

**Higher Technical Institute  
ELECTRICAL ENGINEERING DEPARTMENT**

**DIPLOMA PROJECT**

**ELECTRICAL SERVICES OF A BUILDING  
WHICH INCLUDES OFFICES**

***BY***

***POLYCARPOU VALENTINOS***

**E/1200**

***JUNE 1999***

**ELECTRICAL SERVICES OF A BUILDING WHICH INCLUDES OFFICES**

**POLYCARPOU VALENTINOS  
E/1200**

**FOR THE FULLFILMENT OF THE REQUIREMENTS  
OF THE DIPLOMA FOR THE**

**TECHNICIAN ENGINEERING**

**IN**

**ELECTRICAL ENGINEERING**

**DESIGN OF THE ELECTRICAL SERVICES OF A  
BUILDING WHICH INCLUDES OFFICES**

**PROJECT SUPERVISOR: MR. E.MICHEAL  
TYPE OF PROJECT : INDIVIDUAL**

**JUNE 1999**

HIGHER TECHNICAL INSTITUTE	PROJECT NO. 2996
----------------------------------	---------------------

## **ACKNOWLEDGEMENTS**

I wish to express personal thanks to Mr. S.Eliofotou of Eliofotou and Zinieris MELTEC Co, for his valuable advice and guidance, concerning my diploma project.

I acknowledge the valuable aid given by my project supervisor Mr. E.Michael, lecturer in electrical engineering in H.T.I.

Also I would like to thank Mr. N.Nicolaou (electrical engineer) of Eliofotou and Zinieris MELTEC Co, for providing me with necessary information, specifications and technical data.

Finally, I would like to thank everyone else who helped me in any other way, such as providing necessary information and especially those people who supported me until the project was completed.

Polycarpou Valentinos

H.T.I, June, 99.

## **GENERAL INTRODUCTION**

This project deals with the design of electrical services of specified building, which includes offices. The building, which includes offices, consists of 5 floors and a ground floor.

## **MAIN OBJECTIVES OF THIS PROJECT**

- 1) To study the illumination engineering work involved.
- 2) To design the complete electrical services for a specified building of offices, which includes the following:
  - (a) Power and Lightning
  - (b) Fire Alarm
- 3) Lightning Protection System
- 4) To provide all necessary diagrams schedule of materials and costing including labor.

## **TERMS AND CONDITIONS**

- 1) Supply voltage 415/240V, 50Hz, T.T earthing system.
- 2) IEE 16<sup>th</sup> edition and EAC regulations must be complied with.
- 3) Wiring method : In conduit (method 3)
- 4) Cables : PVC copper cable single core non- armored.
- 5) The efficiency and power factor of high power circuits where not given and must be taken to be 0.8.
- 6) The external earth fault loop impedance is chosen to be 0.5.

## CONTENTS

	PAGE
<b>AKNOWLEDGEMENTS</b>	
<b>GENERAL INTRODUCTION</b>	
<b>CHAPTER 1: ILLUMINATION DESIGN</b>	1
1.1 INTRODUCTION	1
1.2 ADVANTAGES OF GOOD ILLUMINATION	1
1.3 USEFUL DEFINITIONS AND UNITS	1
1.4 RULES FOR ENERGY EFFICIENT LIGHTING	2
1.5 ILLUMINATION DESIGN PROCEDURE	3
1.6 METHODS OF ILLUMINATION CALCULATION	3
1.7 CALCULATION PROCEDURE	3
1.8 TYPICAL CALCULATIONS	4
1.9 GROUND FLOOR	4
1.10 FIRST FLOOR	5
1.11 SECOND FLOOR	7
1.12 THIRD\FOURTH\FIFTH FLOOR	8
1.13 RESULTS OF ILLUMINATION DESIGN	10
1.14 GROUND FLOOR	10
1.15 FIRST FLOOR	11
1.16 SECOND FLOOR	12
1.17 THIRD\FOURTH\FIFTH FLOOR	13
<b>CHAPTER 2:ELECTRICAL INSTALLATION</b>	14
2.1 REQUIREMENTS OF AN ELECTRICAL INSTALLATION	14
2.1.1 CABLES	14
2.1.2 CONDUIT	14
2.1.2.1ADVANTAGES AND DISADVANTAGES	15
2.1.3 PROTECTIVE DEVICES	15
2.1.4 DISTRIBUTION BOARD	15
2.2 SELECTION OF LIVE CONDUCTOR	15
2.2.1 WHAT IS A CABLE?	15
2.2.2 CO-ORDINATIONS OF CONDUCTORS	16
2.3 PROTECTION FOR SAFETY	16
2.3.1 GENERAL	16
2.3.2 OVERCURRENT PROTECTION	16
2.3.3.1SHORT CIRCUIT PROTECTION	17
2.3.3.2CONDITIONS FOR PROTECTIVE DEVICES	17
2.4 ELECTRIC SHOCK PROTECTION	17

2.4.1	PROTECTION AGAINST DIRECT CONTACT	17
2.4.2	PROTECTION AGAINST INDIRECT CONTACT	18
2.5	TYPES OF BONDING	18
2.5.1	MAIN BONDING CONDUCTOR	18
2.5.2	SUPPLEMENTARY BONDING CONDUCTOR	18
2.6	ISOLATION AND SWITCHING	18
2.7	DISTRIBUTION	18
<b>CHAPTER 3: LIGHTING CIRCUIT</b>		<b>20</b>
3.1	GENERAL	20
3.2	DESIGN CALCULATIONS OF A TYPICAL LIGHTING CCT	20
3.2.1	SELECTION OF APPROPRIATE PROTECTIVE DEVICE	20
3.2.1.1	CALCULATION OF THE DESIGN CURRENT(I <sub>b</sub> )	20
3.2.1.2	CALCULATION OF THE NOMINAL CURRENT(I <sub>n</sub> )	21
3.2.2	SELECTION OF APPROPRIATE C.S.A OF LIVE CONDUCTORS	21
3.2.3	CHECK FOR VOLTAGE DROP	21
3.2.4	CHECK FOR SHOCK PROTECTION	22
3.2.5	CHECK FOR THERMAL CONSTRAINS	23
3.2.6	SIZE OF CONDUITS FOR LIGHTING CIRCUIT	23
<b>CHAPTER 4: SOCKET OYTLETS</b>		<b>26</b>
4.1	GENERAL	26
4.1.1	DESIGN CALCULATIONS OF A TYPICAL RING CIRCUIT	26
4.1.2	CHECK FOR VOLTAGE DROP LIMITATION	27
4.1.3	CHECK FOR SHOCK PROTECTION	28
4.1.4	CHECK FOR THERMAL CONSTRAINS	29
4.1.5	SIZE OF CONDUIT FOR RING CIRCUIT OUTLETS CIRCUITS	30
4.2	RESULTS OF ALL SOCKET OUTLETS CIRCUITS	31
<b>CHAPTER 5: MOTOR CIRCUITS</b>		<b>32</b>
5.1	LIFT MOTOR	32
5.1.1	SHOCK PROTECTION	32
5.1.2	VOLTAGE DROP	33
5.2	WATER PUMP	33
5.2.1	SHOCK PROTECTION	34
5.2.2	VOLTAGE DROP	34
<b>CHAPTER 6: LIGHTNING PROTECTION</b>		<b>35</b>
6.1	DEFINITION	35
6.2	CREATION OF LIGHTNING	35
6.3	EFFECTS OF LIGHTNING	35
6.4	LOCATION OF LIGHTNING	36
6.5	LIGHTNING PROTECTION SYSTEMS	36
6.6	HOW IT WORKS	36

6.7	MATERIALS	37
6.8	COMPONENT PARTS	37
6.9	METHODS TO PROVIDE PROTECTION	37
6.10	NEED FOR PROTECTION	38
6.11	BONDING	38
6.12	EARTH ELECTRODES	38
6.13	DOWN CONDUCTORS	39
6.14	CALCULATION OF OVERALL RISK FACTOR	39
<b>CHAPTER 7: FIRE ALARM</b>		<b>41</b>
7.1	FIRE DETECTION AND ALARM SYSTEMS	41
7.2	AYTOMATIC F.A.S ( FIRE ALARM SYSTEMS)	41
<b>CHAPTER 8: DISTRIBUTION BOARDS</b>		<b>46</b>
8.1	GROUND FLOOR	46
8.2	FIRST FLOOR	49
8.3	SECOND FLOOR	51
8.4	THIRD FLOOR	54
8.5	FOURTH FLOOR	56
8.6	FIFTH FLOOR	59
<b>CHAPTER 9: MAIN DISTRIBUTION BOARD</b>		<b>62</b>
9.1	BALANCING OF PHASES	62
<b>CHAPTER 10: INSPECTION AND TESTING</b>		<b>64</b>
10.1	INTRODUCTION	64
10.2	VISUAL INSPECTION	64
10.3	TESTING	64
10.3.1	CONTINUITY OF PROTECTIVE CONDUCTORS	64
10.3.2	CONTINUITY OF RING FINAL CONDUCTORS	64
10.3.3	INSULATION RESISTANCE	65
10.3.4	SITE APPLIED INSULATION	65
10.3.5	PROTECTION BY SEPARATION OF CIRCUITS	65
10.3.6	PROTECTION AGAINST DIRECT CONTACT BY A BARRIER OR ENCLOSURE PROVIDED DURING ERECTION	65
10.3.7	INSULATION OF NON-CONDUCTING FLOORS AND WALLS	65
10.3.8	POLARITY	65
10.3.9	EARTH FAULT LOOP IMPENDANCE	66
10.3.10	EARTH ELECTRODE RESISTANCE	66
10.3.11	OPERATION OF RESIDUAL CURRENT OPERATED DEVICES	66
10.4	PERIODIC INSPECTION AND TESTING	66
10.5	CERTIFICATION AND REPORTING	66
<b>CHAPTER 11: COSTING</b>		<b>67</b>
11.1	IMPORTANCE OF PROPER COSTING	67