NEAR EAST UNIVERSITY

Faculty of Engineering

Department of Electrical and Electronic Engineering

Electrical Illumination and Installation Project

Graduation Project
EE- 400

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ABSTRACT

The subject of our project is the ilimunation and electrical project. Ilumination is in general consists of generation, distribution, economy and measurement of light. The benefits of good ilimunation are good sight, helping to keep eyes healthy, less accidents, increase productivity, increase economic potential, increase security, increase convertibility. Meaning of electrical project is choosing the correct equipments in correct region with their calculations. Electrical project is very important because if there is a mistake in electrical project, it can be very dangerous and the system may be inefficient. The benefits of correct electrical project are secure and effective system.

The main objective of this thesis is to make ilumination calculations and electrical calculations of a building according to architectural plan that we have and to design electrical project correct, secure and effective. While doing these calculations we tried to use the best methods in order to get the true results. Our aim was to make the most suitable design according to these calculations. Efficiency and cost were very important.

INTRODUCTION

Our Project is about electrical installation, distribution and illumination project of the factory. This Project contains illumination calculations, designing of lamps, designing of switches and distribution boards, power and distribution diagrams, selecting circuit breakers and other important calculations.

The first chapter is about the definition of illumination. It involves generation, distribution and measurement of light. And we clarified that how we calculate the illumination calculations.

The second chapter is about circuit types and usage area. And also contains the meaning of circuit and advantages-disadvantages of the circuit types.

Third chapter is about light switches, practical informations about the light switches and light switch types.

Forth chapter we defined circuit breaker's and their importance for distribution systems.

CHAPTER 1: GENERAL PARTS OF ILLUMINATION

1.1 What is Light?

Light is electromagnetic radiation that is visible to the human eye and it is responsible for the sense of sight. Visible light is usually defined as having a wavelength in the range of 400nm or 700 nanometres between the infrared, with longer wavelengths and the ultraviolet, with shorter wavelengths. These numbers do not represent the absolute limits of human vision, but the approximate range within which most people can see reasonably well under most circumstances.

1.1.a Light Flux:

Light flux is the measure of the perceived power of light. It differs from radiant flux, the measure of the total power of electromagnetic radiation, in that light flux is adjusted to reflect the varying sensitivity of the human eye to different wavelengths of light. Light flux iss denoted by letter Ø. The unit is Lumen(lm).

1.1.b Light Level (Illumination Level) :

Denoted by E. The unit is Lux. It is equal to one lumen per square metre. In photometry, this is used as a measure of the intensity, as perceived by the human eye, of light that hits or passes through a surface.

1.1.c Glare:

Glare is the effect of the external events to cause an eye to be blinded temporarily. If the luminance of the target area of the eye is more than 10000 cd/m^2 glare effect occurs on eye. This type of glare is called absolute glare. If there is a big variation on the luminances in the target area this also cause a glare that is called dependent glare.

1.1.d Light Sources:

The general properties expected from a light source are: High effectivity, long lifetime, useful shape, simple to operate, light close to day light, high luminance, small size, resistive to hard enviromental condition.

1.2 Types of Electric Lamps:

Electric lamps are devices converting electric energy into light.

1.2.a Incandescent Lamps:

The main principle of incandescent lamp is to heat a wire until it becomes a core by electric current. The wire can be broken due to corrosion if it is exposed to air. This is the reason why the bulb is filled with vacuum or with some other gasses. They operate with lowest efficiency per watt. But they are used for their simplicity.

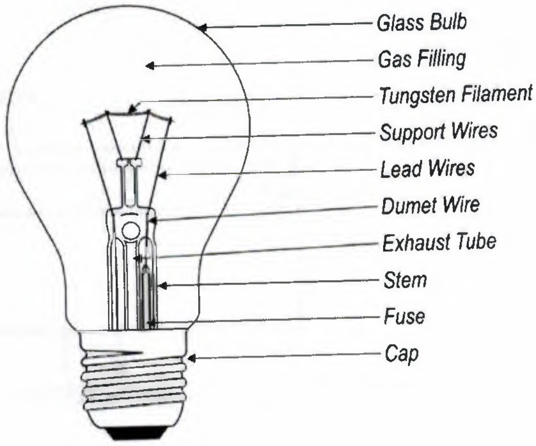


Fig.1: Incandascent Lamp

Advantages of incandascent lamps:

- Easy Connection
- Cheap
- Small size
- İmmediate turn on
- AC and DC usage
- Number of switchings does not effect the lifetime
- Operating voltage can be varied (dimmer)
- Proper for places that are illuminated less than 500 hours/year

Disadvantages of incandascent lamps:

- Efficiency is low
- Operation cost is high
- Cause a lot of heat
- Short lifetime

1.2.b Discharge Lamps:

The gasses are generally insulators. If they are energised and free electrons are created they become conductors. The conductivity of the gas depend on the amount of power, the type of the gas, pressure and the geometric dimensions of the container. The electrons under the influece of electric field travels towards the anode rapidly and cause heat, light and new particles by collision with gas atoms.

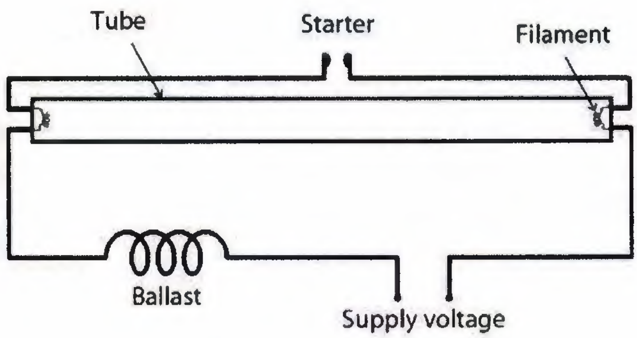


Fig.2: Circuit of Discharge Lamp

Advantages of Discharge Lamps

- Energy efficiency
- Very long lamp life

Disadvantages of Discharge Lamps:

- Slow warm up
- Installation cost is high

1.2.c LED (Light Emitting Diode):

Invented in 1960's and up to 1990's us efor indication purpose. In recent years they are used for internal and external illumination. They are manufactored by gallium arsenite and gallium phosphate. The colours are obtained by changing the ratios of arsenite and phosphor. Led is a two-lead semiconductor light source that resembles a basic pn-junction diode, except that an Led also emits light. They are long life devices.

Advantages of LED:

- High efficiency
- Low operation cost
- Various colours
- Easily programmable

Disadvantages of LED:

- LEDs must be supplied with the correct voltage and current at a constant flow. This requires some electronics expertise to design the electronic drivers.
- LED's can shift color due to age and temperature. Also two different white LED will have two different color characteristics, which affect how the light is perceived.
- Expensive

1.3 How to Make Illumination Calculations:

1-) In illumination calculations the distance between the work plane and the luminarie is important.

$$H= h_1-(h_2+h_3),$$

H= Height of light source to working surface. (m)

h_1= Height of the working surface from the floor. (m)

h_2= Lenght of the wire for the light source to be hanged. (m)

2-) K index (usage factor) is calculated

$$K= (axb)/((a+b)xH)$$

a= Width of the room

b= Length of the room

3-) The related efficiency is found from the table according to the K index value as the row and for column we check the reflection factors of ceiling walls and the floor.

4-) The necessary total flux to illuminate the medium, required illumination level is calculated

$$Ø= (ExS)/(mx\eta)$$

Ø= Total light flux

E= Required illumination level (standart)

S= Area of the medium to be illuminated

η= Efficiency

m= Dirt factor (it is factor that how much dirt is collected on the luminary due to dust)

5-) Determining how many luminaries is necessary for illuminating the medium

$$N= Ø/ ØL$$

N= Number of luminaries

ØL= Light flux of the lamp

- Benefits of the Good Illumination are: Good sigth, help to keep eyes healty, less accidents, increase productivity, increase security, increase comfortability

CHAPTER 2: TYPES OF CIRCUITS (WIRING TECHNIQUES)

2.1 Ring Circuit:

In electricity supply, a ring circuit is an electrical wiring technique developed and primarily used in the United Kingdom. This design enables the use of smaller-diameter wire than would be used in a radial circuit of equivalent total current. Appliances connected to sockets on a ring circuit are individually protected by a fused plug.

Ideally, the ring circuit acts like two radial circuits proceeding in opposite directions around the ring, the dividing point between them dependent on the distribution of load in the ring. If the load is evenly split across the two directions, the current in each direction is half of the total, allowing the use of wire with half the current-carrying capacity. In practice, the load does not always split evenly, so thicker wire is used. The ring starts at the consumer unit (also known as fuse box, distribution board, or breaker box), visits each socket in turn, and then returns to the consumer unit. The ring is fed from a fuse or circuit breaker in the consumer unit.

Ring circuits are commonly used in British wiring with socket-outlets to BS 1363. They are generally wired with 2.5 mm^2 cable and protected by a 32 A circuit breaker. The advantages are clear. To feed a given number of socket outlets using a ring main requires less copper and fewer protective devices.

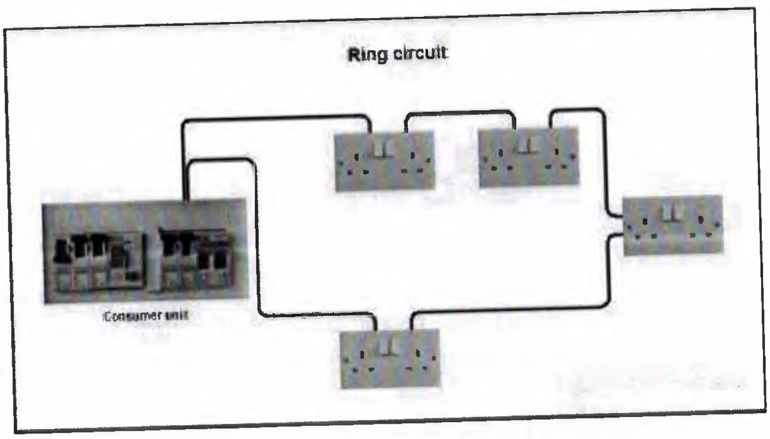


Fig.3: Ring Circuit

2.2 Radial Circuit:

A radial circuit is a power circuit found in some homes to feed sockets and lighting points. It is simply a length of appropriately rated cable feeding one power point then going on to the next. The circuit terminates with the last point on it. It does not return to the consumer unit or fuse box. There is no limit to the number of sockets used on a radial circuit providing the circuit is contained within an area not exceeding 50 square m, and, just like a ring main, spurs, or extra sockets, can be added. The number of spurs must not exceed the number of existing sockets. High powered appliances like showers and cookers must have their own radial circuit.

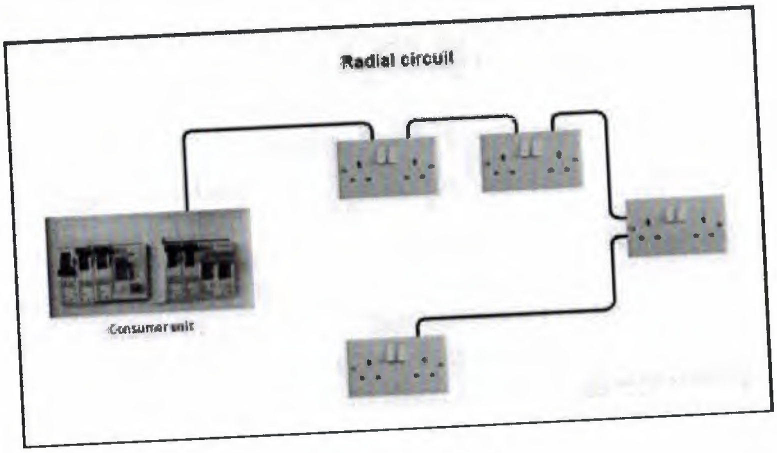


Fig.4: Radial Circuit

2.3 Converting a Radial Circuit to Ring Circuit:

There are two types of radial circuit; 20 amp circuits wired with 2.5 mm ^{2} cable and 32 amp circuits wired with 4 mm^2. The principle of the radial circuit, is that the mains cable leaves the consumer unit and passes through each socket until it reaches and ends at the last socket.
Alternatively, on a ring circuit the mains cable leaves the consumer unit passes through every socket and then returns to the consumer unit.
The advantage of the ring circuit is that electricity can reach the sockets from two directions and so reduces the load on the cable.

Ring circuits are wired with 2.5mm cable and always have a 30 amp fuse/ 32 amp MCB. If
your existing radial circuit is a 30 amp circuit with 4mm^2 cable you can simply complete the new part of the circuit using 2.5mm^2 cable returning from the last socket to the consumer unit.
If however your existing radial circuit is a 20 amp circuit using 2.5mm^2 cable, then you can complete the loop back to the consumer unit with 2.5mm^2 cable but the fuse will have to be upgraded from a 20 amp to a 30 amp fuse.
The usual reason to convert a radial to a ring circuit is because the return stretch of cable can be used to add more sockets to the house.

CHAPTER 3: LIGHT SWITCHES

3.1 Definition of Light Switches:

In building wiring, a light switch is a switch, most commonly used to operate electric lights. The switches may be single or multiple, designed for indoor or outdoor use. Optional extras may include dimmer-controls, environmental protection, weather and security protection. In residential and light commercial lighting systems, the light switch directly controls the circuit feeding the lamps. The contacts of a switch are under their greatest stress while opening or closing. As the switch is closed, the resistance between the contacts changes from almost infinite to almost zero. At infinite resistance, no current flows and no power is dissipated. At zero resistance, there is no voltage drop and no power is dissipated. However, when the contacts change state, there is a brief instant of partial contact when resistance is neither zero nor infinite, and electrical power is converted into heat. If the heating is excessive, the contacts may be damaged, or may even weld themselves closed.

A switch should be designed to make its transition as swiftly as possible. This is achieved by the initial operation of the switch lever mechanism storing potential energy, usually as mechanical stress in a spring. When sufficient mechanical energy is stored, the mechanism in the switch "breaks over", and quickly drives the contacts through the transition from open to closed, or closed to open, without further action by the switch operator.

3.2 Multiway switching

Multiway switching is the interconnection of two or more electrical switches to control from more than one location. For example, this allows lighting in a hallway, stairwell, or large room to be controlled from multiple locations. While a "normal" light switch needs to be only a Single Pole, Single Throw switch, multiway switching requires the use of switches that have one or more additional contacts and two or more wires must be run between the switches. When the load is controlled from only two points, Single Pole, Double Throw switches are used.

3.3 Variations of Light Switches:

3.3.a Push Button:

The push-button light switch has two buttons that alternatively close and open the contacts. Pushing the raised button opens or closes the contacts and pops out the previously depressed button so the process can be reversed

Fig.5: Push Button Switch

3.3.b Toggle Switch:

The switch actuator does not control the contacts directly, but through an intermediate arrangement of springs and levers. Turning the actuator does not initially cause any motion of the contacts, which in fact continue to be positively held open by the force of the spring. Turning the actuator gradually stretches the spring. When the mechanism passes over the center point, the spring energy is released and the spring, rather than the actuator, drives the contacts rapidly and forcibly to the closed position with an audible "snapping" sound. This mechanism is safe, reliable, and durable, but produces a loud snap or click.

Fig 6: Toggle Switch

3.3.c Dimmer Switch:

A dimmer switch is a kind of light switch that allows a light to be dimmed or brightened continuously. Conceptually, a variable resistor in series with a lamp would allow adjustment of its brightness, but this would be inefficient and costly owing to power dissipated in the resistance as heat.

Fig. 7: Dimmer Switch

CHAPTER 4: CIRCUIT BREAKERS

4.1 Definition of Circuit Breaker:

A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and interrupt current flow. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. Circuit breakers are made in varying sizes, from small devices that protect an individual household appliance up to large switchgear designed to protect high voltage circuits feeding an entire city. All circuit breakers have common features in their operation, although details vary substantially depending on the voltage class, current rating and type of the circuit breaker.

The circuit breaker must detect a fault condition; in low voltage circuit breakers this is usually done within the breaker enclosure.

4.2 Types of Circuit Breakers:

4.2.a Miniature Circuit Breaker (MCB) :

Miniature Circuit Breakers are electromechanical devices which protect an electrical circuit from an overcurrent. The overcurrent, in an electrical circuit, may result from short circuit, overload or faulty design. An MCB is a better alternative to a Fuse since it does not require replacement once an overload is detected. Unlike fuse, an MCB can be easily reset and thus offers improved operational safety and greater convenience without incurring large operating cost.

The principal of operation is simple. An MCB functions by interrupting the continuity of electrical flow through the circuit once a fault is detected.

In simple terms MCB is a switch which automatically turns off when the current flowing through it passes the maximum allowable limit. Generally MCB are designed to protect against over current and over temperature faults (over heating).

There are two contacts one is fixed and the other moveable. When the current exceeds the predefined limit a solenoid forces the moveable contact to open and the MCB turns off thereby stopping the current to flow in the circuit. In order to restart the flow of current the MCB is manually turned on. This mechanism is used to protect from the faults arising due to over current or over load.

To protect against fault arising due to over heating or increase in temperature a bi-metallic strip is used. MCBs are generally designed to trip within 2.5 millisecond when an over current fault arises. In case of temperature rise or over heating it may take 2 seconds to 2 minutes for the MCB to trip.

Fig.8: Miniature Circuit Breaker

4.2.b Residual Current Device (RCD):

A residual-current device (RCD)is an electrical wiring device that disconnects a circuit whenever it detects that the electric current is not balanced between the energized conductor and the return neutral conductor.
Such an imbalance may indicate current leakage through the body of a person who is grounded and accidentally touching the energized part of the circuit. A lethal shock can result from these conditions.
RCDs are designed to disconnect the circuit if there is a leakage current. By detecting small leakage currents (typically 5–30 milliamperes) and disconnecting quickly enough (<300 ms), they may prevent electrocution.
RCDs operate by measuring the current balance between two conductors using a differential current transformer.
This measures the difference between current flowing through the live conductor and that returning through the neutral conductor. If these do not sum to zero, there is a leakage of current to somewhere else (to earth/ground, or to another circuit), and the device will open its contacts.

Residual current detection is complementary to over-current detection. Residual current detection cannot provide protection for overload or short-circuit currents, except for the special case of a short circuit from live to ground. For a RCD used with three-phase power, all three live conductors and the neutral (if fitted) must pass through the current transformer.

Fig. 9: Residual Current Device

4.2.c ELCB (Earth Leakage Circuit Breaker)

An ELCB is a safety device used in electrical installations with high earth impedance to prevent shock. It detects small stray voltages on the metal enclosures of electrical equipment, and interrupts the circuit if a dangerous voltage is detected. Once widely used, more recent installations instead use residual current circuit breakers which instead detect leakage current directly. An ELCB is a specialised type of latching relay that has a building's incoming mains power connected through its switching contacts so that the ELCB disconnects the power in an earth leakage (unsafe) condition. The ELCB detects fault currents from live to the earth (ground) wire within the installation it protects. If sufficient voltage appears across the ELCB's sense coil, it will switch off the power, and remain off until manually reset. A voltage-sensing ELCB does not sense fault currents from live to any other earthed body.

There are two types of ELCB: voltage operated and current operated.

1) Voltage-operated:

Voltage-operated ELCBs were introduced in the early 20th century, and provided a major advance in safety for mains electrical supplies with inadequate earth impedance. V-ELCBs have been in widespread use since then, and many are still in operation but are no longer installed in new construction. A voltage-operated ELCB detects a rise in potential between the protected interconnected metalwork (equipment frames, conduits, enclosures) and a distant isolated earth reference electrode. They operate at a detected potential of around 50 volts to open a main breaker and isolate the supply from the protected premises.

A voltage-operated ELCB has a second terminal for connecting to the remote reference earth connection.

The earth circuit is modified when an ELCB is used; the connection to the earth rod is passed through the ELCB by connecting to its two earth terminals. One terminal goes to the installation earth CPC (circuit protective conductor, aka earth wire), and the other to theearth rod (or sometimes other type of earth connection).
Disadvantages of the voltage-operated ELCB are the requirement for a second connection, and the possibility that any additional connection to earth on the protected system can disable the detector.

2) Current- Sensing Protection:

Residual-current devices (RCD)s protect against earth leakage using a different method of detection. Both circuit conductors (supply and return) are run through a sensing coil; any imbalance of the currents means the magnetic field does not perfectly cancel. The device detects the imbalance and trips the contact.
When the term ELCB is used it usually means a voltage-operated device. Similar devices that are current operated are called residual-current devices. However, some companies use the term ELCB to distinguish high sensitivity current operated 3 phase devices that trip in the milliamp range from traditional 3 phase ground fault devices that operate at much higher currents (traditional earth fault devices are insensitive due to the error inherently associated with the summation of currents from multiple current transformers).

Fig.10: ELCB

APPENDIX A: ILLUMINATION CALCULATIONS

- **For Car Park:**

Length of car park= 72m , Width of carpark= 48m

For value of K index, we divided this car park to 4 equal parts. So we have Length of each part= 36m, Width of each part= 24m.
Height of the car park is 5m. Desk and lamp height are 0m. Expected illumination level is 50 Lux.

$H= h_1-(h_2+h_3)$ So $H=5-(0+0)= 5m$

$K=(axb)/H(a+b)$ So $(36x24)/((36+24)x5)= 2.88$

We need interpolation for the value of k. Because in our table we haven't got every numbers. For calculate the efficiency we need interpolated k value.

Interpolation Formula = $y_2=y_1+((x_2-x_1)/(x_3-x_1))(y_3-y_1)=0.56$

Efficiency= 0.56

$\phi T= (E \times S)/(m x \eta)$ = $(50x864)/(0.9x0.56)= 85714$ Lm

$\phi L= 7500$ Lm (For 2x58 W Waterprof Fluorescent lamp)

$N=\phi T/\phi L= 85714/7500= 11$ Lamps (For each of the part)

For total area N= 11x4=44 Lamps

- **For 1224m² Storage (Ground Floor):**

Length of Storage= 60m , Width of carpark= 24m

Height of the storage is 3.8m. Desk and lamp height are 0m. Expected illumination level is 50 Lux.

$H= h_1-(h_2+h_3)$ So $H=3.8-(0+0)= 3.8m$

$K=(axb)/H(a+b)$ So $(60x24)/((60+24)x3.8)= 4.5$

We need interpolation for the value of k. Because in our table we haven't got every numbers. For calculate the efficiency we need interpolated k value.

Interpolation Formula = $y_2=y_1+((x_2-x_1)/(x_3-x_1))(y_3-y_1)=0.645$

Efficiency= 0.645

$\phi T = (E \times S)/(m \times \eta)$ = (50x1440)/(0.9x0.645)= 124031 Lm

ϕL= 7500 Lm (For 2x58 W Waterprof Fluorescent lamp)

$N = \phi T/\phi L$= 124031/7500= 17 Lamps

- **For Office in Ground Floor:**

Length of the office= 3.61m , Width of carpark= 4.3m

E=400 Lux (From the table for single office)

h_1=3m, h_2=0.8, h_3=0

$H = h_1-(h_2+h_3)$ So H=3-(0.8+0)= 2.2m

K=(axb)/H(a+b) So (3.61x4.3)/((3.61+4.3)x2.2)= 0.89

We need interpolation for the value of k. Because in our table we haven't got every numbers. For calculate the efficiency we need interpolated k value.

Interpolation Formula = $y_2=y_1+((x_2-x_1)/(x_3-x_1))(y_3-y_1)$=0.311

Efficiency= 0.311

$\phi T = (E \times S)/(m \times \eta)$ = (400x15.523)/(0.9x0.311)= 22183.64 Lm

ϕL= 7500 Lm (For 2x58 W Fluorescent lamp)

$N = \phi T/\phi L$= 22183.64/7500= 3 Lamps

- **For Security Room:**

Length of the office= 7.2m , Width of carpark= 4.4m

E=30 Lux (From the table for computer practice rooms)

h_1=3m, h_2=0.8, h_3=0

$H = h_1-(h_2+h_3)$ So H=3-(0.8+0)= 2.2m

K=(axb)/H(a+b) So (7.2x4.4)/((7.2+4.4)x2.2)= 1.25

Efficiency= 0.41

$\phi T = (E \times S)/(m \times \eta)$ = (30x31.68)/(0.9x0.41)= 2576 Lm

ϕL= 2350 Lm (For 2x18 W Fluorescent lamp)

$N=\phi T/\phi L= 2576/2350= 1$ Lamp

- **For 1693.24m² Storage:**

Length of Storage= 64m , Width of storage= 24m

Height of the storage is 6.9m. Desk and lamp height are 0m. Expected illumination level is 50 Lux from EMO's Table.

$H= h_1-(h_2+h_3)$ So $H=6.9-(0+0)= 6.9$m

$K=(axb)/H(a+b)$ So $(64x24)/((64+24)x6.9)= 2.50$

Efficiency= 0.56

$\phi T= (E \times S)/(m \times \eta) = (50x1536)/(0.9x0.56)= 152380$ Lm

$\phi L= 7500$ Lm (For 2x58 W Waterprof Fluorescent lamp)

$N=\phi T/\phi L= 152380/7500= 21$ Lamps

- **For Kitchen (First Floor):**

Length of the kitchen= 11.5m , Width of kitchen= 8.2m

E=500 Lux (From the table for kitchen)

$h_1=3$m, $h_2=0.8$, $h_3=0$

$H= h_1-(h_2+h_3)$ So $H=3-(0.8+0)= 2.2$m

$K=(axb)/H(a+b)$ So $(11.5x8.2)/((11.5+8.2)x2.2)= 2.18$

We need interpolation for the value of k. Because in our table we haven't got every numbers. For calculate the efficiency we need interpolated k value.

Interpolation Formula = $y_2=y_1+((x_2-x_1)/(x_3-x_1))(y_3-y_1)= 0.532$

Efficiency= 0.532

$\phi T= (E \times S)/(m \times \eta) = (500x4.3)/(0.9x0.532)= 98475$ Lm

$\phi L= 7500$ Lm (For 2x58 W Waterprof Fluorescent lamp)

$N=\phi T/\phi L= 98475/7500= 13$ Lamps

- **For Refectory (First Floor):**

Length of the refectory= 29m , Width of refectory= 24m, For value of K index, we divided this refectory to 4 equal parts. So we have Length of each part= 14.5m, Width of each part= 12m.

E=100 Lux (From the table for Self Service Restaurant)

h_1=3m, h_2=0.8, h_3=0

H= h_1-(h_2+h_3) So H=3-(0.8+0)= 2.2m

K=(axb)/H(a+b) So (14.5x12)/((14.5+12)x2.2)= 3

Efficiency= 0.59

ϕT= (E x S)/(mxη) = (100x174)/(0.9x0.59)= 32768 Lm

ϕL= 4700 Lm (For 4x18 W Fluorescent lamp)

N=ϕT/ϕL= 32768/4700= 7 Lamps (For each of the part)

N=28 lamps for total area

- **For Bottom Part of Refectory (First Floor):**

Length of the part= 14m , Width of part= 6.3m

E=100 Lux (From the table for Self Service Restaurant)

h_1=3m, h_2=0.8, h_3=0

H= h_1-(h_2+h_3) So H=3-(0.8+0)= 2.2m

K=(axb)/H(a+b) So (14x6.3)/((14+6.3)x2.2)= 2

Efficiency= 0.51

ϕT= (E x S)/(mxη) = (100x88.2)/(0.9x0.51)= 19215.69 Lm

ϕL= 4700 Lm (For 4x18 W Fluorescent lamp)

N=ϕT/ϕL= 19215.69/4700= 4 Lamps (For each of the part)

- **For Visitor's Refectory:**

Length of the visitor's refectory= 11.5, width of the visitor's refectory= 8.2

E=100 Lux (From the table for Self Service Restaurant)

h_1=3m, h_2=0.8, h_3=0

H= h_1-(h_2+h_3) So H=3-(0.8+0)= 2.2m

K=(axb)/H(a+b) So (11.5x8.2)/((11.5+8.2)x2.2)=2

Efficiency= 0.51

ϕT= (E x S)/(mxΠ) = (100x94.3)/(0.9x0.51)=20544.66 Lm

ϕL= 4700 Lm (For 4x18 W Fluorescent lamp)

N=ϕT/ϕL= 20544.66/4700=4 lamps

- **For Visitor's Lobby:**

Length of the visitor's lobby= 6.9, width of the visitor's lobby= 4.4

E=300 Lux (From the table for Rest rooms, Circulation areas)

h_1=3m, h_2=0.8, h_3=0

H= h_1-(h_2+h_3) So H=3-(0.8+0)= 2.2m

K=(axb)/H(a+b) (6.9x4.4)/((6.9+4.4)x2.2)=1.25

Efficiency= 0.41

ϕT= (E x S)/(mxΠ) = (300x30.36)/(0.9x0.41)= 24683 Lm

ϕL= 4700 Lm (For 4x18 W Fluorescent lamp)

N=ϕT/ϕL= 24683/4700=5 lamps

- **For Office 15.86m² (First Floor):**

Length of the office= 5, width of the office= 3

E=400 Lux (From the table for single office)

h_1=3m, h_2=0.8, h_3=0

H= h_1-(h_2+h_3) So H=3-(0.8+0)= 2.2m

K=(axb)/H(a+b) (5x3)/((5+3)x2.2)=0.8

Efficiency= 0.31

ϕT= (E x S)/(mxη) = (400x15)/(0.9x0.31)= 21505 Lm

ϕL= 4700 Lm (For 4x18 W Fluorescent lamp)

N=ϕT/ϕL= 21505/4700=4 lamps

- **For Office 19.38m² (First Floor):**

Length of the office= 5, width of the office= 3.8

E=400 Lux (From the table for single office)

h_1=3m, h_2=0.8, h_3=0

H= h_1-(h_2+h_3) So H=3-(0.8+0)= 2.2m

K=(axb)/H(a+b) (5x3.8)/((5+3.8)x2.2)=1

Efficiency= 0.36

ϕT= (E x S)/(mxη) = (400x19)/(0.9x0.36)= 23456.8 Lm

ϕL= 4700 Lm (For 4x18 W Fluorescent lamp)

N=ϕT/ϕL= 23456.8/4700=5 lamps

- **For Office 21.16m² (First Floor):**

Length of the office= 5, width of the office= 4.2

E=400 Lux (From the table for single office)

h_1=3m, h_2=0.8, h_3=0

H= h_1-(h_2+h_3) So H=3-(0.8+0)= 2.2m

K=(axb)/H(a+b) (5x4.2)/((5+4.2)x2.2)=1

Efficiency= 0.36

ϕT= (E x S)/(mxΠ) = (400x21)/(0.9x0.36)= 25923.9 Lm

ϕL= 4700 Lm (For 4x18 W Fluorescent lamp)

N=ϕT/ϕL= 25923.9/4700=6 lamps

- **For Office 30.09m² (First Floor):**

Length of the office= 5, width of the office= 6

E=400 Lux (From the table for single office)

h_1=3m, h_2=0.8, h_3=0

H= h_1-(h_2+h_3) So H=3-(0.8+0)= 2.2m

K=(axb)/H(a+b) (5x6)/((5+6)x2.2)=1

Efficiency= 0.36

ϕT= (E x S)/(mxΠ) = (400x30)/(0.9x0.36)= 37037 Lm

ϕL= 4700 Lm (For 4x18 W Fluorescent lamp)

N=ϕT/ϕL= 37037/4700=8 lamps

- **For Office 68m² (First Floor):**

Length of the office= 21, width of the office= 2.9

E=400 Lux (From the table for single office)

h_1=3m, h_2=0.8, h_3=0

H= h_1-(h_2+h_3) So H=3-(0.8+0)= 2.2m

K=(axb)/H(a+b) (21x2.9)/((21+2.9)x2.2)=1

Efficiency= 0.36

ϕT= (E x S)/(mxȠ) = (400x61)/(0.9x0.36)= 75185 Lm

ϕL= 4700 Lm (For 4x18 W Fluorescent lamp)

N=ϕT/ϕL= 75185/4700=16 lamps

- **For Men's Mosque 49.88m² (First Floor):**

Length of the office= 8.15, width of the office= 6.12

E=80 Lux (From the table for mosque)

h_1=3m, h_2=0, h_3=0

H= h_1-(h_2+h_3) So H=3-(0+0)= 3m

K=(axb)/H(a+b) (8.15x6.12)/((8.15+6.12)x3)=1.17

We need interpolation for the value of k. Because in our table we haven't got every numbers. For calculate the efficiency we need interpolated k value.

Interpolation Formula = $y_2=y_1+((x_2-x_1)/(x_3-x_1))(y_3-y_1)$= 0.4

Efficiency= 0.4

ϕT= (E x S)/(mxȠ) = (80x49.88)/(0.9x0.4)= 11084 Lm

ϕL= 4700 Lm (For 4x18 W Fluorescent lamp)

N=ϕT/ϕL= 11084/4700=2 lamps

- **For Women's mosque 15.75m² (First Floor):**

Length of the office= 5.25, width of the office= 3

E=80 Lux (From the table for mosque)

h_1=3m, h_2=0, h_3=0

H= h_1-(h_2 +h_3) So H=3-(0+0)= 3m

K=(axb)/H(a+b) (5.25x3)/((5.25+3)x3)=0.64

We need interpolation for the value of k. Because in our table we haven't got every numbers. For calculate the efficiency we need interpolated k value.

Interpolation Formula = $y_2=y_1+((x_2-x_1)/(x_3-x_1))(y_3-y_1)$= 0.254

Efficiency= 0.254

ϕT= (E x S)/(mxƞ) = (80x15.75)/(0.9x0.254)= 5212 Lm

ϕL= 4700 Lm (For 4x18 W Fluorescent lamp)

N=ϕT/ϕL= 5212/4700=1 lamp

- **For Bereket Management (First Floor):**

Length of the office= 4.5, width of the office= 6.2

E=400 Lux (From the table for single office)

h_1=3m, h_2=0.8, h_3=0

H= h_1-(h_2 +h_3) So H=3-(0.8+0)= 2.2m

K=(axb)/H(a+b) (4.5x6.2)/((4.5+6.2)x2.2)=1.19

We need interpolation for the value of k. Because in our table we haven't got every numbers. For calculate the efficiency we need interpolated k value.

Interpolation Formula = $y_2=y_1+((x_2-x_1)/(x_3-x_1))(y_3-y_1)$

Efficiency= 0.4

ϕT= (E x S)/(mxƞ) = (400x27.9)/(0.9x0.4)= 31000 Lm

ϕL= 4700 Lm (For 4x18 W Fluorescent lamp)

N=ϕT/ϕL= 31000/4700=6 lamps

APPENDIX B: DISTRIBUTION BOARD CALCULATIONS

- **For DT 3-1 (First Floor)**

Total Power in Board: 112448 W

Total Current drawn by Board: 169 A (3 Ø)

Cross Sectional Area of Copper Cable: 4x150mm^2+75mm^2 PVC

Capacity of main MCCB+ELCB: 3*200 A

cos Ø=0,8 (Power Factor)

- **For DT 3-2 (First Floor)**

Total Power in Board: 4700 W

Total Current drawn by Board: 7,47 A (3 Ø)

Cross Sectional Area of Copper Cable: 4x6mm^2+4mm^2 PVC

Capacity of main ELCB: 3*32 A

cos Ø=0,8 (Power Factor)

- **For DT 3-4 (First Floor)**

Total Power in Board: 17418 W

Total Current drawn by Board: 24,19 A (3 Ø)

Cross Sectional Area of Copper Cable: 4x10mm^2+6mm^2 PVC

Capacity of main ELCB: 3*45 A

cos Ø=0,8 (Power Factor)

- **For DT 3-3 (First Floor)**

Total Power in Board: 26949 W

Total Current drawn by Board: 39,25 A (3 Ø)

Cross Sectional Area of Copper Cable: 4x25mm²+10mm² PVC

Capacity of main ELCB: 3*100 A

cos Ø=0,8 (Power Factor)

- **For DT 3 (First Floor)**

Total Power in Board: 144097W

Total Current drawn by Board: 215,72 A (3 Ø)

Cross Sectional Area of Copper Cable: 4x240mm²+75mm² PVC

Capacity of main MCCB+ELCB: 3*240A

cos Ø=0,8 (Power Factor)

- **For DT 2-1 (Ground Floor)**

Total Power in Board: 4463 W

Total Current drawn by Board: 6,47 A (3 Ø)

Cross Sectional Area of Copper Cable: 4x10mm²+6mm² PVC

Capacity of main ELCB: 3*32A

cos Ø=0,8 (Power Factor)

- **For DT 2-2 (Ground Floor)**

Total Power in Board: 15020 W

Total Current drawn by Board: 26,50 A (3 Ø)

Cross Sectional Area of Copper Cable: 4x16mm²+10mm² PVC

Capacity of main ELCB: 3*40A

cos Ø=0,8 (Power Factor)

- **For DT 2-3 (Ground Floor)**

Total Power in Board: 14700 W

Total Current drawn by Board: 25 A (3 Ø)

Cross Sectional Area of Copper Cable: $4x16mm^2+10mm^2$ PVC

Capacity of main ELCB: 3*40A

cos Ø=0,8 (Power Factor)

- **For DT 2 (Ground Floor)**

Total Power in Board: 34183 W

Total Current drawn by Board: 58 A (3 Ø)

Cross Sectional Area of Copper Cable: $4x70mm^2+50mm^2$ PVC

Capacity of main ELCB: 3*100A

cos Ø=0,8 (Power Factor)

- **For DT 1(Car Park)**

Total Power in Board: 125000 W

Total Current drawn by Board: 235,8 A (3 Ø)

Cross Sectional Area of Copper Cable: $4x185mm^2+75mm^2$ PVC

Capacity of main MCCB+ELCB: 3*250A

cos Ø=0,8 (Power Factor)

- **For ADT (Car Park)**

Total Power in Board: 303280 W

Total Current drawn by Board: 509,52 A (3 Ø)

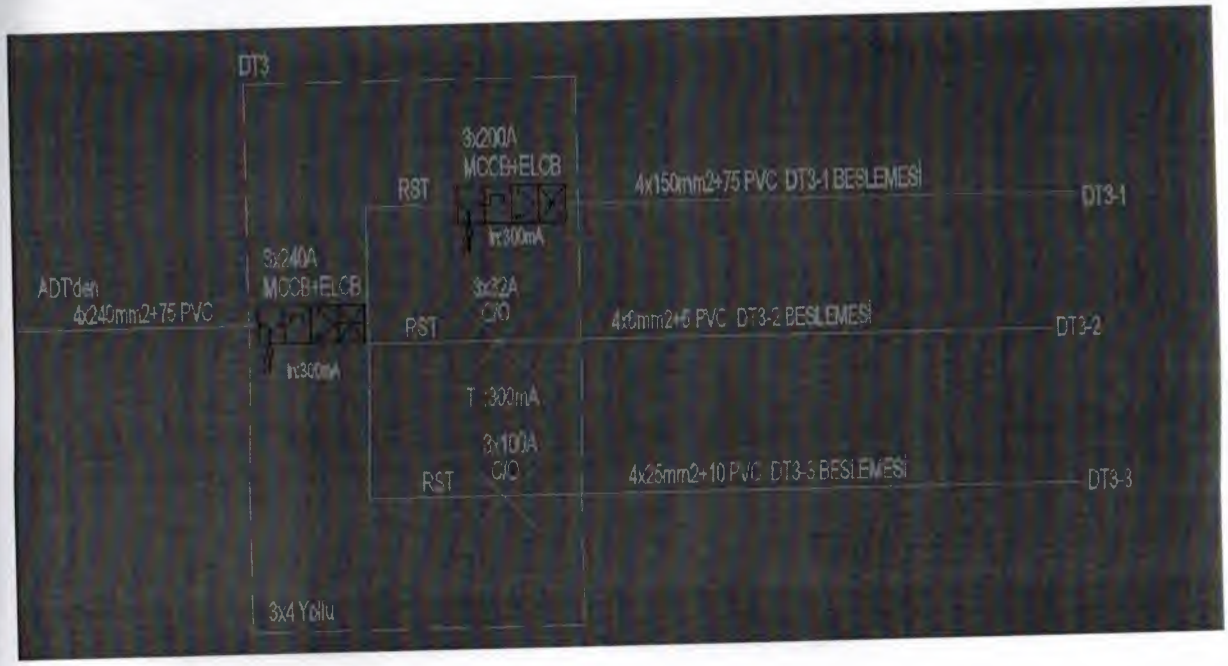
Cross Sectional Area of Copper Cable: 4x400mm²+75mm² PVC

Capacity of main MCCB+ELCB: 3*550A

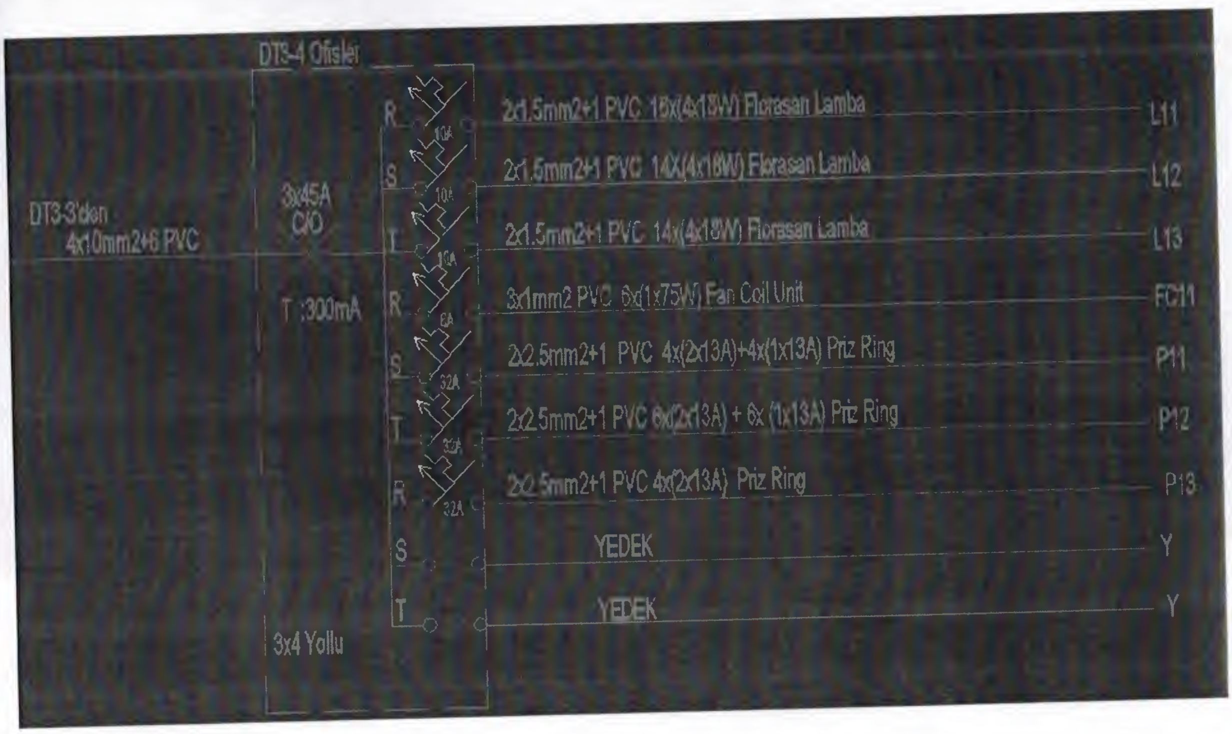
cos Ø=0,8 (Power Factor)

APPENDIX C: DISTRIBUTION BOARD DIAGRAMS

For DT 3 (First Floor):

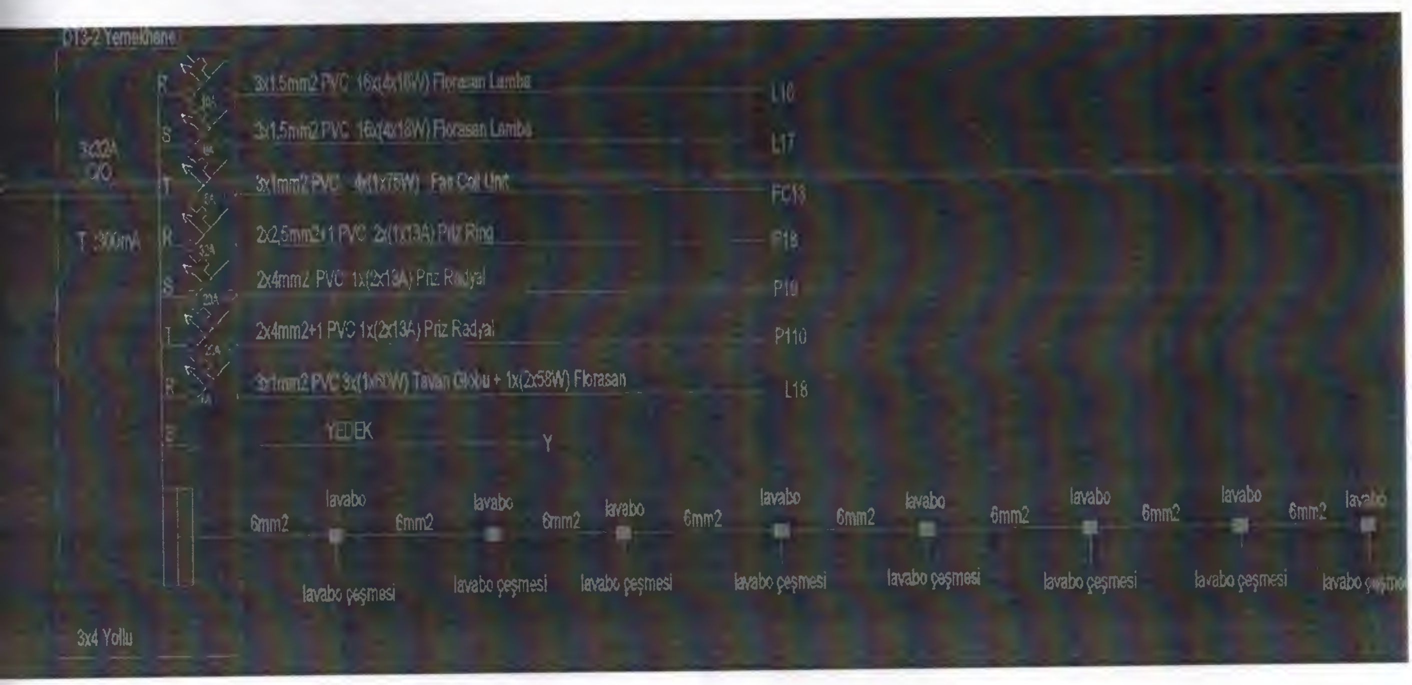


For DT 3-4 (First Floor):

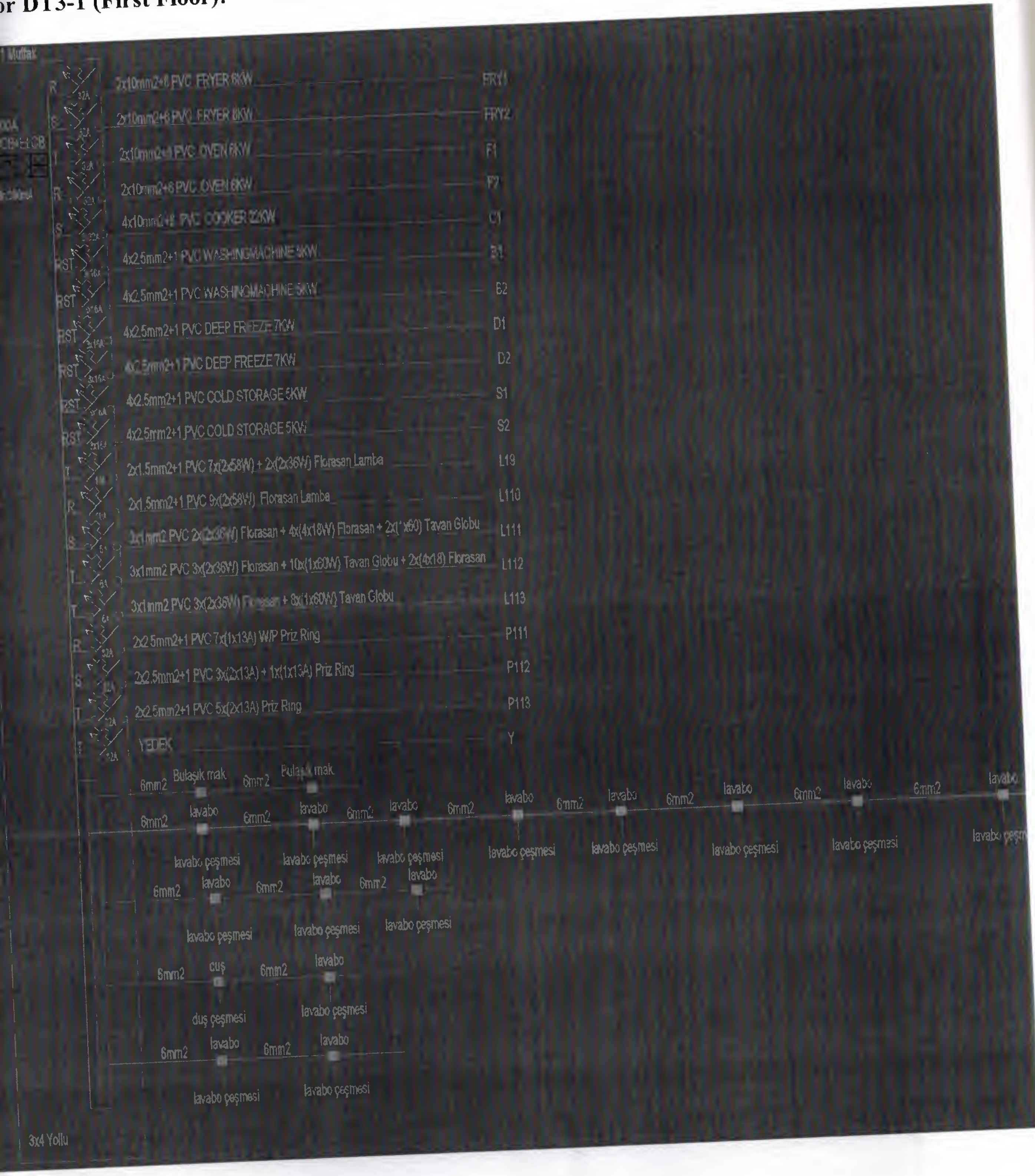


For DT3-3 (First Floor):

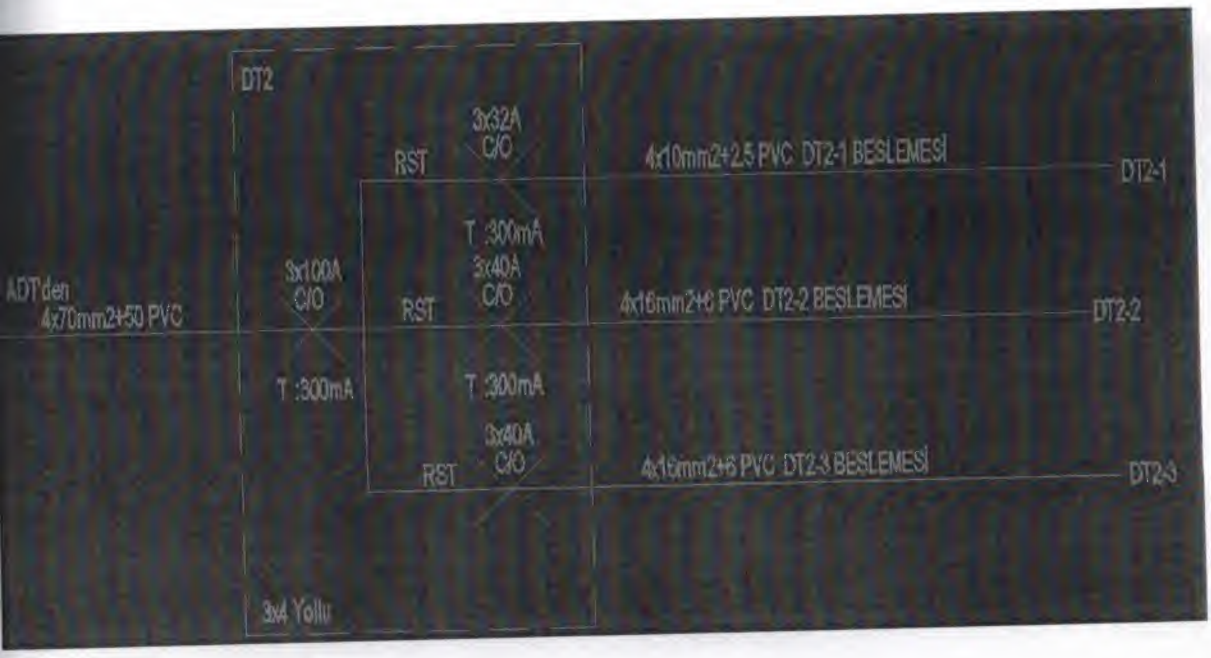
For DT 3-2 (First Floor):



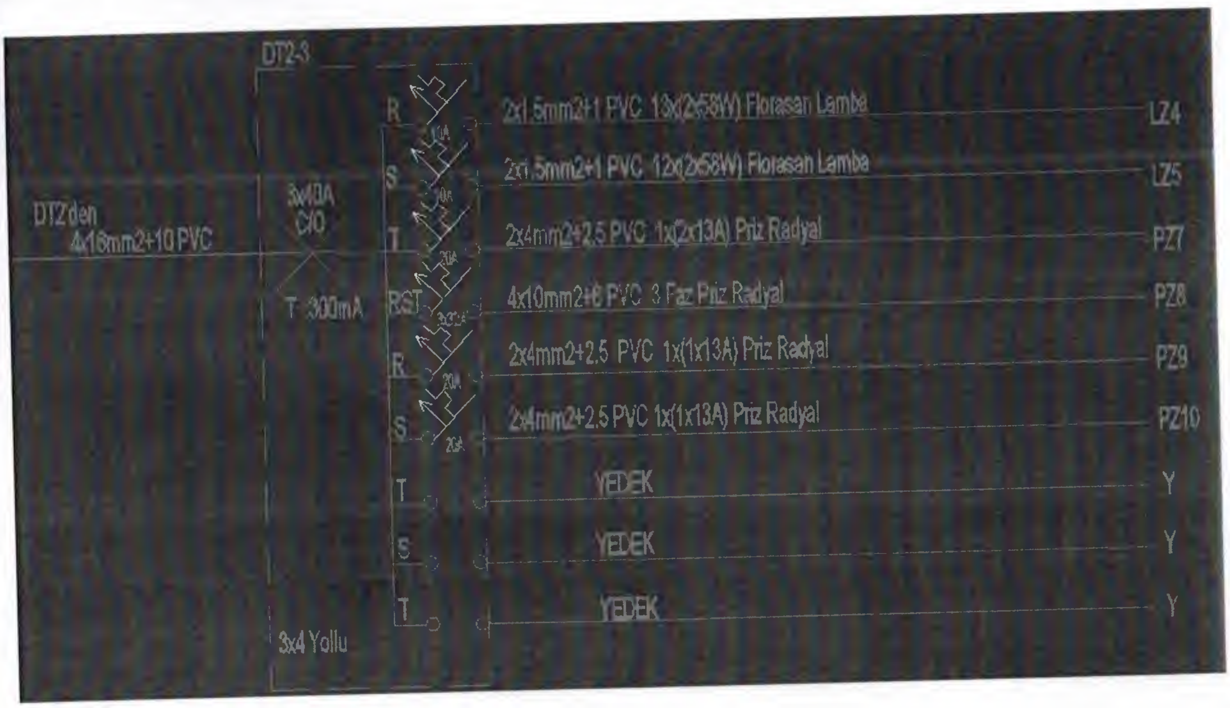
or DT3-1 (First Floor):



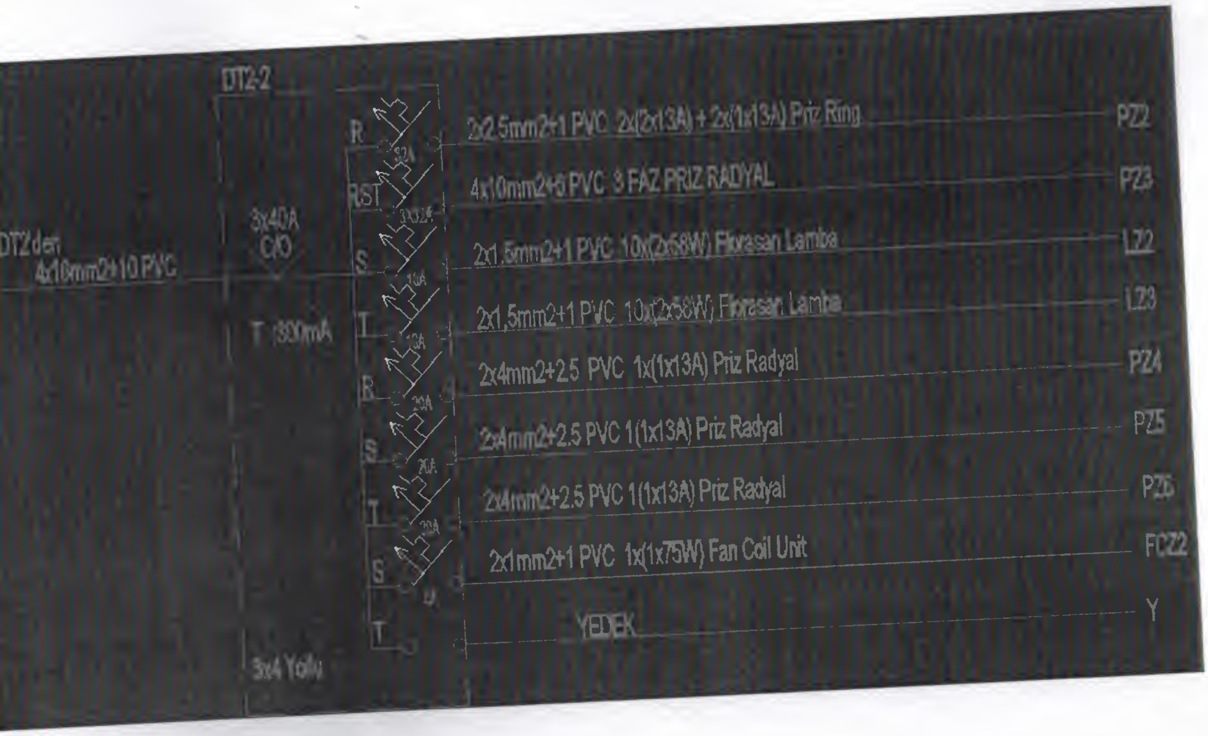
For DT2 (Ground Floor):



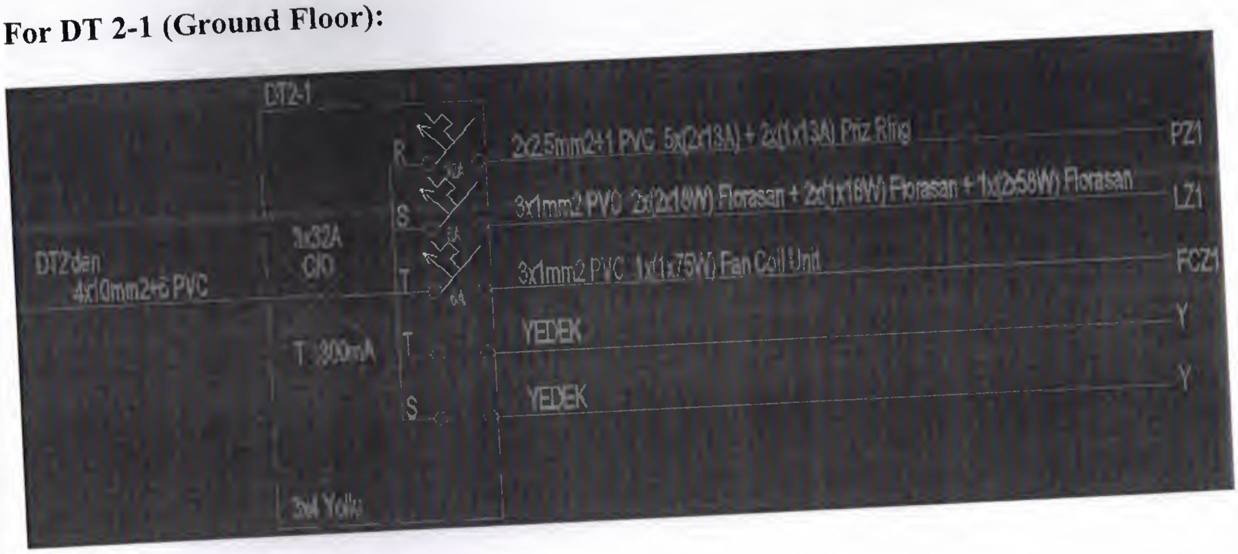
For DT2-3 (Ground Floor):



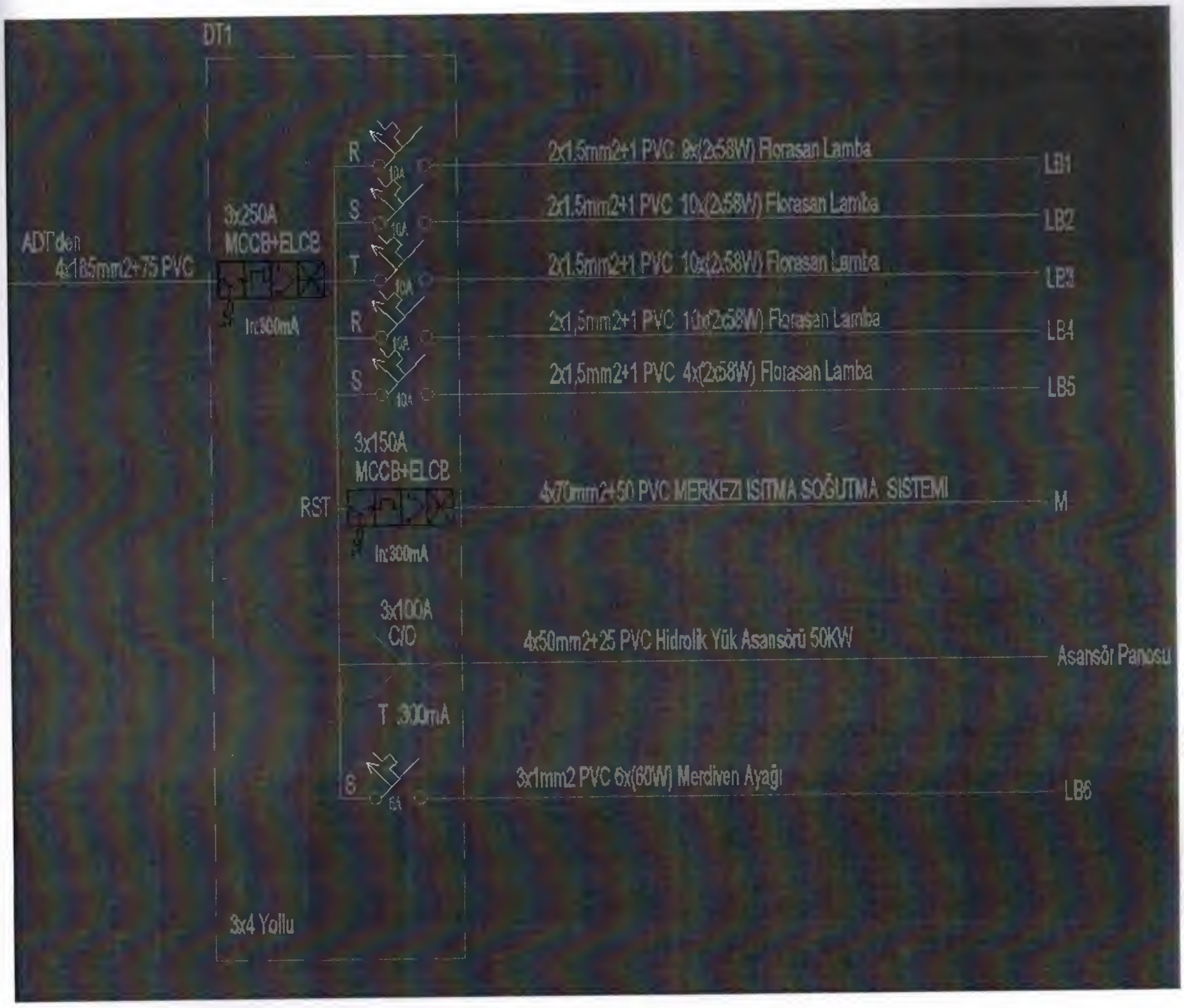
r DT 2-2 (Ground Floor):



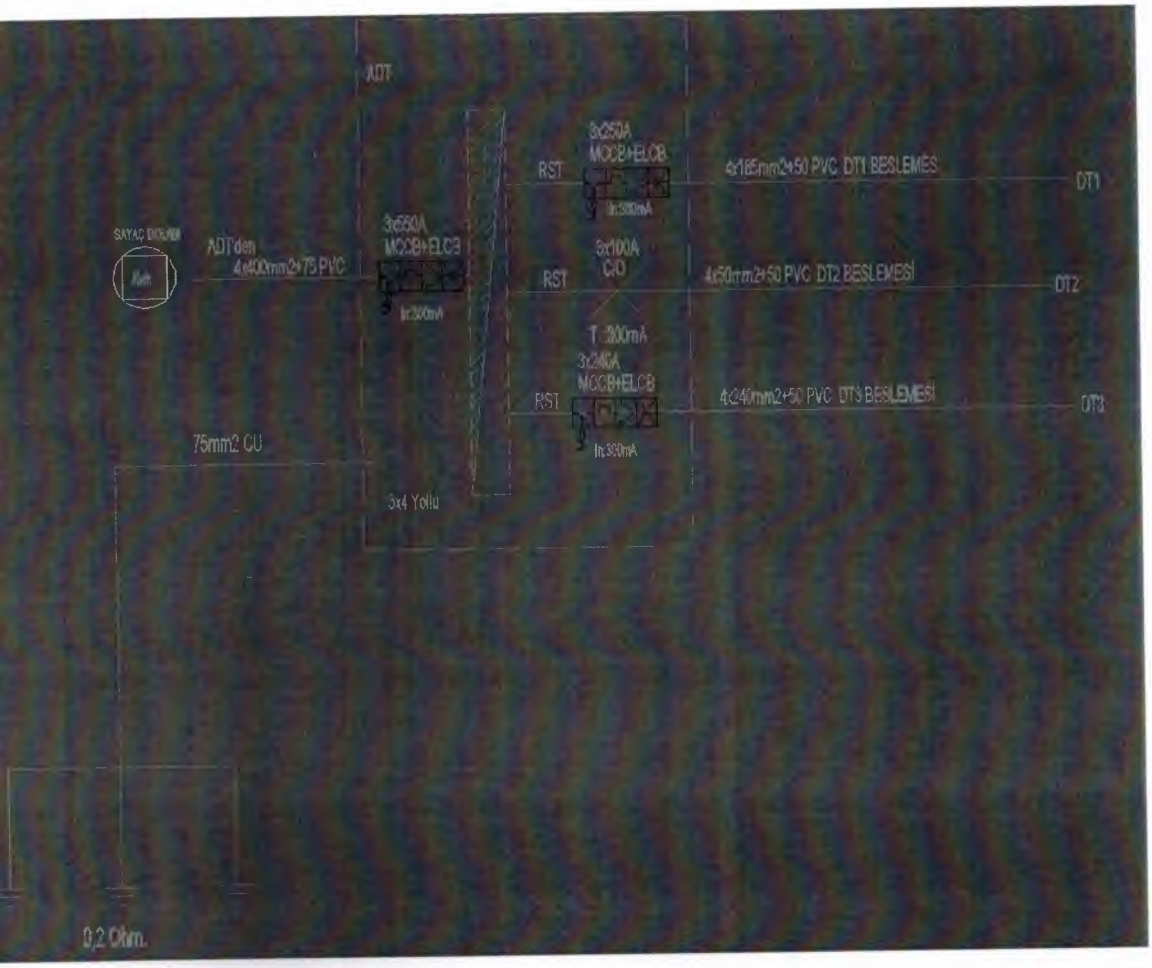
For DT 2-1 (Ground Floor):



For DT1 (Floor -1):



.DT (Floor -1):


ADT
3x250A
MCCB+ELCB
RST
In:300mA
4x185mm2+50 PVC DT1 BESLEMES
DT1
SAYAÇ
ADT'den
4x400mm2+75 PVC
3x550A
MCCB+ELCB
In:300mA
3x100A
C/O
RST
4x50mm2+50 PVC DT2 BESLEMESİ
DT2
T :300mA
3x240A
MCCB+ELCB
RST
In:300mA
4x240mm2+50 PVC DT3 BESLEMESİ
DT3
75mm2 CU
3x4 Yollu
0,2 Ohm.

CONCLUSION

Our project is about building illumination, distribution and installation. First of all we tried to use the best methods in order to get the true results. Because safety and correct answer are very important in electrical engineering.

The standart illumination level data is obtained from the standards of EMO's table and from our illumination lecture notes. The type and number of armature is selected from the standarts and calculations.

We explained about circuit types and their usages. After next section we explained about switch and their working principles and configuration usages of today.

However we have explained the types of circuit breakers and importance of circuit breakers in human life. We also clarified the principles and operations of circuit breakers.

In our project we did illumination calculations for given building design. We decided what types of lamps, plugs and sockets should be used in each room. We calculated how many lamps should be used in a room. Cable cross sections and illumination levels that we used in our project are from standarts of EMO.

Finally, our aim was to design good quality, economic and safety building.

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