights. Recessed lights are used mainly in the false ceiling and surface lights are used in the true ceiling. Track Lighting is first discovered by Mr. Anthony Donato, who got the patent for the same in 1961. He designed the track fixtures throughout his career and got 32 patents. There are many advantages of residential track lighting. Track lighting adds to the beauty of the room as well as we can use different type of light in one track and adjust the focus lights as required. If, the driver permits, we can also add more lights to the track, without any masonry work in the ceiling or wall.

With the design of home with modern lights, in this era of IOT, Alexa, residences also require automation for switching, dimming and changing the CCT of light with one click of a button as well as controlling the HVAC system, curtains etc. to turn a residence to 'Smart Home'. 'Smart Home' may seem a new concept, but world's first home automation system ECHO IV is invented by Jim Sutherland in 1966. It could store recipes, relay messages, control a home's temperature etc. It was never commercialized and was for personal use of Jim Sutherland. The invention of computer chip, digital network, Wi-Fi technology, advancement of power electronics in 20th century make the background for the Smart Home System. Residential lighting au-

Figure 1.1: Track Lighting

Figure 1.2: Profile Lighting [1]

tomation mainly deals with dimming the lights and creating different scenes. Dimming the light as per requirement save the energy in one hand as well as create the drama within a scene. To dim a light or adjust the brightness level of a light , we need a dimmer. Early dimmers used variable mechanical resistance to drop excess voltage and hence was very wasteful and unsafe. Granvile Woods invented safety dimmer , which greatly reduced the waste of energy. In 1959, Joel S. Spira, who found the Lutron Electronics Company later, invented SCR based dimmer. The small dimmer can be installed in the wall electrical box and helps to save energy by dimming the light as required. Eugene Alessio invented a triac based light bulb socket adapter to adjust the light level of a single bulb. After Solid state dimmers came into the market,

analog lighting control is possible like 0-10V dimming systems. Then gradually digital lighting control is developed like DALI, DMX512, KNX where lighting control is more accurate and less complex.

2 Background Theory

2.1 LED Lighting concepts and Lighting Standards

Modern residential lighting mostly consists of LED downlights. Design of LED downlights may look simple from outside, but they involve many critical concept like binning, risk of eye damage etc. Lighting is a combination of art and science. We need light of proper beam angles for creating drama as well as for several functions. For making a proper beam angle, specific lenses and reflectors are used. For panel lights, diffusers are used. No two LEDs are exactly of the same technical characteristics. In the mass production procedure of LEDs, there are always variations in the features of LEDs due to the production process. To avoid big variations in similar products, LEDs with similar characteristics are grouped in bins. This is called binning process. LEDs are sorted mainly based on brightness, color temperatures and voltage to a bin. The color temperature variations is measured through SDCM (Standard Deviation Color Matching) i.e. by the steps of MacAdam Ellipse. The ANSI (American National Standard Institute) recommends the color of the LEDs in a same bin has to be located within four steps of MacAdam ellipse i.e. the color variation of LEDs in a same bin should not be detectable by human eye. ANSI standard C78.377 provides six light points on the CIE 1931 XYZ color space, which are standards for the different type of white lights.

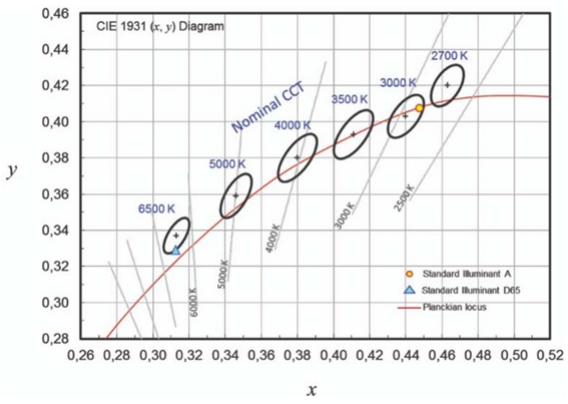

Figure 2.1: Illustration of ANSI C78.377-2014 3-step ellipses [2]

The International Commission of Illumination (CIE), first developed the

XYZ color space in 1931, consisting the full gamut of visible colors. The black curved line shown in the fig.2.1, is called Planckian Locus, which indicates how the chromaticity changes for a blackbody radiator as its temperature changes.

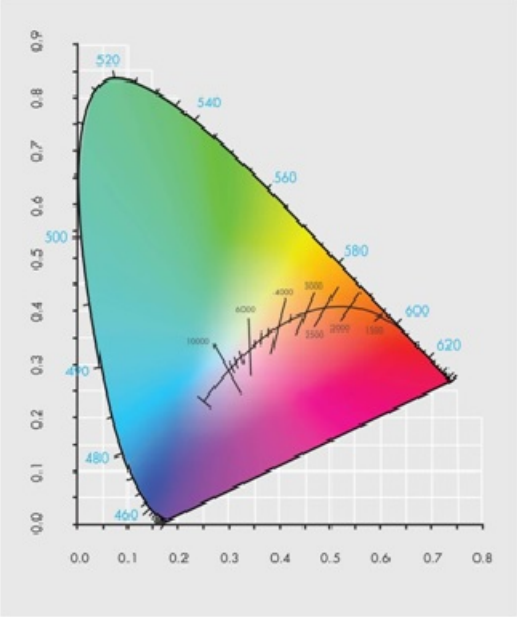

Figure 2.2: CIE 1931 XYZ color space and Planckian locus [3]

MacAdam had done an experiment, where a observer will see two color source fixed at luminance 48Cd/m2 . One source color is fixed and the observer is said to vary another source color to match the previous one. Obviously, the match was not perfect, since human eye contains error. Now, MacAdam had seen, that all the matches made by observers fell in a ellipse in the CIE 1931 chromaticity diagram. MacAdam had marked a total of 25 ellipse on the CIE 1931 chromaticity diagram. The ellipse is divided into steps, which indicates how much the source of the color varies from the target value. Any point on the boundary of the –step ellipse represents 1 standard deviations from the target. The physical interpretation of step size or SDCM is depicted in Table 2.1.

For residential purposes, the photobiological safety for LED lights must be taken into accounts, since human will spend maximum time under those lights. According to EN 62471:2008 sources of optical radiation, are classified

Table 2.1: Physical interpretation of Macadam ellipse

MacAdam Ellipse (SDCM)	Physical Interpretation
1-SDCM	Almost impossible to see a color difference
2-SDCM	Differences can be seen through measuring instruments
3-SDCM	Less color differences are visible
4-SDCM	Color differences are visible
5-SDCM	Clear distinct differences are visible

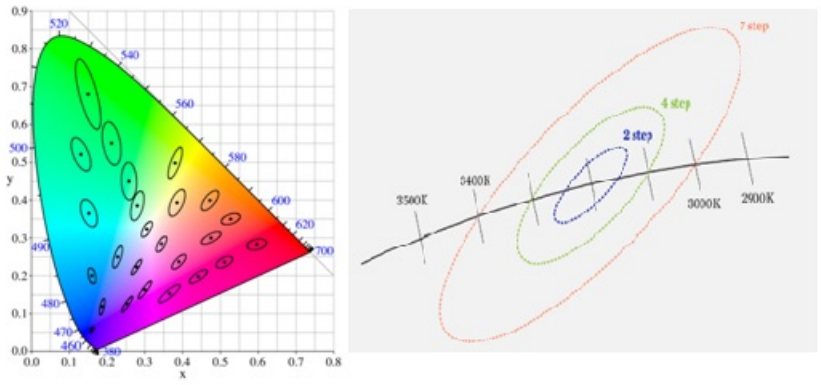

Figure 2.3: Macadam Ellipse[4][5]

o four risk groups. The details of risk groups are depicted in Table 2.2.

Modern indoor LED luminaries usually belongs to risk group-1. If a light source belongs to risk group-2 or 3 this must be indicated.

2.1.1 Lighting Standards

For interior illumination we use IS-3646 standard in India. Internationally, CIE and IESNA give the lighting standards. In practical lighting design, sometimes average illumination for interior is kept slightly higher than the recommended value, as the light output will depreciate over time due to dust accumulation, age of lamp and ballast, other lamp burnouts etc. The recommended value of illuminance according to IS 3646 are depicted in Table 2.3

Table 2.2: Photobiological risk groups for luminaries

RISK GROUP	**REMARKS**
RISK GROUP-0 OR EXEMPT GROUP	No risk, even if the light source is in full view
RISK GROUP-1	No photobiological hazard under normal behavioural limitations. However not more than 10000 seconds (approx. 3 hours) should be spent looking at the lamp
RISK GROUP-2	Does not pose hazard due to aversion response or thermal discomfort; however, a maximum of 100 seconds of direct exposure to the light is allowed
RISK GROUP-3	Hazardous for a momentary exposure;upto 0.25 seconds of viewing is allowed. This is shorter than natural viewing reflex of eye.

Table 2.3: Recommended Illuminance Ranges for Residence from IS-3646 [6]

ROOM	**RECOMMENDED ILLUMINANCE (LUX)**
Bedroom	30-50-100
Bathroom	50-100-150
Entrance Foyer	150-200-300
Dressing Room	100-150-200
Kitchen	300-500-750
Bar	50-200
Dining Area	150-200-300
Living Area/Den Area	50-200
Passage	50-100-150

2.2 Lighting automation theory and standards

The most simple lighting control is to switch on and switch off the light. One can employ mechanical switch or relay for this simple control. But, then came the requirement of dimming the lights for proper applications and

energy savings. When rheostat based dimmer was used, then there was no reduction of energy. Electronic dimmers results in the reduction of energy. For dimming a light, there are number of ways, which are elaborated further.

2.2.1 Phase-Cut Dimming

Phase-cut dimming is chopping-off the mains power supply to reduce the overall power supplied to the lamps. The 0-cross over points of the mains supply are very critical in this regard, because upon its location the calculation of phase cut is based.

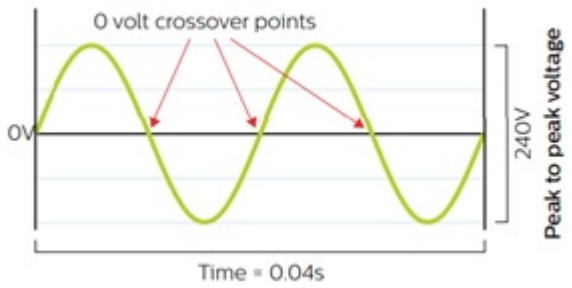

Figure 2.4: Ideal Sinusoidal Power Supply And 0 Volt Crossover Points[10]

Two style of phase cut dimming is available to accommodate different types of lamps available in the market. They are :

Leading edge dimming: For leading edge dimming, supply is stopped at the first 0-volt crossover points, then started when the average power reached the desired value. Generally, SCR or TRIAC is used for this kind of dimming. Drivers are managed in this kind of dimming using a combination of digital and analog inputs for smooth and safe operations.

Trailing edge dimming: For, trailing edge dimming initially supply is allowed to flow from 0-crossover point, then supply is stopped when the average power attend the desired value. Typically, MOSFET is used 2 trailing edge dimming. Here, drivers are managed through digital inputs only for smooth and safe operations.

Care must be taken to choose proper control type to match the lamp requirements. Trailing edge dimming should not be used with lamp with

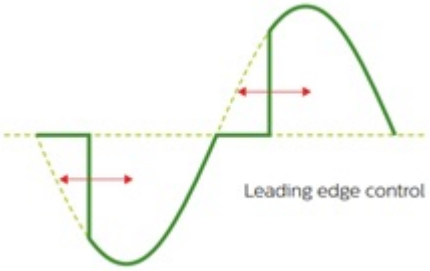

Figure 2.5: Leading Edge Dimming.jpg[10]

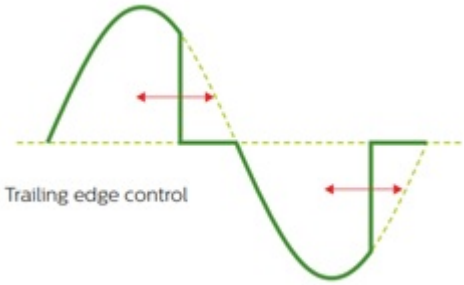

Figure 2.6: Trailing Edge Dimming[10]

inductive coils. Moreover, in phase cut dimming, average output voltage also decreases, hence LED strip cannot be dimmed with phase cut, since LED strip require constant voltage to be driven. In phase cut, no programme is stored in the driver of the light. Phase cut dimming is referred as Primary Side Regulation (PSR). The comparison of leading edge and trailing edge dimmer is given in Table 2.4

A phase cutting controller or dimmer switch is used with phase cut driver. The wiring diagram for phase cut is seen in the diagram below. There is no break in the neutral wire.

Table 2.4: Pros and Cons of Leading Edge Dimming and Traiing Edge Dimming

Dimming Way	**Pros**	**Cons**
Leading Edge (Forward Phase)	Less components, lower cost, Can Control L load e.g. AC fan	Noticeable buzzing noise occurs due to the inductor oscillation caused by surge, Poor EMI interfering the operation of other devices, Poor efficiency with heat generation easily, Larger minimum operating power
Trailing Edge (Reverse Phase)	No buzzing noise when dimming, Better EMI, Lower minimum operating power	More components, higher cost, Cannot control L load, e.g. AC fan, Higher insertion loss under poor design

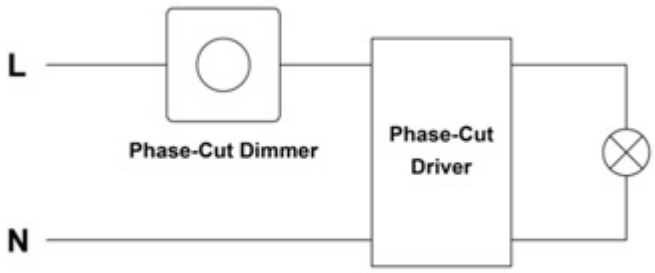

Figure 2.7: Wiring Diagram for Phase Cut Connection of Lamp[9]

2.2.2 0-10V Dimming

0-10V/1-10V dimming is the most simple and old way of dimming. It uses two extra control signals, which if shorted i.e. 0V results in minimum light output and if 10V is given to the control signal, results in maximum light output. 0-10V dimming allows smooth operation of dimming of light. There are two standards for 0-10V dimming, which are incompatible to each other. There are two standards for this dimming. IES standard 60929 annex E

refers to current sink control scheme. Current sink control means the device under controlled sources the voltage to controller, but controller reduces the returned voltage to lighting fixtures. In this standard, the light will be the highest intensity at 10V and minimum intensity if the returned voltage less than 1V. Current source control scheme, standardized by ESTA E1.3, was used for dimming theatrical lighting. Controller sources (generate) the low voltage to controlled device in current source control. Device under control adjusts the lighting intensity according to the voltage, scaling to maximum intensity at 10V and minimum at 0V. All fittings within one lighting group will respond to this dimming instruction at the same time. There is no method of error checking and, as any voltage on the control line will be considered by the fittings as a correct signal, the lighting control system might not be able to turn lamps off through the control line alone. Switching off the power supply to the fittings from a relay in parallel with the control signal will be required to ensure correct operation.0-10V and 1-10V do not support bidirectional communication – so if sensors are required additional systems may be necessary.

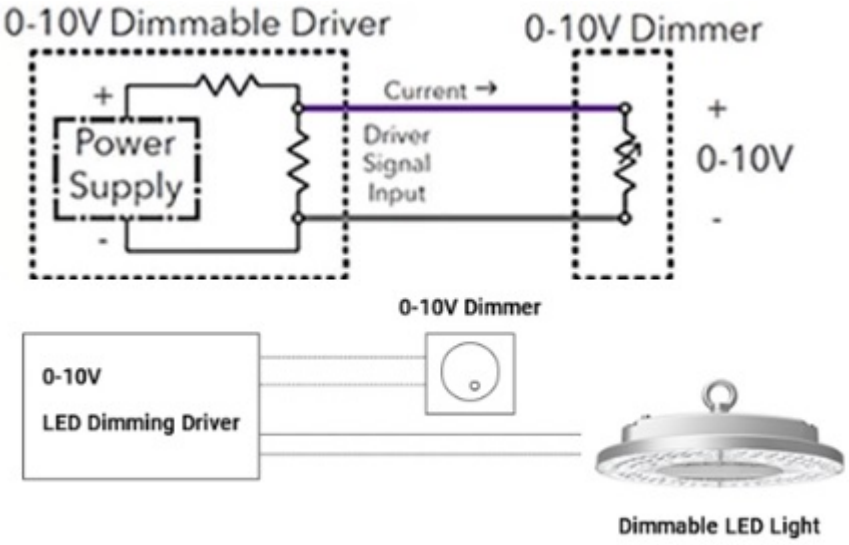

Figure 2.8: 1 Circuit Diagram of 0-10v Dimming System[11] [12]

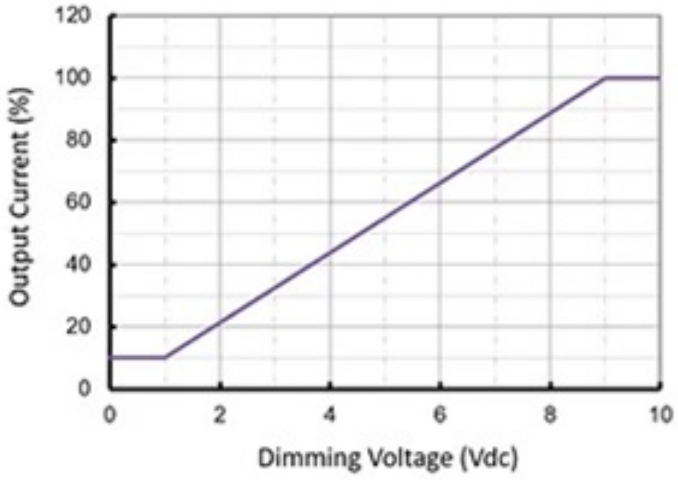

Figure 2.9: Curve of Output Current vs Control Voltage in 1-10V Dimming[13]

2.2.3 PWM Dimming

PWM dimming refers to Pulse Width Modulation Dimming; here the average output power is controlled through rapid switching ON/OFF by modulating the width of the pulses. The switching occurs very fast ensuring smooth dimming. The ratio of ON period to OFF period controls the output.

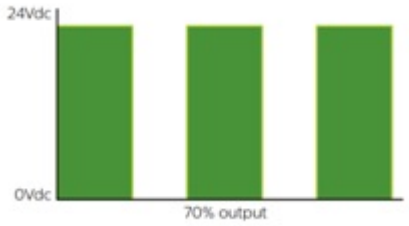

Figure 2.10: 70% Output by Pulse Width Modulation[10]

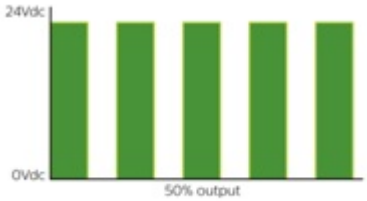

Figure 2.11: 50% Output by Pulse Width Modulation [10]

2.2.4 DALI Dimming

DALI refers to Digital Addressable Lighting Interface. It is specified by IEC 62386 standard and first offered bi-directional communication. In this system, the load controller transmits a digital signal to the lamps. DALI lights have built in Intelligence that allows multiple addressing. DALI has two modes: DALI Broadcast and DALI Addressing.

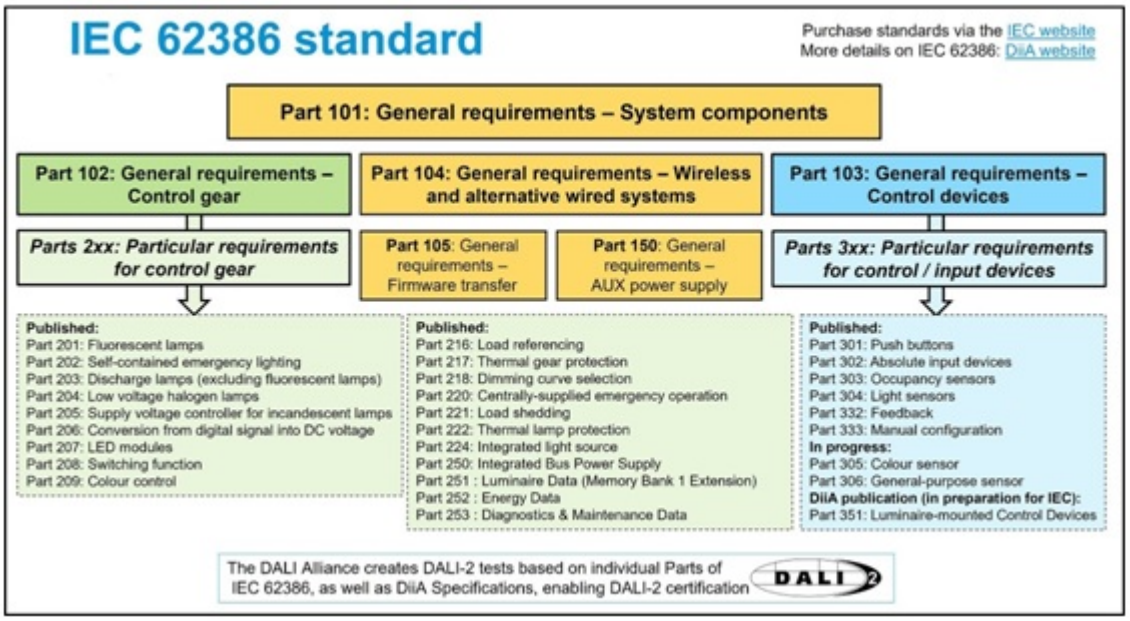

Figure 2.12: IEC 62386 Standard for DALI[15]

In DALI broadcast, all luminaires in a group will respond at the same time, but the luminaires cannot perform any feedback or DALI addressing functions. In DALI addressing, each DALI lamp in a group can be controlled individually, also it can fetch lamp status and do emergency lighting testing.

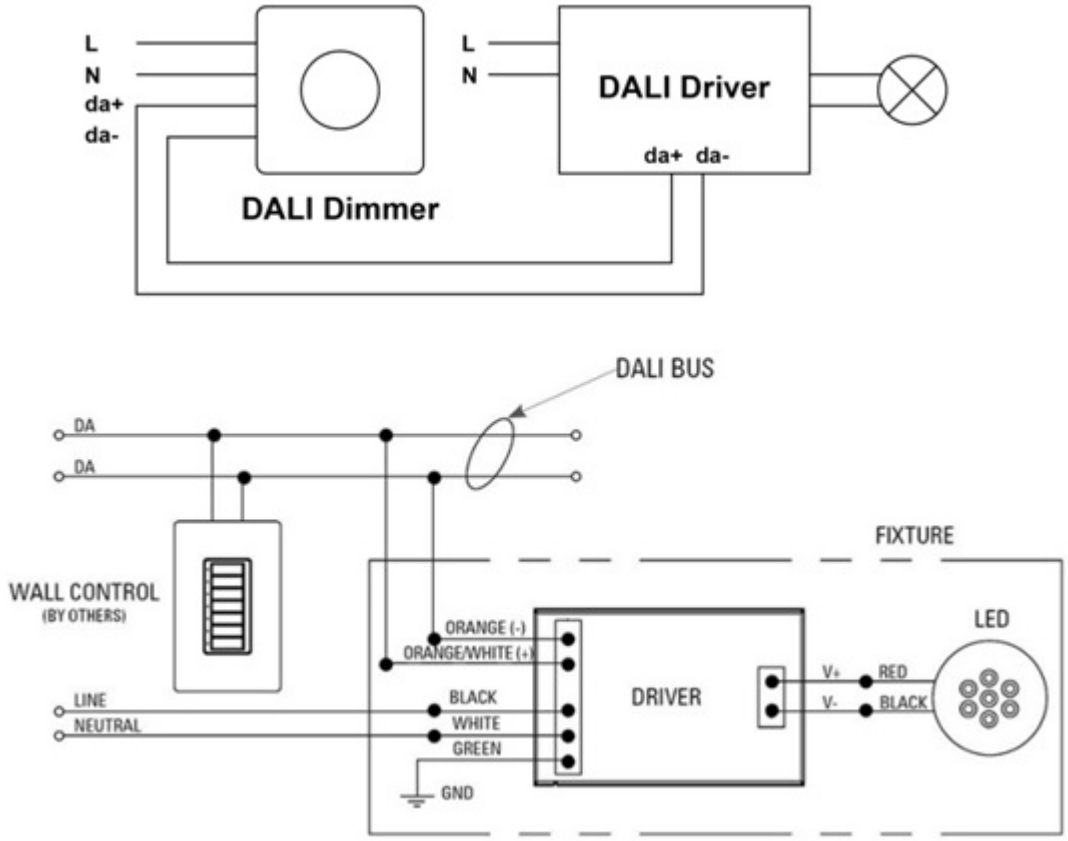

Figure 2.13: Connection Diagram of Dali Driver, Lamp and Keypad[14]

DALI system would require two extra control lines for function. The connection of DALI driver with lamp is shown in the Fig 2.13.

The first generation of DALI system is called DALI-1 and it can give independent address to 64 lights in a group. In 2017, second generation DALI-2 is introduced which supports 128 drivers with independent address in

a group. DALI-2 also have greater compatibility and co-ordination between the devices from different brands. DALI-2 also supports sensors. Both the system have to be tested and certified by Professional DALI tester probit and shown on DiiA website. Another new release in this connection is D4i to indicate the devices, which have DALI-2 as well as energy report facility, data transmission, diagnose and maintenance facility.

2.2.5 DMX512 Dimming

DMX512 (DIGITALMULTIPLEX 512 Channels) is extremely fast method of dimming, where network gateways are used to transmit digital signals to the lamp. DMX provides very fast as well as smooth dimming, so it is mainly used for stage and architectural lighting. Smoking machines, direction stepper motors etc can also be controlled through DMX512. DMX is broadcasting system i.e. it do not have any feedback system from the lamp. It supports individual addressing for the lamp, but lamp cannot be grouped into logical areas.

2.2.6 Other Protocols

There are other communication protocols like, PLC, KNX, RS485, CAN which are wired system and many wireless protocols like LoRa, ZigBee, Bluetooth, Radio frequency, Wi-fi etc. Visible light communication or Li-fi is the rising domain, where research is going on.

3 Lighting automation products and technical specifications

In this project, lights from brand Delta Light is used. The products are :

INFORM ST 828 83067 B-B: This is a linear recessed task light used on the study table. The specifications of this light are 14W, 3000K, Black-black (trim is black and reflector is black) in color.

Figure 3.1: INFORM ST 828 83067 B-B[7]

MICRO SNAP-IN OK 93015 B: This is adjustable downlight with only 1 inch diameter. The light is 5W, 3000K, with 15 degree beam angle and black in color. This light has been used mainly above the bed to highlight the wall.

Figure 3.2: MICRO SNAP-IN OK 93015 B[7]

MINI PARTOU IP 93025 B-B: This is the most basic downlight from Delta light with 9W, 3000K, beam angle 25 degree, black color. This light is used in bathroom, toilets etc.

Figure 3.3: MINI PARTOU IP 93025 B-B[7]

ENTERO RD-S 93045 B: This downlight is mainly used in bedrooms. This is 6W, 3000K, with 45 degree beam angle and black in color.

Figure 3.4: ENTERO RD-S 93045 B[7]

DOT.COM L4 ST 93046 B-B: This is linear downlight from Delta with 6W, 3000K, 46 degree beam angle and black color. This luminaire is used in den room.

Figure 3.5: DOT.COM L4 ST 93046 B-B[7]

MICROSPY 39 C 92724 B: This is a pendant type downlight with 39 mm diameter, 8W, 2700K and 24 degree beam angle. This is used over the bar counter.

Figure 3.6: MICROSPY 39 C 92724[7]

SPY 27 L CLIP 93030 B-B: This is a semi recessed light protruding from ceiling, with 27 mm diameter, 7W, 3000K and black color. This light is used to focus on the dining table, book shelf etc.

Figure 3.7: SPY 27 L CLIP 93030 B-B[7]

BAND-OH! 930 DIM8 PB-B: It is a wall light of 16W, 3000K and piano black finish. It is used in the living room.

Figure 3.8: BAND-OH! 930 DIM8 PB-B[7]

SPM20 PROFILE B: It is recessed magnetic track from Delta. Different track lights can be used with it for illumination.

Figure 3.9: SPM20 PROFILE B[7]

M20/M26H - SPY 52 93045 DIM5 B: It is track focus light which is 14W, 3000K, with 45 degree beam angle and black in color. This is used for accent lighting.

Figure 3.10: M20/M26H – SPY 52 93045 DIM5 B[7]

M-INFORM L8 93067 B-B: This is track mounted linear spot light which is 14W, 3000K, black-black. This is used for ambient lighting.

Figure 3.11: M-INFORM L8 93067 B-B[7]

M-GIBBO 930 B: This is pendant type track light which is 8W and 3000K. The glass globe used here is in Amber in color. This is mounted in the magnetic track.

Figure 3.12: M-GIBBO 930 B[7]

The lighting automation products used in this project are from Philips dynalite DALI range. The products used are listed below:

DDBC320-DALI: DDBC320-DALI is a all-in-one three universe controller, which is based on Dynet protocol and able to control 192 devices in total. It supports both DALI 207 (DALI DT6) and DALI 209 (DALI DT8). It constantly checks for any change in DALI driver, updated the status of all driver and if there is change of one driver we can just program that driver without affecting other lights. It eliminates the standby power i.e. isolates the power circuit if all the lights are at 0% dimming level.

Figure 3.13: DDBC320-DALI[8]

DDRC1220FR-GL: The Philips Dynalite DDRC1220FR-GL is a 12-channel controller to control the switched loads. This can be used for fan loads as well as difficult lighting loads i.e. Halogen lamp. This is basically a on-off relay controller which is used for Fan control in this case. Each channel have capacity up to 20A with a total maximum load of 180A. For first floor it is used.

Figure 3.14: DDRC1220FR-GL[8]

DDRC420 FR: This module exactly works like DDRC1220FR-GL i.e. is used to control any type of switched loads including inductive loads, difficult lighting loads. The difference is, DDRC420 FR has 4 channels. It has been used for fan control in the second floor.

Figure 3.15: DDRC420FR[8]

DDRC810DT-GL: This module is ideal for controlling bidirectional motors like curtain motors and blind motors. It is an eight channel device to control max 10A per channel, with a consolidated max load of 40A. Separate channels are needed for up and down motion of curtain.

Figure 3.16: DDRC810DT-GL[8]

Antumbra Button Keypad: This is the button keypad to build the interface between the automation system and user. This use field effect technology and with the click of a button the lights in sites can be controlled or desired scene can be activated. PA6BPE or 6 button keypad is used here. Multiple finish options are available for this product.

Figure 3.17: Philips Antumbra 6-Button Keypad PA6BPE[8]

Display Keypad: Philips Antumbra display keypad or PADPE is used here. This also uses field effect technology and has a central display to provide multiple pages of functions and system information. Multiple finish options are available for this product.

Figure 3.18: Philips Antumbra Display Keypad PADPE[8]

DACMv3: This is used as keypad backend to button or display keypad. This is the Antumbra Dynet module to be compatible with Dynalite.

Figure 3.19: Philips Antumbra DyNet Module DACMv3[8]

PDEG ETHERNET GATEWAY: PDEG provides a multipurpose Ethernet gateway to the dynalite lighting control system, so that the control system can be accessed through Philips mobile app or different web services. It acts as bridge between Ethernet backbone and the DyNet fieldus devices.

Figure 3.20: Philips PDEG Ethernet Gateway[8]

4 Csse Study

4.1 Test Residence

The test residence consists of two floors. We will name the room only where the lighting and automation is in our scope.

Figure 4.1: Test Residence 1st Floor

After entering the 1st floor of the building, there is Foyer, which leads to the Bar area. In the left of Foyer, there is Kitchen and Utility area. There is a powder toilet attached to the passage connected the foyer and bar area. In Bar area, there are the door to Guest room and Dining room. Guest room has dresser and bathroom inside it. Dining room has a big round dining table and it opens door to the Den area. Den area is informal living area for members of house. The door of the Living area is opposite to powder toilet. It is basically a rectangular hall with cozy sitting arrangements.

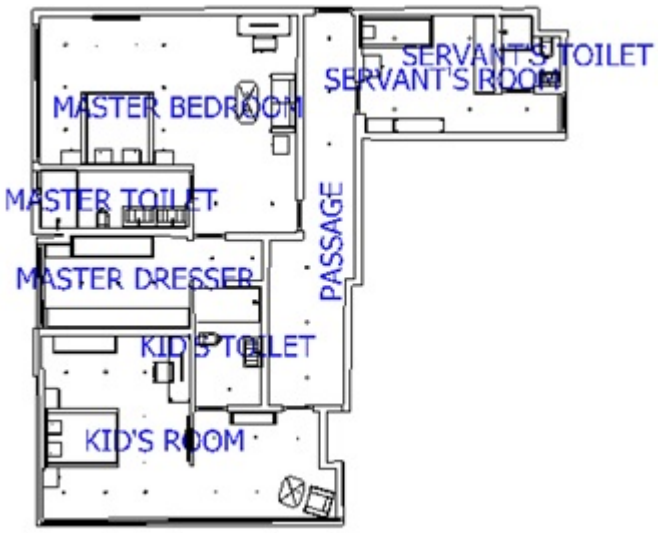

Figure 4.2: Test Residence 2nd Floor

After entering the 2nd floor from Staircase and lift area, there is a big long passage leading to Kid's Room. On the left of the passage there are servant's room and servant's toilet. On the right side of the passage there is Master Bedroom. Inside it, there are Master Dresser and Master Bathroom. Inside, the Kid's Room at the end of the passage, there is study area and Kid's toilet.

4.2 Simulation of lighting in DIALux

The lighting design of different areas is listed below:

4.2.1 1st Floor Foyer and Bar area

Here downlights Entero Rd-S is used with 6W, 3000K. On the bar counter, three pendant light Microspy 39 C is used for getting light on the counter as well as beautifying it. Working plane is taken at 0.700 meter and average illumination achieved is 248 lux, which is between the value mentioned in IS 3646 i.e. 150-200-300 lux for Foyer area and 50-200 lux in Bar Area.

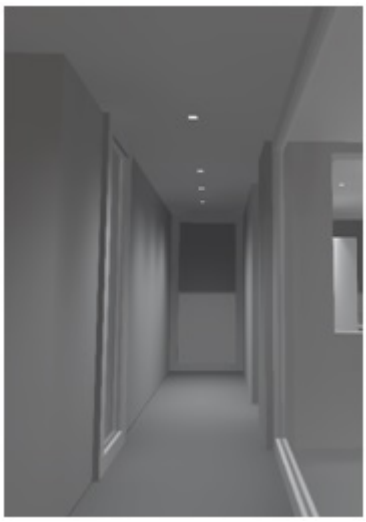

Figure 4.3: Foyer area

Figure 4.4: Bar area

4.2.2 Guest Bedroom

Here, Entero Rd-S (6W, 3000K) downlight is used and above bed and near TV Microspy IN OK, which downlight is with very small diameter and ad-

justable, is used. The average illumination achieved here is 171 lux, which is slightly higher than the range 30-50-100 recommended by IS-3646.

Figure 4.5: Guest Bedroom

4.2.3 Guest Dresser

Here, two Entero Rd-S is used as downlight. The average illumination achieved here is 179 lux which is between the standard 100-150-200 lux according to IS-3646.

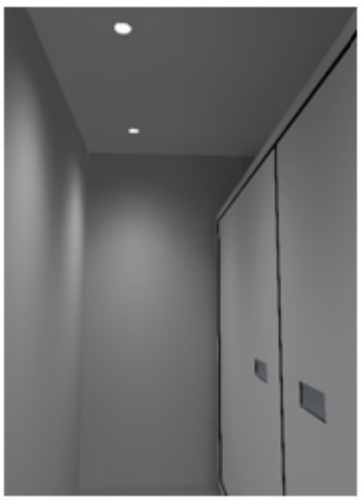

Figure 4.6: Guest Dresser

4.2.4 Guest Toilet

Here, two downlights Mini Partou IP, 7W, 3000K, is used is in the guest toilet. Average illumination achieved here is 129 lux which is between 50-100-150 lux according to IS-3646.

Figure 4.7: Guest Toilet

4.2.5 Powder Toilet

Here, one downlight Mini Partou IP with 7W, 3000K is used and achieved illumination is 161 lux, which is slightly higher than 50-100-150 lux according to IS-3646.

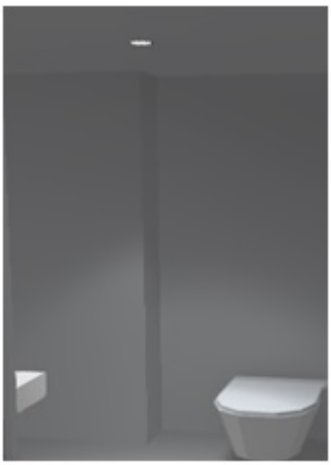

Figure 4.8: Powder Toilet

4.2.6 Dining Room

Here, two focus light SPY 27 Clip is used which is tilted to focus on the dining table. Rest downlights Entero Rd-S are used for ambient lighting. Achieved illumination is 201 lx which is between 150-200-300 lux.

Figure 4.9: Dining Room

4.2.7 Den Room

Here, linear downlight DOT.COM L4 ST with 6W 3000K is used in the den room. Achieved average illumination is 151 lx, which is between 50-200 lux as per IS-3646.

Figure 4.10: Den Room

4.2.8 Living Area

Here, magnetic track SPM20 from delta light is used. In the track adjustable focus light SPY 52 is used to focus on the table, linear light inform is used for ambient lighting and pendant light GIBBO is used over the side table for beautifying as well as ambient lighting. Wall light Band-Oh! is also used here for enhancing the drama of the interior. Achieved illumination here is 234 lux, which is slightly higher than the recommended illumination 50-200 lux by IS-3646.

Figure 4.11: Living Area

4.2.9 Kitchen

Here, Mini Partou IP with 7W 3000K is used as downlight. Working plane is at 0.700 meter. The average illumination level achieved here is 323 lux, which is between the illumination level 300-500-700 lux recommended by IS-3646.

Figure 4.12: Kitchen

4.2.10 2nd Floor Passage

Here, downlight Entero RD-S is used to achieve illumination of 153 lux, which is slightly higher than 50-100-150 lux recommended by IS-3646.

Figure 4.13: 2nd Floor Passage

4.2.11 Master Bedroom

Here, Entero Rd-S, 6W, 3000K is used for basic ambient lighting. Above bed two adjustable small diameter light Microspy IN OK, 5W, 3000K is used for highlighting the wall behind. Near TV set also, two Microspy IN OK have been used to maintain the symmetry. On, the study table, a recessed linear task light Inform ST has been used. The achieved illumination here is 175 lux, which is slightly higher than the illumination 30-50-100 recommended by IS-3646.

Figure 4.14: Master Bedroom

Figure 4.15: Master Bedroom(Another Angle)

4.2.12 Master Dresser

Here, downlight Entero RD-S, 6W, 3000K is used for general illumination to achieve average illumination of 150 lux, which is within the range 100-150-200 lux recommended by IS-3646.

Figure 4.16: Master Dresser

4.2.13 Master Toilet

Here, Mini Partou IP with 7W, 3000K is used and achieved average illumination is 123 lux, which is between 50-100-150 lux according to IS-3646.

Figure 4.17: Master Toilet

4.2.14 Kid's Room

Here, Entero RD-S, 6W, 3000K is used for general illumination. Adjustable small diameter light MICROSPY IN OK is used above bed to highlight the wall behind. The same luminaire is used near the TV to maintain symmetry. A linear task light Inform ST is used over the study table. SPY 27 clips are used to focus on the book shelf and another reading table. The average illumination achieved here is 190 lux, which is slightly higher than the range of illumination 30-50-100 lux recommended by IS-3646.

Figure 4.18: Kid's Room

Figure 4.19: Kid's Room(Another Angle)

4.2.15 Kid's Toilet

Here, Mini Partou IP with 7W, 3000K is used and achieved average illumination is 197 lux, which is slightly higher than 50-100-150 lux according to IS-3646.

Figure 4.20: Kid's Toilet

4.2.16 Servant's Room

Here, Mini Partou IP with 7W, 3000K is used and achieved average illumination is 136 lux, which is slightly higher than 30-50-100 lux according to IS-3646.

4.2.17 Servant's Toilet

Here, Mini Partou IP with 7W, 3000K is used and achieved average illumination is 145 lux, which is between the range 50-100-150 lux recommended by IS-3646.

Figure 4.21: Servant's Room

Figure 4.22: Servant's Toilet

4.3 Lighting Automation Features

The fun behind the automation is felt only when, the entire lighting of room suits the relevant mood of the owner with one push of a button. For this reason, control groups have been created in DALI Dynalite in which the

lights, which will switch on and off simultaneously will be added as per the lighting scenes requirement. Then all control groups will be added in different scenes and set to proper dimming level as per requirement. Several scenes are created in this project. They are :

4.3.1 Party Scene

In the party scene, the whole house should look bright and impressive. The dining area, living area, Foyer, Passage, powder room and kitchen lights are at 100% dimming level. The bar counter lights are at 100% dimming level, but other downlights in the bar area are at 50% dimming level to maintain the atmosphere. All the lights of the bathroom are at 100% dimming level. The lights of the bedrooms and dressing rooms are at 50% dimming level to have a cozy atmosphere. The task lights above the tables are at 0% dimming level.

4.3.2 Welcome Scene

In the welcome scene, the essential areas, that owner would use after arriving home should look bright. Lights in Living area, Kitchen, Foyer area, Passage, Master Bedroom, Master dresser and master bathroom are at 100% dimming level. All other lights are at 0% dimming level.

4.3.3 Goodnight Scene

In the goodnight scene, the lights of all areas except attached toilets are closed. All blinds and curtains are closed as well. Lights of the attached toilets are at 20% dimming level, in case if anyone gets up at night.

4.3.4 Emergency Scene

In this scene, all the lights in the building is at 100% level and all blinds and curtains are open. In case of an emergency this is used.

4.3.5 Movie Scene

In the movie scene, the curtains and blinds of the relevant room are closed, the lights near the TV and in front of sofa are at 0% dimming level. The light on a certain distance at the back of sofa are at 50% dimming level.

Besides above scenes, scenes for all lights at 100%, all lights at 0%, all lights are at 50%, all blinds and curtains are closed have been made.

5 Conclusion and Future Scopes

In this project, the lighting of a test residence consisting of two floors is designed with Delta Light products and simulated in DIALux to achieve average illumination level according to IS-3646. For Bedrooms, the lux level is kept higher than the recommended value, because, in this project, the bedroom is not only meant for sleeping, studying and some other task will also be done within the room. So, considering that, the illumination is designed at a higher level. The uniformity is all over less than 0.4, because, it was the intent of the architect to design the residence in that way, to create drama by playing with light and shadow.

However, to increase the illumination level, the current rating of the downlight driver I can be increased to increase the wattage of the downlight.

The DALI based lighting automation is also done with Philips Dynalite, the modules previously mentioned are used and programmed with Dynalite System Builder. Different lighting scenes are created to give the actual feel of automation to the client.

In addition to the above systems, there are more things that can be added to this residence. Coolmaster can be added to control the HVAC system. With Control4 AV integration module, we can control audio video also. Daylight sensor can be added and the programming can be done accordingly to dim the luminaires near window for energy savings. Tunable lights can also be used and programmed with Dynalite to achieve human centric lighting by mimicking daylight. Also, sprinkler system for unseen fire hazards, occupancy sensors in bathroom, CCTV, door lock system can be added. So, as a future scope, all the above stated systems can be used to have a whole Building Management System (BMS) to create a true “Smart Home”.

6 References

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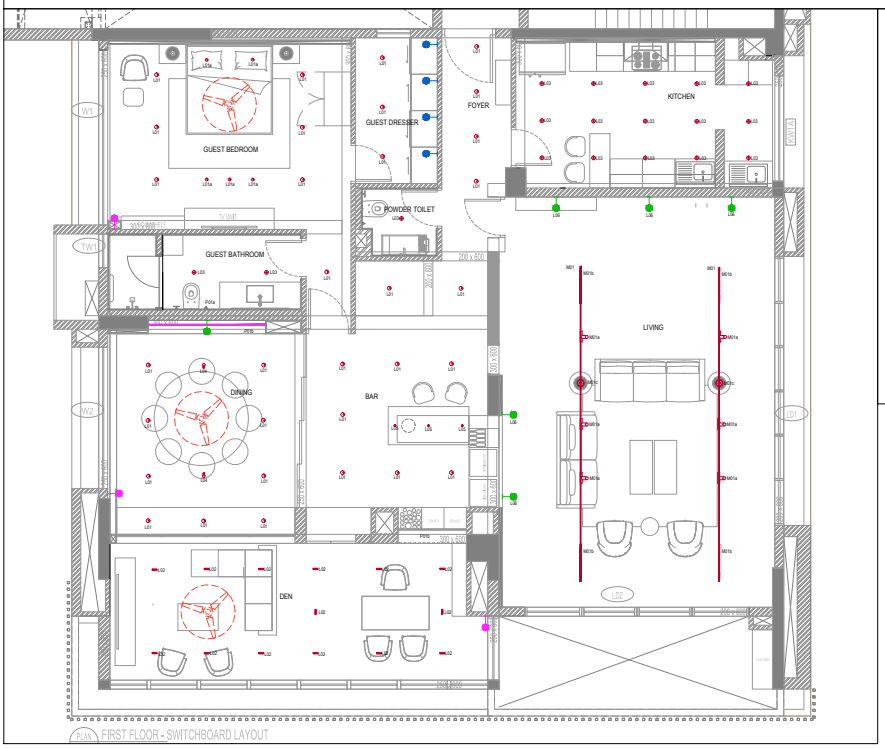
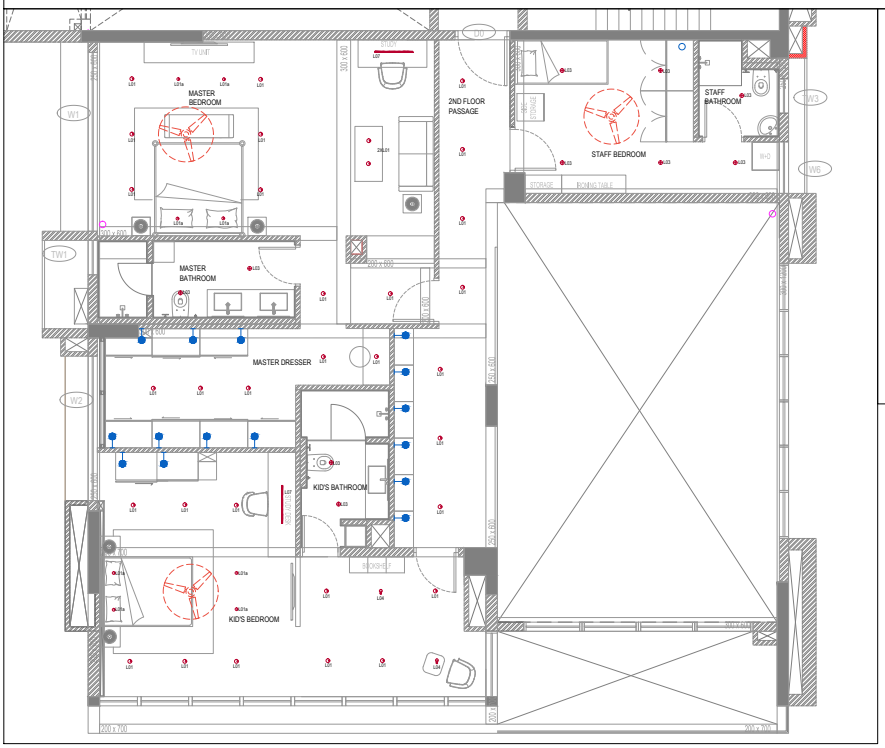
A Annexure 1
Light Placement Diagram in AUTOCAD
For 1st Floor of Test Residence



DWG CODE	NAME	MOUNTING	QTY	UNIT
L01	ENTERO RD-S 93045 B	RECESSED	64	NOS
L01a	MICRO SNAP-IN OK 93015 B	RECESSED	13	NOS
L02	DOT.COM L4 ST 93046 B-B	RECESSED	14	NOS
L03	MINI PARTOU IP 93025 B-B	RECESSED	28	NOS
L04	SPY 27 L CLIP 93030 B-B	RECESSED	04	NOS
L05	MICROSPY 39 C 93045 B	RECESSED	03	NOS
L06	BAND-OH! 930 DIM8 PB-B	RECESSED	05	NOS
L07	INFORM ST 828 83067 B-B	RECESSED	02	NOS
M01	SPM20 - PROFILE	RECESSED	14	MTR
M01a	M20/M26H - SPY 52 93045 DIM5 B	TRACK MOUNTED	06	NOS
M01b	M - INFORM L8 93067 DIM5 B	TRACK MOUNTED	04	NOS
M01c	M - GIBBO 930 DIM5 B	TRACK MOUNTED	02	NOS
PROJECT : TEST RESIDENCE		DESIGNED BY : ISHITA BHATTACHARYA		

A Annexure 2
Light Placement Diagram in AUTOCAD For 2nd Floor of Test Residence



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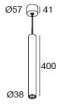
L01a	MICRO SNAP-IN OK 93015 B	RECESSED	13	NOS
L02	DOT.COM L4 ST 93046 B-B	RECESSED	14	NOS
L03	MINI PARTOU IP 93025 B-B	RECESSED	28	NOS
L04	SPY 27 L CLIP 93030 B-B	RECESSED	04	NOS
L05	MICROSPY 39 C 93045 B	RECESSED	03	NOS
L06	BAND-OH! 930 DIM8 PB-B	RECESSED	05	NOS
L07	INFORM ST 828 83067 B-B	RECESSED	02	NOS
M01	SPM20 - PROFILE	RECESSED	14	MTR
M01a	M20/M26H - SPY 52 93045 DIM5 B	TRACK MOUNTED	06	NOS
M01b	M - INFORM L8 93067 DIM5 B	TRACK MOUNTED	04	NOS
M01c	M - GIBBO 930 DIM5 B	TRACK MOUNTED	02	NOS
PROJECT : TEST RESIDENCE		DESIGNED BY : ISHITA BHATTACHARYA		

A Annexure 3
BOM of Luminaries

BOM OF LUMINAIRES

Sl No.	DWG CODE	Product	Ref. Images	Product Code	Color Finish	Make	Dim/ Non-Dim	Wattage / CCT	Qty.	Unit	Dimension
FIRST FLOOR											
GUEST BEDROOM											
1	L01	ENTERO RD-S 93045 B		28402 9330 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	6W 3000K	7	NOS	
2	L01a	MICRO SNAP-IN OK 93015 B		24112 9310 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	5W 3000K	5	NOS	
2A		MOUNTING KIT TRIMLESS MICROSPY IN OK		15212 2020		DELTA LIGHT (BELGIUM			5	NOS	
GUEST DRESSER											
3	L01	ENTERO RD-S 93045 B		28402 9330 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	6W 3000K	3	NOS	
GUEST BATHROOM											
4	L03	MINI PARTOU IP 93025 B-B		25211 9320 B-B	BLACK-BLACK	DELTA LIGHT (BELGIUM)	NON-DIM	9W 3000K	2	NOS	Ø85 x 75(H)
FOYER											
5	L01	ENTERO RD-S 93045 B		28402 9330 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	6W 3000K	4	NOS	
BAR											
6	L01	ENTERO RD-S 93045 B		28402 9330 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	6W 3000K	9	NOS	
7	L05	MICROSPY 39 C 92745 B		279 773 811 927 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	8W 2700K	3	NOS	
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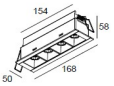
9	L04	SPY 27 L CLIP 93030 B-B		24133 9320 B-B	BLACK	DELTA LIGHT (BELGIUM)	DALI	7W 3000K	2	NOS	
DEN AREA											

10	L02	DOT.COM L4 ST 93046 B-B		LFSL1050	BLACK	DELTA LIGHT (BELGIUM)	DALI	6W 3000K	14	NOS	
KITCHEN											
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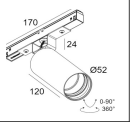
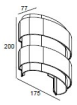
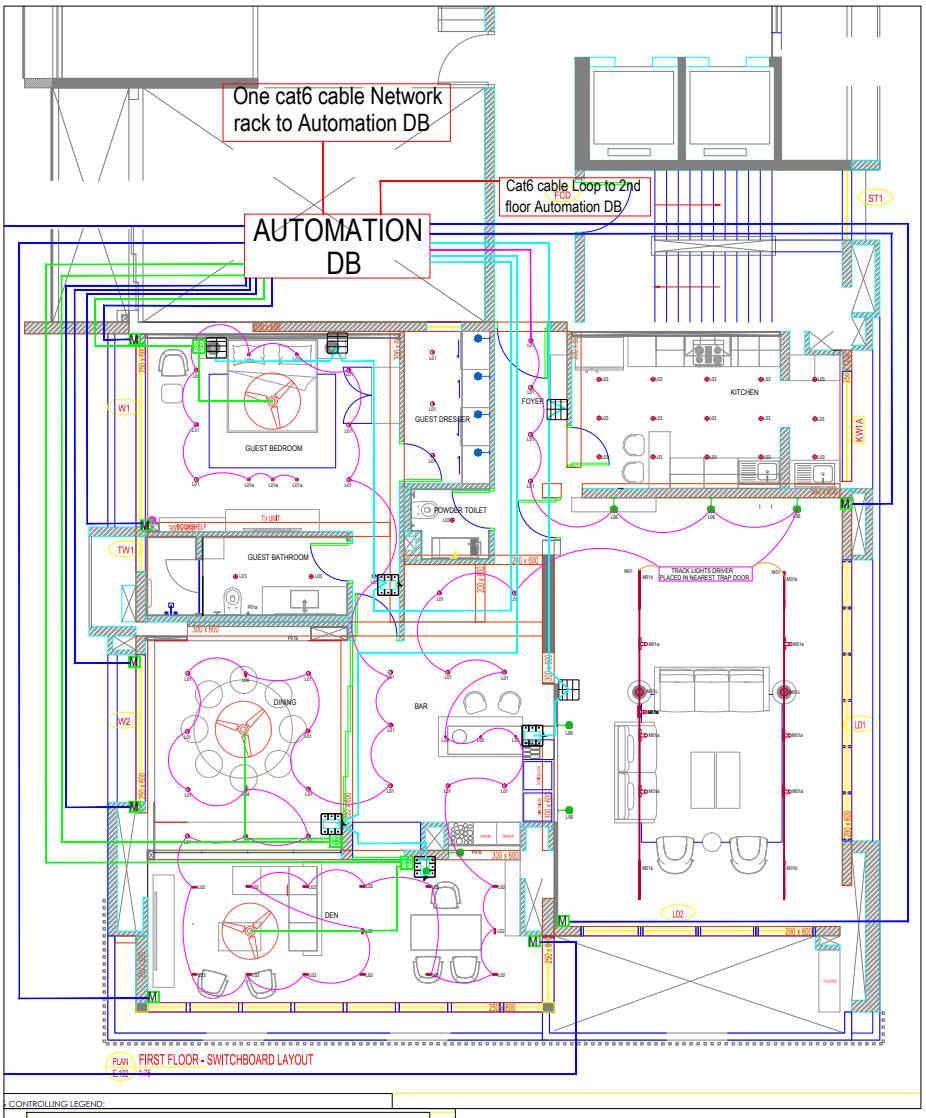
POWDER TOILET											
12	L03	MINI PARTOU IP 93025 B-B		25211 9320 B-B	BLACK-BLACK	DELTA LIGHT (BELGIUM)	NON-DIM	9W 3000K	1	NOS	Ø85 x 75(H)
LIVING AREA											
13	M01	SPM20 - PROFILE 2m (7000 MM X2)		420 20 20 00 B	BLACK	DELTA LIGHT (BELGIUM)	DALI		6	NOS	
13	M01	SPM20 - PROFILE 1m (7000 MM X2)		420 20 10 00 B	BLACK	DELTA LIGHT (BELGIUM)	DALI		2	NOS	
13A		SPM20 - FIXATION SET		420 20 14 01		DELTA LIGHT (BELGIUM)			28	NOS	
13A		SPM - SUPPLY 48V		420 99 03		DELTA LIGHT (BELGIUM)			4	NOS	
13A		SPM20 - END CAP		420 20 03 01 B	BLACK	DELTA LIGHT (BELGIUM)			4	NOS	
13A		SPM - CORNER 180°		420 06 01		DELTA LIGHT (BELGIUM)			6	NOS	
13A		SPM - CONNECTOR 48V-180°		420 99 01		DELTA LIGHT (BELGIUM)			6	NOS	
14	M01a	M20/M26H - SPY 52 93045 DIM5 B		23324 9335 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	14W 3000K	6	NOS	
14A		SPY 52 TUBE B		19810 0100 B	BLACK	DELTA LIGHT (BELGIUM)			6	NOS	
15	M01b	M - INFORM L8 93067 DIM5 B		23382 9325 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	12W 3000K	4	NOS	
16	M01c	M - GIBBO 930 DIM5 B		23354 9305 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	8W 3000K	2	NOS	

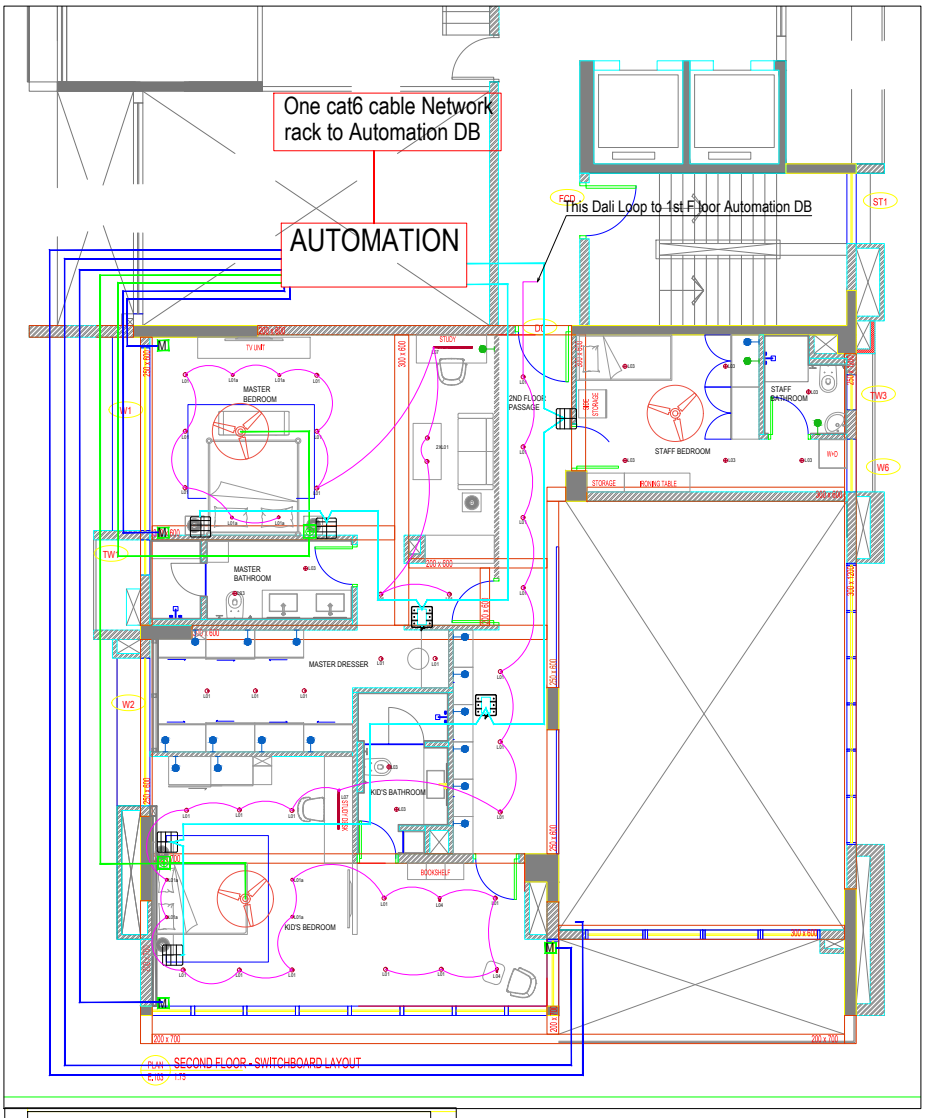
17		DRIVER FOR MAGNETIC TRACK						100W 48V DC	2	NOS	
18	L06	BAND-OH! 930 DIM8 PB-B		30311 9308 PB-B	PIANO BLACK-BLACK	DELTA LIGHT (BELGIUM)	DALI	16W 3000K	5	NOS	
SECOND FLOOR											
MASTER BEDROOM											
19	L01	ENTERO RD-S 93045 B		28402 9330 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	6W 3000K	10	NOS	
20	L01a	MICRO SNAP-IN OK 93015 B		24112 9310 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	5W 3000K	4	NOS	
20A		MOUNTING KIT TRIMLESS MICROSPY IN OK		15212 2020		DELTA LIGHT (BELGIUM			4	NOS	
21	L07	INFORM ST 828 83067 B-B		25501 8320 B-B	BLACK-BLACK	MEC	DALI DIM	17W 3000K	1	Nos	
MASTER BATHROOM											
22	L03	MINI PARTOU IP 93025 B-B		25211 9320 B-B	BLACK-BLACK	DELTA LIGHT (BELGIUM)	NON-DIM	9W 3000K	2	NOS	Ø85 x 75(H)
MASTER DRESSER											
23	L01	ENTERO RD-S 93045 B		28402 9330 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	6W 3000K	5	NOS	
KID'S BEDROOM											
24	L01	ENTERO RD-S 93045 B		28402 9330 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	6W 3000K	10	NOS	
25	L01a	MICRO SNAP-IN OK 93015 B		24112 9310 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	5W 3000K	4	NOS	
25A		MOUNTING KIT TRIMLESS MICROSPY IN OK		15212 2020		DELTA LIGHT (BELGIUM			4	NOS	
26	L07	INFORM ST 828 83067 B-B		25501 8320 B-B	BLACK-BLACK	MEC	DALI DIM	17W 3000K	1	Nos	
27	L04	SPY 27 L CLIP 93030 B-B		24133 9320 B-B	BLACK	DELTA LIGHT (BELGIUM)	DALI	7W 3000K	2	NOS	

KID'S BATHROOM											
28	L03	MINI PARTOU IP 93025 B-B		25211 9320 B-B	BLACK-BLACK	DELTA LIGHT (BELGIUM)	NON-DIM	9W 3000K	2	NOS	Ø85 x 75(H)
2ND FLOOR PASSAGE											
29	L01	ENTERO RD-S 93045 B		28402 9330 B	BLACK	DELTA LIGHT (BELGIUM)	DALI	6W 3000K	7	NOS	
STAFF BEDROOM											
30	L03	MINI PARTOU IP 93025 B-B		25211 9320 B-B	BLACK-BLACK	DELTA LIGHT (BELGIUM)	NON-DIM	9W 3000K	5	NOS	Ø85 x 75(H)
STAFF BATHROOM											
31	L03	MINI PARTOU IP 93025 B-B		25211 9320 B-B	BLACK-BLACK	DELTA LIGHT (BELGIUM)	NON-DIM	9W 3000K	1	NOS	Ø85 x 75(H)

A Annexure 4
Wiring and Keypad Location Diagram of 1st Floor of Test Residence


One cat6 cable Network rack to Automation DB
AUTOMATION DB
Cat6 cable Loop to 2nd floor Automation DB
GUEST BEDROOM
GUEST DRESSER
FOYER
KITCHEN
POWDER TOILET
GUEST BATHROOM
TV UNIT
DINING
BAR
DEN
TRACK LIGHTS DRIVER PLACED IN NEAREST TRAP DOOR
FIRST FLOOR - SWITCHBOARD LAYOUT
LIGHTING CONTROLLING LEGEND:
DISPLAY KEYPAD
BUTTON KEYPAD
REGULATOR
CURTAIN MOTOR
DALI (2 Core X 1.5 sqmm cable (Signal) + 2 wires 1.5 sqmm or as per load (P&N) in separate conduits)
Courtain (3 Core X 1.5sq mm cable (Signal) + 2 wires 1.5sqmm (P & N) in separate conduits)
Cat6 cable for Keypad
2 wires 1.5 sqmm or as per load (P&N) for Fan on/off
DRAWN BY : ISHITA BHATTACHARYA

A Annexure 5
Wiring and Keypad Location Diagram of 2nd Floor of Test Residence



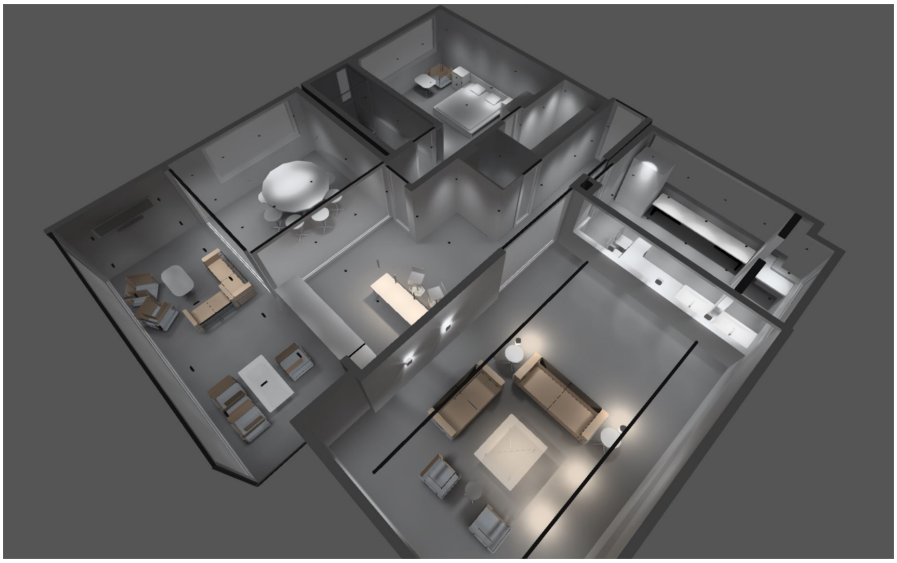
LIGHTING CONTROLLING LEGEND:			
	DISPLAY KEYPAD		
	BUTTON KEYPAD		Courtain (3 Core X 1.5sq mm cable (Signal) + 2 wires 1.5qmm (P & N)) in separate conduits)
	REGULATOR		Cat6 cable for Keypad
M	CURTAIN MOTOR		2 wires 1.5 sqmm or as per load (P&N) for Fan on/off
	DALI (2 Core X 1.5 sqmm cable (Signal) + 2 wires 1.5 sqmm or as per load (P&N) in separate conduits)		
DRAWN BY : ISHITA BHATTACHARYA			

A Annexure 6
BOM of Automation Modules

BOM OF AUTOMATION MODULES

Sl No.	Description	Make	Article No	Qty	Unit	Item Figure	Remarks
Lighting & Blind Controls							
1	3 Universe DALI 209 Ballast Controller and Multi Master gateway (+ 3 x 20Amp Relay)	Philips Dynalite (Australia)	DDBC320-DALI	1	Nos		DALI Dimmer controls up to 64 Light
2	12 x 20A Relays Controller (for FAN On-off)	Philips Dynalite (Australia)	DDRC1220 FRGL	1	Nos		On Off Control - 12 channels
3	4x 20A Relays Controller (for FAN On-off)	Philips Dynalite (Australia)	DDRC420 FR	1	Nos		On Off Control - 4 channels
4	8 x 10A Relays Controller (for Curtain Motors)	Philips Dynalite (Australia)	DDRC810DTGL	5	Nos		Curtain Control - 4 motors
Keypads & User Interface							
5	Philips Antumbra, 6 buttons, Panel, EU, White facia & White rim - No Labelling	Philips Dynalite (Australia)	PA6BPE	6	Nos		6 Button Keypad
6	Philips Antumbra, Display, Panel, EU, White facia & White rim - No Labelling	Philips Dynalite (Australia)	PADPE	9	Nos		Display Keypad
7	Antumbra Communication module Rev 3	Philips Dynalite (Australia)	DACMv3	15	Nos		Keypad Backend
8	Philips Dynalite (Australia) Ethernet Gateway DIN Rail mounted ,Dynet to Ethernet,Scheduling functionality,Dynet diagonosis functionality	Philips Dynalite (Australia)	PDEG	1	Nos		For Mobile / iPAD Control

A Annexure 7
DIALux Report for Simulation of Lighting Design for the Test Residence



TEST_PROJECT_ISHITA

Preface

Notes on planning:

The energy consumption quantities do not take into account light scenes and their dimming levels.

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Product data sheets

Site 1 - Building 1 - Storey 1

DEN AREA

Site 1 - Building 1 - Storey 1

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FOYER + BAR AREA

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GUEST DRESSER

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MASTER DRESSER

Contacts

LIGHTING DESIGNER
ISHITA BHATTACHARYA

M.TECH IN ILLUMINATION
TECHNOOGY AND DESIGN,
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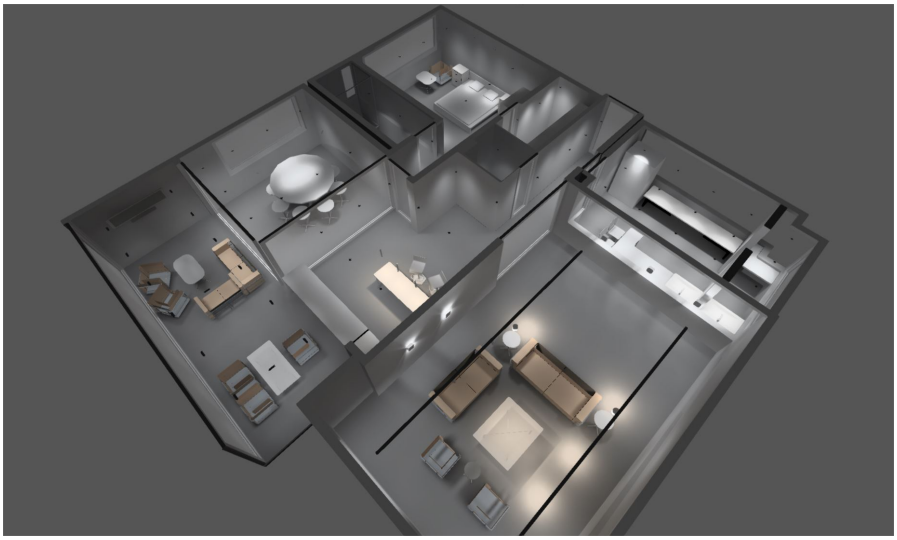
ishitabhattacharya2012@gmail
.com



Description

THE PROJECT CONSISTS OF A RESIDENCE WITH TWO FLOOR. IN GROUND FLOOR, THERE ARE ENTRANCE FOYER, GUEST BESROOM, GUEST DRESSER, GUEST TOILET, KITCHEN AND UTLITY, BAR AREA, DINING AREA, DEN AREA AND LIVING AREA.
IN FIRST FLOOR, THERE ARE MASTER BEDROOM, MASTER DRESSER, MASTER TOILET, KID'S BEDROOM, KID'S TOILET, PASSAGE, SERVANT'S BEDROOM AND SERVANT TOILET.
THE PROJECT IS DESIGNED WITH DOWNLIGHTS, WALL LIGHTS, TRACK LIGHTING AND PENDANT LIGHT AS REQUIRED.
THE LIGHTING DESIGN IS DONE ACCORDING TO THE IS-3646 (1992) STANDARD.

LIGHTING DESIGNER
ISHITA BHATTACHARYA

M.TECH IN ILLUMINATION TECHNOOGY AND DESIGN, JADAVPUR UNIVERSITY

ishitabhattacharya2012@gmail.com

Images

Images

Luminaire list

Φ_{total}	P_{total}	Luminous efficacy
81976 lm	1041.0 W	78.7 lm/W

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
4	Delta Light	23381 932x // 23382 932x	M - INFORM L8 93067	14.0 W	1569 lm	112.1 lm/W
13	Delta Light	24112 9310 B	MICRO SNAP-IN OK 93015 B	5.0 W	271 lm	54.2 lm/W
28	Delta Light	25211 9320 B-B	MINI PARTOU IP 93025 B-B	7.0 W	517 lm	73.8 lm/W
3	Delta Light	279 / 421 122 - 773 811 921	MICROSPY 39 C 92724	8.0 W	555 lm	69.4 lm/W
2	Delta Light	286 67 811 930 + 286 67 02	GIBBO 930 + BOWL GLASS AMBER	8.0 W	713 lm	89.1 lm/W
5	Delta Light	30311 9308 PB-B	BAND-OH! 930 DIM8 PB-B	16.0 W	876 lm	54.7 lm/W
14	Delta Light	424 213 04 933 black cover	DOT.COM L4 ST 93046 black cover	6.0 W	317 lm	52.8 lm/W
64	Delta Light	Entero RD-S 93045 B	Entero Round S 93045 Black	6.0 W	580 lm	96.6 lm/W
2	Delta Light	Inform ST / Inf SQ+ DOWN 828mm 83067 B	Inform ST / Inf SQ+ DOWN 828mm 83067 BLACK raster	12.0 W	1432 lm	119.3 lm/W
4	Delta Light	SPY 27 L 93030	SPY 27 L 93030	7.0 W	288 lm	41.2 lm/W

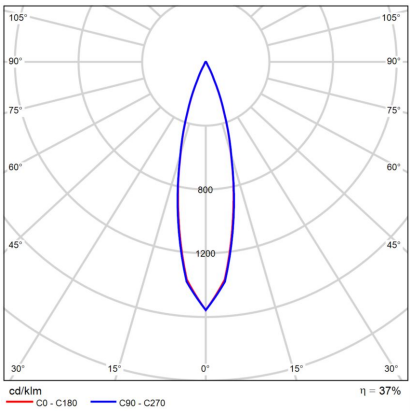
Luminaire list

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
6	Delta Light	SPY 52 / SOLI - 52 92720 + 19810 0100 B	SPY 52 / SOLI - 52 92720 + SPY 52 TUBE BLACK	14.0 W	776 lm	55.4 lm/W

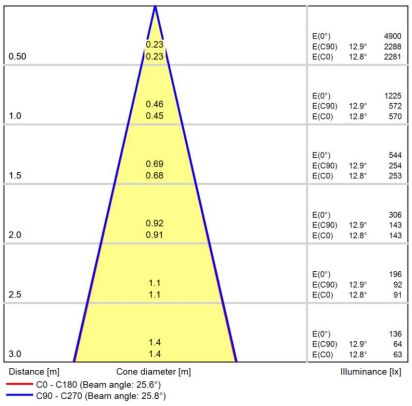
Product data sheet

Delta Light - SPY 27 L 93030

Article No.	SPY 27 L 93030
P	7.0 W
Φ_{Lamp}	787 lm
$\Phi_{Luminaire}$	288 lm
η	36.61 %
Luminous efficacy	41.2 lm/W
CCT	3000 K
CRI	90



Polar LDC



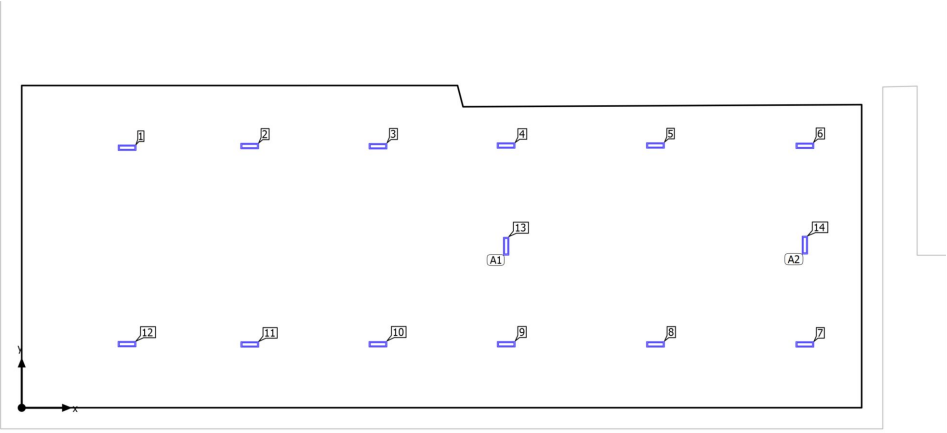
Cone diagram

Building 1 · Storey 1 · DEN AREA

Description

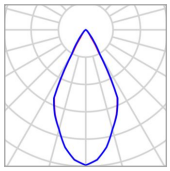
Building 1 · Storey 1 · DEN AREA

Luminaire layout plan



Building 1 · Storey 1 · DEN AREA

Luminaire layout plan



Manufacturer	Delta Light	P	6.0 W
Article No.	424 213 04 933 black cover	$\Phi_{Luminaire}$	317 lm
Article name	DOT.COM L4 ST 93046 black cover		
Fitting	4x LED array @ 500mA		

1 x Delta Light DOT.COM L4 ST 93046 black cover

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	4.585 m / 1.529 m / 2.493 m	4.585 m	1.529 m	2.493 m	13
X-direction	1 pcs., Centre - centre, 1.856 m				
Arrangement	A1				

1 x Delta Light DOT.COM L4 ST 93046 black cover

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	7.412 m / 1.540 m / 2.493 m	7.412 m	1.540 m	2.493 m	14
X-direction	1 pcs., Centre - centre, 1.830 m				
Arrangement	A2				

Individual luminaires

Building 1 · Storey 1 · DEN AREA

Luminaire layout plan

X	Y	Mounting height	Luminaire
0.998 m	2.461 m	2.493 m	1
2.157 m	2.477 m	2.493 m	2
3.372 m	2.475 m	2.493 m	3
4.585 m	2.482 m	2.493 m	4
5.998 m	2.483 m	2.493 m	5
7.413 m	2.480 m	2.493 m	6
7.412 m	0.600 m	2.493 m	7
5.999 m	0.600 m	2.493 m	8
4.586 m	0.601 m	2.493 m	9
3.372 m	0.601 m	2.493 m	10
2.159 m	0.600 m	2.493 m	11
0.997 m	0.603 m	2.493 m	12

Building 1 · Storey 1 · DEN AREA

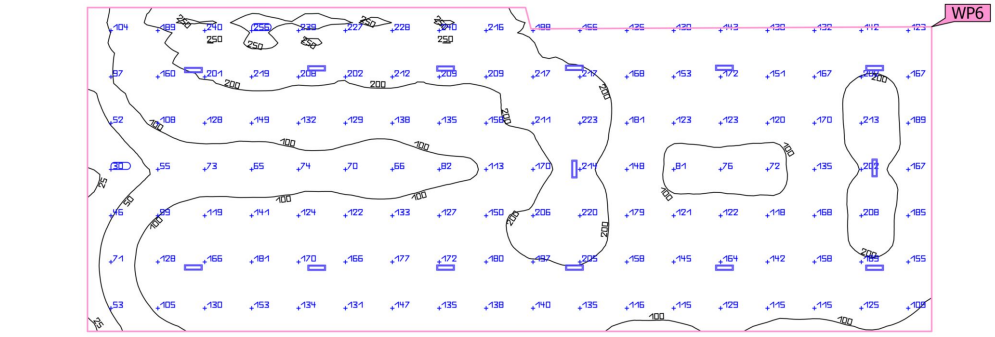
Luminaire list

Φ_{total}	P_{total}	Luminous efficacy
4438 lm	84.0 W	52.8 lm/W

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
14	Delta Light	424 213 04 933 black cover	DOT.COM L4 ST 93046 black cover	6.0 W	317 lm	52.8 lm/W

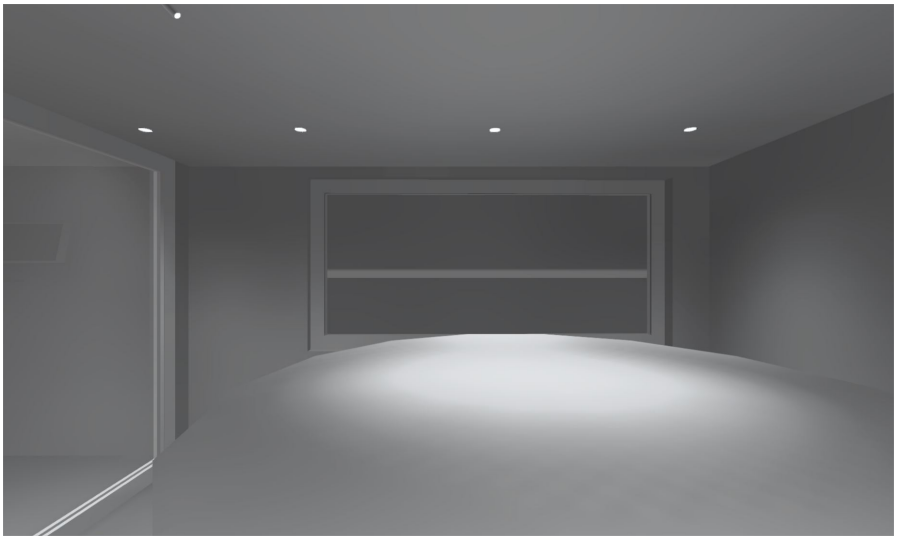
Building 1 · Storey 1 · DEN AREA (Light scene 1)

Working plane (DEN AREA)



Properties	Ē (Target)	E_{min}	E_{max}	g_1 (Target)	g_2	Index
Working plane (DEN AREA) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	151 lx (≥ 50.0 lx) ✓	22.9 lx	257 lx	0.15 (≥ 0.40) ✗	0.089	WP6

Utilisation profile: General areas inside buildings - Rest, sanitation and first aid rooms (10.2 Rest rooms)

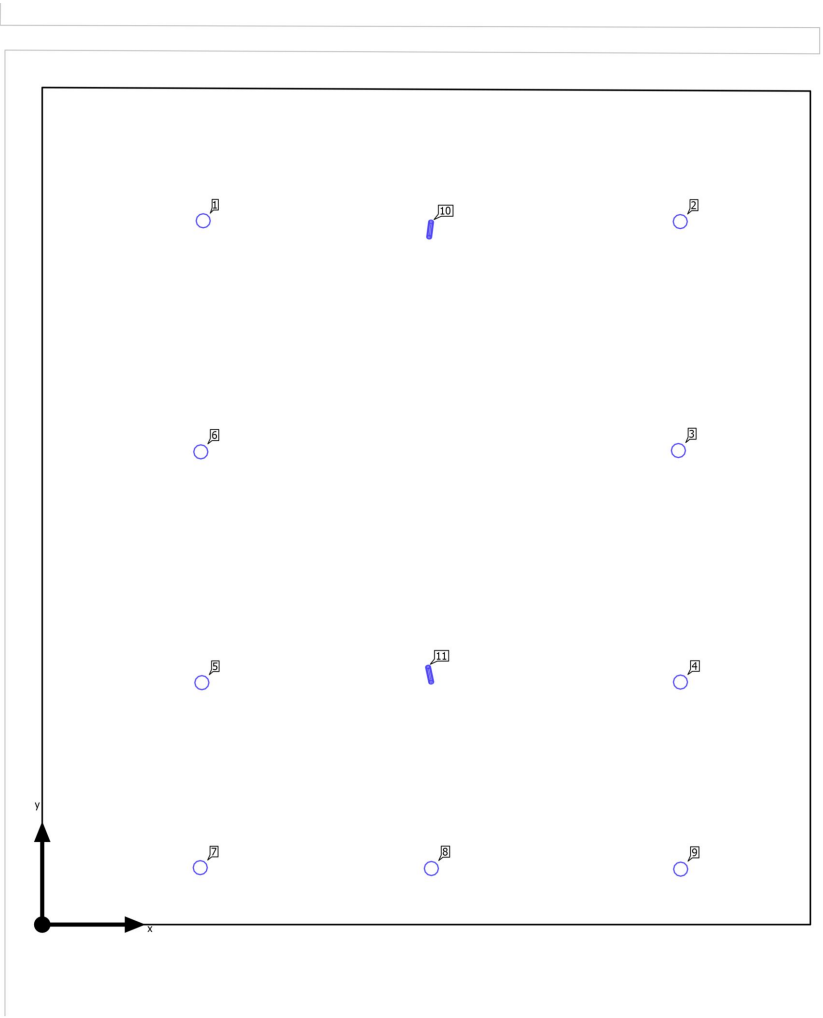


Building 1 · Storey 1 · DINING

Description

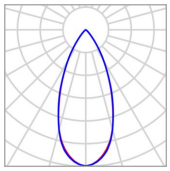
Building 1 · Storey 1 · DINING

Luminaire layout plan



Building 1 · Storey 1 · DINING

Luminaire layout plan



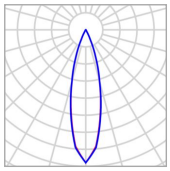
Manufacturer	Delta Light	P	6.0 W
Article No.	Entero RD-S 93045 B	$\Phi_{Luminaire}$	580 lm
Article name	Entero Round S 93045 Black		
Fitting	1x led array @ 350mA		

Individual luminaires

X	Y	Mounting height	Luminaire
0.864 m	3.778 m	2.493 m	1
3.426 m	3.774 m	2.493 m	2
3.416 m	2.545 m	2.493 m	3
3.427 m	1.302 m	2.493 m	4
0.857 m	1.299 m	2.493 m	5
0.852 m	2.538 m	2.493 m	6
0.849 m	0.306 m	2.493 m	7
2.090 m	0.301 m	2.493 m	8
3.428 m	0.298 m	2.493 m	9

Building 1 · Storey 1 · DINING

Luminaire layout plan



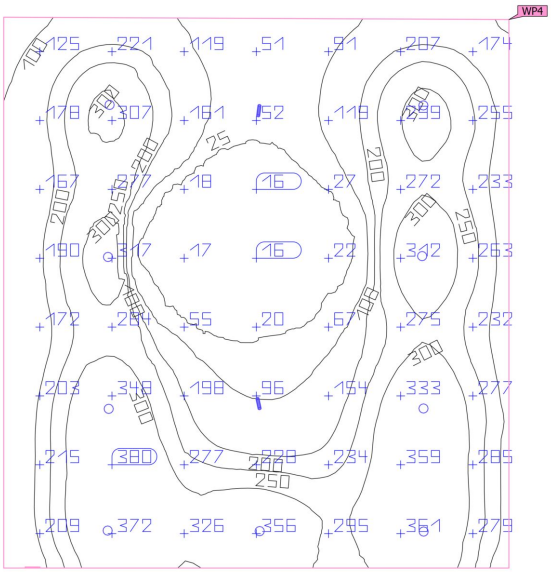
Manufacturer	Delta Light	P	7.0 W
Article No.	SPY 27 L 93030	$\Phi_{Luminaire}$	288 lm
Article name	SPY 27 L 93030		
Fitting	1x LED array @350mA		

Individual luminaires

X	Y	Mounting height	Luminaire
2.088 m	3.772 m	2.493 m	10
2.089 m	1.301 m	2.493 m	11

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

Working plane (DINING)



Properties	Ē (Target)	E_{min}	E_{max}	g_1 (Target)	g_2	Index
Working plane (DINING) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	201 lx (≥ 150 lx) ✓	15.0 lx	389 lx	0.075 (≥ 0.40) ✗	0.039	WP4

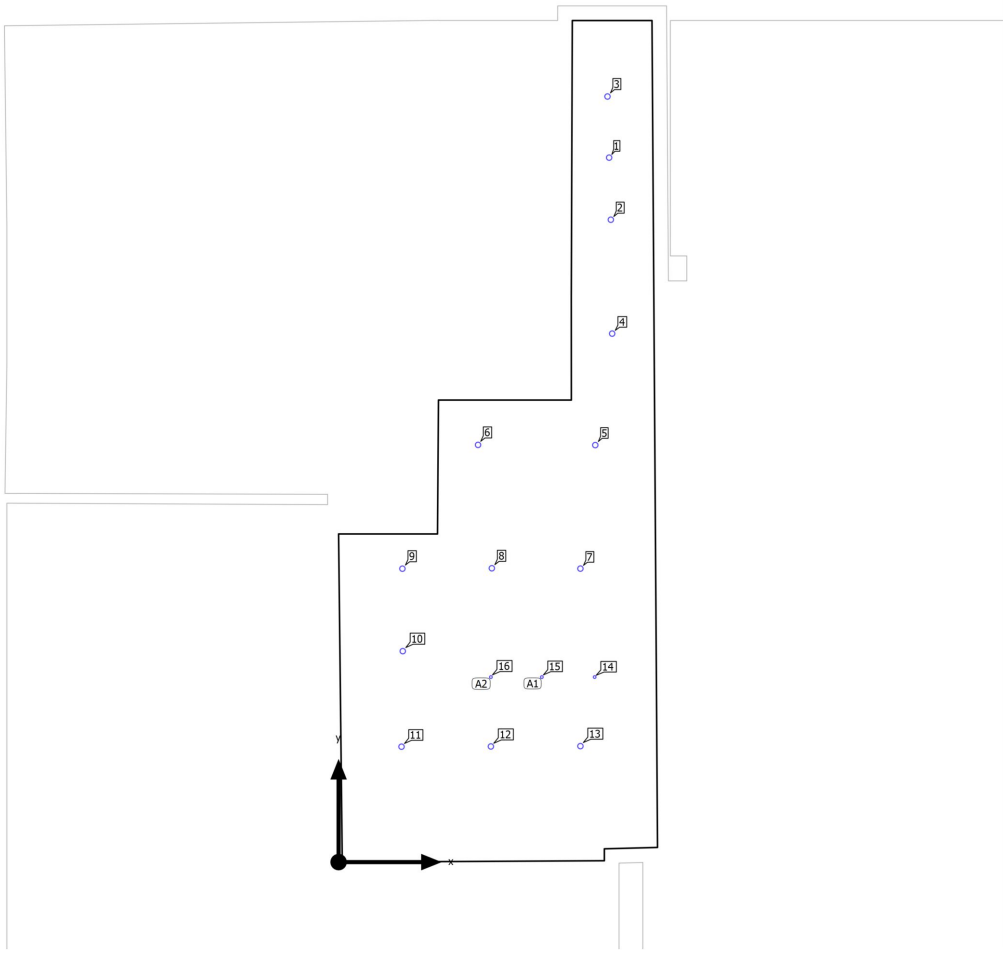
Utilisation profile: General areas inside buildings - Rest, sanitation and first aid rooms (10.1 Canteens, pantries)

Building 1 · Storey 1 · FOYER + BAR AREA

Description

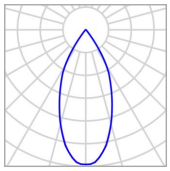
Building 1 · Storey 1 · FOYER + BAR AREA

Luminaire layout plan



Building 1 · Storey 1 · FOYER + BAR AREA

Luminaire layout plan



Manufacturer	Delta Light	P	8.0 W
Article No.	279 / 421 122 - 773 811 921	$\Phi_{Luminaire}$	555 lm
Article name	MICROSPY 39 C 92724		
Fitting	1x LED array		

1 x Delta Light MICROSPY 39 C 92724

Type	Line arrangement
1st luminaire (X/Y/Z)	2.773 m / 2.523 m / 2.000 m
X-direction	1 pcs., Centre - centre, 1.440 m
Arrangement	A1

X	Y	Mounting height	Luminaire
2.773 m	2.523 m	2.000 m	15

1 x Delta Light MICROSPY 39 C 92724

Type	Line arrangement
1st luminaire (X/Y/Z)	2.078 m / 2.523 m / 2.000 m
X-direction	1 pcs., Centre - centre, 1.390 m
Arrangement	A2

X	Y	Mounting height	Luminaire
2.078 m	2.523 m	2.000 m	16

Individual luminaires

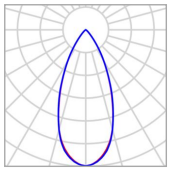
Building 1 · Storey 1 · FOYER + BAR AREA

Luminaire layout plan

X	Y	Mounting height	Luminaire
3.493 m	2.523 m	2.000 m	14

Building 1 · Storey 1 · FOYER + BAR AREA

Luminaire layout plan



Manufacturer	Delta Light	P	6.0 W
Article No.	Entero RD-S 93045 B	$\Phi_{Luminaire}$	580 lm
Article name	Entero Round S 93045 Black		
Fitting	1x led array @ 350mA		

Individual luminaires

X	Y	Mounting height	Luminaire
3.690 m	9.606 m	2.493 m	1
3.713 m	8.759 m	2.493 m	2
3.668 m	10.439 m	2.493 m	3
3.732 m	7.206 m	2.493 m	4
3.501 m	5.686 m	2.493 m	5
1.902 m	5.689 m	2.493 m	6
3.299 m	4.002 m	2.493 m	7
2.090 m	4.007 m	2.493 m	8
0.871 m	4.001 m	2.493 m	9
0.875 m	2.876 m	2.493 m	10
0.858 m	1.574 m	2.493 m	11
2.077 m	1.577 m	2.493 m	12
3.299 m	1.581 m	2.493 m	13

Building 1 · Storey 1 · FOYER + BAR AREA

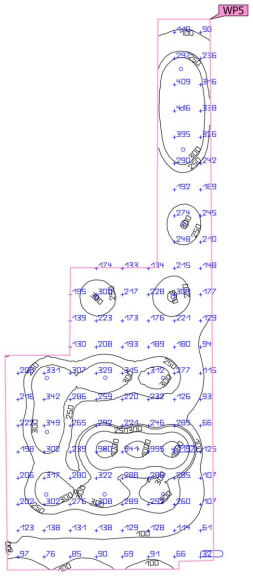
Luminaire list

Φ_{total}	P_{total}	Luminous efficacy
9205 lm	102.0 W	90.2 lm/W

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
3	Delta Light	279 / 421 122 - 773 811 921	MICROSPY 39 C 92724	8.0 W	555 lm	69.4 lm/W
13	Delta Light	Entero RD-S 93045 B	Entero Round S 93045 Black	6.0 W	580 lm	96.6 lm/W

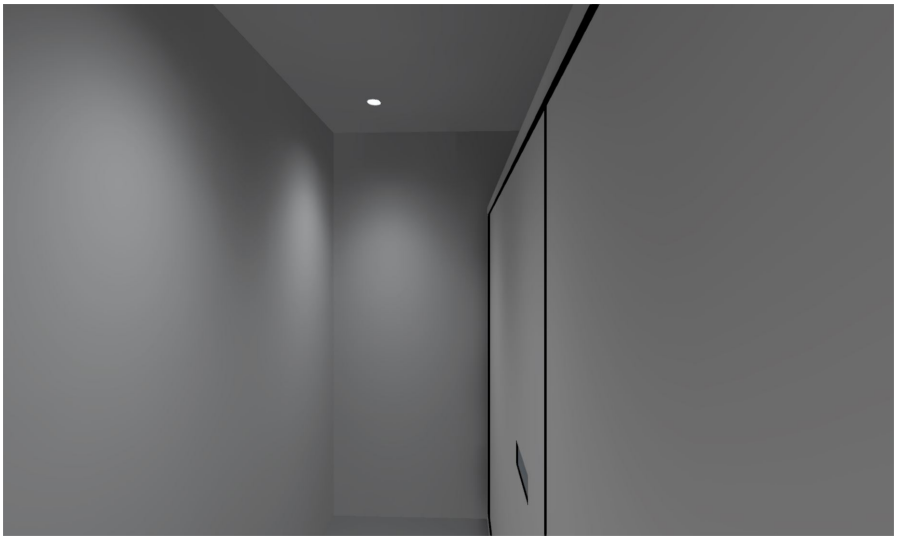
Building 1 · Storey 1 · FOYER + BAR AREA (Light scene 1)

Working plane (FOYER + BAR AREA)



Properties	Ē (Target)	E_{min}	E_{max}	g_1 (Target)	g_2	Index
Working plane (FOYER + BAR AREA) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	248 lx (≥ 150 lx) ✓	29.0 lx	1291 lx	0.12 (≥ 0.40) ✗	0.022	WP5

Utilisation profile: General areas inside buildings - Rest, sanitation and first aid rooms (10.1 Canteens, pantries)

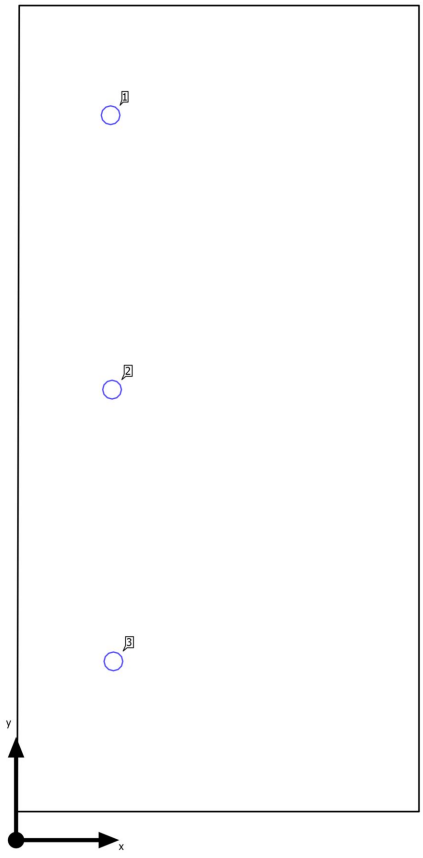


Building 1 · Storey 1 · GUEST DRESSER

Description

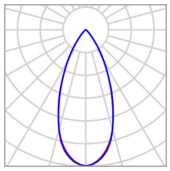
Building 1 · Storey 1 · GUEST DRESSER

Luminaire layout plan



Building 1 · Storey 1 · GUEST DRESSER

Luminaire layout plan



Manufacturer	Delta Light	P	6.0 W
Article No.	Entero RD-S 93045 B	$\Phi_{Luminaire}$	580 lm
Article name	Entero Round S 93045 Black		
Fitting	1x led array @ 350mA		

Individual luminaires

X	Y	Mounting height	Luminaire
0.381 m	2.923 m	2.493 m	1
0.387 m	1.816 m	2.493 m	2
0.393 m	0.721 m	2.493 m	3

Building 1 · Storey 1 · GUEST DRESSER

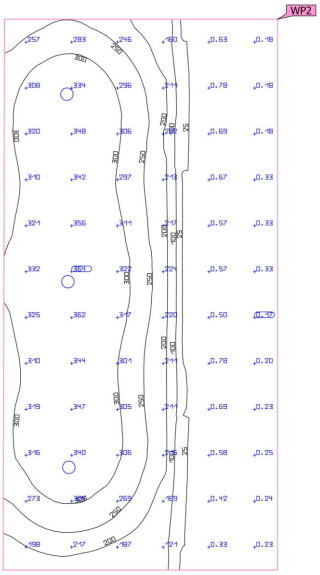
Luminaire list

Φ_{total}	P_{total}	Luminous efficacy
1740 lm	18.0 W	96.7 lm/W

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
3	Delta Light	Entero RD-S 93045 B	Entero Round S 93045 Black	6.0 W	580 lm	96.6 lm/W

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

Working plane (GUEST DRESSER)



Properties	Ē (Target)	E_{min}	E_{max}	g_1 (Target)	g_2	Index
Working plane (GUEST DRESSER) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	179 lx (≥ 100 lx) ✓	0.17 lx	366 lx	0.001 (≥ 0.40) ✗	0.000	WP2

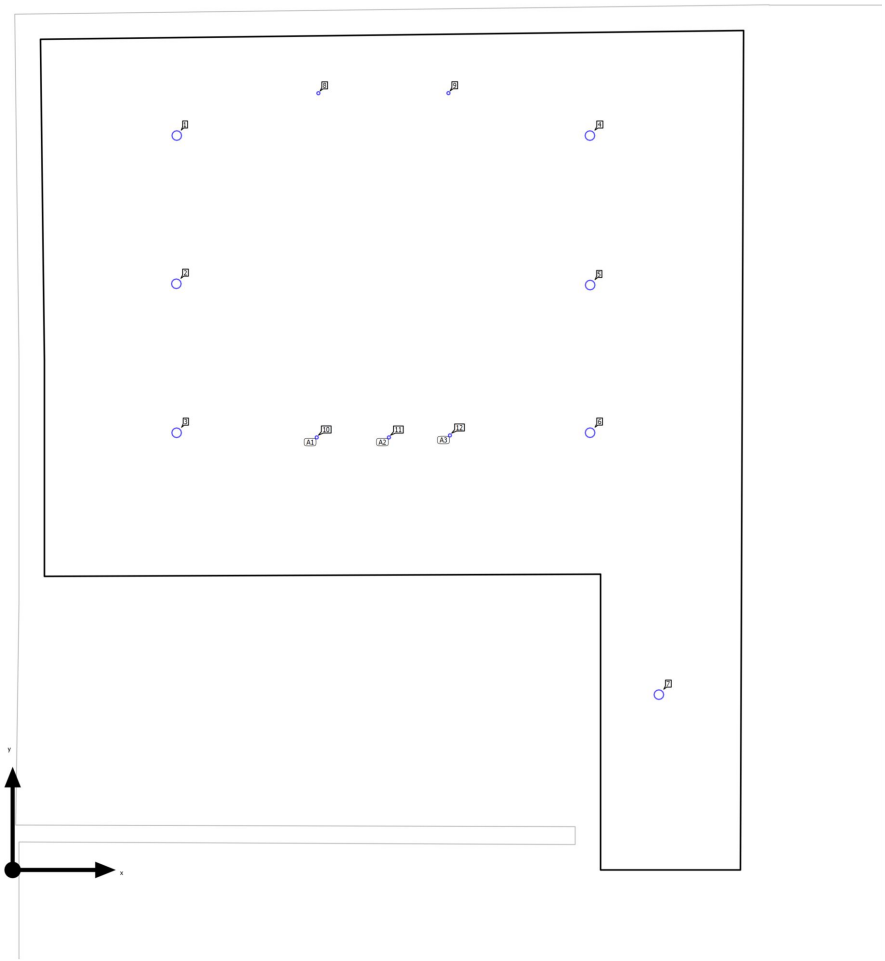
Utilisation profile: General areas inside buildings - Rest, sanitation and first aid rooms (10.5 Face lighting in front of mirrors)

Building 1 · Storey 1 · GUEST ROOM

Description

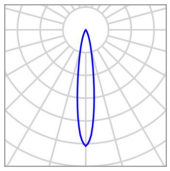
Building 1 · Storey 1 · GUEST ROOM

Luminaire layout plan



Building 1 · Storey 1 · GUEST ROOM

Luminaire layout plan



Manufacturer	Delta Light	P	5.0 W
Article No.	24112 9310 B	$\Phi_{Luminaire}$	271 lm
Article name	MICRO SNAP-IN OK 93015 B		
Fitting	1x LED @ 350mA		

1 x Delta Light MICRO SNAP-IN OK 93015 B

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	2.392 m / 3.401 m / 2.493 m	2.392 m	3.401 m	2.493 m	10
X-direction	1 pcs., Centre - centre, 2.740 m				
Arrangement	A1				

1 x Delta Light MICRO SNAP-IN OK 93015 B

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	2.960 m / 3.401 m / 2.493 m	2.960 m	3.401 m	2.493 m	11
X-direction	1 pcs., Centre - centre, 1.110 m				
Arrangement	A2				

1 x Delta Light MICRO SNAP-IN OK 93015 B

Building 1 · Storey 1 · GUEST ROOM

Luminaire layout plan

Type	Line arrangement
1st luminaire (X/Y/Z)	3.440 m / 3.417 m / 2.493 m
X-direction	1 pcs., Centre - centre, 2.710 m
Arrangement	A3

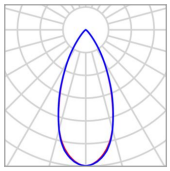
X	Y	Mounting height	Luminaire
3.440 m	3.417 m	2.493 m	12

Individual luminaires

X	Y	Mounting height	Luminaire
2.405 m	6.108 m	2.493 m	8
3.428 m	6.108 m	2.493 m	9

Building 1 · Storey 1 · GUEST ROOM

Luminaire layout plan



Manufacturer	Delta Light	P	6.0 W
Article No.	Entero RD-S 93045 B	$\Phi_{Luminaire}$	580 lm
Article name	Entero Round S 93045 Black		
Fitting	1x led array @ 350mA		

Individual luminaires

X	Y	Mounting height	Luminaire
1.291 m	5.775 m	2.493 m	1
1.288 m	4.609 m	2.493 m	2
1.290 m	3.438 m	2.493 m	3
4.541 m	5.774 m	2.493 m	4
4.543 m	4.599 m	2.493 m	5
4.542 m	3.438 m	2.493 m	6
5.084 m	1.378 m	2.493 m	7

Building 1 · Storey 1 · GUEST ROOM

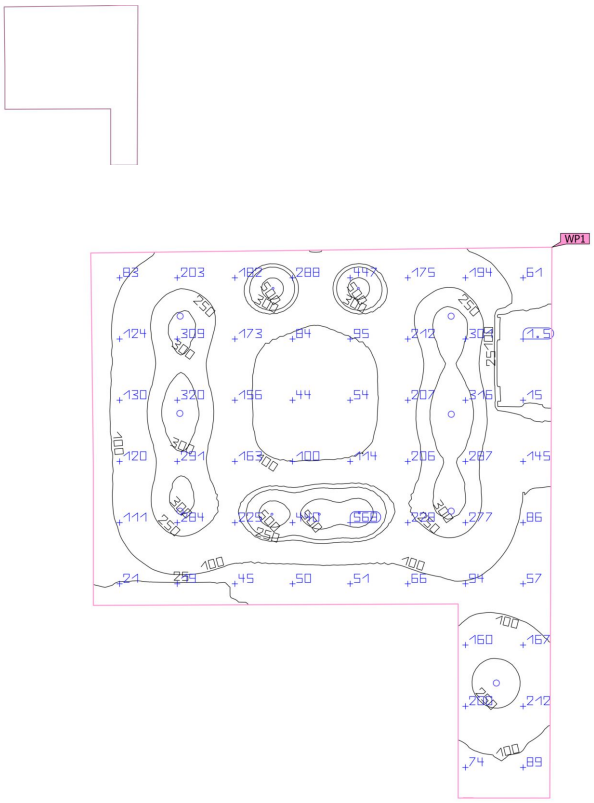
Luminaire list

Φ_{total}	P_{total}	Luminous efficacy
5415 lm	67.0 W	80.8 lm/W

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
5	Delta Light	24112 9310 B	MICRO SNAP-IN OK 93015 B	5.0 W	271 lm	54.2 lm/W
7	Delta Light	Entero RD-S 93045 B	Entero Round S 93045 Black	6.0 W	580 lm	96.6 lm/W

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

Working plane (GUEST ROOM)



Properties	Ē (Target)	E_{min}	E_{max}	g_1 (Target)	g_2	Index
Working plane (GUEST ROOM) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	171 lx (≥ 30.0 lx) ✓	1.29 lx	698 lx	0.008 (≥ 0.40) ✗	0.002	WP1

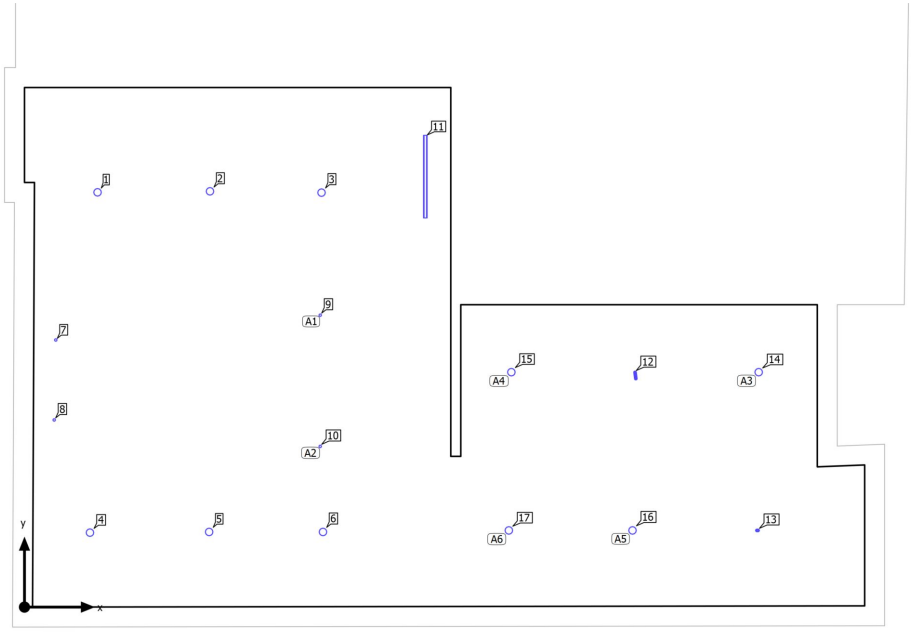
Utilisation profile: General areas inside buildings - Rest, sanitation and first aid rooms (10.2 Rest rooms)

Building 1 · Storey 1 · KID'S ROOM

Description

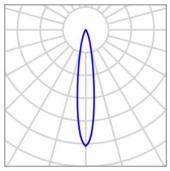
Building 1 · Storey 1 · KID'S ROOM

Luminaire layout plan



Building 1 · Storey 1 · KID'S ROOM

Luminaire layout plan



Manufacturer	Delta Light	P	5.0 W
Article No.	24112 9310 B	$\Phi_{Luminaire}$	271 lm
Article name	MICRO SNAP-IN OK 93015 B		
Fitting	1x LED @ 350mA		

1 x Delta Light MICRO SNAP-IN OK 93015 B

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	2.966 m / 2.926 m / 2.493 m	2.966 m	2.926 m	2.493 m	9
X-direction	1 pcs., Centre - centre, 1.723 m				
Arrangement	A1				

1 x Delta Light MICRO SNAP-IN OK 93015 B

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	2.966 m / 1.611 m / 2.493 m	2.966 m	1.611 m	2.493 m	10
X-direction	1 pcs., Centre - centre, 1.642 m				
Arrangement	A2				

Individual luminaires

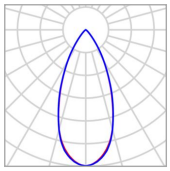
Building 1 · Storey 1 · KID'S ROOM

Luminaire layout plan

X	Y	Mounting height	Luminaire
0.314 m	2.677 m	2.493 m	7
0.298 m	1.876 m	2.493 m	8

Building 1 · Storey 1 · KID'S ROOM

Luminaire layout plan



Manufacturer	Delta Light	P	6.0 W
Article No.	Entero RD-S 93045 B	$\Phi_{Luminaire}$	580 lm
Article name	Entero Round S 93045 Black		
Fitting	1x led array @ 350mA		

1 x Delta Light Entero Round S 93045 Black

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	7.362 m / 2.355 m / 2.493 m	7.362 m	2.355 m	2.493 m	14
X-direction	1 pcs., Centre - centre, 2.480 m				
Arrangement	A3				

1 x Delta Light Entero Round S 93045 Black

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	4.882 m / 2.355 m / 2.493 m	4.882 m	2.355 m	2.493 m	15
X-direction	1 pcs., Centre - centre, 2.480 m				
Arrangement	A4				

1 x Delta Light Entero Round S 93045 Black

Building 1 · Storey 1 · KID'S ROOM

Luminaire layout plan

Type	Line arrangement
1st luminaire (X/Y/Z)	6.097 m / 0.769 m / 2.493 m
X-direction	1 pcs., Centre - centre, 2.480 m
Arrangement	A5

X	Y	Mounting height	Luminaire
6.097 m	0.769 m	2.493 m	16

1 x Delta Light Entero Round S 93045 Black

Type	Line arrangement
1st luminaire (X/Y/Z)	4.857 m / 0.769 m / 2.493 m
X-direction	1 pcs., Centre - centre, 2.480 m
Arrangement	A6

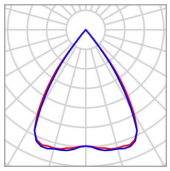
X	Y	Mounting height	Luminaire
4.857 m	0.769 m	2.493 m	17

Individual luminaires

X	Y	Mounting height	Luminaire
0.733 m	4.157 m	2.493 m	1
1.860 m	4.167 m	2.493 m	2
2.979 m	4.154 m	2.493 m	3
0.657 m	0.746 m	2.493 m	4
1.852 m	0.753 m	2.493 m	5
2.993 m	0.753 m	2.493 m	6

Building 1 · Storey 1 · KID'S ROOM

Luminaire layout plan



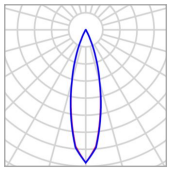
Manufacturer	Delta Light	P	12.0 W
Article No.	Inform ST / Inf SQ+ DOWN 828mm 83067 B	$\Phi_{Luminaire}$	1432 lm
Article name	Inform ST / Inf SQ+ DOWN 828mm 83067 BLACK raster		
Fitting	1x LED strip @ 300mA		

Individual luminaires

X	Y	Mounting height	Luminaire
4.020 m	4.315 m	2.493 m	11

Building 1 · Storey 1 · KID'S ROOM

Luminaire layout plan



Manufacturer	Delta Light	P	7.0 W
Article No.	SPY 27 L 93030	$\Phi_{Luminaire}$	288 lm
Article name	SPY 27 L 93030		
Fitting	1x LED array @350mA		

Individual luminaires

X	Y	Mounting height	Luminaire
6.131 m	2.288 m	2.493 m	12
7.356 m	0.769 m	2.493 m	13

Building 1 · Storey 1 · KID'S ROOM

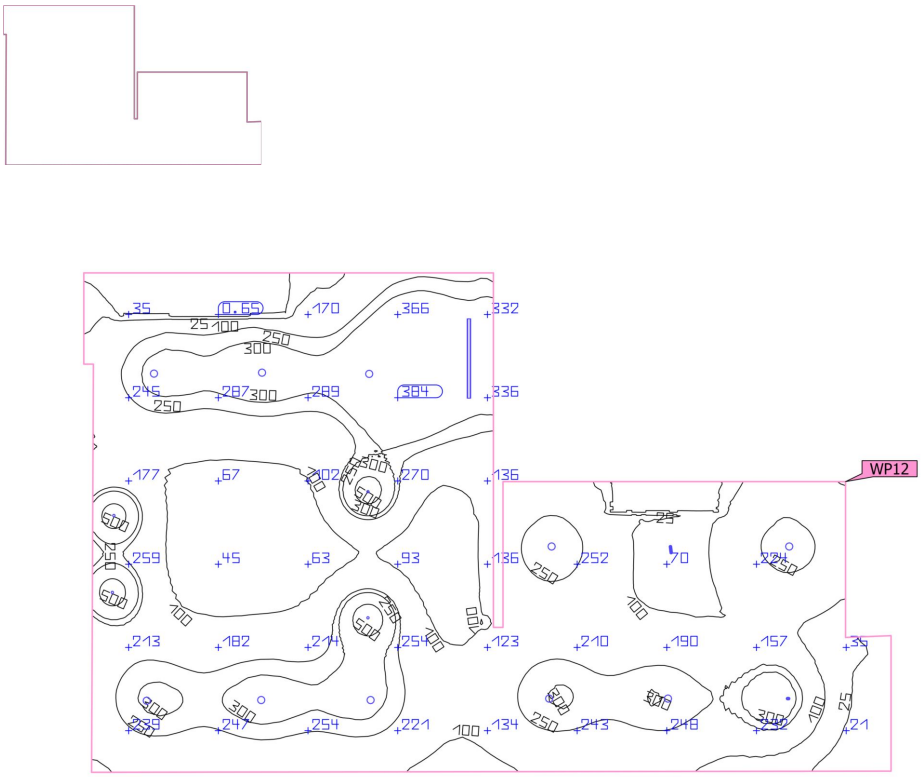
Luminaire list

Φ_{total}	P_{total}	Luminous efficacy
8892 lm	106.0 W	83.9 lm/W

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
4	Delta Light	24112 9310 B	MICRO SNAP-IN OK 93015 B	5.0 W	271 lm	54.2 lm/W
10	Delta Light	Entero RD-S 93045 B	Entero Round S 93045 Black	6.0 W	580 lm	96.6 lm/W
1	Delta Light	Inform ST / Inf SQ+ DOWN 828mm 83067 B	Inform ST / Inf SQ+ DOWN 828mm 83067 BLACK raster	12.0 W	1432 lm	119.3 lm/W
2	Delta Light	SPY 27 L 93030	SPY 27 L 93030	7.0 W	288 lm	41.2 lm/W

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

Working plane (KID'S ROOM)



Properties	Ē (Target)	E_{min}	E_{max}	g_1 (Target)	g_2	Index
Working plane (KID'S ROOM) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	190 lx (≥ 30.0 lx) ✓	0.60 lx	646 lx	0.003 (≥ 0.40) ✗	0.001	WP12

Utilisation profile: General areas inside buildings - Rest, sanitation and first aid rooms (10.2 Rest rooms)

Building 1 · Storey 1 · KITCHEN

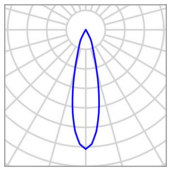
Description

Building 1 · Storey 1 · KITCHEN

Luminaire layout plan

Building 1 · Storey 1 · KITCHEN

Luminaire layout plan



Manufacturer	Delta Light	P	7.0 W
Article No.	25211 9320 B-B	$\Phi_{Luminaire}$	517 lm
Article name	MINI PARTOU IP 93025 B-B		
Fitting	1x Led array @ 350mA		

1 x Delta Light MINI PARTOU IP 93025 B-B

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	0.615 m / 2.415 m / 2.493 m	0.615 m	2.415 m	2.493 m	1
X-direction	1 pcs., Centre - centre, 0.069 m				
Arrangement	A1				

1 x Delta Light MINI PARTOU IP 93025 B-B

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	0.615 m / 0.375 m / 2.493 m	0.615 m	0.375 m	2.493 m	2
X-direction	1 pcs., Centre - centre, 4.080 m				
Arrangement	A2				

1 x Delta Light MINI PARTOU IP 93025 B-B

Building 1 · Storey 1 · KITCHEN

Luminaire layout plan

Type	Line arrangement
1st luminaire (X/Y/Z)	5.190 m / 2.415 m / 2.493 m
X-direction	1 pcs., Centre - centre, 9.150 m
Arrangement	A3

X	Y	Mounting height	Luminaire
5.190 m	2.415 m	2.493 m	3

1 x Delta Light MINI PARTOU IP 93025 B-B

Type	Line arrangement
1st luminaire (X/Y/Z)	5.190 m / 0.375 m / 2.493 m
X-direction	1 pcs., Centre - centre, 9.150 m
Arrangement	A4

X	Y	Mounting height	Luminaire
5.190 m	0.375 m	2.493 m	4

1 x Delta Light MINI PARTOU IP 93025 B-B

Type	Line arrangement
1st luminaire (X/Y/Z)	2.903 m / 2.415 m / 2.493 m
X-direction	1 pcs., Centre - centre, 4.575 m
Arrangement	A5

X	Y	Mounting height	Luminaire
2.903 m	2.415 m	2.493 m	5

1 x Delta Light MINI PARTOU IP 93025 B-B

Type	Line arrangement
1st luminaire (X/Y/Z)	2.903 m / 0.375 m / 2.493 m
X-direction	1 pcs., Centre - centre, 4.575 m
Arrangement	A6

X	Y	Mounting height	Luminaire
2.903 m	0.375 m	2.493 m	6

Building 1 · Storey 1 · KITCHEN

Luminaire layout plan

1 x Delta Light MINI PARTOU IP 93025 B-B

Type	Line arrangement
1st luminaire (X/Y/Z)	0.615 m / 1.395 m / 2.493 m
X-direction	1 pcs., Centre - centre, 2.040 m
Arrangement	A7

X	Y	Mounting height	Luminaire
0.615 m	1.395 m	2.493 m	7

1 x Delta Light MINI PARTOU IP 93025 B-B

Type	Line arrangement
1st luminaire (X/Y/Z)	5.190 m / 1.395 m / 2.493 m
X-direction	1 pcs., Centre - centre, 2.040 m
Arrangement	A8

X	Y	Mounting height	Luminaire
5.190 m	1.395 m	2.493 m	8

1 x Delta Light MINI PARTOU IP 93025 B-B

Type	Line arrangement
1st luminaire (X/Y/Z)	2.903 m / 1.395 m / 2.493 m
X-direction	1 pcs., Centre - centre, 2.040 m
Arrangement	A9

X	Y	Mounting height	Luminaire
2.903 m	1.395 m	2.493 m	9

2 x Delta Light MINI PARTOU IP 93025 B-B

Type	Line arrangement
1st luminaire (X/Y/Z)	1.759 m / 2.415 m / 2.493 m

X	Y	Mounting height	Luminaire
1.759 m	2.415 m	2.493 m	10

Building 1 · Storey 1 · KITCHEN

Luminaire layout plan

X-direction	2 pcs., Centre - centre, 2.288 m	X	Y	Mounting height	Luminaire
Arrangement	A10	4.046 m	2.415 m	2.493 m	11

2 x Delta Light MINI PARTOU IP 93025 B-B

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	1.759 m / 1.395 m / 2.493 m	1.759 m	1.395 m	2.493 m	12
X-direction	2 pcs., Centre - centre, 2.287 m	4.046 m	1.395 m	2.493 m	13
Arrangement	A11				

2 x Delta Light MINI PARTOU IP 93025 B-B

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	1.759 m / 0.375 m / 2.493 m	1.759 m	0.375 m	2.493 m	14
X-direction	2 pcs., Centre - centre, 2.288 m	4.046 m	0.375 m	2.493 m	15
Arrangement	A12				

Building 1 · Storey 1 · KITCHEN

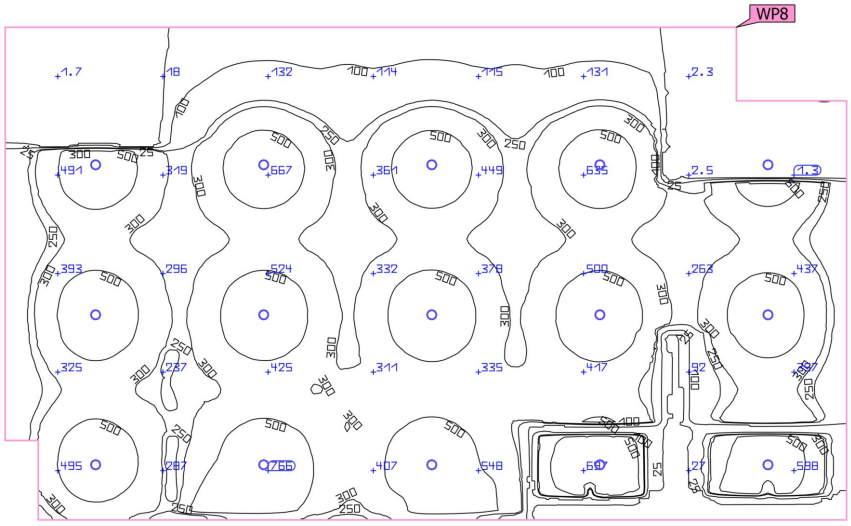
Luminaire list

Φ_{total}	P_{total}	Luminous efficacy
7755 lm	105.0 W	73.9 lm/W

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
15	Delta Light	25211 9320 B-B	MINI PARTOU IP 93025 B-B	7.0 W	517 lm	73.8 lm/W

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

Working plane (KITCHEN)



Properties	Ē (Target)	E_{min}	E_{max}	g_1 (Target)	g_2	Index
Working plane (KITCHEN) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	323 lx (≥ 300 lx) ✓	1.23 lx	865 lx	0.004 (≥ 0.40) ✗	0.001	WP8

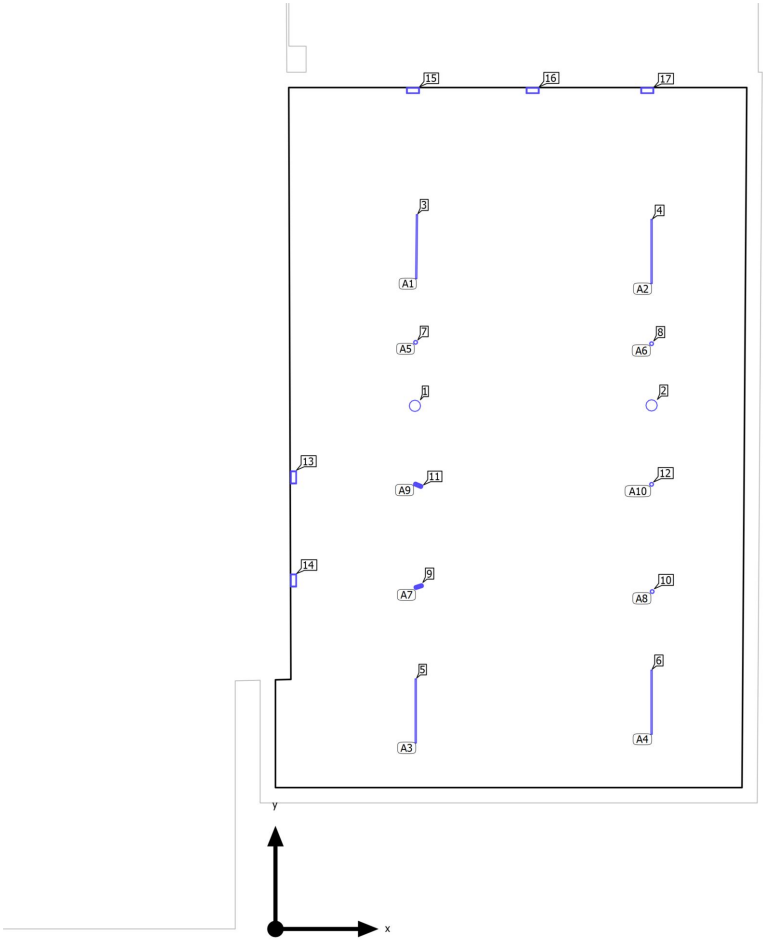
Utilisation profile: General areas inside buildings - Rest, sanitation and first aid rooms (10.1 Canteens, pantries)

Building 1 · Storey 1 · LIVING

Description

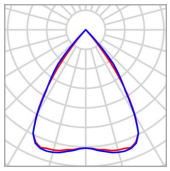
Building 1 · Storey 1 · LIVING

Luminaire layout plan



Building 1 · Storey 1 · LIVING

Luminaire layout plan



Manufacturer	Delta Light	P	14.0 W
Article No.	23381 932x // 23382 932x	$\Phi_{Luminaire}$	1569 lm
Article name	M - INFORM L8 93067		
Fitting	1x LED strip		

1 x Delta Light M - INFORM L8 93067

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	1.842 m / 8.899 m / 2.493 m	1.842 m	8.899 m	2.493 m	3
X-direction	1 pcs., Centre - centre, 4.152 m				
Arrangement	A1				

1 x Delta Light M - INFORM L8 93067

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	4.908 m / 8.837 m / 2.493 m	4.908 m	8.837 m	2.493 m	4
X-direction	1 pcs., Centre - centre, 3.976 m				
Arrangement	A2				

1 x Delta Light M - INFORM L8 93067

Building 1 · Storey 1 · LIVING

Luminaire layout plan

Type	Line arrangement
1st luminaire (X/Y/Z)	1.831 m / 2.844 m / 2.493 m
X-direction	1 pcs., Centre - centre, 5.043 m
Arrangement	A3

X	Y	Mounting height	Luminaire
1.831 m	2.844 m	2.493 m	5

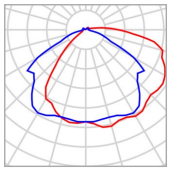
1 x Delta Light M - INFORM L8 93067

Type	Line arrangement
1st luminaire (X/Y/Z)	4.908 m / 2.958 m / 2.493 m
X-direction	1 pcs., Centre - centre, 5.037 m
Arrangement	A4

X	Y	Mounting height	Luminaire
4.908 m	2.958 m	2.493 m	6

Building 1 · Storey 1 · LIVING

Luminaire layout plan



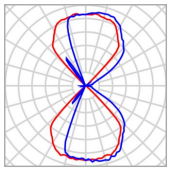
Manufacturer	Delta Light	P	8.0 W
Article No.	286 67 811 930 + 286 67 02	$\Phi_{Luminaire}$	713 lm
Article name	GIBBO 930 + BOWL GLASS AMBER		
Fitting	1x LED array		

Individual luminaires

X	Y	Mounting height	Luminaire
1.820 m	6.823 m	1.600 m	1
4.908 m	6.829 m	1.700 m	2

Building 1 · Storey 1 · LIVING

Luminaire layout plan



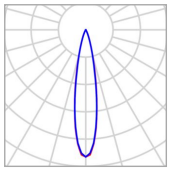
Manufacturer	Delta Light	P	16.0 W
Article No.	30311 9308 PB-B	$\Phi_{Luminaire}$	876 lm
Article name	BAND-OH! 930 DIM8 PB-B		
Fitting	1x led array @ 230V		

Individual luminaires

X	Y	Mounting height	Luminaire
0.236 m	5.890 m	1.500 m	13
0.236 m	4.546 m	1.500 m	14
1.794 m	10.936 m	1.500 m	15
3.356 m	10.936 m	1.500 m	16
4.852 m	10.936 m	1.500 m	17

Building 1 · Storey 1 · LIVING

Luminaire layout plan



Manufacturer	Delta Light	P	14.0 W
Article No.	SPY 52 / SOLI - 52 92720 + 19810 0100 B	$\Phi_{Luminaire}$	776 lm
Article name	SPY 52 / SOLI - 52 92720 + SPY 52 TUBE BLACK		
Fitting	1x LED array @ 700mA		

1 x Delta Light SPY 52 / SOLI - 52 92720 + SPY 52 TUBE BLACK

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	1.828 m / 7.652 m / 2.493 m	1.828 m	7.652 m	2.493 m	7
X-direction	1 pcs., Centre - centre, 1.657 m				
Arrangement	A5				

1 x Delta Light SPY 52 / SOLI - 52 92720 + SPY 52 TUBE BLACK

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	4.908 m / 7.634 m / 2.493 m	4.908 m	7.634 m	2.493 m	8
X-direction	1 pcs., Centre - centre, 1.569 m				
Arrangement	A6				

Building 1 · Storey 1 · LIVING

Luminaire layout plan

1 x Delta Light SPY 52 / SOLI - 52 92720 + SPY 52 TUBE BLACK

Type	Line arrangement
1st luminaire (X/Y/Z)	1.829 m / 4.453 m / 2.493 m
X-direction	1 pcs., Centre - centre, Distances not equal
Arrangement	A7

X	Y	Mounting height	Luminaire
1.829 m	4.453 m	2.493 m	9

1 x Delta Light SPY 52 / SOLI - 52 92720 + SPY 52 TUBE BLACK

Type	Line arrangement
1st luminaire (X/Y/Z)	4.916 m / 4.401 m / 2.493 m
X-direction	1 pcs., Centre - centre, Distances not equal
Arrangement	A8

X	Y	Mounting height	Luminaire
4.916 m	4.401 m	2.493 m	10

1 x Delta Light SPY 52 / SOLI - 52 92720 + SPY 52 TUBE BLACK

Type	Line arrangement
1st luminaire (X/Y/Z)	1.822 m / 5.804 m / 2.493 m
X-direction	1 pcs., Centre - centre, Distances not equal
Arrangement	A9

X	Y	Mounting height	Luminaire
1.822 m	5.804 m	2.493 m	11

1 x Delta Light SPY 52 / SOLI - 52 92720 + SPY 52 TUBE BLACK

Type	Line arrangement

X	Y	Mounting height	Luminaire

Building 1 · Storey 1 · LIVING

Luminaire layout plan

1st luminaire (X/Y/Z)	4.908 m / 5.799 m / 2.493 m
X-direction	1 pcs., Centre - centre, 2.100 m
Arrangement	A10

X	Y	Mounting height	Luminaire
4.908 m	5.799 m	2.493 m	12

Building 1 · Storey 1 · LIVING

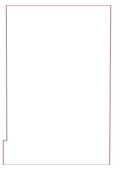
Luminaire list

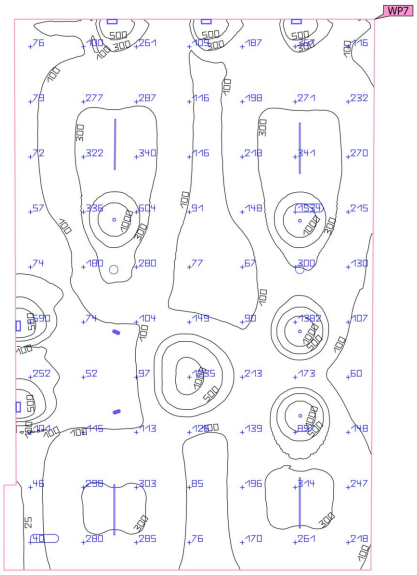
Φ_{total}	P_{total}	Luminous efficacy
16738 lm	236.0 W	70.9 lm/W

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
4	Delta Light	23381 932x // 23382 932x	M - INFORM L8 93067	14.0 W	1569 lm	112.1 lm/W
2	Delta Light	286 67 811 930 + 286 67 02	GIBBO 930 + BOWL GLASS AMBER	8.0 W	713 lm	89.1 lm/W
5	Delta Light	30311 9308 PB-B	BAND-OH! 930 DIM8 PB-B	16.0 W	876 lm	54.7 lm/W
6	Delta Light	SPY 52 / SOLI - 52 92720 + 19810 0100 B	SPY 52 / SOLI - 52 92720 + SPY 52 TUBE BLACK	14.0 W	776 lm	55.4 lm/W

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

Working plane (LIVING)





Properties	Ē (Target)	E_{min}	E_{max}	g_1 (Target)	g_2	Index
Working plane (LIVING) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	234 lx (≥ 50.0 lx) ✓	16.9 lx	1916 lx	0.072 (≥ 0.40) ✗	0.009	WP7

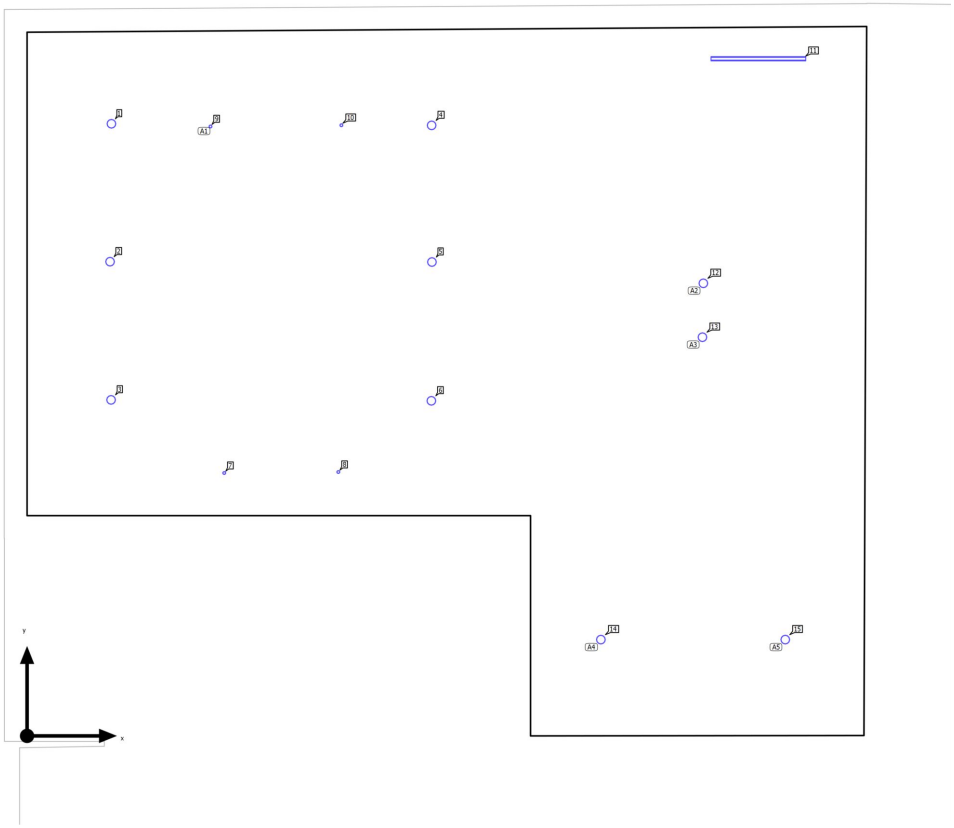
Utilisation profile: General areas inside buildings - Rest, sanitation and first aid rooms (10.2 Rest rooms)

Building 1 · Storey 1 · MASTER BEDROOM

Description

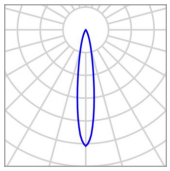
Building 1 · Storey 1 · MASTER BEDROOM

Luminaire layout plan



Building 1 · Storey 1 · MASTER BEDROOM

Luminaire layout plan



Manufacturer	Delta Light	P	5.0 W
Article No.	24112 9310 B	$\Phi_{Luminaire}$	271 lm
Article name	MICRO SNAP-IN OK 93015 B		
Fitting	1x LED @ 350mA		

1 x Delta Light MICRO SNAP-IN OK 93015 B

Type	Line arrangement
1st luminaire (X/Y/Z)	1.603 m / 5.326 m / 2.493 m
X-direction	1 pcs., Centre - centre, 3.020 m
Arrangement	A1

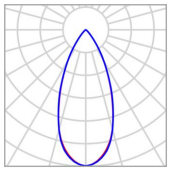
X	Y	Mounting height	Luminaire
1.603 m	5.326 m	2.493 m	9

Individual luminaires

X	Y	Mounting height	Luminaire
1.723 m	2.298 m	2.493 m	7
2.720 m	2.306 m	2.493 m	8
2.747 m	5.337 m	2.493 m	10

Building 1 · Storey 1 · MASTER BEDROOM

Luminaire layout plan



Manufacturer	Delta Light	P	6.0 W
Article No.	Entero RD-S 93045 B	$\Phi_{Luminaire}$	580 lm
Article name	Entero Round S 93045 Black		
Fitting	1x led array @ 350mA		

1 x Delta Light Entero Round S 93045 Black

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	5.910 m / 3.956 m / 2.493 m	5.910 m	3.956 m	2.493 m	12
X-direction	1 pcs., Centre - centre, 3.030 m				
Arrangement	A2				

1 x Delta Light Entero Round S 93045 Black

Type	Line arrangement	X	Y	Mounting height	Luminaire
1st luminaire (X/Y/Z)	5.902 m / 3.485 m / 2.493 m	5.902 m	3.485 m	2.493 m	13
X-direction	1 pcs., Centre - centre, 2.350 m				
Arrangement	A3				

1 x Delta Light Entero Round S 93045 Black

Building 1 · Storey 1 · MASTER BEDROOM

Luminaire layout plan

Type	Line arrangement
1st luminaire (X/Y/Z)	5.015 m / 0.842 m / 2.493 m
X-direction	1 pcs., Centre - centre, 4.250 m
Arrangement	A4

X	Y	Mounting height	Luminaire
5.015 m	0.842 m	2.493 m	14

1 x Delta Light Entero Round S 93045 Black

Type	Line arrangement
1st luminaire (X/Y/Z)	6.626 m / 0.842 m / 2.493 m
X-direction	1 pcs., Centre - centre, 3.300 m
Arrangement	A5

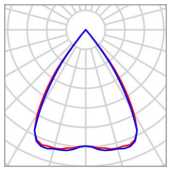
X	Y	Mounting height	Luminaire
6.626 m	0.842 m	2.493 m	15

Individual luminaires

X	Y	Mounting height	Luminaire
0.737 m	5.350 m	2.493 m	1
0.725 m	4.145 m	2.493 m	2
0.734 m	2.937 m	2.493 m	3
3.536 m	5.336 m	2.493 m	4
3.538 m	4.142 m	2.493 m	5
3.533 m	2.929 m	2.493 m	6

Building 1 · Storey 1 · MASTER BEDROOM

Luminaire layout plan



Manufacturer	Delta Light	P	12.0 W
Article No.	Inform ST / Inf SQ+ DOWN 828mm 83067 B	$\Phi_{Luminaire}$	1432 lm
Article name	Inform ST / Inf SQ+ DOWN 828mm 83067 BLACK raster		
Fitting	1x LED strip @ 300mA		

Individual luminaires

X	Y	Mounting height	Luminaire
6.391 m	5.918 m	2.493 m	11

Building 1 · Storey 1 · MASTER BEDROOM

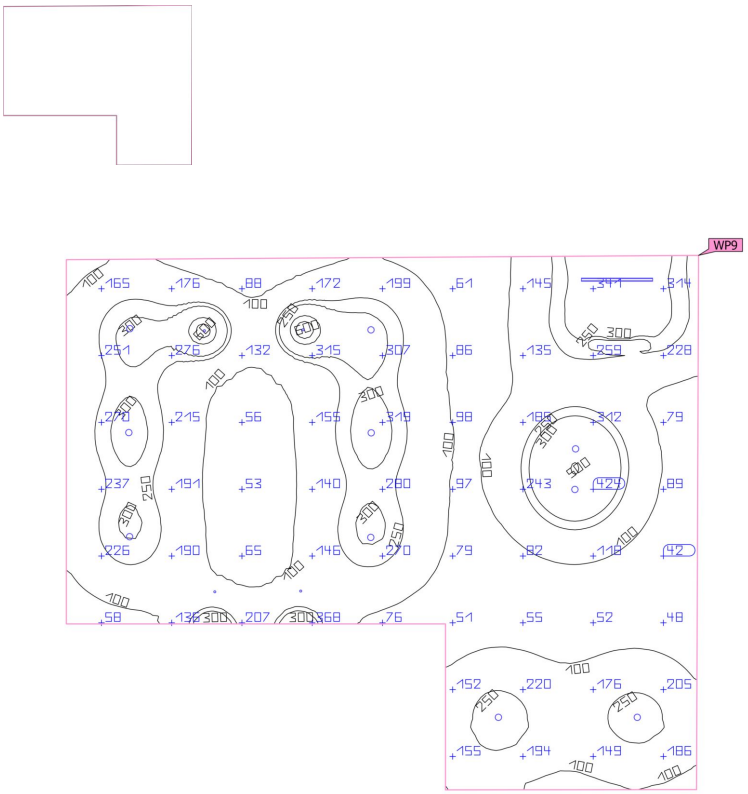
Luminaire list

Φ_{total}	P_{total}	Luminous efficacy
8316 lm	92.0 W	90.4 lm/W

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
4	Delta Light	24112 9310 B	MICRO SNAP-IN OK 93015 B	5.0 W	271 lm	54.2 lm/W
10	Delta Light	Entero RD-S 93045 B	Entero Round S 93045 Black	6.0 W	580 lm	96.6 lm/W
1	Delta Light	Inform ST / Inf SQ+ DOWN 828mm 83067 B	Inform ST / Inf SQ+ DOWN 828mm 83067 BLACK raster	12.0 W	1432 lm	119.3 lm/W

Building 1 · Storey 1 · MASTER BEDROOM (Light scene 1)

Working plane (MASTER BEDROOM)



Properties	Ē (Target)	E_{min}	E_{max}	g_1 (Target)	g_2	Index
Working plane (MASTER BEDROOM) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	175 lx (≥ 30.0 lx) ✓	26.8 lx	658 lx	0.15 (≥ 0.40) ✗	0.041	WP9

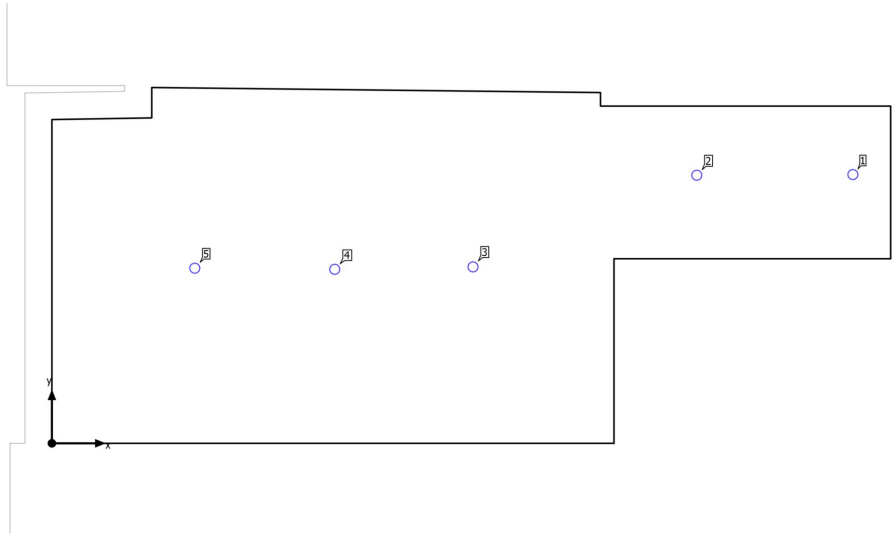
Utilisation profile: General areas inside buildings - Rest, sanitation and first aid rooms (10.2 Rest rooms)

Building 1 · Storey 1 · MASTER DRESSER

Description

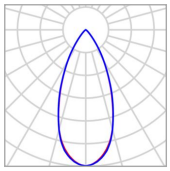
Building 1 · Storey 1 · MASTER DRESSER

Luminaire layout plan



Building 1 · Storey 1 · MASTER DRESSER

Luminaire layout plan



Manufacturer	Delta Light	P	6.0 W
Article No.	Entero RD-S 93045 B	$\Phi_{Luminaire}$	580 lm
Article name	Entero Round S 93045 Black		
Fitting	1x led array @ 350mA		

Individual luminaires

X	Y	Mounting height	Luminaire
5.935 m	1.991 m	2.493 m	1
4.778 m	1.986 m	2.493 m	2
3.120 m	1.307 m	2.493 m	3
2.096 m	1.289 m	2.493 m	4
1.059 m	1.297 m	2.493 m	5

Building 1 · Storey 1 · MASTER DRESSER

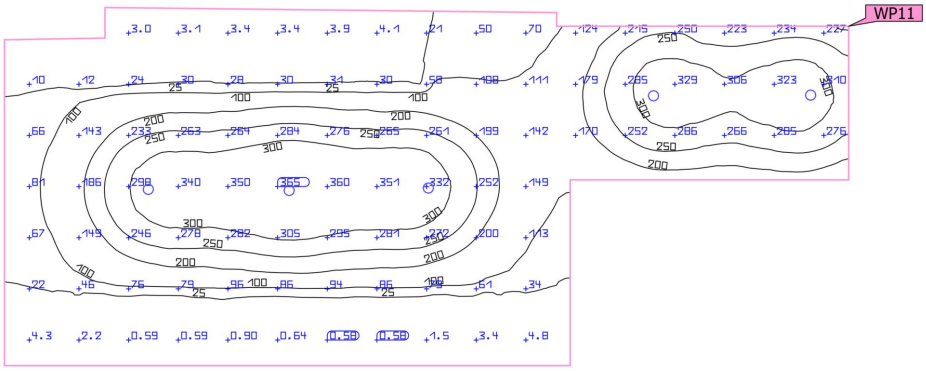
Luminaire list

Φ_{total}	P_{total}	Luminous efficacy
2900 lm	30.0 W	96.7 lm/W

pcs.	Manufacturer	Article No.	Article name	P	Φ	Luminous efficacy
5	Delta Light	Entero RD-S 93045 B	Entero Round S 93045 Black	6.0 W	580 lm	96.6 lm/W

Building 1 · Storey 1 · MASTER DRESSER (Light scene 1)

Working plane (MASTER DRESSER)



Properties	Ē (Target)	E_{min}	E_{max}	g_1 (Target)	g_2	Index
Working plane (MASTER DRESSER) Perpendicular illuminance (adaptive) Height: 0.800 m, Wall zone: 0.000 m	150 lx (≥ 100 lx) ✓	0.58 lx	366 lx	0.004 (≥ 0.40) ✗	0.002	WP11

Utilisation profile: General areas inside buildings - Rest, sanitation and first aid rooms (10.5 Face lighting in front of mirrors)