Palestine Polytechnic University

College of Engineering

DIALUX EVO Program

HOTEL DESIGN BY DIALUX EVO

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Abstract

Electrical designs that include both the distribution of lighting in addition to the electrical power and low voltage that may involve each of the houses, hotels, and other facilities are among the most important things that must be taken into consideration from the beginning of the implementation of the project, and that neglecting may lead to problems that may cause material or human losses, so to design an electrical, lighting and light current works based on the approved codes and specifications.

This project aims to design electrical plans such as lighting, electrical power, and low voltage, for a proposed hotel to be implemented in Bethlehem city, based on the code and in professional ways, because good designs provide comfort and safety for users, and this will be done using

Dialux evo, Microsoft excel and AutoCAD.

The total power of the hotel is 1386 kVA. A transformer with a value of 1500kVA is selected

The use of the Deluxe Evo program due to its efficiency in lighting designs and due to the limited labor market due to the presence of specialists in it

ملخص : تعتبر التصميمات الكهربائية التي تشمل كلاً من توزيع الإضاءة بالإضافة إلى الطاقة الكهربائية والجهد المنخفض التي قد تشمل كل من المنازل والفنادق والمنشآت الأخرى من بين أهم الأشياء التي يجب مراعاتها منذ بداية تنفيذ المشروع ، وهذا الإهمال قد يؤدي إلى مشاكل قد تتسبب في خسائر مادية أو بشرية ، وذلك لتصميم أعمال الكهرباء والإنارة والتيار الخفيف بناءً على الكود والمواصفات المعتمدة.

يهدف هذا المشروع إلى تصميم مخططات كهربائية كالإضاءة والطاقة الكهربائية والجهد المنخفض ، لفندق مقترح يتم تنفيذه في مدينة بيت لحم ، بناءً على الكود وبطرق احترافية ، لأن التصميمات الجيدة توفر الراحة والأمان للمستخدمين ، وهذا سيتم باستخدام

الطاقة الإجمالية للفندق 1386 كيلو فولت أمبير. تم اختيار محول بقيمة 1500 كيلو فولت أمبير

استخدام برنامج Deluxe Evo لفعاليته في تصميمات الإضاءة وبسبب سوق العمل المحدود لوجود متخصصين فيه

- AutoCAD.
- Microsoft excel
- Dialux evo

Table of Contents

Abbreviations

Circuit Breakers	CB
Un-interrupted Power Supply	UPS
Ring main unit	RMU
Kilo watt	KW
Phase A	Ph A
Phase B	Ph B
Phase C	Ph C
load current	Il
Length	L
Width	W
Hight	H
Meter square	m2
Volte Ambeer	VA
National electrical code	NEC
Television	TV
Registered Jack	Rj11 port
Automatic transfer switch	ATC

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الإهداء

إلى تراب المسجد الأقصى المعطر بدماء الشهداء

إلى من يضحون بأرواحهم لنحيا كرامًا

إلى الشمس التي تضيء لنا أيامنا

أمي الحنون

إلى من سارعلى الشوك ليرانا نجومًا منيرة

قائدي وصديقي والدي

الى جامعتنا العزيزة

Chapter one

Introduction

1.1 introduction

1.2 Importance

1.3 motivation

1.4 Objectives

1.5 Why DIALux Evo

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1.7 Software

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1.9 Load estimation

1.1 introduction

DIAL was founded in 1989 as the German Institute for Applied Lighting Technology (DIAL) and since then has offered a wide range of expertise in the field of lighting design and building automation. Since 1994, the focus has been on the development of DIALux – the world's leading lighting design software.

It is a well-known program that is used in the design of interior and exterior lighting, street lighting, stadium lighting, etc. It is to show all values and to show high-quality images. You can also go around the project to inspect it and produce a video about it, free, with no activation code required.

Backed by more than 120 global companies

1.2 Importance:

In the beginning, the main goal is to become a professional in the simulation program to excel in the labor market, then the second goal is to make electrical plans to apply them on the ground. Finally, as engineers, we have to master all the equations, calculations, and costs necessary for any building or facility, whatever it is.

1.3 motivation:

We went to work on this program because of the lack of engineers who can use this program professionally, in addition to that, we can simulate the electrical designs of the building and make sure that the wiring and lighting are as required and sufficient for the building requirements.

1.4 Objectives:

- Designing lighting and power schemes, protection panels, and internal and external extensions for the hotel, in addition to all hotel facilities and all details related to electricity
- We will simulate through the professional DIALUX EVO program in addition to many well-known programs.

1.5 Why DIALux Evo?

We believe that good software and usability, contribute to an easier lighting design that is fun – and even free for the user. It is important to us to make the designer's work easier and to offer luminaire manufacturers an optimal platform with which to market products professionally and in a target-group-oriented manner. We employ enthusiastic software, lighting, and smart building planners who deal with issues relating to lighting and intelligent buildings daily and share their knowledge in seminars.

1.6 Research method:

Collecting information from approved codes, references, and visits to engineers association.

1.7 Softwares:

- Dialux
- Autocad
- Microsoft (Excel)

1.8 Timeline:

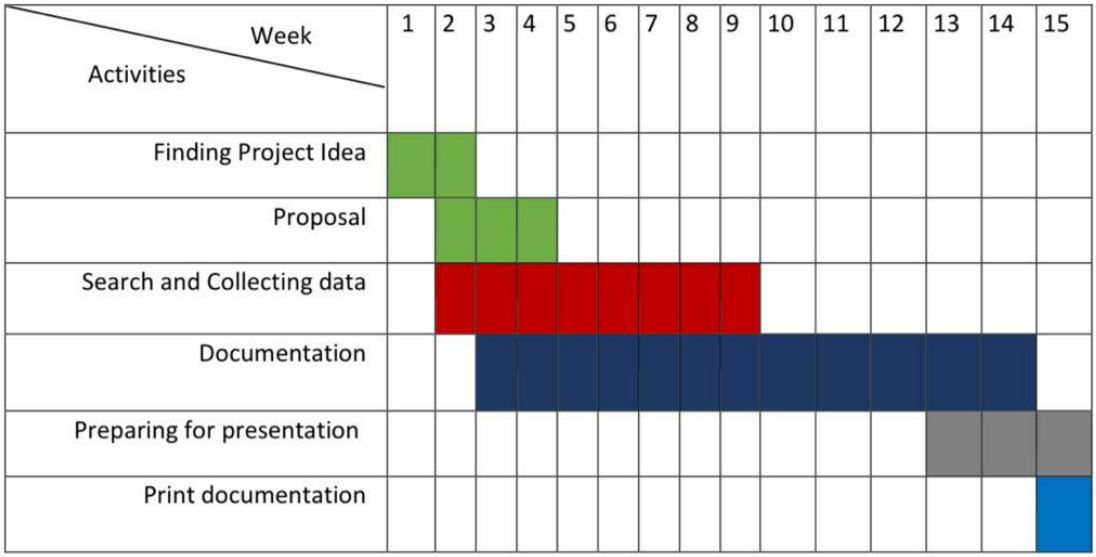


Fig 1.1 Timeline

1.9 Load estimation?

The first step in designing the electrical installations for any building is to estimate the through it, we can determine the size of the transformer and emergency generator needed for the building and the area of the rooms for electrical equipment.

The loads for the project were estimated based on the Egyptian code, where the loads were estimated Lighting devices, sockets, air conditioning, low voltage, and other devices such as fire pumps and elevators.

According to Egyptian code we estimate the kVA/$100m^2$ for hotel equal

6 kVA/$100m^2$[1]

The next chapter about the case study, estimate the dynamic loads, why we use the static transfer switch, show the important loads and sizing the transformer, generator and UPS.

Chapter Two

The case study Hotel

2.1 Overview

2.2 The case study

2.3 Dynamic loads

2.4 Transformer Size

2.5 why STS

2.6 Generator Size

2.7 Uninterruptible Power Supply (UPS)

2.8 Static Transfer Switch (STS)

2.1 Overview:

The city of Bethlehem is one of the most important tourist attractions in Palestine because of its historical landmarks, so the presence of luxury hotels is of great importance. Therefore, we have chosen to implement high-quality and professional electrical designs for a tourist hotel through electrical installations of all kinds.

2.2 The case study: Hotel

The hotel consists of eight floors with a total area of 16,346 square meters. It consists of two underground floors in which a car park is used it contains an indoor and outdoor swimming pool and a garden, and the other is a basement, which contains laundry rooms and ironing rooms, in addition to a restaurant, rest rooms, a kitchen, a reception desk, rooms for mechanical equipment, and storage rooms, in addition to that it contains a gym. As for the ground floor, it is used For the reception, it contains a wedding hall, a meeting room, a cafe, a kitchen, 8 offices, in addition to a security office, in addition to 8 bedrooms, 3 waiting area, 20 bathrooms, and the first floor consists of two parts, as it contains 26 bedrooms divided into double rooms, single rooms, and 4 offices. 3 waiting area The second floor consists of two parts, containing 28 bedrooms, divided into double rooms, single rooms, and 1 Waiting area, And the third, fourth, and fifth floors are similar in design, as they contain 11 bedrooms, a waiting area, and a storage room.

2.3 Dynamic loads

Estimate the elevator loads:

To estimate the elevator loads, figure2.1. As the hotel contains four elevators, the demand factor is 0.72 and the gearless elevator speed 4.5 m / s. The total weight of The cabin and the people in the elevator is 2000 kg.

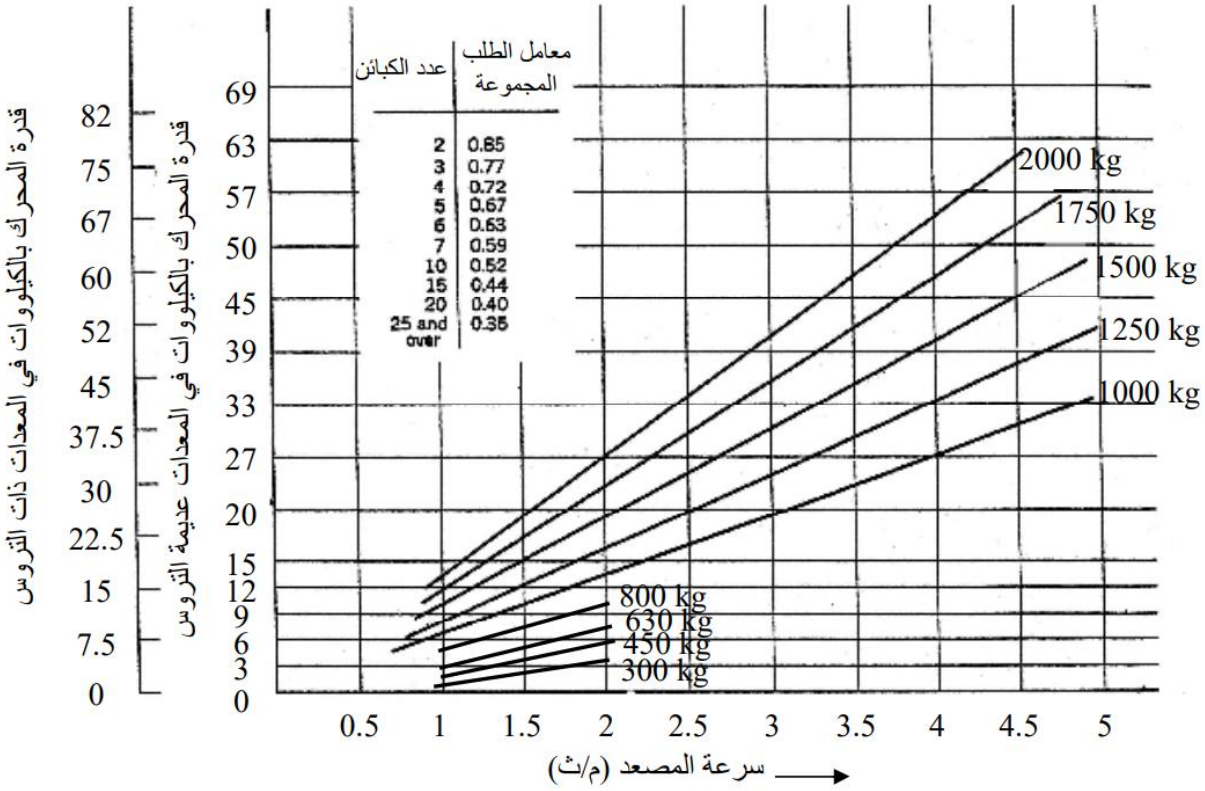


Figure 2.1: Speed of elevator with power [2]

From then figure the power of the elevator 63 kW appendix C

$$\text{Power in kVA} = \frac{power\ (kw) * demand\ factor}{power\ factor}$$

$$\text{Power in kVA} = \frac{4*62*0.72}{0.85}$$

$$= 210\ \text{kVA}$$

Water pump load:

Based on Egyptian code it needed 6 pump 5.5 kW

$$\text{Power kVA} = \frac{P_{kw}}{P.F} \quad (2.1)$$

$$\text{Power kVA} = \frac{6*5.5}{0.85}$$

$$\text{Power kVA} = 38.8 \text{ kVA}$$

Fire pump load:

To calculate the required fire pump capacity, using the following equation

$$W = \frac{Q*P}{600*efficiency} \text{ .[2]} \quad (2.2)$$

Where:

W: power in KW

Q: Required flow (liter/ minute), according to the of Level severity of the expected fire

P: The pressure required at this flow Efficiency: (70-80) %

Table 2.1: The level of severity with the required amount of flow from the pump.[2]

Level of severity	The Hight difference of pump low buildings	Nominal rated to add to largest outlet pressure	
Normal (third group)	More than 30 m	The pressure at the pump outlet (bar)	Flow Liter/minute
		2.5	3100

According to table 2.1, for this project that it's highest is 38 m

$$W = \frac{3100*2.5}{600*0.75}$$

$$= 17 \text{ kw}$$

$$\text{In KVA} = \frac{17\ kw}{0.85}$$

$$= 20 \text{ KVA}$$

HVAC system:

The central HVAC system was used in the hotel, Based on the Egyptian code, which is related to hotels, as each 1 ton covers 21 square meters, and every 1 ton is enough for 1.5 kW [1]

Basement:

$$\frac{2732}{21} * 1.5 = 195\ kW$$

Ground:

$$\frac{3732}{21} * 1.5 = 266.7\ kW$$

First:

$$\frac{2620}{21} * 1.5 = 187.1\ kW$$

Second:

$$\frac{1805}{21} * 1.5 = 128.1\ kW$$

Third:

$$\frac{650}{21} * 1.5 = 46.4\ kW$$

Forth:

$$\frac{650}{21} * 1.5 = 46.4\ kW$$

Fifth:

$$\frac{650}{21} * 1.5 = 46.4\ kW$$

Total = 916.9 kW

In kVA

$$P_{kVA} = \frac{P_{kW}}{P.F}$$

$$P_{kVA} = \frac{916.9}{0.85}$$

P_{kVA}=1078.7 kVA

Demand factor = 0.8

P_{kVA}=1078.7 *0.8

P_{kVA}= 862.96 kVA

657.4

Table 2.2: Load estimation by code.

Category	Area (m^2)	Estimated load (kVA)
Parking	3507	210.42
Basement	2732	163.92
Ground floor	3432	205.92
1st floor	2620	157.2
2nd floor	1805	108.3
3rd floor	650	39
4th floor	650	39
5th floor	650	39
HVAC		1078.7
Elevator		210
Water pump		38.8
Fire pump		20
Total kVA		2310.26

From the code we take the following value [1]

Demand factor = 0.8

Diversity factor = 0.75

Total load =2310.26

Total load =total load *demand factor *diversity factor

Total load = 2310.26 * 0.8 * 0.75

Total load = 1386.1 kVA

This approximately matches the final calculations for the building

The total kVA =1640.67

Demand factor = 0.8

Diversity factor = 0.75

Total load =total load *demand factor *diversity factor

Total load = 1640.67 * 0.8 * 0.75

Total load = 984 kVA

should not loaded exceed 80%

transformer = $\frac{984}{0.8}$

$= 1230kVA$

2.4 Transformer Size

Based on code [1] it should not the load exceed 80%, the total load of the hotel after 80% loaded was 1250 kVA. So, the capacity of a suitable transformer is 1.5 MVA

Transformer, Schneider, dry type, 1500kVA, 11kV, 400V, IP31 enclosure, air forced cooling

The primary voltage is 11 kV and the secondary is 0.4kV [13] appendix A

indoor transformer cooling mode ANAF (air natural air forced)

With dimensions (L, W, H) 2430 x 1500 x 2400 mm and the total weight is 3800 kg and the same dimension for RMU [13].

The transformer room, as it must leave a distance of 1 meter from each of the sides for maintenance purposes.

= 0.5m + Transformer hight (m) [3] (2.3)

So the height of the room equal

= 0.5m +2.4 m

=2.9 m

the height of the room = 4m

The area of the air inlet:

$$H=\frac{A}{2}+(B-A)+0.5 \text{ [4]} \quad (2.4)$$

H: The vertical distance between the centre of the cover of transformer and the centre of the air inlet (m)

A: Transformer height (m)

B: Transformer body height (m)

$$H=\frac{A}{2}+(B-A)+0.5\ m$$

$$H=\frac{1.6}{2}+(2.4-1.6)+0.5\ m$$

=1.14 m

From curve the area of the air inlet = 1 m^2

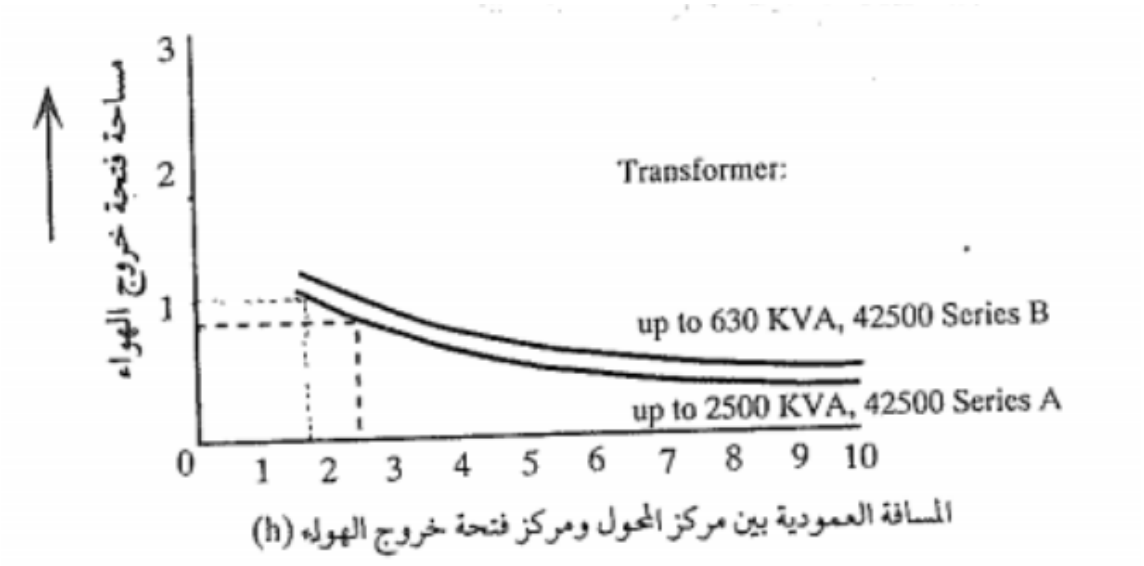


Figure 2.3: The area of the air outlet curve [2]

Since air inlet provided with a mesh, the air inlet must be increased by 10%. [4]

Air inlet area = 1.1 * 1 = 1.1 m^2 = the area of the air outlet.

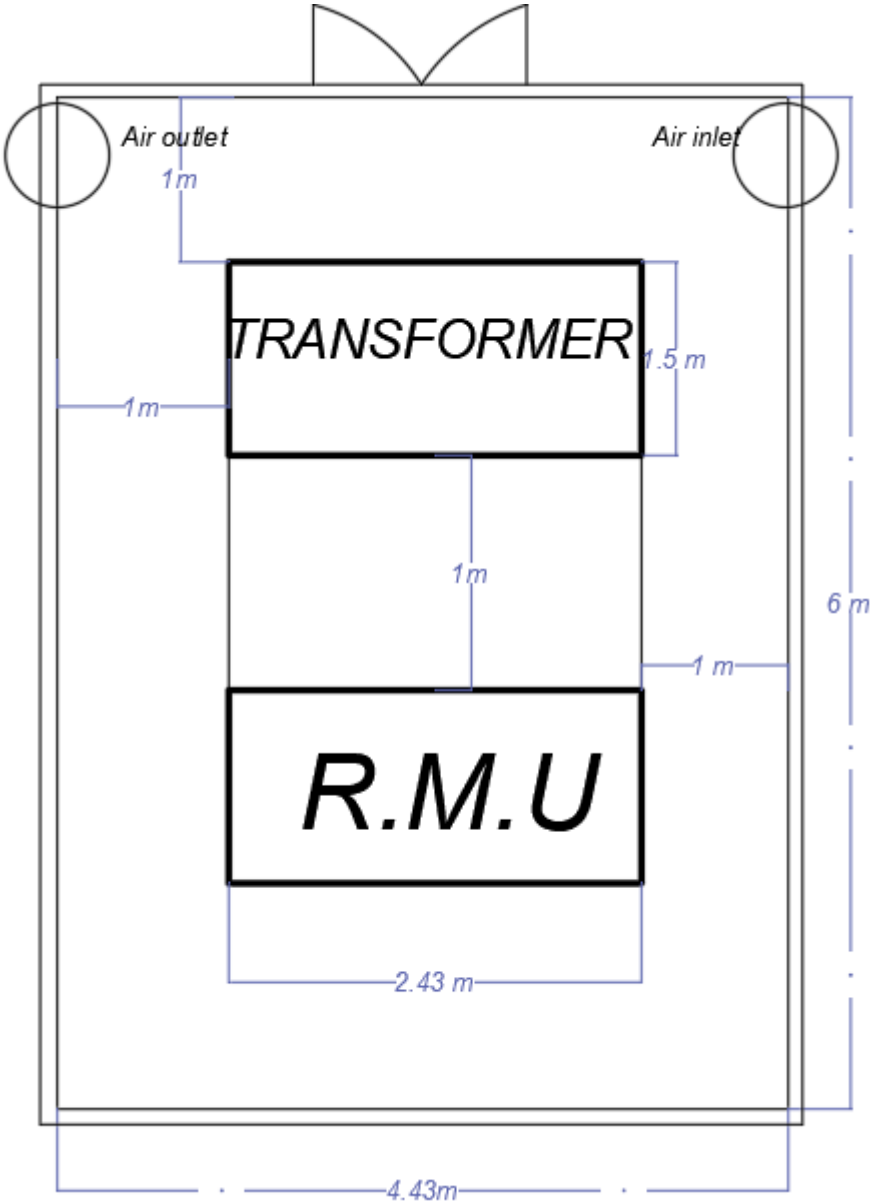


Figure 2.4: The dimenstions of transformer room

R.M.U: Ring Main Unit

2.5 What is STS:

The STS is used to convert between two power sources to achieve the reliability of the system and due to the presence of loads that cannot tolerate power outages. In this project, the task loads are divided into two types, the most important of which are emergency loads, which are fed from the generator, and critical loads, which are fed from the UPS and the generator, as shown in Figure (2.4).

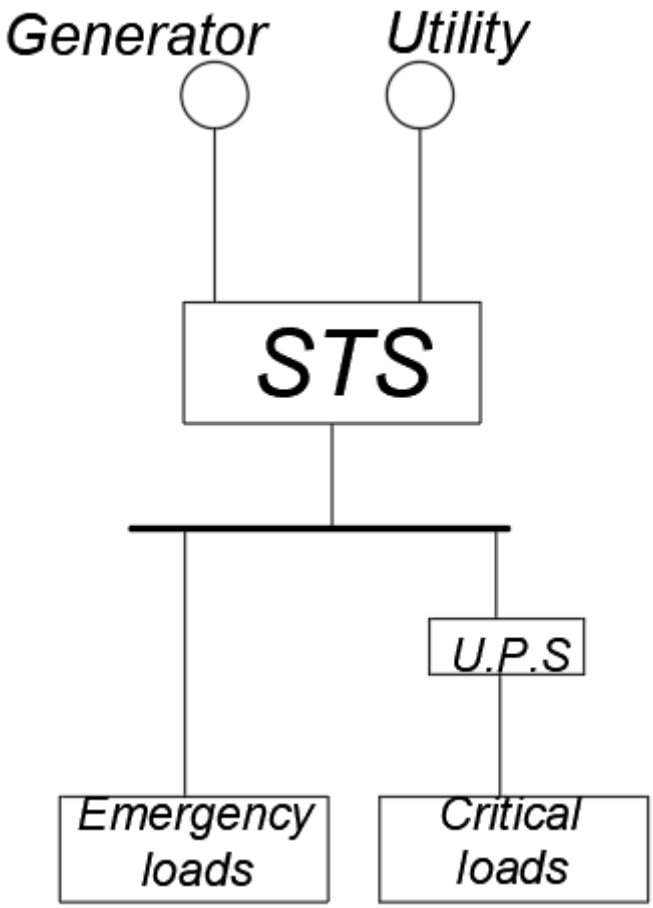


Figure 2.5: Important loads.

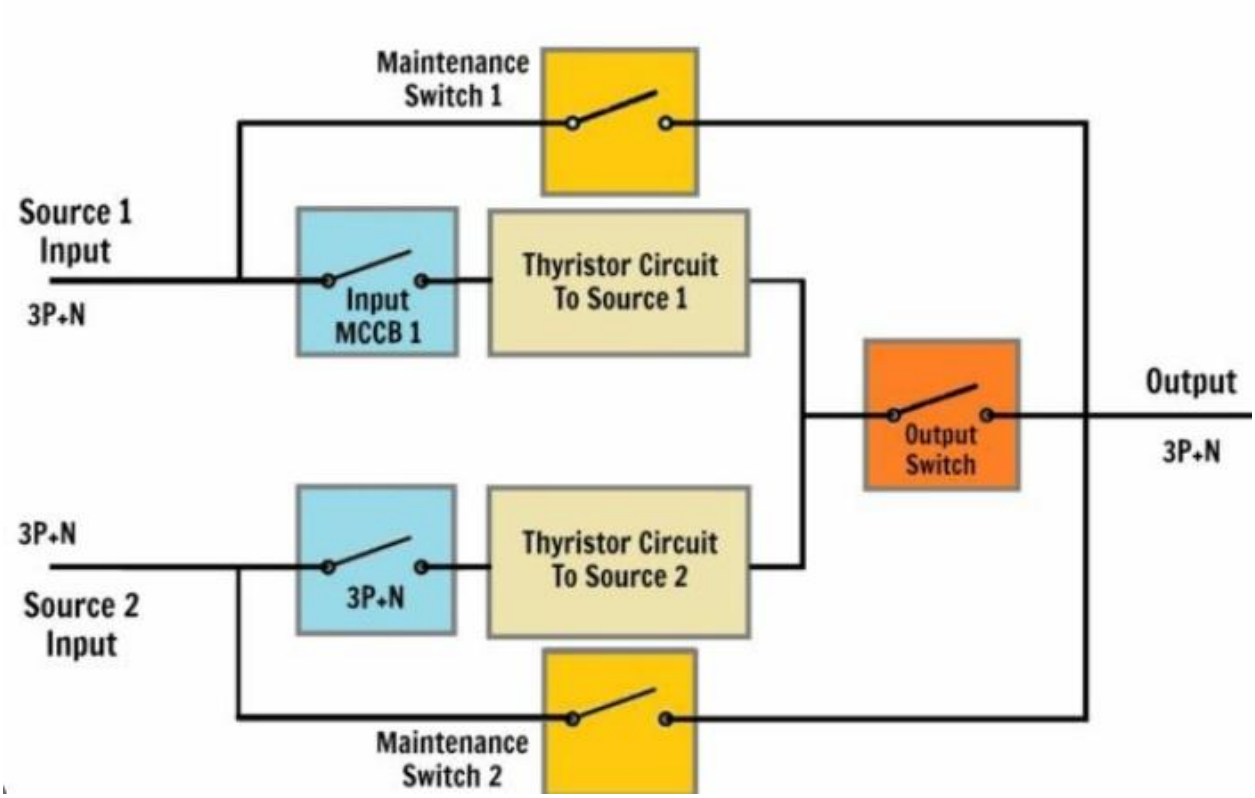


Figure: STS block diagram.

2.6 Generator Size:

The loads in the building can be divided into two types, heavy loads and important loads (emergency loads), as for the important loads, it is separated into a special emergency DBs panel, and this panel is fed from the generator and the network, and the choice between them is through the STS method.

In table 2.3 shown the calculation of the generator and the loads regarded as emergency loads

Table 2.3: Emergency loads

Load specification	S_{st}kVA
Light	0.823
Elevators	393.88
Office	6.7
Office light	0.938
CCT	1.7
sound	0.36
Fire alarm	0.514
Fire pump	26.25
Total	431.18 kVA

Size of generator = Starting kVA *Future expansion *Average use of equipment

= Starting kVA *1.1 *0.8

= 431.18*1.1 *0.8

= 379.4 kVA

The generator was chosen 400 kVA attached in appendix F

2.7 Un-interruptible Power Supply (UPS):

As for the extremely important loads that cannot tolerate power outages, such as computers, fire and monitoring systems, etc., they are fed from the Un-interruptible Power Supply device, and the function of this device is to ensure that the power is never interrupted.

There are several ways to connect the UPS:

- On-line connection
- Standby connection
- Interactive mode

Each method is distinguished from the other by the transmission time in On-line connection method transmission time is zero, in Standby connection method transmission time take 5 - 12 msec and in Interactive mode method transmission time take 3 - 8 msec [2], The choice between the methods depends on the application for which the UPS will be used, was selected on-line connection in this case [2]

In table 2.4 shown the calculation of the UPS and the loads regarded as extremely important loads

Table 2.4: Critical loads

Load specification	S_{st}kVA
19 OFFICE	6.705882
CCT	1.364706
SOUND	0.411765
Total	8.48

Size of UPS = Starting kVA *Future expansion (2.5)

Size of UPS= 8.48 *1.25

Size of UPS =10.6 kVA

The chosen ups 11 kVA attached in appendix G

2.8 Static Transfer Switch (STS):

The generator was linked with the public network by means of a automatic transfer switch the load from public electricity to the generator and the specifications of this switch are:

- The switch operates at 220/380 volts - 50 Hz frequency - 3 phase.

-The switch consists of two main contactors connected to each other electrically and mechanically, one of which is fed from the public electricity and the other from the backup generator.

- The contactor connected to the public electricity is in the ON position as long as the public electricity is on the third phases, and this is done by means of a relay that is sensitive to the third phases

When voltage is lost on one or more relays on the public network, an operating signal goes to the relay generator control panel after a time delay of approximately 20 seconds

- When the generator voltage reaches 90% of the nominal value, a relay is measured that measures the voltage of one of the phases, then a signal is given to the public feed breaker to become OFF and the generator contactor to become ON

- After the arrival of the public electricity and the relay senses the voltage on the three phases, the signal repeats the generator contactor is OFF and the public electricity contactor is ON. After a time delay (1-10), Min adjusts manually

In table 2.5 shown the calculation of the ATS and the loads regarded as emergency loads

Table 2.5: important loads

Load specification	I_LA
Light	2.99
Elevators	319.5
Office	15.24
Office light	2.1
CCT	6.2
sound	1.31
Fire alarm	1.87
Fire pump	21
Total	370.29

$$I\_ATS \geq 1.25 * I_L \quad (2.6)$$

$$I\_ATS \geq 1.25 * 370.29$$

$$I\_ATS \geq 563.2 \text{ A}$$

$$I\_ATS = 600 \text{ A}$$

The ATS chosen attached in appendix H

In the next chapter , how to distribute the lighting for the hotel and choose the most appropriate and the final features of the designed project are clarified, the distribution of lighting units inside and outside the building, and how the final form of the project will be, as it conforms to reality upon implementation.

Chapter Three

Lighting Design

3.1 Overview

3.2 Objectives

3.3 Internal lighting Design

3.4 External lighting Design

3.1 Overview:

This chapter about lighting design for the hotel by using Dialux evo, Includes lighting design basics and design presentation the main places in the hotel in addition the design of emergency lighting.

3.2 Objectives

Good lighting is one of the most important aesthetic matters that achieve comfort, taking into account the nature of the building and the nature of use, so it must be chosen very carefully, and not limited to the number of lamps used.

One of the most important methods used to estimate the intensity of illumination is lumens, which expresses the sensitivity of the eye to the emitted light power resulting from radiation, which we will rely on in calculating the number of lighting devices we need.

The main point for light design:

- Determining the appropriate amount of lux for the room from the codes
- Determine the type of lighting device used and the type of lamps
- Determine the factors of use and maintenance
- Calculate the number of lighting devices that must be installed in the room to achieve the Lighting required

The equation to calculate the required luminous intensity: [2]

$$E = \frac{n*\Phi*U_f*M_f}{A} \quad (3.1)$$

$$n = \frac{E*A}{\Phi*U_f*M_f} \quad (3.2)$$

Where :

n: The number of bulbs

E: Required luminous intensity (lum)

A: Operating level space (m)

UF: utilization factor (less than 1)

MF: Maintenance factor (less than 1)

The design was based on the CIBSE lighting code in the Dialux Evo program.

Table 3.1 lighting units used and some details.

Lamp picture	The name	Input power (W)	Initial luminous flux (lm)	place of use	Location
	WT490C LED80S/840 PSD WB PI5 L1600 (Philips)	51	8000	Car parking	Internal lighting
	DN470B LED30S/830 PSD-VLC-E C WH P (Philips)	23	2900	General lighting in most rooms	Internal lighting
	SALT 5 DIM DALI 3000K WG (ARKOSLIGHT)	35	5125	In the bedrooms as central lighting	Internal lighting
	TL973 (Frank lite)	3.3	331	In the bedrooms at the head of the bed	Internal lighting

	BCB500 T25 1 XLED27/740 S DF (Philips)	17.7	1364	In the garden and outside walls	External lighting
	LEDWALL-LUCIA-E RE135-6W-830-WH (OPPLE)	6	570	Stone facades of the walls	External lighting
	LEDWALL-LUCIA-E RE135-6W-830-PT320T 1 XLED39S/PC930 MB (Philips)	36	3307	Above surfaces that need additional lighting, such as kitchen surfaces	Internal lighting
	SM480C W24L134 1 XLED40S/940 ACC-MLO (Philips)	33	4000	Offices	Internal lighting

	BDP651 FG T25 1 XLED18-4S/740 DPL1 (Philips)	19.2	2400	In the garden and outside walls	External lighting
	BSP530 T25 1 XLED100-4S/840 DM50 (Philips)	77	10000	In bathroom	Internal lighting
	CIRCULAR INWARD 5 RINGS (leds_c4)	334	10533	In waiting area	Internal lighting
	LSC43 2700K 4.8W 10CM LENGTHS (COLLINGWOOD)	0.5	34	In the exterior of the building	External lighting

3.3 Internal lighting Design

3.3.1 Lighting for car parking

The hotel contains six floors, basement and parking.

Good lighting plays an important role in providing users with positive experiences in any parking lot.

Deluxe lighting reduces shadows and improves visibility, which helps people feel safe and helps drivers feel their leadership in the place around them.

A luminaire of type WT490C LED80S/830 PSD WB PI5 L1600 was chosen from Philips. This type is characterized by being economical, energy-saving, and easy to install and maintain.

Table 3.2: Luminescent requirements in car parking. [9]

	Maintained luminance (lux)	Limiting glare rating	Minimum colour rendering (Ra)	Colour Temperature	Maintenance Factor	Height of working plan
car parking	75	0	40	2000	0.8	0

3.3.2 Lighting for cafe and restaurant:

The basement and ground floor of the hotel contains a restaurant and a café, therefore low lighting is designed to create a comfortable mood and relax for customers inside the café and restaurant.

Café:

The café is one of the most important places in which the lighting must be taken care of, as it must provide comfortable lighting that causes relaxation and tranquility.

Kitchen:

For the kitchens, a type of DN470B lighting unit was chosen, highly efficient and reliable LED waterproof luminaire that offers an excellent quality of light, with a uniform light distribution without visible striping or colour artefacts.

3.3.3 Lighting for offices

The hotel contains 2 floors (Ground and first) containing various offices, and the design of lighting for them needs attention to achieve the desired goal.

In this offices a DN470B from Philips were used. Unattainable performance when it comes to lighting an office space with LED luminaires that provides a comfortable working environment.

Table 3.3: Luminescent requirements in office. [9]

	Maintained illuminance (lux)	Limiting glare rating	Minimum colour rendering (Ra)	Colour Temperature	Maintenance Factor	Height of working plan
Office	500	19	80	4000	0.8	0.8
Meeting room	500	19	80	4000	0.8	0.8
Waiting area	200	22	80	3000	0.8	0.8

Waiting area

For waiting area DN470B was chosen from Philips, low power consumption, while delivering consistent light output, stable color performance and high color rendering.

And figure 3.1 show distribution the lighting units in the waiting area.

Figure3.1: waiting area by Dialux Evo program

3.3.4 Lighting for bedroom.

Hotel bedroom lighting is a kind of decorative lighting or atmosphere lighting, it is mainly through light or light body color, dynamic changes and intelligent lighting control systems, Based on the lighting conditions, by some decorative lighting to add a climatic environment.

For waiting area DN470B was chosen from Philips, A2200541NW was chosen from Arkoslight and TL973 was chosen from frank lite low power consumption while delivering consistent light output, stable color performance, and high color rendering.

And figure 3.2 showed distribution the lighting units in the bedroom.

Figure3.2: bedroom by Dialux Evo program.

3.4 External lighting Design

3.4.1 Lighting the fence and the garden:

The external shape of the hotel and the lighting of the garden are very important, as it provides a quantity of visual comfort and enjoyment of the beauty of green nature, water and outdoor sessions, so that leaves a significant impact on the psychology of visitors.

A Philips BCB500 was used in this fence. The most important reason is the power of the illumination emitted by the lamp and the external beauty of the lamp.

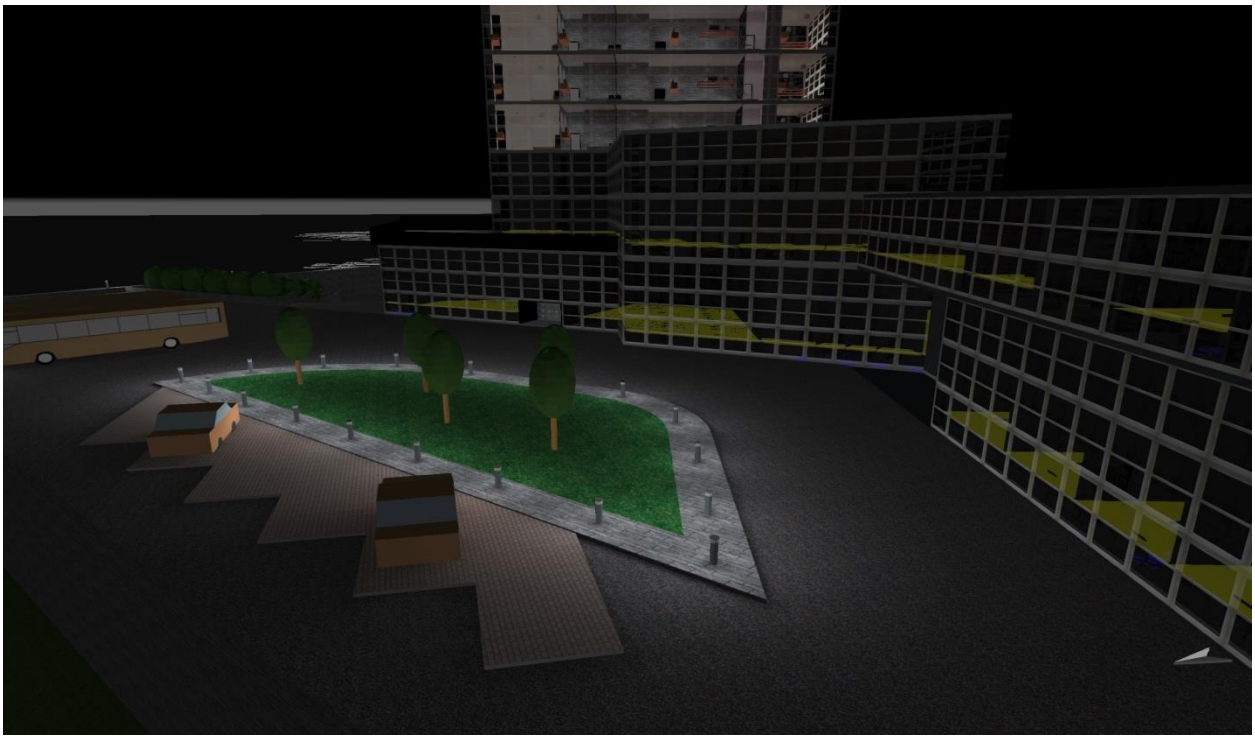


Figure3.3: Lighting design fence and the garden in Dialux Evo program

In the next chapter shown the socket and this types and how we design it .

Chapter Four

Power Design

4.1 Overview

4.2 Sockets

4.3 Type of Sockets

4.4 How we design the sockets plan

4.5 Estimation of final loads

4.1 Overview:

In this chapter, we will talk about the design of the electrical power for the project, in addition to the design of the sockets and their type.

4.2 Sockets:

The socket is an important part of the electrical components, as it is the medium that connects the mechanical part. Therefore, it must be chosen carefully and be within the required reliability and desired effectiveness.

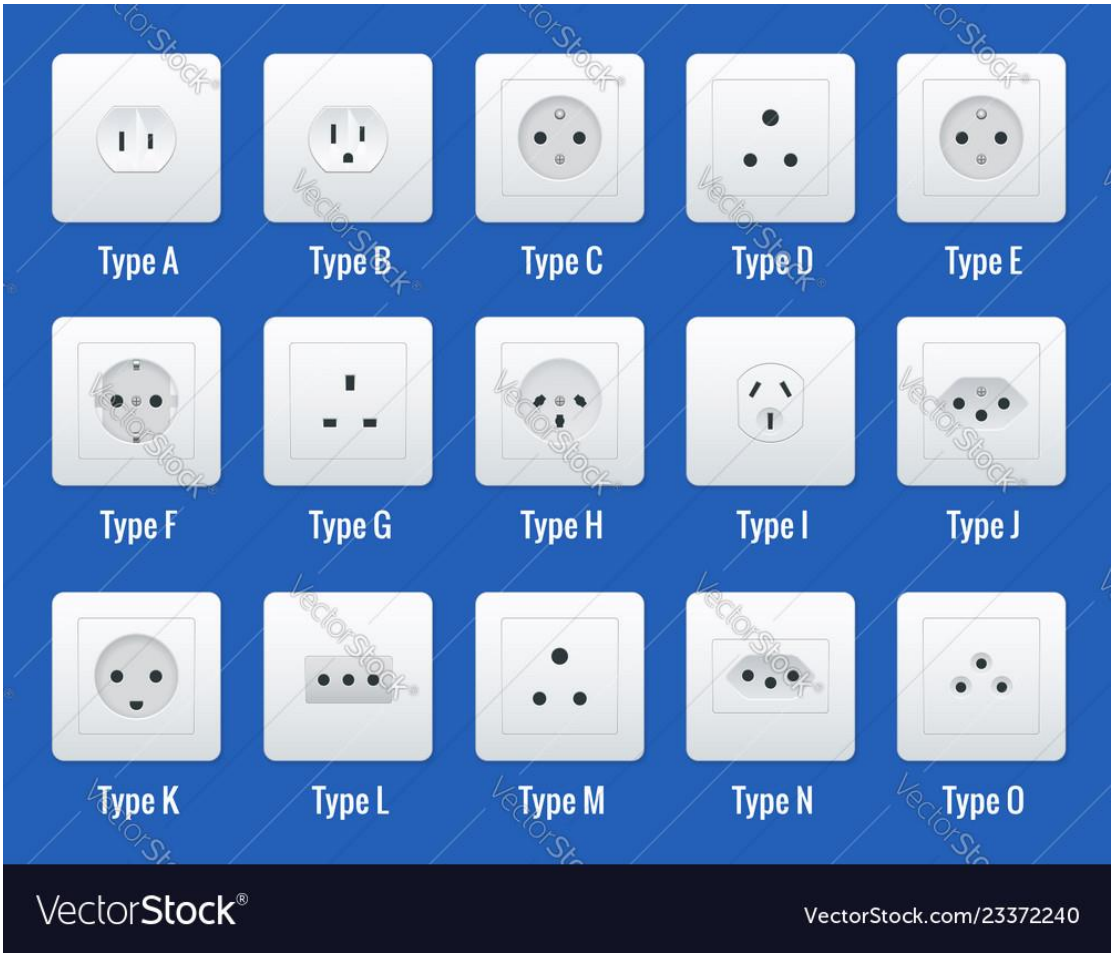


Figure 4.1 Type of sockets [10]

4.3 Types of sockets:

1. Single and double sockets :

Figure 4.2. Single sockets [10]

2. UPS Socket :

Figure 4.3 UPS sockets [10]

3. Water Proof Socket :

Figure 4.4 Water Proof Sockets [10]

4. Floor Box :

Figure 4.5 Floor Box [10]

4.4 Distributed the sockets:

Sockets are usually distributed after receiving furniture information from the architect so that all loads are fed. Sockets must be placed on all interfaces so that it fits any changes that may occur.

1. A normal electric socket and a double-ups socket next to the computer desk
2. Waterproof sockets in kitchens and washing rooms
3. refrigerator socket
4. mobile phone socket
5. nightstand socket – right
6. nightstand socket – left
7. floor lamp socket
8. TV socket
9. free sockets (3x)
10. Connect every 3 or 4 normal sockets in one circuit breaker 16A
11. Connect every 3 or 4 UPS sockets in one circuit breaker 16A
12. Connect AC socket in one circuit breaker[10]

Block diagram :

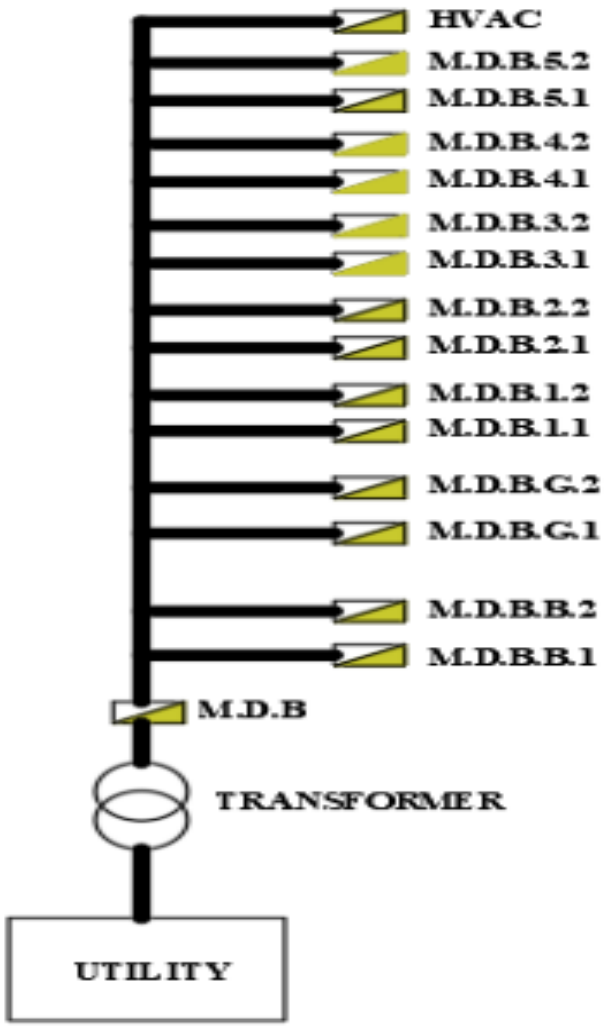


Figure 4.6 Block diagram

Chapter Five

Load Calculation

5.1 Overview

5.2 load calculation

5.3 circuit breaker

5.4 Bus Ducts:

5.5 Voltage drop:

5.6 Power factor correction:

5.7 Electrical distribution Boards:

5.1 Overview:

This chapter about load calculation, include load for every type, circuit breakers, cable, bus duct, voltage drop, power factor correction, and distribution board.

5.2 Load calculation:

Luminous loads according to the capacity of each bulb

Single socket loads 180 watts per one

double socket loads 300 watts per one

Central HVAC system load every 1Ton =1.5 kW, and every $21m^2$ need 1 Ton [1]

The loads were distributed among the three phases so that the three phases were balanced

5.3 Circuit breaker:

A circuit breaker is defined as a "device that is designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without being damaged itself when properly applied within its rating ". [1][2]

After fixing the rated voltage, the circuit breakers are classified into two values:

- Rated current :

  It determines the value of the maximum current that passes continuously without causing the breaker to disconnect, and it has known standard values measured in (A) [2]

- Short circuit capacity :

  Short circuit capacity is measured in (kA), which means the maximum current that the cutter can withstand during the short circuit without burning, which are high values, of

course, and the period in which the cutter withstands it is a very short period measured in seconds and does not exceed a few seconds [2]

The most famous values of (SCC) are: 3,6,10,15,22,35,50,75,80,100 (KA) [2]

Types of circuit breakers:

1. Miniature Circuit Breaker (MCB)
2. Molded Case Circuit Breaker (MCCB)
3. Air Circuit Breaker (ACB)
4. Ground Fault Circuit Breaker (GFCB)

1. Miniature Circuit Breaker (MCB)

The Most common type used, in figure 5.1 shows two types, one of them use in single-phase circuits and the other is used in a three-phase circuit[2].

Figure 5.1 miniature circuit breaker [2]

Table 5.1: Type characteristics of circuit breakers [6]

Type	Tripping Current (factor to be multiplied by nominal rating)	Application
B	3*In – 5*In	Protection of cables of light- and socket circuits and heaters
C	5*In – 10*In	Protection of cables in motor power circuits
K	8*In – 14*In	Protection of cables in power circuits with high-power electrical lambs and transformers with high starting currents
D	10*In – 20*In	Only for special conditions

Note: In: nominal current

2. Molded Case Circuit Breaker (MCCB)

This type is more complex than the MCB, as it is mainly used in 3-phase circuits, as it is characterized by the fact that the current can be adjusted in it, in addition to that it can withstand high currents, as shown in figure 5.2 [1][2].

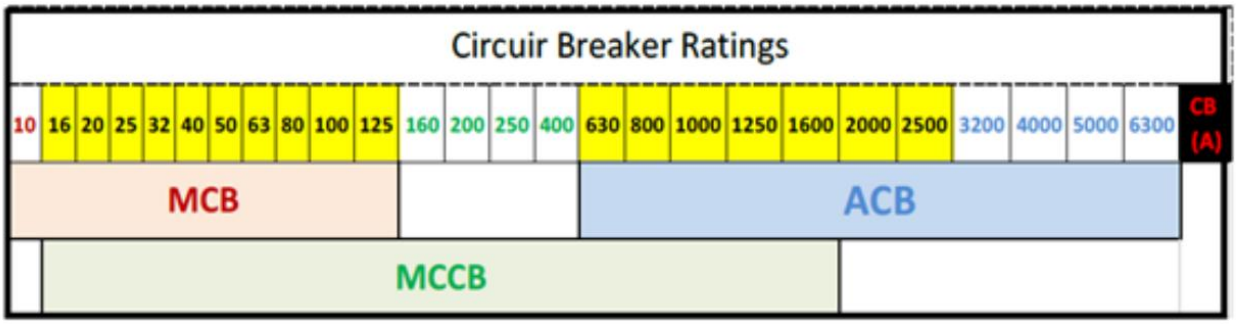


Figure 5.2 circuit breaker current rating [2]

Figure 5.3 molded case circuit breaker [2]

3. Air Circuit Breaker (ACB) :

It is used in high currents, in which there must be a medium used to extinguish the spark

Figure 5.4 air circuit breaker [2]

4. Ground Fault Circuit Breaker (GFCB)

Residual current devices (RCDs) are also referred to as residual current-operated circuit-breakers (RCCBs) or ground-fault circuit interrupters (GFCIs). RCDs with operating current I_{dn} not exceeding 30 mA are additional means of protection against direct contact. When they are used in households and similar environments and in industrial application , if a fault occurs, the Current will seep through the ground, causing the phase Neutral currents to differ and this will turn on a relay that separates the RCD.[2][6]

Figure 5.5 Residual current devices [2]

Circuit Breaker and wire size:

When choosing a cable, attention should be paid to the safety factor, which is usually taken at 25% of the value of the load current, and then choose circuit breakers, which come in standard sizes, so it is important to specify Standard sizes available in the region. To specify a categorical one add a factor of 25% (to avoid annoying stumbling) and then choose the next largest size available [2].

The most important thing to consider when choosing a cable:

1. Maximum operating voltage
2. Maximum load
3. Maximum overload
4. Maximum short circuit current and SCC
5. Insulation level
6. Cable length
7. Voltage drops
8. Cable extension method
9. The lower and the greater the temperature the cable is exposed to
10. Soil physical and chemical specifications[2]

Cable components:

The cable consists of a conductor and is called the CORE, wrapped in an insulator to isolate the conductors from each other and isolate them from what surrounds them. The higher the voltage, the more complex the cable. [2]

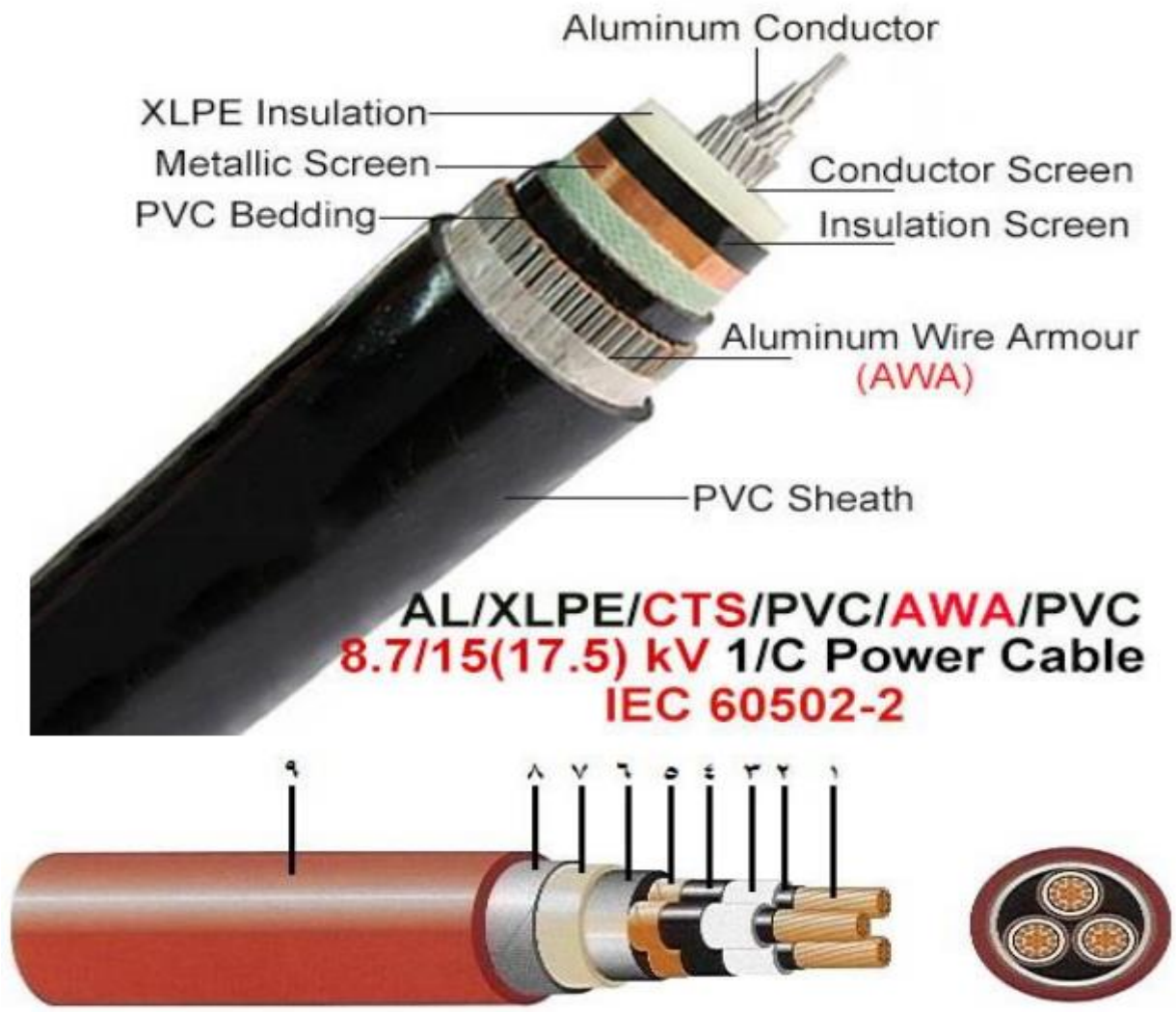


Figure 5.6 cable components [2]

Conduit:

Wires are placed inside pipes for protection, and these pipes are either internal inside the wall, under the floors, or external, and there are many types, including PVC pipes, which are characterized by lightweight and do not need any grounding, and it must be noted that the number of conductors does not exceed the maximum limit [2]

Raceway:

Made of plastic or open in an area that can be simply opened in the gate of a gate Made of plastic or open in an area that can be simply opened in the gate of the e-commerce gate [2].

Figure 5.7 Raceway [2]

Classification of cables based on insulation:

Cables used in Installation the insulating materials are:

- **PVC:** It has excellent electrical properties at low voltages (up to 3.3 kV) and at low temperatures, in addition to its cheap price.[2][1]
  Not suitable in high temperatures, it can only withstand up to 70°C. [3][4]
- **XLPE:** It has high humidity resistance, and withstands overloads and short circuit conditions. withstands high temperatures up to 90°C. [3][4][1].

The most important determining factors of Current carrying capacity:

1. Temperature
2. The type of material of the conductor
3. The number of cables inside the tube.
4. Cable extension method(this is due to temperature difference because the cable generates heat as a result of the passage of a current through it, and if the rate of heat expulsion is greater than its generation, then the value of the current passing through the cable may increase).[2][3][4]

Steps for determining the appropriate cable section:[3]

1. Determine the maximum load current of a circuit. Il

2. Determine the current set for the appropriate protection of the circuit, so that it is greater or equal to the maximum load current $ICB > 1.25\ Il$

3. Determine the cable installation method, the number of adjacent cables, and the ambient temperature to find out the De-rating factors (K)

4. Determine the permissible current in the circuit that is proportional to the section of the cable protected by the breaker so that $Iz > In$

5. The current Iz is divided by the correction factors and the resulting current is the current based on which the cable section is chosen Iz [4]

Table 5.2: cross-section area for cable [2]

Nominal cross sectional area	Max. Conductor resistance		Current rating			Approx. overall diameter	Approx. weight
	DC at 20 °C	AC at 70 °C	Laid direct in ground	Laid in ducts	Laid in free air		
mm^2	Ω/km	Ω/km	A	A	A	mm	kg/km
Two core cables							
1.5 rm	12.1000	14.600	24	19	20	10.1	120
2.5 rm	7.4100	8.870	30	25	28	10.9	145
4 rm	4.6100	5.540	40	32	39	12.9	205
6 rm	3.0800	3.690	50	40	50	13.9	255
10 rm	1.8300	2.190	65	55	66	15.8	390
16 rm	1.1500	1.390	85	65	88	17.9	527
25 rm	0.7270	0.870	110	85	116	21.3	770
35 rm	0.5240	0.628	130	105	143	23.5	965
Three core cables							
1.5 rm	12.1000	14.600	21	18	18	10.6	145
2.5 rm	7.4100	8.870	27	23	22	11.5	190
4 rm	4.6100	5.540	35	30	31	13.6	270
6 rm	3.0800	3.690	45	36	39	14.7	340
10 rm	1.8300	2.190	60	48	53	16.9	510
16 rm	1.1500	1.390	75	60	72	19.0	710
25 rm	0.7270	0.870	100	80	94	22.7	1050
35 rm	0.5240	0.628	120	95	110	25.1	1360
Four core cables							
1.5 rm	12.1000	14.600	21	18	18	11.4	180
2.5 rm	7.4100	8.870	27	23	22	12.4	230
4 rm	4.6100	5.540	35	30	31	14.8	335
6 rm	3.0800	3.690	45	36	39	16.0	425
10 rm	1.8300	2.190	60	48	53	18.5	650
16 rm	1.1500	1.390	75	60	72	20.9	910
25 rm	0.7270	0.870	100	80	94	25.0	1360
35 sm	0.5240	0.628	120	95	110	25.1	1650
50 sm	0.3870	0.464	145	115	138	29.3	2225
70 sm	0.2680	0.322	175	145	171	32.9	3065
95 sm	0.1930	0.232	210	165	209	37.8	4175
120 sm	0.1530	0.185	240	195	242	41.2	5205
150 sm	0.1240	0.151	270	220	275	45.9	6400
185 sm	0.0991	0.121	300	245	314	50.7	7960
240 sm	0.0754	0.084	345	290	374	57.0	10330
300 sm	0.0601	0.077	390	320	440	63.3	12915

5.4 Bus Ducts:

It is bars of copper or aluminum grouped together and isolated inside a metal structure that is used as an alternative to cables because it reduces the number of cables and differs among themselves in the nature of the insulator [2].

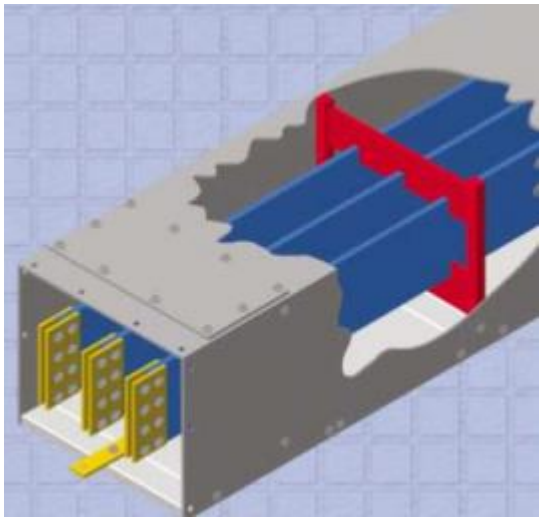


Figure 5.8 Bus Ducts [2]

Type of bus ducts:

- Non-Segregated duct
- Segregated duct
- Isolated duct

  The only difference between them is the insulators among them. In the first, there are no spacers except for the spacers for fixing, while the second is inside the metal frame that contains the three phases. As for the last type, there are spacers that separate each phase from the other and isolate it. [2]

  The chosen bus ducks rated current 3200 A, made by ABB

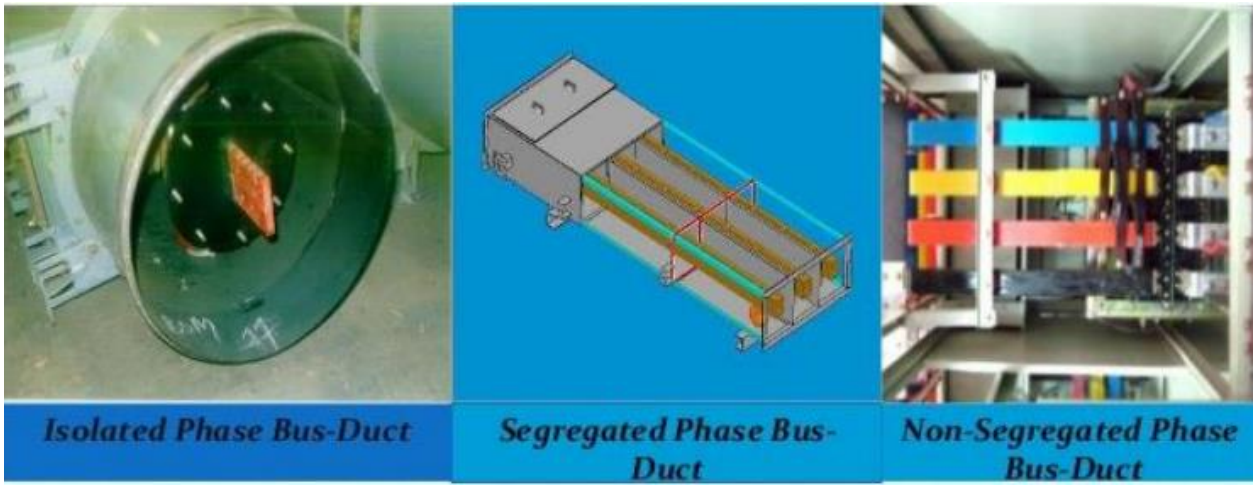


Figure 5.9 type of Bus Ducts [2]

5.5 Voltage drop:

Voltage drop calculation as per corporate tables for cables(mV/Amp/Meter), then to current and distance then divide 380V, and cable less than 16 mm^2 , shod be less than 4% [1]

$$D.V = 2 * \frac{L*P}{@*q*V} \quad (5.1)$$

$$D.V = \frac{L*P}{@*q*V} \quad (5.2)[1]$$

L: cable length

P: power

q: cross-section

DV: drop voltage

V: voltage

@: Conductivity

Table 5.3: Voltage drop for multi-core L.V cable [2]

C.S.A mm^2	Copper conductor	
	Voltage drop (mv / AMP / Meter)	
	PVC insulation & PVC sheathed	XLPE insulation & PVC sheathed
1.5	20.345	20.341
2.5	12.397	13.197
4	7.741	7.731
6	5.199	5.191
10	3.101	3.094
16	1.988	1.982
25	1.280	1.276
35	0.959	0.955
50	0.720	0.715
70	0.524	0.520
95	0.398	0.394
120	0.341	0.337
150	0.285	0.282
185	0.244	0.241
240	0.204	0.201
300	0.180	0.177
400	0.157	0.155

$$D.V = \frac{L*P}{@*q*V}$$ [1]

For example basement floor room B6:

Cable cross-section $6mm^2$

Total connected power =2187.5 W

Cable length =31m

The electrical conductivity of copper is 56

$$D.V = \frac{31 * 2187.5}{56 * 6 * 380}$$

$$D.V = 0.53\text{V}$$

$$\%D.U = \frac{D.U}{U} * 100\%$$

$$\%D.U = \frac{0.53}{380} * 100\%$$

$$\%D.U = \%0.13$$

Less than 4%, it's acceptable.

For cables large than $16mm^2$

Cabe cross-section $50mm^2$

Cable length =19m

mV/A/m =0.285 table 5.3

Voltage drop = ((mV/A/m)*current through*length)/1000

For basement floor room B3

$$D.U = \frac{0.285 * 181.2 * 19}{1000}$$

$$D.U = 0.98\text{v}$$

$$\%D.U = \frac{D.U}{U} * 100\%$$

$$\%D.U = \frac{0.98}{380} * 100\%$$

$$D.U = \%0.25$$

Less than 4%, it's acceptable.

Voltage drop for bus ducts:

$$Actual\ voltage\ drop = a * v.d \frac{Actual\ load\ current}{Rated\ current} * \frac{Actual\ distance}{100m} \quad (5.3)$$

a:load distribution constant

a=1, consentrated load

a=0.5, distributed load

v.d: voltage drop it attached from appendix B

$$Actual\ voltage\ drop = 1 * 0.0536 * \frac{2496}{3200} * \frac{34}{100m}$$

$$Actual\ voltage\ drop = 0.14\text{v}$$

5.6 Power factor correction:

Power factor correction is done by adding capacitors to the Main Distribution Board, and we can calculate the power factor correction by using the following table:

Table 5.3: Power factor correction table [2]

	final cosφ												
initial cosφ	0.80	0.85	0.90	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99	1
0.60	0.583	0.714	0.849	0.878	0.907	0.938	0.970	1.005	1.042	1.083	1.130	1.191	1.333
0.61	0.549	0.679	0.815	0.843	0.873	0.904	0.936	0.970	1.007	1.048	1.096	1.157	1.299
0.62	0.515	0.646	0.781	0.810	0.839	0.870	0.903	0.937	0.974	1.01 5	1.062	1.123	1.265
0.63	0.483	0.613	0.748	0.777	0.807	0.837	0.870	0.904	0.941	0.982	1.030	1.090	1.233
0.64	0.451	0.581	0.716	0.745	0.775	0.805	0.838	0.872	0.909	0.950	0.998	1.058	1.201
0.65	0.419	0.549	0.685	0.714	0.743	0.774	0.806	0.840	0.877	0.919	0.966	1.027	1.169
0.66	0.388	0.519	0.654	0.683	0.712	0.743	0.775	0.810	0.847	0.888	0.935	0.996	1.138
0.67	0.358	0.488	0.624	0.652	0.682	0.713	0.745	0.779	0.816	0.857	0.905	0.966	1.108
0.68	0.328	0.459	0.594	0.623	0.652	0.683	0.715	0.750	0.787	0.828	0.875	0.936	1.078
0.69	0.299	0.429	0.565	0.593	0.623	0.654	0.686	0.720	0.757	0.798	0.846	0.907	1.049
0.70	0.270	0.400	0.536	0.565	0.594	0.625	0.657	0.692	0.729	0.770	0.817	0.878	1.020
0.71	0.242	0.372	0.508	0.536	0.566	0.597	0.629	0.663	0.700	0.741	0.789	0.849	0.992
0.72	0.214	0.344	0.480	0.508	0.538	0.569	0.601	0.635	0.672	0.713	0.761	0.821	0.964
0.73	0.186	0.316	0.452	0.481	0.510	0.541	0.573	0.608	0.645	0.686	0.733	0.794	0.936
0.74	0.159	0.289	0.425	0.453	0.483	0.514	0.546	0.580	0.617	0.658	0.706	0.766	0.909
0.75	0.132	0.262	0.398	0.426	0.456	0.487	0.519	0.553	0.590	0.631	0.679	0.739	0.882
0.76	0.105	0.235	0.371	0.400	0.429	0.460	0.492	0.526	0.563	0.605	0.652	0.713	0.855
0.77	0.079	0.209	0.344	0.373	0.403	0.433	0.466	0.500	0.537	0.578	0.626	0.686	0.829
0.78	0.052	0.183	0.318	0.347	0.376	0.407	0.439	0.474	0.511	0.552	0.599	0.660	0.802
0.79	0.026	0.156	0.292	0.320	0.350	0.381	0.413	0.447	0.484	0.525	0.573	0.634	0.776
0.80		0.130	0.266	0.294	0.324	0.355	0.387	0.421	0.458	0.499	0.547	0.608	0.750
0.81		0.104	0.240	0.268	0.298	0.329	0.361	0.395	0.432	0.473	0.521	0.581	0.724
0.82		0.078	0.214	0.242	0.272	0.303	0.335	0.369	0.406	0.447	0.495	0.556	0.698
0.83		0.052	0.188	0.216	0.246	0.277	0.309	0.343	0.380	0.421	0.469	0.530	0.672
0.84		0.026	0.162	0.190	0.220	0.251	0.283	0.317	0.354	0.395	0.443	0.503	0.646
0.85			0.135	0.164	0.194	0.225	0.257	0.291	0.328	0.369	0.417	0.477	0.620
0.86			0.109	0.138	0.167	0.198	0.230	0.265	0.302	0.343	0.390	0.451	0.593
0.87			0.082	0.111	0.141	0.172	0.204	0.238	0.275	0.316	0.364	0.424	0.567
0.88			0.055	0.084	0.114	0.145	0.177	0.211	0.248	0.289	0.337	0.397	0.540
0.89			0.028	0.057	0.086	0.117	0.149	0.184	0.221	0.262	0.309	0.370	0.512
0.90				0.029	0.058	0.089	0.121	0.156	0.193	0.234	0.281	0.342	0.484

- The initial power factor is in the first column (0.85).
- The final power factor (0.97).
- We look at the value of the corresponding factor(0.369)
- We multiply this factor with the power.

Initial power factor=0.85

final power factor= 0.97

The factor = 0.324

Power = 836.74 kW

After correction:

effective power= 836.74*0.369 = 308.7 kVAR

distribute it to 6 stages, every stage is 50 kVAR

5.7 Electrical distribution Boards:

A distribution board is a safe system designed for houses or buildings that included protective devices, isolator switches, circuit breakers, and fuses to connect safely the cables and wires to the subcircuits and final sub-circuits including their associated Live (Phase) Neutral and Earth conductors.

Main Distribution Board (MDB)

Main Distribution Board (MDB) where the main protective and isolation devices are installed to provide electricity in a safe range to the connected electrical appliances.

Sub Distribution Board (SDB)

The Sub distribution board is connected and supplied from the Main Distribution Board through different wires and cables rated according to the load requirement.

Distribution Board (DB)

The Distribution Board provides electric supply to the Final.

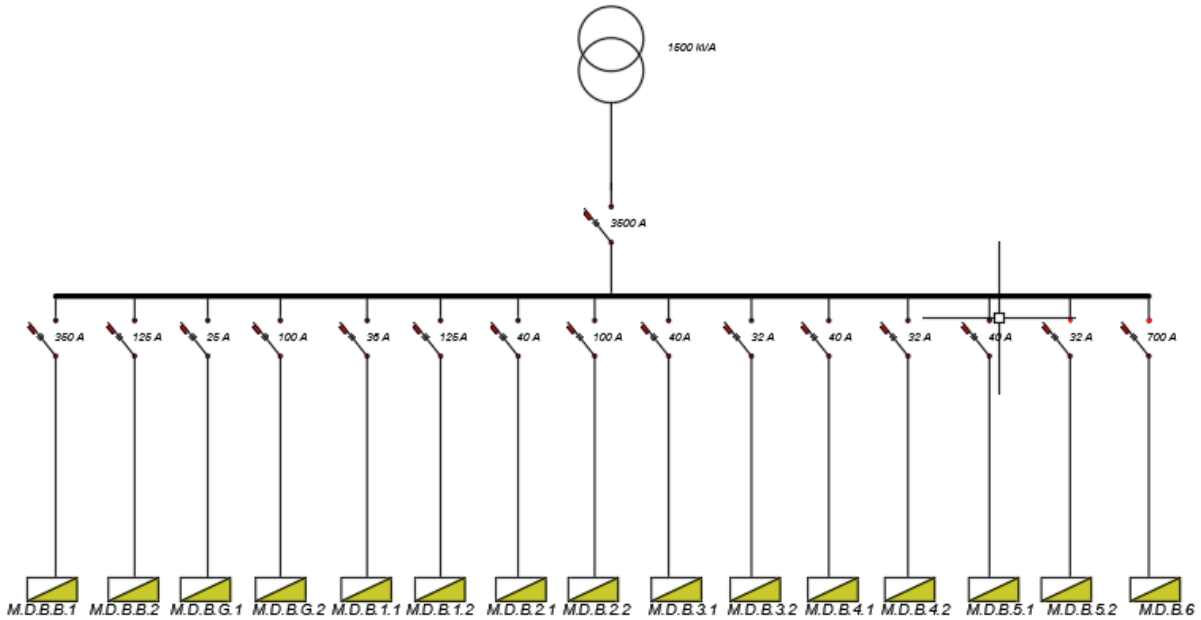


Figure 5.10 Main Distribution Board

M.D.B.x.y

x: floor number

y: distribution panel number

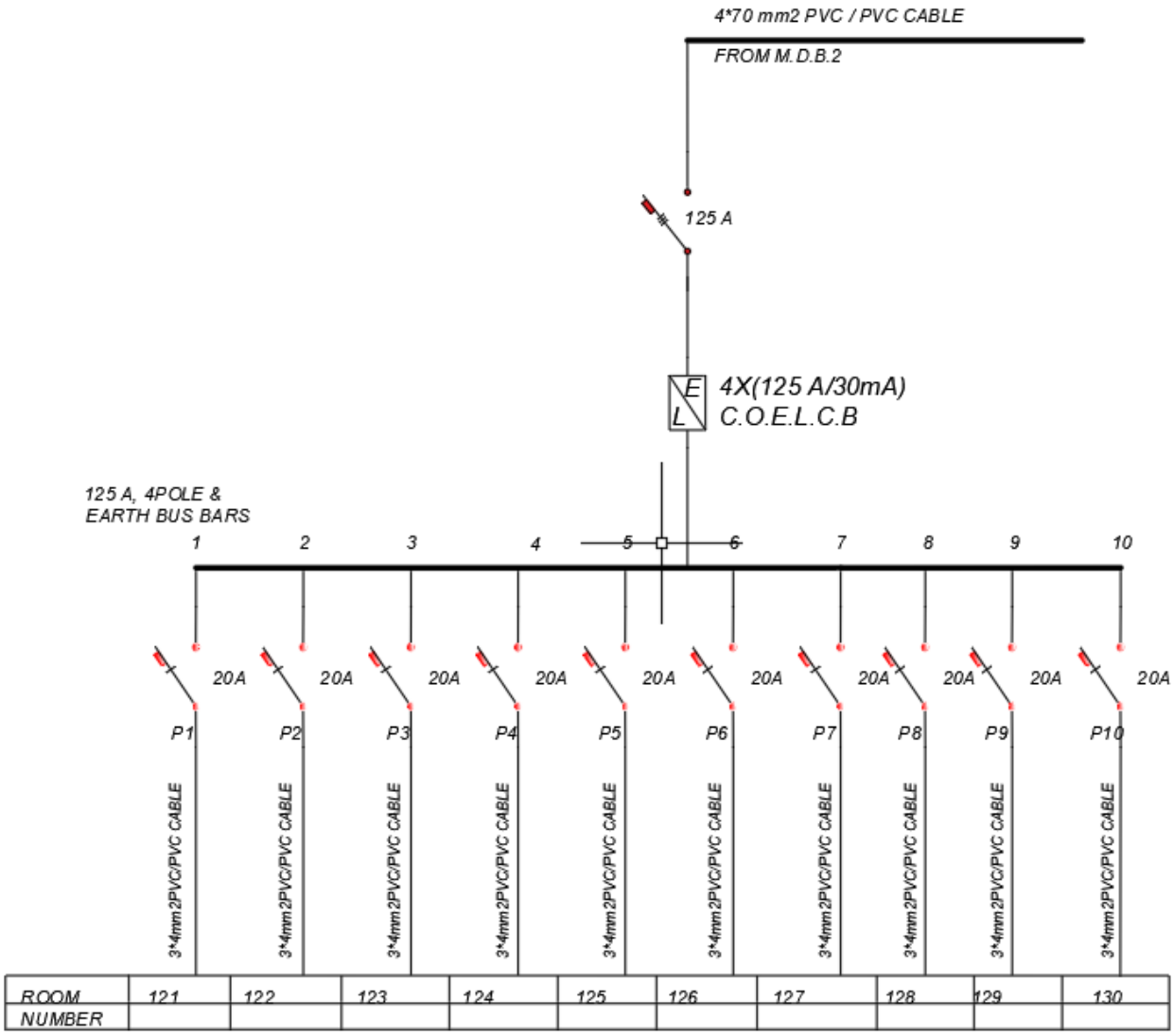


Figure 5.11 Sub distribution bord

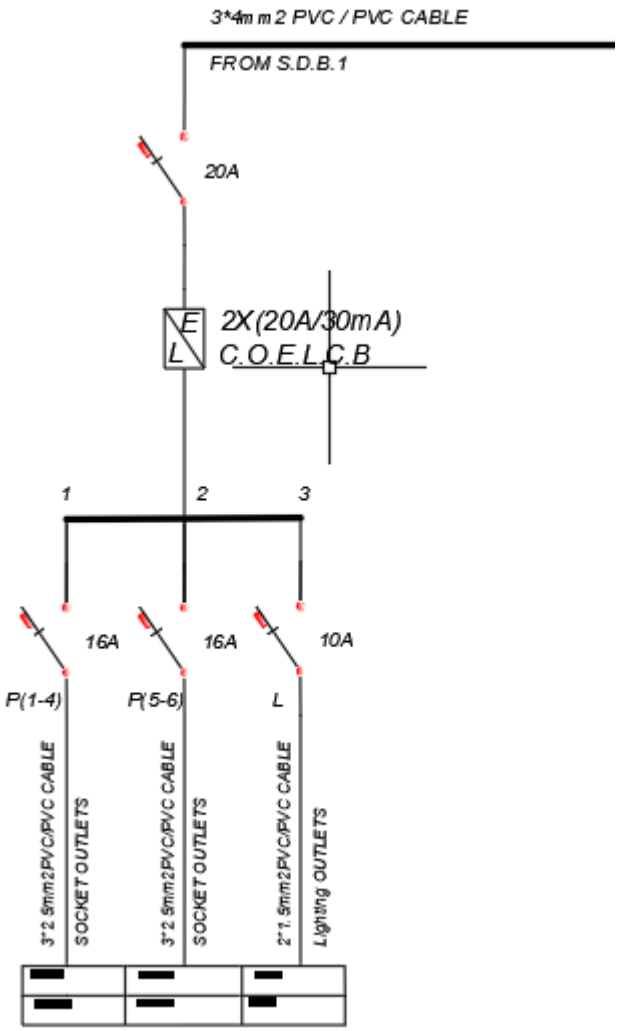


Figure 5.12 Distribution bord

Chapter six

Fire Alarm System

6.1 Overview

6.2 Objective of this system

6.3 Main components of the system

6.4 Types of control systems

6.5 Advantages of the addressable system

6.6 Steps for designing a fire alarm system

6.7 Automatic fire extinguishing system

6.1 Overview

This chapter is about the fire alarm system in general, as it includes the devices used in the design of the system

6.2 Objectives

It is a system that aims to detect the fire at the moment of its occurrence and then convert this early detection into an audio and visual signal to alert the people present in the facility and alert the authorities responsible for extinguishing or relief that there is a fire in its early stage.

6.3 Main components of the system

1. Fire Alarm control panel
2. Sensors and fire detectors.
3. Network (Cable & Pipe fitting)
4. Call point
5. Sound or visual alarm unit

6.4 Types of control systems [8]

1. The old traditional system: (FACP Conventional)
2. addressable system (FACP type Addressable)
3. Intelligent Fire alarm system
4. Wireless system.

The second system was used in the design because it is the most effective is attached in appendix D

6.5 Advantages of the addressable system [8]

1. A large number of sensors can be bound
2. Helps locate the detector that is sensitive to the state of fire.
3. Ensure a permanent reading of the detectors, where in the event of a break in one of the cables, the feed will be from the other direction.
4. It can be linked to other systems.
5. Easy maintenance.

6.6 Steps for designing a fire alarm system [8]

1. **Determining the seriousness of the building:**

   The design of fire alarm systems is divided into categories from L1 to M, which is a descending order according to the seriousness of the building and the possibility of fire.
   Must be taken into account the number of residents, the distance of the project from the nearest fire station, the type of stored materials, and the existing fire-fighting equipment in the building.
   The L1 class design was used
   The L1 classification includes the detection of fires in all rooms, in all emergency exits, and in all architectural voids of more than 0.8 m [8]

2. **Division of Fire Zones:**

   Dividing areas according to the nature of use and height

3. **Selection of call areas:**

- The buttons must be compatible with the system, clear, distinct, and easy to use, and the method of use should be written them it.
- Buttons must be installed in the escape routes in the paths leading to the exits and halls leading to the stairs on each floor. As well as in the outlet's exchange exits[8]

Figure 6.1 Manual Operating Units [10]

- The distance between the person and the alarm button should not exceed 30 meters in the path of the escape route, and the distance between the button and the other should not exceed about 40 meters
- The alarm buttons must be installed at a height of not less than 1.2 meters and not more than 1.6 meters from the floor in a place that is easily accessible and has sufficient lighting and must be distinguished from the color of the wall on which it is installed.[8]

4. Selecting suitable fire detectors and distributing them:

The detector is chosen according to the nature of the place.

Smoke detectors it's divided into two types:

1. Ionization detectors which used in fast fire and energy fire.[12]
2. Optical smoke detectors are used for slow fire, and it not used in places that contain smoke or dust.[12]

Heat detectors it's divided into four types:

• Fixed types used in places that accuse changes in temperature.[12]

• Rate of rising heat detectors used in places where there is smoke or steam or dust.[12]

• Flame detectors used in places of high altitude.[12]

• Gas detectors work in the area of existing pipes to transport gases and it's transported near the pipes to discover any leakage of gases. [12]

5. **Selection and distribution of audio and visual alarm devices:**

Alarm devices are connected in a circuit different from that of the detectors

Figure 6.2 Visual alarm device

In distributing sound alarms, it is taken into account that they give a sound intensity that is 5 decibels higher than the loudest noise in the place. Not less than 65 decibels and not more than 110 decibels, and for a period longer than 30 seconds.

In the case of using sound alarms in hotel bedrooms, the sound intensity at the head of the sleeping person must not be less than 75 decibels to wake the sleeping person.

Emergency signs are placed approximately every 30 m to identify the way out of the building.[8]

Cables and wires

The copper wire must be of the appropriate type for the purpose.[11]

Wire segments should be selected so that they don't cause low voltage and do not affect the efficiency of the equipment.[11]

The outer shell of the wire shall be of moisture-resistant and non-flammable type.[11]

The electrical connections of the detection and warning system shall be installed in an area not less than 50mm from any other electrical connection. [11]

The rules for placing detectors and the area covered by each type:

- **Smoke Detector**
  It covers an area with a radius of 7.5m but uses a radius of 5m to insure there is no uncovered area.

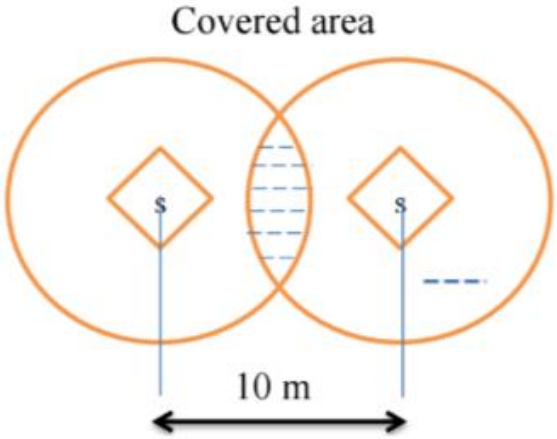


Figure 6.3 The area covered by the smoke detector. .[10]

- **Heat Detector Spacing**
  It covers an area with a radius of 5m but uses a radius of 4m to insure there are no uncovered areas.

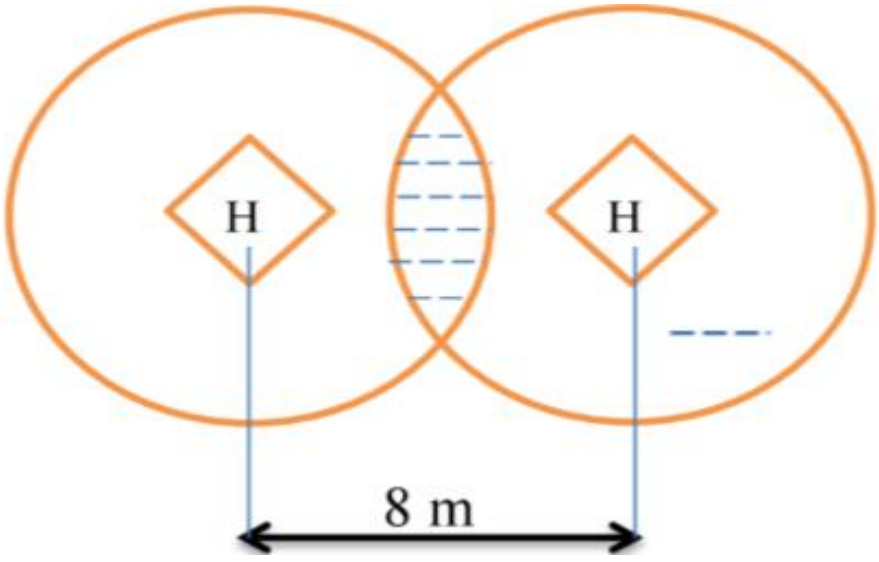


Figure 6.4 The area covered by the heat detector. .[10]

Fire Alarm Control Panel

It controls the system, feeds it with the necessary voltage, and monitors its work, where the alarm reaches it from the detectors, and it operates the bells that give an audio and light warning when a fire occurs.

Determine the area of the fire.

Equipped with a backup battery that operates automatically in the event of a power outage, and it has a charging device that charges the batteries when the power returns

Figure 6.5 Fire Alarm Control Panel.[10]

6.7Automatic fire extinguishing system

- It is an alarm system connected to a gas cylinder 200-FM (a chemical compound used to extinguish the fire (by pipes and sprinklers).
- This system is usually used to protect electrical panels that are more than 100 amps, server rooms, and rooms with an important location, such as archives.[10]

Chapter Seven

Light Current

7.1 overview

7.2 Telephone Network

7.3 Sound System

7.4 Closed Circuit Television SYSTEM (CCTV)

7.1 Overview

This chapter is about light current, including telephone Networks, CCTV systems, and sound systems.

7.2Telephone Network

The telephone systems are among the important systems that must be designed in the project, which works to connect all the phones in the project together through an internal network through which employees can easily talk to each other through an internal central. [8]

There are two types:

1. Traditional system :
    1. Analog :

       It is an ordinary device that can only make calls, and you can identify it by its wire, which consists of one pair of wires.

    2. Digital :

       You can perform additional operations such as storing numbers, forwarding calls, and revealing the caller's number.

2. The modern system (Protocol Internet)

System components:

- **Outlets:** registered jack RJ-11 usually it use [8].
- **IP-telephone:** Usually phones use built-in IP feature so that it is connected directly to the network [8].
- **Telephone box:** It is used to collect the ends of telephone cables together to facilitate the branching and maintenance process [8].
- **Intermediate distribution frame:** also called SDF Sub Distribution Frame, it is an intermediate panel between the main panel of the building and the distribution boxes in the building every turn [8].
- **Main distribution frame:** it is a collection board in which all lines entering and leaving it are collected and organized, and it is considered the focal point for all lines and is distributed from it to the sub-complexes scattered throughout the building[8].
- **Private automatic branch exchange:** the PABX is used to connect a group of internal telephone lines and exchange calls between them [8].
- **Cables/Wires:** The data transmission cables consist of 4 pairs of wires here, and if the distances are more than 90 meters, it uses Fiber Optics type [8].

7.3 Sound System

Figure 7.1 sound system

This system is used in.

1. Send a voice message to everyone in the building
2. Background music
3. Evacuation system during a fire
4. Sound systems in meeting rooms and halls

System components

1. Mixer Amplifier.
2. Microphones.
3. Loudspeaker.
4. Microphone Socket.
5. Cable

7.4 Closed Circuit Television SYSTEM (CCTV)

Types of monitoring systems

1. Analog CCTV System
2. Network CCTV System

The network CCTV System is used in the project

System parts

1. Network Video Recorders (NVR)
2. IP cameras
3. UTP Cable as Cat6a

System design

1. Choose the number of cameras and their locations, as they are placed in corridors, entrances, rooms that contain sensitive devices, server rooms, at reception and outdoor yards.

- In corridors and indoor places, we choose Indoor Cameras to cover the area to be monitored.it attached from appendix E
- In outdoor places we choose outdoor Cameras

2. Choose the NVR so that the number of its entrances is suitable for the number of cameras it attached from appendix E

3. Choose the screen so that its size is suitable for the number of cameras to give us a clear vision when dividing the screen into small screens with the number of cameras. [10]

Chapter Eight

Earthing and lightning system

8.1 overview

8.2 Earthing System

8.3 Grounding methods

8.4 Lightning Design

8.1 overview

This chapter about earthing systems, types, lightning system

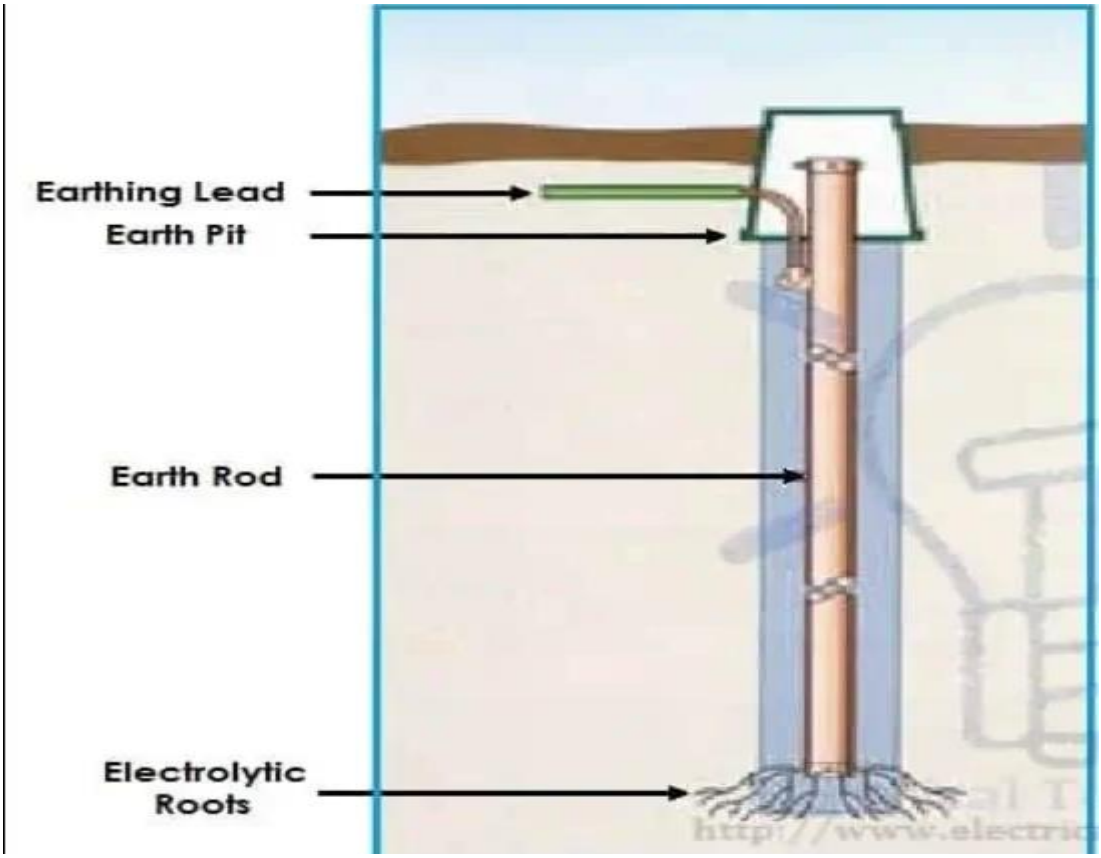
8.2 Earthing System

Earthing is defined as a conductive connection to the electrical potential of the earth's surface, it is the most important part of electrical design, to ensure human and equipment protection.

Components of the earthing system:

- Soil resistivity.
- Earth rod.
- the grounding conductors that connect the electrode to the objects to be grounded.

Figure 8.1 copper rod earthing system [7]



the main earthing terminal(MET), as it is a bus bar from which all protection conductors come out, and from protective conductors all nearby metallic objects that do not originally carry current (gas pipes, windows, and metal doors) it is known as equal potential conductors.[2]

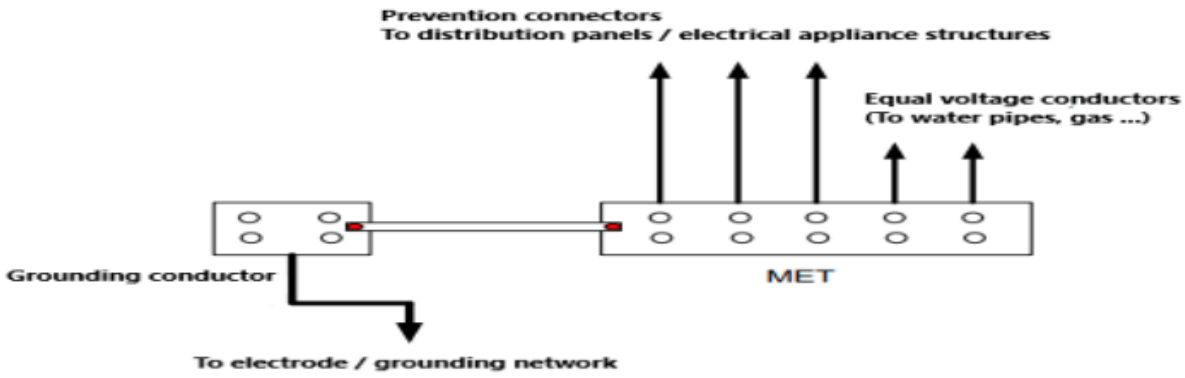


Figure 8.2 M.E.T

The MET connects with earthing electrode through conductor earthing, so differentiation must be between protective conductors and earthing conductors, the protective conductors connect with objects to be earthed and with the earthing conductor in panels [2].

The earthing conductors connect on the one hand to the MET and on the other to earthing network [2].

The most important factors affecting on-ground resistance value:

- The percentage of humidity in the soil.
- Burial depth.
- The resistance of the ground in which the electrodes are buried
- The number of earthing electrodes.

Soil resistivity:

The soil must be suitable in terms of the specific resistance of the soil and the possibility of placing electrodes, as the resistance varies from one soil to another.

Earthing Electrodes:

Earthing electrodes are the rods that are buried in the ground, and the devices that need grounding are connected through the ground connection, and they are considered one of the cheapest types of electrodes, as they are buried for a distance of not less than three meters in the ground, the electrode is mostly made of copper.

Figure 8.3 earthing electrodes [2]

Earthing leads:

It is a copper strip with a section within 2.5*25mm, this is to connect the device to be grounded with the ground electrode.

Grounding in residential buildings:

In building installations, a separate ground electrode (or grounding network) is allocated for the distribution transformer or for the main feeding box. It should be noted that the low voltage panels are separated by another electrode, which is connected to the MET, and then connected to all the BBS in the feeding sub-panels for sockets.[2]

As for devices such as central air conditioning located on rooftops, they are connected together in a row with copper connections and then to the ground through two electrodes.

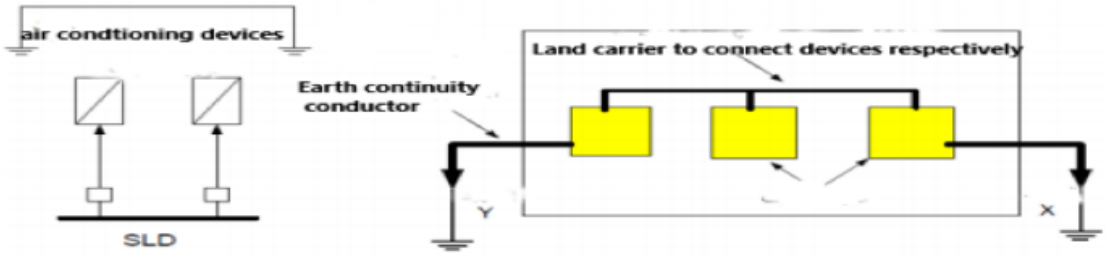


Figure 8.4 earthing of AC [2]

Grounding of communication devices:

It must be taken into account when grounding communication devices that they are separated from the grounding of power devices because the multiplicity of grounding points between power and communication equipment leads to problems in communication systems due to noise [2].

8.3 Grounding methods

- Electrode grounding :

  Earthing using an electrode copper rod (one or more) inserted into the ground to reach the layers of the earth with low specific resistance and thus obtaining a low ground resistance is connected to the main grounding rod in the electrical panel. [10]

- Galvanized grounding :

  Earthing by means of copper tape or galvanized iron, which is welded with the building's foundation iron, and is connected to the main earthing rod. [10]

8.4 Lightning Design

A lightning rod tool connected to the ground with a pointed head fixed at the highest peak in the building collects the huge charges resulting from lightning strikes and discharges them into the ground, and its purpose is to protect electrical appliances and equipment. [10]

Pulsar:

A lightning rod consists of a tapered rod of different lengths connected to the ground by means of a cable and electrodes.

The cable connecting the pulsar is extended in non-metallic pipes that are fixed to the walls of the facility by means of special cleats placed at equal distances over the entire height. [10]

The most important things related to the pulsar:

- The electrical resistance should not be increased about (10 ohms) for the protection system.
- Ground bars are made from red copper and no less in diameter than About 12 mm
- You have to be Electrodes at the closer possible distance from Enterprise. [10]

Pulsar design:

Rp : Radius of protection in a horizontal plane located at vertical distance h from the Pulsar tip

h : Height of the Pulsar tip above the surface(s) to be protected

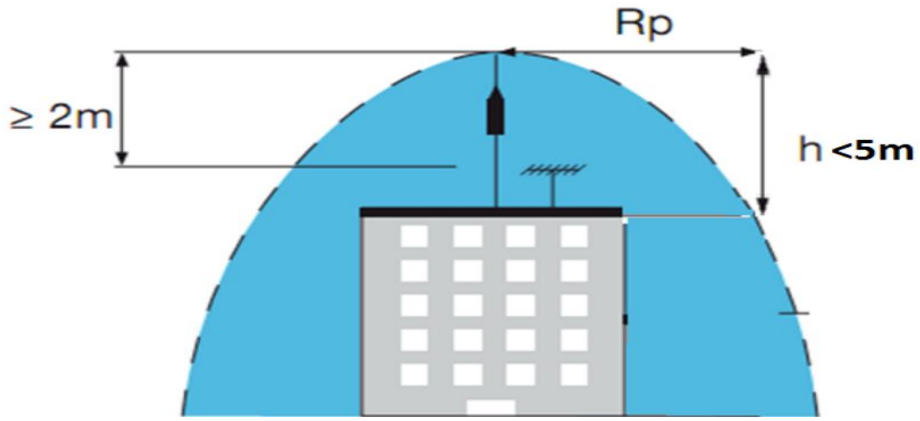


Figure 8.5 Pulsar design [10]

Pulsar references

ΔT (µs)	Description	Reference	L(m)	Weight (kg)
30	Pulsar 30 stainless steel 2 m Lightning conductor	**HO IMH 3012**	2.0	5.0
45	Pulsar 45 stainless steel 2 m Lightning conductor	**HO IMH 4512**	2.03	5.3
60	Pulsar 60 stainless steel 2 m Lightning conductor	**HO IMH 6012**	2.06	5.7

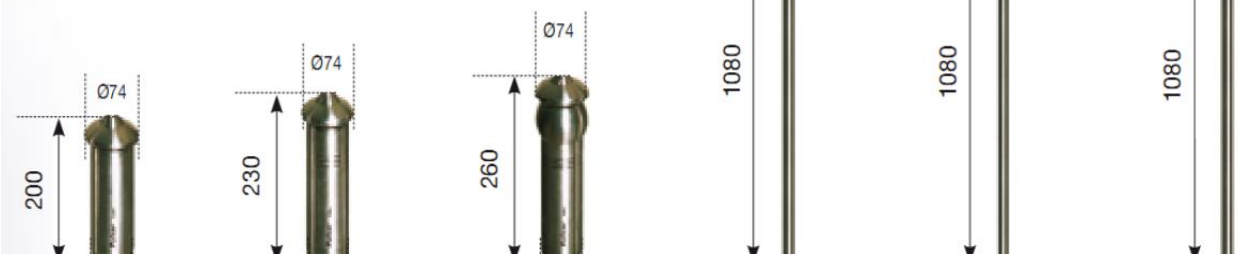


Figure 8.6 lightning rod [10]

Table 8.1 lightning table [10]

Level of protection	I (D = 20 m)			II (D = 30 m)			III (D = 45 m)			IV (D = 60 m)		
Pulsar	Pulsar 30	Pulsar 45	Pulsar 60	Pulsar 30	Pulsar 45	Pulsar 60	Pulsar 30	Pulsar 45	Pulsar 60	Pulsar 30	Pulsar 45	Pulsar 60
h (m)	Radius of protection RP (m)											
2	19	25	32	22	28	35	25	32	40	28	36	44
3	28	38	48	33	42	52	38	48	59	42	57	65
4	38	51	64	44	57	69	50	65	78	57	72	87
5	**48**	**63**	**79**	**55**	**71**	**86**	**63**	**81**	**97**	**71**	**89**	**107**
6	48	63	79	55	71	87	64	81	97	72	90	108
8	49	64	79	56	72	87	66	83	99	75	92	109
10	49	64	79	57	72	88	66	83	99	75	92	109
15	50	65	80	58	73	89	69	85	101	78	95	111
20	50	65	80	59	74	89	71	86	102	81	97	113
45	50	65	80	60	75	90	75	90	105	89	104	119
60	50	65	80	60	75	90	75	90	105	90	105	120

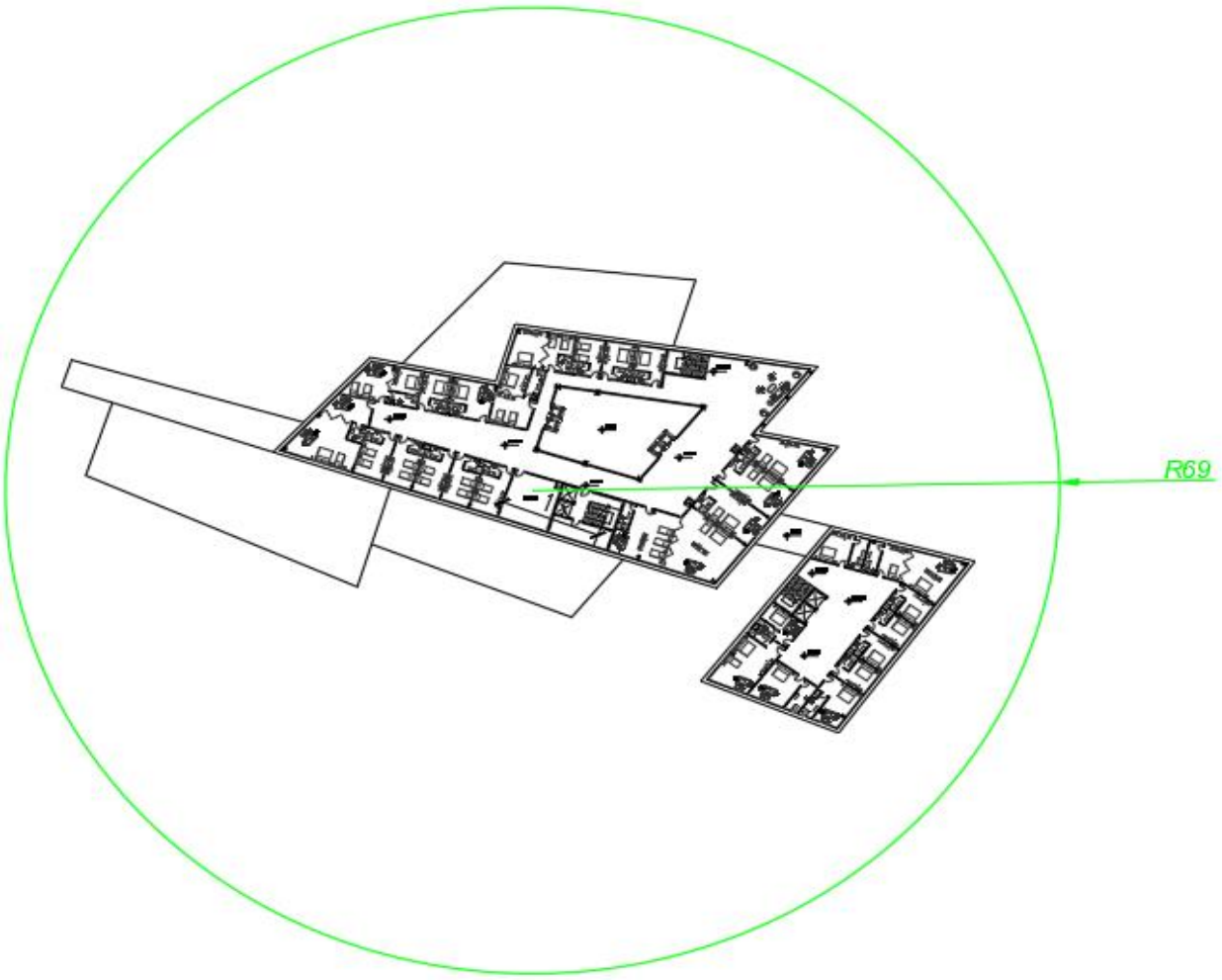


Figure 8.7 lightning for hotel

Chapter Nine

Conclusion

9.1 Conclusion

9.2 Recommendation

9.1 Conclusion

Electrical designs are considered one of the most important things that must be taken into account when designing buildings in general, as the designs must be characterized by accuracy, safety, ease of maintenance, and use, and the designs must take into account the use of the code and its instructions.

When designing the transformer room, the necessary considerations should be taken in spacing, which helps in the ease of maintenance work.

In this project, all the electrical designs necessary for the hotel were designed, which include all of the electrical outlet designs, the design of dynamic load diagrams, fire systems, monitoring systems, calling and telephone, and then calculating the size of the necessary transformer,

As for the lighting, the building lighting was designed by a program specialized in the design of internal and external lighting systems, as it works on simulating the lighting systems in the building before implementation, which facilitates the selection of lighting units according to the used area required and to ensure that the appropriate level of lighting intensity is reached.

9.2 Recommendation

When working on the dialux program for lighting , work on the latest version, which helps to choose lighting units that save energy, as we were unable to work on the latest version because there are some problems in the program as it is under updating.

Work on designing a building management system for the hotel, which helps to save and rationalize energy

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[11]: Nel Sclater and Jhon E. Traister , Hand book of Electrical Design Details ,McGrow-Hill , USA ,2003

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Appendix :

Appendix a

Main

Product range	Trihal
Product or component type	Transformer
Transformer type	Dry type transformer
Network type	AC
Directives	2015/2014/548/EC- ecodesign
Type of installation	Indoor
Maximum altitude	< 1000 m
Cooling mode	ANAF (air natural air forced)
Winding material	Aluminium
Insulation material	Cast resin (HV) Pre-impregnated (LV)
Degree of protection	IP00 IP31 enclosure
Mounting mode	Fixed

Complementary

Phase	3 phases
Rated power	1500 kVA
Rated frequency	50 Hz
Rated primary voltage	11 kV
Secondary voltage (at no-load)	No load: 433 V
Insulation voltage to industrial frequency (50 Hz 1 mn)	12 kV AC primary 1.1 kV AC secondary
Rated insulation level	Primary circuit: 35 kV AC Secondary circuit: 3 kV AC
Lighting impulse whistand voltage (BIL) , 1.2/50 µs	95 kV for primary circuit
Vector group	Dyn11
HV tappings (off circuit)	+/- 2 x 2.5 %
Short circuit impedance	6 %
No-load losses	2560 W
Load losses at 75°C/120 °C	13300 W at 75 °C

	15200 W at 120 °C
Temperature rise of windings	100 K (winding)
Thermal class	F
Sound power level	68.5 dB at 1 m
Electrical connection	Cable high voltage connection Cable low voltage connection
Height	2430 mm
Width	1500 mm
Length	2400 mm
Total weight	3800 kg

Environment

Ambient air temperature for operation	-25...40 °C for C2
Ambient air temperature for storage	-50...40 °C C4
Environmental certification	0...95 % (E4)
Fire certificate	F1
Standards	IEC 60076-11:2018

Offer Sustainability

REACh Regulation	REACh Declaration
REACh free of SVHC	Yes
EU RoHS Directive	Pro-active compliance (Product out of EU RoHS legal scope) EU RoHS Declaration
Mercury free	Yes
RoHS exemption information	Yes
China RoHS Regulation	China RoHS declaration Product out of China RoHS scope. Substance declaration for your information

Recommended replacement(s)

Technical parameters

Resistance, reactance, impedance and voltage drop
Pmax bus duct offers low voltage drop, and its high-purity copper conductor provides very low resistance. The compact "sandwich" structure design and aluminum enclosure of weakly magnetic material minimize conductor reactance.

Following are impedance and voltage drop data for straight line segments of the bus duct.

Pmax-C (50 Hz, temperature 20 ˚C)

Influence of ambient temperature on operation
Pmax bus duct can operate continuously at rated current if the average temperature of its surroundings does not exceed 35 ˚C. When average temperature is higher than normal value, bus duct shall be properly derated. Derating parameters are shown below:

Ambient temperature ˚C	Derating coefficient
40	1
45	0.97
50	0.94
55	0.91
60	0.88
65	0.85

Rated current (A)	R_{20}	X_{20}	Z_{20}	Voltage drop U				
				cosϕ 0.6	cosϕ 0.7	cosϕ 0.8	cosϕ 0.9	cosϕ 1.0
400	0.00009851	0.00003536	0.00010467	0.0363	0.0391	0.0415	0.0432	0.0409
630	0.0000862	0.00003409	0.0000927	0.0516	0.0553	0.0584	0.0604	0.0563
800	0.00006896	0.00003147	0.0000758	0.0552	0.0587	0.0614	0.0629	0.0572
1000	0.00005305	0.00002033	0.00005681	0.0499	0.0536	0.0567	0.0587	0.055
1250	0.00003831	0.00001687	0.00004186	0.0473	0.0504	0.0529	0.0542	0.0497
1600	0.00002873	0.00001368	0.00003182	0.0468	0.0496	0.0518	0.0528	0.0477
2000	0.00002155	0.00001041	0.00002393	0.0441	0.0467	0.0487	0.0496	0.0447
2500	0.00001642	0.00000887	0.00001866	0.0439	0.0462	0.0479	0.0483	0.0426
3200	0.00001437	0.00000777	0.00001633	0.0492	0.0518	0.0536	0.0542	0.0477
4000	0.00001045	0.00000595	0.00001202	0.0458	0.048	0.0495	0.0498	0.0433
5000	0.00000802	0.00000372	0.00000884	0.0404	0.0429	0.0448	0.0458	0.0416
6300	0.00000575	0.00000262	0.00000632	0.0362	0.0385	0.0403	0.0413	0.0375

Table of overall dimensions and weights of Pmax-C bus duct

S/N	Rated current (A)	Width W (mm)	Height H (mm)	Straight line segment weight (kg/m)		Start terminal weight of start terminal (kg/m)		Connector weight (kg/set)		L-type horizontal elbow eight (kg/segment) X*Y=500*500	
				Four-wire 100% N	Five-wire 100% N +50% PE	Four-wire 100% N	Five-wire 100% N +50% PE	Four-wire 100% N	Five-wire 100% N +50% PE	Four-wire 100% N	Five-wire 100% N +50% PE
1	400	125	110	11.0	11.8	12.1	13.7	3.336	3.599	9.3	10.0
2	630	125	110	11.9	12.8	13.1	14.8	3.336	3.599	10.1	10.8
3	800	125	120	14.0	15.1	15.4	17.5	3.640	3.926	11.9	12.8
4	1000	125	135	17.0	18.4	18.7	21.3	4.095	4.417	14.4	15.6
5	1250	125	160	22.0	24.1	24.2	28.0	4.853	5.235	18.6	20.4
6	1600	125	190	28.1	30.7	30.9	35.6	5.763	6.216	23.8	26.0
7	2000	125	230	36.1	39.7	39.7	46.1	6.976	7.525	30.6	33.6
8	2500	125	280	46.2	50.8	50.8	58.9	8.492	9.161	39.1	43.0
9	3200	125	360	55.5	60.8	61.1	70.5	10.919	11.778	47.0	51.5
11	4000	125	450	73.5	80.9	80.9	93.8	13.649	14.723	62.3	68.5
12	5000	125	550	93.8	103.5	103.2	120.1	16.682	17.994	79.4	87.7
13	6300	125	770	131.2	144.9	144.3	168.1	23.354	25.192	111.1	122.7

Table of weights of Pmax-C plug-in unit

S/N	Branching current (A)	Weight of Pmax-C plug-in unit (kg/PCs)
1	100	100
2	160	160
3	250	250
4	400	400
5	630	630
6	800	800
7	1000	1000

BENEFITS

- Long life expectancy
- Heavy duty construction
- Drop in replacement availability
- Quiet operation
- Available through 100 HP

FEATURES

- Drip-proof enclosure
- 600–1,800 rpm
- Single and two bearing designs
- Encoder and encoder mounting options
- Hot rolled steel shafts
- UL/CSA CUS Certified

APPLICATIONS

- Dry hydraulic elevators

AC Dry Hydraulic Motors
Frames 215T through 365T

Quiet, efficient AC dry hydraulic motors.

Designed for use with belted hydraulic pump systems, Imperial Electric AC Dry Hydraulic Motors are exceptionally quiet, highly efficient and built for rugged duty. Totally Enclosed Fan Cooled (TEFC) designs are available for most ratings.

Rated for 80 or 120 starts per hour, the AC Dry Hydraulic Motor is a drop-in replacement for existing motors, making any elevator modernization project more efficient.

The AC Dry Hydraulic Motor is just one of many highly engineered products developed for the elevator industry by Imperial Electric. Imperial Electric has more than 100 years experience in electrodynamic devices. Learn how Imperial Electric can benefit your next project. Call your representative today for more information.

AC Dry Hydraulic Motors duty table, 80 starts per hour

HP	Full Load RPM	Frame	Voltage	Amps (A)					Elevator Duty BTU Per Hour
				Delta				WYE	
				Full Load	No Load	Locked Rotor	KVA Code	Locked Rotor	
15	1740	215T	200	46	23	270	G	89	1859
	1735	215T	230/460	39.2/19.6	19/9.5	230/115	G	76/38	1859
	1735	215T	575	15.7	7.6	92	G	31	1859
20	1750	254T	200	62	31	340	G	112	2263
	1750	254T	230/460	54/27	27/13.5	296/148	G	98/49	2263
	1750	254T	575	22	11	120	G	40	2263
25	1755	256T	200	73	31	420	G	139	2360
	1755	256T	230/460	62/31	26.4/13.2	366/183	G	120/60	2360
	1755	256T	575	25	10.6	146	G	48	2360
30	1760	284T	200	87	36	500	G	165	2774
	1760	284T	230/460	74/37	31/15.5	430/215	G	142/71	2774
	1760	284T	575	30	12.4	172	G	57	2774
40	1760	286T	200	112	42	670	G	221	3282
	1760	286T	230/460	98/49	37/18.5	580/290	G	192/96	3282
	1760	286T	575	39	14.5	230	G	76	3282
50	1760	324T	200	138	70	850	G	281	3869
	1760	324T	230/460	118.8/59.4	62/31	740/370	G	244/122	3869
	1760	324T	575	49	25	310	G	102	3869
60	1760	326T	200	162	70	1000	G	330	4477
	1760	326T	230/460	143.2/71.6	64/32	920/480	G	304/152	4477
	1760	326T	575	58	26	370	G	122	4477
75	1770	364T	200	210	87	1320	G	436	5253
	1770	364T	230/460	180/90	72/36	1120/560	G	370/185	5253
	1770	364T	575	72	29	450	G	149	5253
100	1780	365T	230/460	228/114	76/38	1590/795	G	524/262	6015
	1780	365T	575	91	30	636	G	210	6015

AC dry hydraulic motors are available across a wide range of horsepower ratings, including 80 or 120 starts per hour.

AC Dry Hydraulic Motors DIMENSIONAL DIAGRAM: Page 11

Specification

Operating Voltage 230V 50Hz AC (+10%, -15% voltage tolerance)

Max. PSU Rating
220VA total, comprising: Battery Charger: 1 Amp

Internal & External Loads
General System Load: 2.25A @ 24V nominal
Loop Load: 2.50A

Standby Batteries 24V sealed lead acid batteries
Minimum Capacity: 2x 12V 7Ah
Maximum Capacity: 2x 12V 24Ah

Dimensions (mm) 500 x 500 x 195

Weight 20 kg without batteries

Environmental Operating Limits
Temperature: 0°C to +40°C
Humidity: 85% non-condensing (maximum)

Construction Sheet steel painted, sealed to IP32

Cable Entry 24 x 20mm knock-outs in top of cabinet
24 x 20mm knock-outs in bottom of cabinet

Loop Capacity 1 to 5 Loops expandable
460mA per loop Maximum

Apollo, Nittan and Hochiki Protocols:
Max. 126 devices (detectors and modules) per loop
Morley-IAS and System Sensor Protocols:
Max. 99 sensor and 99 module addresses per loop
Note: Mulitiple sensor protocols cannot be used in the panel simultaneously.

Zones Up to 20 zone with individual LED indicators. Expandable to 40 or 80 individual LED indicators. A maximum 200 can be programmed with up to 120 software zones with no LED indication.

Internal Sounder Intermittent buzzer (fault condition) High-pitched continuous buzzer (fire condition)

External Outputs
Sounder Outputs 2 programmable outputs. Open and short circuit monitoring. 1A maximum per output.
Auxiliary Relays 1 fault and 1 fire relay voltage free, changeover outputs Contacts rated at 24V AC/DC, 1A, 0.6 PF maximum.

User Controls
SOUND ALARMS, SILENCE/ RESOUND, MUTE BUZZER, ACCEPT, SYSTEM RESET

Programming Controls
Alphanumeric multi-level keypad with 15 keys and 5 control keys: YES, NO, CHANGE, ENTER and SHIFT

LED type general panel status indicators
FIRE, FAULT, ACKNOWLEDGED, DISABLEMENT, TEST, SOUNDER FAULT, DELAYED MODE, RELAYS DISABLED, EARTH FAULT, SYSTEM /CPU FAULT, SOUNDERS DISABLED, ALARMS SILENCED, SUPPLY FAULT, POWER.

LED type zone Indicators (for 20 zones)
FIRE, FAULT/TEST/DISABLED

Display
4x40-character LCD alphanumeric display with back-light.

Serial Interface
3 serial ports with connections for optional RS485 or RS232 plug-in communication cards.

Networking
Maximum 99 panels can be networked using a Master Network and connected Sub-Networks.

Part Numbers

721-001-301	ZX5Se Fire Alarm Control Panel
795-066-100	Apollo XP95 & Discovery Loop Driver Card
795-058-105	Hochiki ESP Loop Driver Card
795-044-001	Nittan Loop Driver Card
795-068-100	System Sensor Loop Driver Card
795-072-100	Morley-IAS Loop Driver Card
795-005	RS232 Communication Card
795-004-001	RS485 Communication Card
795-077-020	20 Zone LED Display Indicator Card
795-077-060	60 Zone LED Display Indicator Card
795-051-001	Internal Printer
797-062	ZX5Se Bezel Kit.
797-064	ZX5Se Glass Door Kit
795-082	Engineer's Software Programming Kit including Fire 6
795-080	Programming interface lead
795-081-001	Fire 6 Enhanced Feature Set Software Key.
795-014	4 way programmable relay module, pcb only.
795-015	4 way programmable sounder module, pcb only.
795-029	8 way programmable input module, pcb only.
795-038-001	Hi-485 communication module, pcb only.
795-065	40 way programmable mimic interface module, pcb only.
709-601-001	ZXr-A Active Repeater. LCD, System Status indicators and user controls for Silence, Reset, Mute and Evacuate all activated by a key switch.
709-701-001	ZXr-P Passive Repeater. LCD and system status indicators.
020-600-002	Bezel Kit for ZXr series repeaters
795-060-002	External remote printer module.
795-057	MODBUS interface unit.
795-067-001	Paging system interface module. Suitable for SCOPE, ASCOM/TELENOVA.

Fire System Compatibility

Morley-IAS is fully committed to offering practical solutions and supporting products that enhance your buildings control systems.

Other Supporting Products Include

- Morley-IAS Intelligent Public Address and Voice Alarm Equipment
- Morley-IAS Visualeyez range of Alarm Management Graphical Interface Systems
- Morley-IAS Dimension Analogue Addressable Panels
- Morley-IAS Horizon Conventional Panels
- Morley-IAS Extinguishing Panels

For further details on these or any other Morley-IAS product please contact your local distribution point, Morley-IAS Regional Sales Manager or via our contact details.

Morley-IAS by Honeywell a real choice for fire detection solutions, committed to supporting our device partners.

HIKVISION

Specifications

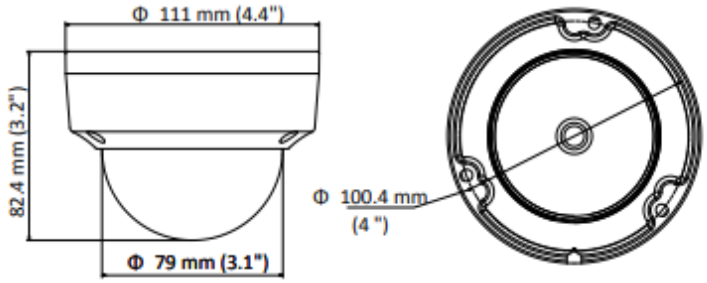
Camera	
Image Sensor	1/2.7" Progressive Scan CMOS
Min. Illumination	Color: 0.01 Lux @(F1.2; AGC ON), 0.028 Lux @(F2.0; AGC ON)
Shutter Speed	1/3 s to 1/100,000 s
Slow Shutter	Yes
Auto-Iris	No
Day & Night	IR Cut Filter
Digital Noise Reduction	3D DNR
Wide Dynamic Range	120 dB
3-Axis Adjustment	Pan: 0° to 355°, tilt: 0° to 70°, rotate: 0° to 355°
Lens	
Focal Length	2.8/4/6 mm
Aperture	F2.0
Focus	Fixed
FOV	2.8 mm, horizontal FOV: 100°, vertical FOV: 74°, diagonal FOV: 130° 4 mm, horizontal FOV: 75°, vertical FOV: 55°, diagonal FOV: 98° 6 mm, horizontal FOV: 49°, vertical FOV: 37°, diagonal FOV: 60°
Lens Mount	M12
IR	
IR Range	Up to 40 m
Wavelength	850nm
Compression Standard	
Video Compression	Main stream: H.265/H.264 Sub-stream: H.265/H.264/MJPEG Third stream: H.265/H.264
H.264 Type	Baseline Profile/Main Profile/High Profile
H.264+	Main stream supports
H.265 Type	Main Profile
H.265+	Main stream supports
Video Bit Rate	32 Kbps to 8Mbps
Smart Feature-set	
Behavior Analysis	Line crossing detection, intrusion detection
Region of Interest	Support 1 fixed region for main stream
Image	
Max. Resolution	2560 × 1920
Main Stream	50Hz: 12.5fps (2560 × 1920), 20fps (2560 × 1440), 25fps (2304 × 1296, 1920 × 1080, 1280 × 720) 60Hz: 15fps (2560 × 1920), 20fps (2560 × 1440), 30fps (2304 × 1296, 1920 × 1080, 1280 × 720)
Sub Stream	50Hz: 25fps (640 × 480, 640 × 360, 320 × 240) 60Hz: 30fps (640 × 480, 640 × 360, 320 × 240)
Third Stream Max. Frame Rate	50Hz: 1fps (1920 x 1080, 1280 x 960, 1280 x 720, 704 x 480, 640 x 480, 352 x 240, 320 x 240) 60Hz: 1fps (1920 x 1080, 1280 x 960, 1280 x 720, 704 x 480, 640 x 480, 352 x 240, 320 x 240)
Image Enhancement	BLC/3D DNR/HLC
Image Settings	Saturation, brightness, contrast and sharpness are adjustable via client software and web browser
Day/Night Switch	Auto/Scheduled/Day/Night

Network	
Alarm Trigger	Motion detection, video tampering, network disconnected, IP address conflict, illegal login, HDD error, HDD full
Network Storage	NAS (NFS,SMB/CIFS)
Protocols	TCP/IP, ICMP, HTTP, HTTPS, FTP, DHCP, DNS, DDNS, RTP, RTSP, RTCP, PPPoE, NTP, UPnP, SMTP, SNMP, IGMP, QoS, IPv6, UDP, Bonjour, 802.1x
General Function	One-key reset, heartbeat, mirror, password protection, privacy mask, watermark, IP address filter
Firmware Version	V5.5.52
API	ONVIF(PROFILE S,PROFILE G), ISAPI
Simultaneous Live View	Up to 6 channels
User/Host	Up to 32 users 3 levels: Administrator, Operator and User
Client	iVMS-4200, Hik-Connect, iVMS-5200, iVMS-4500
Web Browser	IE8+, Chrome 31.0-44, Firefox 30.0-51, Safari 8.0+
Interface	
Communication Interface	1 RJ45 10M/100M self-adaptive Ethernet port
Reset Button	Yes
General	
Operating Conditions	-30 °C to +60 °C (-22 °F to +140 °F), Humidity 95% or less (non-condensing)
Power Supply	12 VDC ± 25% PoE: 802.3af, class 3
Power Consumption and Current	12 VDC, 0.5 A, max. 6 W PoE (802.3af, 36 to 57 V), 0.2 A to 0.1 A, max. 7.5 W
Protection Level	IP67, IK10
Material	Bubble: plastic, bottom base: metal
Dimensions	Camera: Ø 111 mm × 82.4 mm (4.4" × 3.2") With package: 134 mm × 134 mm × 108 mm (5.3" × 5.3" × 4.3")
Weight	Camera: approx. 400 g (0.9 lb.) With package: approx. 600 g (1.3 lb.)

Available Model:

DS-2CD3151G0-I (2.8/4/6 mm)

Dimensions



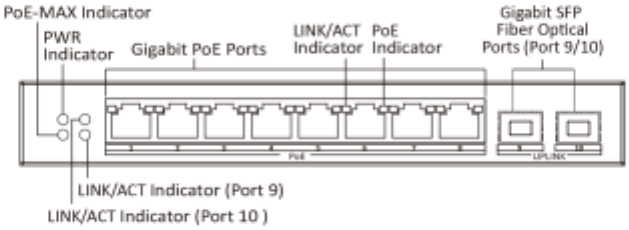
Specification

Model		DS-3E1510P-EI
Network parameters	Port number	8 × gigabit PoE ports, and 2 × gigabit fiber optical ports
	Port type	RJ45 port, full duplex, MDI/MDI-X adaptive
	Standard	IEEE 802.3, IEEE 802.3u, IEEE 802.3x, IEEE 802.3ab, and IEEE 802.3z
	Forwarding mode	Store-and-forward switching
	Working mode	Standard mode (default); Extend mode
	MAC address table	8 K
	Switching capacity	20 Gbps
	Packet forwarding rate	14.88 Mpps
	Internal cache	4.1 Mbits
PoE power supply	PoE standard	IEEE 802.3af, IEEE 802.3at
	PoE power pin	Ethernet cables 1/2/3/6 provide power supply.
	PoE port	Ports 1 to 8
	Max. port power	30 W
	PoE power budget	110 W
General	Shell	Metal material, fan-free design
	Net weight	1.21 kg (2.67 lb)
	Gross weight	1.3 kg (2.87 lb)
	Dimension (L × H × D)	217.6 mm × 108.55 mm × 27.8 mm (8.57" × 4.27" × 1.09")
	Operating temperature	-10°C to 55°C (14°F to 131°F)
	Storage temperature	-40°C to 85°C (-40°F to 185°F)
	Operating humidity	5% to 95% (no condensation)
	Relative humidity	5% to 95% (no condensation)
	Power supply	48 VDC, 2.5 A
	Power source	120 W
	Max. power consumption	120 W
	Power consumption in idle	7 W
Software function	Device maintenance	Support remote upgrade, recovering default parameters, viewing logs, configuring basic network parameters, import and export configuration, time sync.
	Port configuration	Support the configuration of port rate and slow control, and ports enabling.
	Long range	Support up to 300 m transmission.
	PoE watchdog	Ports 1 to 8: auto detect and restart the cameras that do not respond.
	Port rate-limiting	Support rate-limiting for ingress and egress ports..
	Storm control	Support the storm control of unknown unicast, multicast and broadcast.
	Port mirroring	Support port mirroring function.
	QoS	Support WRR and SP scheduling and port priority.
	VLAN	Support 4094 VLANs.
	STP	Support STP and RSTP.
	SNMP	Support SNMPv1 and SNMPv2c, the node information for system and interfaces acquisition.
	PoE	Support IEEE 802.3at/af power supply.

Model		DS-3E1510P-EI
Approval	EMC	FCC (47 CFR Part 15, Subpart B); CE-EMC (EN 55032: 2015, EN 61000-3-2: 2014, EN 61000-3-3: 2013, EN 55024: 2010 +A1: 2015); RCM (AS/NZS CISPR 32: 2015); IC (ICES-003: Issue 6, 2016)
	Safety	UL (UL 60950-1); CB (IEC 60950-1:2005 + Am 1:2009 + Am 2:2013); CE-LVD (EN 60950-1:2005 + Am 1:2009 + Am 2:2013)
	Chemistry	CE-RoHS (2011/65/EU); WEEE (2012/19/EU); Reach (Regulation (EC) No 1907/2006)

Physical Interface

Front panel:

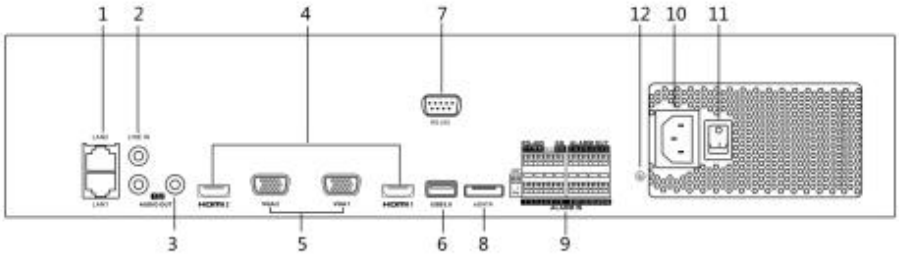


Rear panel:

Available Model

DS-3E1510P-EI

Physical Interfaces



Index	Description	Index	Description
1	LAN1/LAN2 Interface	7	RS-232 Interface
2	LINE IN	8	eSATA Interface
3	AUDIO OUT	9	Alarm In/Alarm Out
4	HDMI1/HDMI2 Interface	10	100 to 240 VAC power supply
5	VGA1/VGA2 Interface	11	Power Switch
6	USB 3.0 Interface	12	GND

Available Models

DS-9608NI-I8, DS-9616NI-I8, DS-9632NI-I8, DS-9664NI-I8

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Hikvision Africa

Hikvision Hong Kong

	(without hard disk)	≤ 10 kg (22 lb)

Generator set data sheet

Model: C400D5EB
Frequency: 50 Hz
Fuel type: Diesel

Spec sheet:	**EMERS-5888-EN**
Noise data sheet :	**MSP-TBD**
Cooling data sheet:	**MCP-TBD**
Prototype test summary data sheet:	**PTS-TBD**
Alternator data sheet:	**ADS-305**

Fuel consumption	**Standby**				**Prime**			
	kVA (kW)				**kVA (kW)**			
Ratings	400 (320)				364 (291)			
Load	**1/4**	**1/2**	**3/4**	**Full**	**1/4**	**1/2**	**3/4**	**Full**
Gal (UK)/hr	7.3	12.2	16.2	20	7.1	11.5	15.3	18.5
L/hr	33.1	55.3	73.5	100.9	28.6	52.9	72	89.2

Engine	**Standby rating**	**Prime rating**
Engine manufacturer	Cummins	
Engine model	QSZ13-G7	
Configuration	4 cycle; in-line 6 cylinder diesel	
Aspiration	Turbocharged and charge air-cooled	
Gross engine power output, kWm	419	366
BMEP at set rated load, kPa	2578	2258
Bore, mm	130	
Stroke, mm	163	
Rated speed, rpm	1500	
Piston speed, m/s	8.1	
Compression ratio	17:1	
Lube oil capacity, L	75.33	
Overspeed limit, rpm	1500 ±10%	
Regenerative power, kW	33	
Governor type	Electronic	
Starting voltage	24 Volts DC	

Fuel flow

Maximum fuel flow, L/hr	247
Maximum fuel inlet restriction, mm Hg	203

Eaton 9SX UPS

1 Remote Off/On and Remote Power Off connectors
2 Slot for Management card
3 External battery module (EBM) connector with automatic detection (RJ11)

Eaton 9SX 11 kVA

4 DB 9 with output contacts
5 USB and serial ports
6 Input/Ouput connections

Technical specifications

	5 kVA	6 kVA	8 kVA	11 kVA
Rating (kVA/kW)	5 kVA/4.5 kW	6 kVA/5.4 kW	8 kVA/7.2 kW	11 kVA/10 kW
Format	Tower or RT (Rack/Tower)	Tower or RT (Rack/Tower)	RT (Rack/Tower)	RT (Rack/Tower)
Electrical characteristics				
Technology	On-line double-conversion with Power Factor Correction (PFC) system			
Nominal voltage	200/208/220/230/240 V		200/208/220/230/240 V/250 V	
Input voltage range	176-276V without derating (RT models: 160-276V with derating; Tower models: 120-276V with derating)			
Input frequency range	40-70 Hz, 50/60 Hz autoselection, frequency converter as standard			
Efficiency	Up to 94% in Online mode, 98% in Hi-Efficiency mode		Up to 95% in Online mode, 98% in Hi-Efficiency mode	
Crest factor/short circuit current	3:1/90 A	3:1/90 A	3:1/120 A	3:1/150 A
Overload capacity	Tower models: 102-110% : 120s, 110-125%: 60s, 125-150% : 10s, >150%: 500ms RT models: 102-130% : 120s, 130-150% : 30s, 125-150%: 10s, >150%: 100ms		102–110% : 120 s, 110–125%: 60 s, 125–150%: 10 s, >150%: 900 ms	
Connections				
Input	Terminal block (up to 10 mm²)		Terminal block (up to 16 mm²)	
Outputs	Tower models: Terminal block RT models: : Terminal block + 2 controlled groups of 4 IEC C13 (10A) + 2 IEC C19 (16A)		Terminal block	
Batteries				
Typical backup times at 50 and 70% load*				
9SX	Tower: 30/19 min RT: 13/10 min	Tower: 24/15 min RT: 11/8 min	15/10 min	9/5 min
9SX + 1 EBM	Tower: 120/70 min, RT: 60/40 min	Tower: 90/57 min RT: 48/34 min	38/25 min	22/15 min
9SX + 4 EBM	Tower : 485/275 min, RT: 220/150 min	Tower: 385/220 min, RT: 170/120 min	120/82 min	80/55 min
Battery management	ABM® & Temperature compensated charging method , Automatic battery test, deep discharge protection, automatic recognition of external battery units			
Communication				
Communication ports	USB and Serial ports (cannot be used simultaneously), Dry contact, 1 Remote Power Off (all models), 1 Remote On/Off (RT format models)			
Communication slot	1 slot for Network-M2, Network-MS, ModBus-MS or Relay-MS cards.			
Operating conditions, standards and approvals				
Operating temperature	0 to 40°C continuous			
Typical noise level	<46dB	<46dB	<48 dB	<50 dB
Safety	IEC/EN 62040-1, UL 1778 & CSA 22.2 (5 & 6kVA RT only)			
EMC, performance	IEC/EN 62040 -2 , IEC/EN 62040-3			
Approvals	CE, CB report (TUV), UL (5 & 6kVA RT only)			
Dimensions H x W x D/Weight				
UPS	Tower: 575x244x542mm/65.5kg, RT: 440(19")x130(3U)x685mm/48kg		440(19")*260(6U)*700mm/84kg	440(19")x260(6U)x700 mm/86 kg
EBM	Tower: 575x244x542mm/104,5kg, RT: 440(19")x130(3U)x645mm/58kg		440(19")*130(3U)*680mm/65kg	440(19")x130(3U)x680 mm/65 kg
Power module	--	--	440(19")x130(3U)x700 mm/19 kg	440(19")x130(3U)x700 mm/21 kg
Customer service and support				
Warranty	2 years warranty			

* Runtimes are shown at 0.7 power factor. Backup times are approximate and may vary with equipment, configuration, battery age, temperature, etc

Parts numbers	9SX 5 kVA	9SX 6 kVA	9SX 8 kVA	9SX 11 kVA
UPS (Tower)	9SX5KI	9SX6KI	-	-
UPS (RT format)*	-	-	9SX8KI	9SX11KI
UPS (RT with rack kit)*	9SX5KIRT	9SX6KIRT	9SX8KIRT	9SX11KIRT
EBM (Tower)	9SXEBM240T	9SXEBM240T	-	-
EBM (RT format)	-	-	9SXEBM240	9SXEBM240
EBM (RT with rack kit)	9SXEBM180RT	9SXEBM180RT	-	-
Power Module	-	-	9SX8KIPM	9SX11KIPM
HotSwap Maintenance ByPass	MBP6KI	MBP6KI	MBP11KI	MBP11KI
Supercharger with Rack Kit	-	-	SC240RT	SC240RT
1.8m Battery Connection Cable	Tower: EBMCBL240T, RT: EBMCBL180	Tower: EBMCBL240T, RT: EBMCBL180	EBMCBL240	EBMCBL240
Rack Kit	-	-	9RK	9RK

* For 8 & 11 kVA UPS: Power Module + EBM

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Powering Business Worldwide

Electrical performance

The transfer switches listed below must be protected by either circuit breakers or fuses. The following WCR ratings are available when protecting the transfer switch with a circuit breaker or fuse. Short circuit ratings are stated in symmetrical RMS ampere.

Fuse protection

Transfer switch ampere	Overload current (make-break test)	Endurance cycles at current (operational performance capability)	WCR at 480V max with current limiting fuse	Max fuse, size and type
40, 63	95 amps	6000 at 63 amps	26,000 amps	RT16NT-00 63 amp IEC NH Fuse type
100, 125	188 amps	6000 at 125 amps	26,000 amps	RT16NT-00 125 amp IEC NH Fuse type
160, 200, 225, 250	375 amps	6000 at 125 amps	38,000 amps	RT16NT-2 250 amp IEC NH Fuse type
350, 400, 500	750 amps	1000 at 0 amps 2000 at 500 amps	50,000 amps	RT16NT-3 500 amp IEC NH Fuse type
630, 800	1200 amps	1000 at 0 amps 2000 at 800 amps	55,000 amps	RT16NT-4 800 amp IEC NH Fuse type
1000, 1250	1875 amps	1500 at 0 amps 1500 at 1250 amps	65,000 amps	RT16NT-4 1250 amp IEC NH Fuse type
1600, 2000	3000 amps	1500 at 0 amps 500 at 2000 amps	120,000 amps	KRP-C 3000 amp Class L Fuse type

Transfer switch ampere	Max breaker rating	Specified Circuit breaker protection manufacturer, model and type
40, 63	63A	Schneider: NSX160FTM, EZD100, NSD100F, NSD100K Siemens: 3VU, 3RV1, 3VT1 ABB: Isomax S1, S2X80, Sim100
100, 125	125A	Schneider: NSX160FTM, NSD160K Siemens: 3VL, 3VT1 ABB: Isomax S2, Isomax S3, S3X, Sim250
160, 200, 225, 250	250A	Schneider: NSX250NTM, NSD250K Siemens: 3VL, 3VT2 ABB: Isomax S3, S4X, Sim250
350, 400, 500	500A	Schneider: NSX630NTM, NSD630K Siemens: 3VL,3VT3 ABB: Isomax S4, S6X, Sim500
630, 800	800A	Schneider: MT08, MT10, NW08 Siemens: 3VL, 3WT, 3VT4 ABB: Isomax S6, E1B, E1N, E1S
1000, 1250	1250A	Schneider: MT12, NW16 Siemens: 3VL, 3WT, 3VT5 ABB: Isomax S7, E2B, E2L
1600, 2000	2000A	Schneider: MT20, MT25, NW20, NW25 Siemens: 3WT ABB: E1N, E2N, E2S, E3S

Enclosures

The transfer switch and control are mounted in a key-operated locked enclosure. Enclosures meet IEC 60947-6-1 standard. 40-500 amp switches are front-connected. 630-2000 amps are rear-connected. Standard enclosure is grey. Green is available as an option (P152).

Cable tie bars are available to relieve stress on lugs for switches smaller than 500 amps.

Dimensions: IP32

Amp rating	Height		Width		Door closed		Door open		Weight		Outline drawing
	in	mm	in	mm	in	mm	in	mm	lb	kg	
40, 63	31.4	800	23.6	600	8.8	226	31.4	800	101.4	46	0300-6004
100, 125	31.4	800	23.6	600	8.8	226	31.4	800	105.8	48	0300-6004
160, 200, 225, 250	39.3	1000	31.4	800	8.8	226	39.3	1000	125.6	57	0300-6005
350, 400, 500	39.3	1000	31.4	800	8.8	226	39.3	1000	143.3	65	0300-6005
630, 800	53.9	1370	29.2	742	24.8	631	53.0	1348	385.8	175	0300-6006
1000, 1250	53.9	1370	29.2	742	24.8	631	53.0	1348	405.6	184	0300-6006
1600, 2000	78.7	2000	39.4	1000	44.3	1126	83.7	2126	888.9	400	A0281839

Dimensions: IP54

Amp rating	Height		Width		Door closed		Door open		Weight		Outline drawing
	in	mm	in	mm	in	mm	in	mm	lb	kg	
40, 63	34.0	864	23.5	598	11.6	296	31.0	788	110	50	0300-4559
100, 125	34.0	864	23.5	598	11.6	296	31.0	788	110	52	0300-4559
160, 200, 225, 250	41.9	1064	31.6	804	11.6	296	39.0	991.8	143.3	65	0300-4560
350, 400, 500	41.9	1064	31.6	804	11.6	296	39.0	991.8	160.9	73	0300-4560
630, 800	53.9	1370	29.5	750	26.6	676	51.9	1319		188	0300-4561
1000, 1250	53.9	1370	29.5	750	26.6	676	51.9	1319	414.5	188	0300-4561
1600, 2000	78.9	2004	39.2	996	45.3	1150	83.7	2126	892.9	405	A026M050

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