# CHAPTER 11

# POWER SUPPLY SYSTEM

## *11.1 OVERVIEW*

**The task of designing the power supply**

The main objective of the power supply design is to ensure that the office building is always of sufficient power with the quality within the allowable range. The following requirements must be satisfied:

- ✓ Small investment, pay attention to save precious foreign currency and rare materials.
- ✓ High reliability of power supply depending on the nature of consumption.
- ✓ Low annual operating costs.
- ✓ Ensure safety for people and equipment.
- ✓ Ensure economy.
- ✓ Convenient for operation, repair etc.

In addition, when designing the power supply must pay attention to other requirements such as:

- ✓ Expected to develop later load.
- ✓ Shorten construction time.

Today, electricity is used extensively in industries such as electronics, transportation, etc. Therefore, the role of electricity in the social life, electricity is considered the norm, is the size Measure on the development of a country.

## *11.2 LIGHTING DESIGN*

In lighting design, Select 2 floor is typical specific design:

1. Fire room

Size :

Lenght a = 7,4 m, Width b = 4.9 m, Height H = 4.25 m, Area S=36,26 $m^2$

Color of paint

Ceiling: plaster Ceiling reflectance: $\rho_{tr} = 0{,}85$

Wall: white Wall reflectivity: $\rho_t$ =0,75

Flooring : Concrete floor reflectivity : $\rho_{sàn} = 0,3$

. Illuminance requirement: Etc=500 lux. Tra bảng 2: Some required illuminance values on the work surface (Book "*Instruction book of power supply design*")

. Select lighting system: uniform lighting

. Select the color temperature: : T=4000 °K

. Choose bulb type :long LED

1 light current =3350 (lm)

Capacity : $P_{bd} = 20$ W

Ra > 80 , Tm = 4000 °K

Choose bulb type:

Level, Capacity 0,66C

Number of lights / 1 set: 2 balls / 1 set

Luminous flux 1 set: 6700 lm

Distribution of light bulbs:

Ceiling way h '= 0 (m)

Working surface coach: $h_{lv}$ = 0.8 (m)

Lamp working height compared to working surface: htt = H - (h '+ $h_{lv}$) = 2.8 (m).

Location index:

$$K=\frac{ab}{h_{tt}(a+b)} = \frac{7,4.4,9}{2,8.(7,4+4,9)} = 1,05$$

. Factor : d = 1,35

. Hanging ratio : j = $\frac{h'}{h'+h_{tt}} = \frac{0}{0+3,2} = 0$

. Coefficients used :

useful coefficient: $U_d = 1.1$

coefficients used U= 0.66 * 1.1 = 0.792.

Total luminous flux :$\emptyset_{total} = \frac{E_{tc}.S.d}{U} = \frac{500.36,26.1,35}{0.792} = 30903,41$ ( lm )

. Determine the number of luminaires :

$$N_{bd} = \frac{\Phi_{total}}{\Phi_{bulbs\ on\ 1\ set\ of\ the\ lights}} = \frac{30903,41}{6700} = 4,61 \text{ lấy } 5$$

luminaires = 5

. Check for luminous flux

$$\Delta\emptyset = \frac{N_{lamp\ set} \cdot \emptyset_{balls\ /\ 1\ set} - \emptyset_{total}}{\emptyset_{total}} = \frac{5.6700 - 30903{,}41}{30903{,}41}\ 0.08\ \%$$

Conclusion: within allowed range (-10%-20%).

. Check the average illuminance on the work surface:

$$E_{tb} = \frac{N_{lamp\ set} \cdot \emptyset_{balls\ /\ 1\ set}\ U}{Sd}\ \frac{5.6700.0.792}{36{,}26.1{,}35} = 684\ \text{lm}$$

. Calculating lamp power:

$$P_đ = N \,.\, n \,.\, P$$

N: Number of luminaires

n: Number of bulbs

P: Lamp power

$$P_đ = N \,.\, n \,.\, P = 5.2.20 = 200\ (W)$$

2. <u>Server room</u>

Size :

Lenght a = 24,8 m, Width b = 10.2 m, Height H = 4.25 m, Area S=252,96 $m^2$

Paint color

Ceiling: plaster Ceiling reflectance: $\rho_{tr} = 0{,}85$

Wall: white Wall reflectivity: $\rho_t$ =0,75

Flooring : Concrete Floor reflectivity : $\rho_{sàn} = 0{,}3$

. Illuminance requirement: Etc=500 lux. Table 2: Some required illuminance values on the work surface (Book "*Instruction book of power supply design*")

. Select lighting system: uniform lighting

. Select the color temperature: : T=4000 °K

. Choose bulb type :long LED

Luminous flux 1 light =3350 (lm)

Capacity : $P_{bd} = 20$ W

Ra > 80 , Tm = 4000 °K

Choose bulb type:

Level, Capacity 0,66C

Number of lights/1 set : 2 light / 1set

Luminous flux 1 set:: 6700 lm

. Distribution of light bulbs:

Ceiling way h'=0 (m)

Working surface coach: $h_{lv}$ =0,8 (m)

Lamp working height compared to working surface: htt = H - (h '+ $h_{lv}$) = 2.8 (m).

Location index:

$$K=\frac{ab}{h_{tt}(a+b)}=\frac{24,8.10.2}{2,8.(24,8+10.2)}=2,58$$

. Factor : d = 1,35

. Hanging ratio: j = $\frac{h'}{h'+h_{tt}}=\frac{0}{0+3,2}=0$

. Coefficients used :

useful coefficient: $U_d = 1$

coefficients used U= 0.66 * 1 = 0.66

Total luminous flux :$\varphi_{total} = \frac{E_{tc}.S.d}{U}=\frac{500.252,96.1,35}{0.66}$ = 258709,09 ( lm )

Determine the number of luminaires :

$$N_{bd} = \frac{\Phi_{total}}{\Phi_{bulbs\ on\ 1\ set\ of\ the\ lights}}=\frac{258709,09}{6700}=38,61$$

Luminaires = 39

. Check for luminous flux

$$\Delta\emptyset=\frac{N_{lamp\ set}.\emptyset_{balls\ /\ 1\ set}-\emptyset_{total}}{\emptyset_{total}}=\frac{39.6700-258709,09}{258709,09}=-0,99\ \%$$

Conclusion: within allowed range (-10%,20%).

. Check the average illuminance on the work surface:

$$E_{tb} = \frac{N_{lamp\ set}.\emptyset_{balls\ /\ 1\ set}\ U}{Sd}=\frac{39.6700.0,66}{252,96.1,35}=505\ lm$$

. Calculating lamp power:

$$P_đ = N\ .\ n\ .\ P$$

N: Number of luminaires

n: Number of bulbs

P: Lamp power

$$P_đ = N\ .\ n\ .\ P = 39.2.20 = 1560\ (W)$$

3. <u>Group Workroom</u>

Size:

Long a = 5,8 m, Wide b = 4 m, High H = 3,625 m, Diện tích S=23,2 $m^2$

Paint color

Ceiling: plaster Ceiling reflectance: $\rho_{tr} = 0{,}85$

Wall: white Wall reflectivity: $\rho_t = 0{,}75$

Flooring : Concrete Floor reflectivity : $\rho_{sàn} = 0{,}3$

. Illuminance requirement: Etc=500 lux. Tra bảng 2: Some required illuminance values on the work surface (Book "*Instruction book of power supply design*")

. Select lighting system: uniform lighting

. Select the color temperature: T=4000 °K

. Choose bulb type :long LED

Luminous flux 1 light =3350 (lm)

Capacity : $P_{bd} = 20$ W

Ra > 80 , Tm = 4000 °K

Choose bulb type:

Level, Capacity 0,66C

Number of lights/1 set : 2 light / 1set

Luminous flux 1 set: 6700 lm

. Distribution of light bulbs:

Ceiling way h'=0 (m)

Working surface coach: $h_{lv}$ =0,8 (m)

Lamp working height compared to working surface: htt = H - (h '+$h_{lv}$) = 2.8 (m).

Location index:

$$K=\frac{ab}{h_{tt}(a+b)} = \frac{5{,}8.4}{2{,}8.(5{,}8+4)} = 0{,}85$$

. Factor : d = 1,35

. Hanging ratio: j = $\frac{h'}{h'+h_{tt}} = \frac{0}{0+3{,}2} = 0$

. Coefficients used :

useful coefficient : $U_d = 1.2$

coefficients used U= 0,66 . 1,2 = 0,792.

Total luminous flux :$\emptyset_{total} = \frac{E_{tc}.S.d}{U} = \frac{500\ .23{,}2.1{,}35}{0.792}$ =19772,72 ( lm )

Determine the number of luminaires :

$$N_{bd} = \frac{\Phi_{total}}{\Phi_{bulbs\ on\ 1\ set\ of\ the\ lights}} = \frac{19772,72}{6700} = 2,95$$

Luminaires = 3

. Check for luminous flux

$$\Delta\emptyset = \frac{N_{lamp\ set}.\emptyset_{balls\ /\ 1\ set} - \emptyset_{total}}{\emptyset_{total}} = \frac{3.6700 - 19772,72}{19772,72} = 0,016\%$$

Conclusion: within allowed range (-10%,20%).

. Check the average illuminance on the work surface:

$$E_{tb} = \frac{N_{lamp\ set}.\emptyset_{balls\ /\ 1\ set}\ U}{Sd} = \frac{3.6700.0,792}{23,2.1,35} = 508.27$$

. Calculating lamp power:

$$P_{đ} = N\ .\ n\ .\ P$$

N: Number of luminaires

n: Number of bulbs

P: Lamp power

$$P_{đ} = N\ .\ n\ .\ P = 3.2.20 = 120\ (W)$$

## *11.3 DETERMINE THE CALCULATION LOAD*

| NO | ROOM NAME | DESCRIPTION | LOAD POWER P(W) | NUMBER OF EQUIPMENT | CAPACITY P(kW) | PHASES | FACTOR | LOAD CALCULATION P(W) | Cosφ | LOAD CALCULATION S (VA) |
|---|---|---|---|---|---|---|---|---|---|---|
| **CENTRAL PLANT-1F** | | | | | | | | | | |
| 1 | Fire room | POWER SUPPLY FOR LIGHTS | 200 | 10 | 0.02 | 1P | 1 | 200 | 0.8 | 250 |
| 2 | | POWER SUPPLY FOR FANS | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |
| 3 | | POWER SUPPLY TO THE SOCKET | 2667 | 133.35 | 0.02 | 1P | 1 | 2667 | 0.8 | 3333.75 |
| 4 | | POWER SUPPLY FOR FCU | 836 | 41.8 | 0.02 | 1P | 1 | 836 | 0.8 | 1045 |
| 5 | Server room | POWER SUPPLY FOR LIGHTS | 1560 | 78 | 0.02 | 1P | 1 | 1560 | 0.8 | 1950 |
| 6 | | POWER SUPPLY FOR FANS | 3120 | 156 | 0.02 | 1P | 1 | 3120 | 0.8 | 3900 |
| 7 | | POWER SUPPLY TO THE | 20802.6 | 1040.13 | 0.02 | 1P | 1 | 20802.6 | 0.8 | 26003.25 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SOCKET | | | | | | | | |
| 8 | | POWER SUPPLY FOR FCU | 6520.8 | 326.04 | 0.02 | 1P | 1 | 6520.8 | 0.8 | 8151 |
| 9 | Chillers and Pumps room | POWER SUPPLY FOR LIGHTS | 1000 | 50 | 0.02 | 1P | 1 | 1000 | 0.8 | 1250 |
| 10 | | POWER SUPPLY FOR FANS | 2500 | 125 | 0.02 | 1P | 1 | 2500 | 0.8 | 3125 |
| 11 | | POWER SUPPLY TO THE SOCKET | 12000 | 600 | 0.02 | 1P | 1 | 12000 | 0.8 | 15000 |
| 12 | | POWER SUPPLY FOR FCU | 8900 | 445 | 0.02 | 1P | 1 | 8900 | 0.8 | 11125 |
| 13 | Transformer room | POWER SUPPLY FOR LIGHTS | 40 | 2 | 0.02 | 1P | 1 | 40 | 0.8 | 50 |
| 14 | | POWER SUPPLY FOR FANS | 100 | 5 | 0.02 | 1P | 1 | 100 | 0.8 | 125 |
| 15 | | POWER SUPPLY TO THE SOCKET | 480 | 24 | 0.02 | 1P | 1 | 480 | 0.8 | 600 |
| 16 | | POWER SUPPLY FOR FCU | 356 | 17.8 | 0.02 | 1P | 1 | 356 | 0.8 | 445 |
| 17 | Medium voltage switchgear room | POWER SUPPLY FOR LIGHTS | 320 | 16 | 0.02 | 1P | 1 | 320 | 0.8 | 400 |
| 18 | | POWER SUPPLY FOR FANS | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |
| 19 | | POWER SUPPLY TO THE SOCKET | 2667 | 133.35 | 0.02 | 1P | 1 | 2667 | 0.8 | 3333.75 |
| 20 | | POWER SUPPLY FOR FCU | 836 | 41.8 | 0.02 | 1P | 1 | 836 | 0.8 | 1045 |
| 21 | Transformer room | POWER SUPPLY FOR LIGHTS | 40 | 2 | 0.02 | 1P | 1 | 40 | 0.8 | 50 |
| 22 | | POWER SUPPLY FOR FANS | 100 | 5 | 0.02 | 1P | 1 | 100 | 0.8 | 125 |
| 23 | | POWER SUPPLY TO THE SOCKET | 480 | 24 | 0.02 | 1P | 1 | 480 | 0.8 | 600 |
| 24 | | POWER SUPPLY FOR FCU | 356 | 17.8 | 0.02 | 1P | 1 | 356 | 0.8 | 445 |
| 25 | Low voltage switchgear room | POWER SUPPLY FOR LIGHTS | 320 | 16 | 0.02 | 1P | 1 | 320 | 0.8 | 400 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 26 | | POWER SUPPLY FOR FANS | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |
| 27 | | POWER SUPPLY TO THE SOCKET | 2667 | 133.35 | 0.02 | 1P | 1 | 2667 | 0.8 | 3333.75 |
| 28 | | POWER SUPPLY FOR FCU | 836 | 41.8 | 0.02 | 1P | 1 | 836 | 0.8 | 1045 |
| 29 | Control center | POWER SUPPLY FOR LIGHTS | 40 | 2 | 0.02 | 1P | 1 | 40 | 0.8 | 50 |
| 30 | | POWER SUPPLY FOR FANS | 100 | 5 | 0.02 | 1P | 1 | 100 | 0.8 | 125 |
| 31 | | POWER SUPPLY TO THE SOCKET | 480 | 24 | 0.02 | 1P | 1 | 480 | 0.8 | 600 |
| 32 | | POWER SUPPLY FOR FCU | 356 | 17.8 | 0.02 | 1P | 1 | 356 | 0.8 | 445 |
| 33 | Technical room | POWER SUPPLY FOR LIGHTS | 180 | 9 | 0.02 | 1P | 1 | 180 | 0.8 | 225 |
| 34 | | POWER SUPPLY FOR FANS | 240 | 12 | 0.02 | 1P | 1 | 240 | 0.8 | 300 |
| 35 | | POWER SUPPLY TO THE SOCKET | 245 | 12.25 | 0.02 | 1P | 1 | 245 | 0.8 | 306.25 |
| 36 | | POWER SUPPLY FOR FCU | 480 | 24 | 0.02 | 1P | 1 | 480 | 0.8 | 600 |
| **CENTRAL PLANT-2F** | | | | | | | | | | |
| 1 | UPS battery room | POWER SUPPLY FOR LIGHTS | 200 | 10 | 0.02 | 1P | 1 | 200 | 0.8 | 250 |
| 2 | | POWER SUPPLY FOR FANS | 500 | 25 | 0.02 | 1P | 1 | 500 | 0.8 | 625 |
| 3 | | POWER SUPPLY TO THE SOCKET | 2400 | 120 | 0.02 | 1P | 1 | 2400 | 0.8 | 3000 |
| 4 | | POWER SUPPLY FOR FCU | 1780 | 89 | 0.02 | 1P | 1 | 1780 | 0.8 | 2225 |
| 5 | Server room support | POWER SUPPLY FOR LIGHTS | 1560 | 78 | 0.02 | 1P | 1 | 1560 | 0.8 | 1950 |
| 6 | | POWER SUPPLY FOR FANS | 3900 | 195 | 0.02 | 1P | 1 | 3900 | 0.8 | 4875 |
| 7 | | POWER SUPPLY TO THE SOCKET | 18720 | 936 | 0.02 | 1P | 1 | 18720 | 0.8 | 23400 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | | POWER SUPPLY FOR FCU | 13884 | 694.2 | 0.02 | 1P | 1 | 13884 | 0.8 | 17355 |
| 9 | Server room | POWER SUPPLY FOR LIGHTS | 1560 | 78 | 0.02 | 1P | 1 | 1560 | 0.8 | 1950 |
| 10 | | POWER SUPPLY FOR FANS | 3900 | 195 | 0.02 | 1P | 1 | 3900 | 0.8 | 4875 |
| 11 | | POWER SUPPLY TO THE SOCKET | 18720 | 936 | 0.02 | 1P | 1 | 18720 | 0.8 | 23400 |
| 12 | | POWER SUPPLY FOR FCU | 13884 | 694.2 | 0.02 | 1P | 1 | 13884 | 0.8 | 17355 |
| 13 | Storage | POWER SUPPLY FOR LIGHTS | 160 | 8 | 0.02 | 1P | 1 | 160 | 0.8 | 200 |
| 14 | | POWER SUPPLY FOR FANS | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |
| 15 | | POWER SUPPLY TO THE SOCKET | 1920 | 96 | 0.02 | 1P | 1 | 1920 | 0.8 | 2400 |
| 16 | | POWER SUPPLY FOR FCU | 1424 | 71.2 | 0.02 | 1P | 1 | 1424 | 0.8 | 1780 |
| 17 | Electrical workroom area | POWER SUPPLY FOR LIGHTS | 260 | 13 | 0.02 | 1P | 1 | 260 | 0.8 | 325 |
| 18 | | POWER SUPPLY FOR FANS | 650 | 32.5 | 0.02 | 1P | 1 | 650 | 0.8 | 812.5 |
| 19 | | POWER SUPPLY TO THE SOCKET | 3120 | 156 | 0.02 | 1P | 1 | 3120 | 0.8 | 3900 |
| 20 | | POWER SUPPLY FOR FCU | 2314 | 115.7 | 0.02 | 1P | 1 | 2314 | 0.8 | 2892.5 |
| 21 | Control room | POWER SUPPLY FOR LIGHTS | 180 | 9 | 0.02 | 1P | 1 | 180 | 0.8 | 225 |
| 22 | | POWER SUPPLY FOR FANS | 450 | 22.5 | 0.02 | 1P | 1 | 450 | 0.8 | 562.5 |
| 23 | | POWER SUPPLY TO THE SOCKET | 2160 | 108 | 0.02 | 1P | 1 | 2160 | 0.8 | 2700 |
| 24 | | POWER SUPPLY FOR FCU | 1602 | 80.1 | 0.02 | 1P | 1 | 1602 | 0.8 | 2002.5 |
| **CENTRAL PLANT-RF** | | | | | | | | | | |
| 1 | Cooling towers | POWER SUPPLY FOR LIGHTS | 8000 | 400 | 0.02 | 1P | 1 | 8000 | 0.8 | 10000 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | | POWER SUPPLY FOR FANS | 20000 | 1000 | 0.02 | 1P | 1 | 20000 | 0.8 | 25000 |
| 3 | | POWER SUPPLY TO THE SOCKET | 96000 | 4800 | 0.02 | 1P | 1 | 96000 | 0.8 | 120000 |
| 4 | | POWER SUPPLY FOR FCU | 71200 | 3560 | 0.02 | 1P | 1 | 71200 | 0.8 | 89000 |
| **LIBRARY-1F** | | | | | | | | | | |
| 1 | Conference/Training room | POWER SUPPLY FOR LIGHTS | 800 | 40 | 0.02 | 1P | 1 | 800 | 0.8 | 1000 |
| 2 | | POWER SUPPLY FOR FANS | 2000 | 100 | 0.02 | 1P | 1 | 2000 | 0.8 | 2500 |
| 3 | | POWER SUPPLY TO THE SOCKET | 9600 | 480 | 0.02 | 1P | 1 | 9600 | 0.8 | 12000 |
| 4 | | POWER SUPPLY FOR FCU | 7120 | 356 | 0.02 | 1P | 1 | 7120 | 0.8 | 8900 |
| 5 | Storage | POWER SUPPLY FOR LIGHTS | 140 | 7 | 0.02 | 1P | 1 | 140 | 0.8 | 175 |
| 6 | | POWER SUPPLY FOR FANS | 350 | 17.5 | 0.02 | 1P | 1 | 350 | 0.8 | 437.5 |
| 7 | | POWER SUPPLY TO THE SOCKET | 1680 | 84 | 0.02 | 1P | 1 | 1680 | 0.8 | 2100 |
| 8 | | POWER SUPPLY FOR FCU | 1246 | 62.3 | 0.02 | 1P | 1 | 1246 | 0.8 | 1557.5 |
| 9 | Frist Aid | POWER SUPPLY FOR LIGHTS | 280 | 14 | 0.02 | 1P | 1 | 280 | 0.8 | 350 |
| 10 | | POWER SUPPLY FOR FANS | 700 | 35 | 0.02 | 1P | 1 | 700 | 0.8 | 875 |
| 11 | | POWER SUPPLY TO THE SOCKET | 3360 | 168 | 0.02 | 1P | 1 | 3360 | 0.8 | 4200 |
| 12 | | POWER SUPPLY FOR FCU | 2492 | 124.6 | 0.02 | 1P | 1 | 2492 | 0.8 | 3115 |
| 13 | Aid relaxing room | POWER SUPPLY FOR LIGHTS | 300 | 15 | 0.02 | 1P | 1 | 300 | 0.8 | 375 |
| 14 | | POWER SUPPLY FOR FANS | 750 | 37.5 | 0.02 | 1P | 1 | 750 | 0.8 | 937.5 |
| 15 | | POWER SUPPLY TO THE SOCKET | 3600 | 180 | 0.02 | 1P | 1 | 3600 | 0.8 | 4500 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 | | POWER SUPPLY FOR FCU | 2670 | 133.5 | 0.02 | 1P | 1 | 2670 | 0.8 | 3337.5 |
| 17 | Storage | POWER SUPPLY FOR LIGHTS | 140 | 7 | 0.02 | 1P | 1 | 140 | 0.8 | 175 |
| 18 | | POWER SUPPLY FOR FANS | 350 | 17.5 | 0.02 | 1P | 1 | 350 | 0.8 | 437.5 |
| 19 | | POWER SUPPLY TO THE SOCKET | 1680 | 84 | 0.02 | 1P | 1 | 1680 | 0.8 | 2100 |
| 20 | | POWER SUPPLY FOR FCU | 1246 | 62.3 | 0.02 | 1P | 1 | 1246 | 0.8 | 1557.5 |
| 21 | Book return room | POWER SUPPLY FOR LIGHTS | 280 | 14 | 0.02 | 1P | 1 | 280 | 0.8 | 350 |
| 22 | | POWER SUPPLY FOR FANS | 700 | 35 | 0.02 | 1P | 1 | 700 | 0.8 | 875 |
| 23 | | POWER SUPPLY TO THE SOCKET | 3360 | 168 | 0.02 | 1P | 1 | 3360 | 0.8 | 4200 |
| 24 | | POWER SUPPLY FOR FCU | 2492 | 124.6 | 0.02 | 1P | 1 | 2492 | 0.8 | 3115 |
| 25 | Post room | POWER SUPPLY FOR LIGHTS | 100 | 5 | 0.02 | 1P | 1 | 100 | 0.8 | 125 |
| 26 | | POWER SUPPLY FOR FANS | 250 | 12.5 | 0.02 | 1P | 1 | 250 | 0.8 | 312.5 |
| 27 | | POWER SUPPLY TO THE SOCKET | 1200 | 60 | 0.02 | 1P | 1 | 1200 | 0.8 | 1500 |
| 28 | | POWER SUPPLY FOR FCU | 890 | 44.5 | 0.02 | 1P | 1 | 890 | 0.8 | 1112.5 |
| 29 | Storageo/Receiving | POWER SUPPLY FOR LIGHTS | 140 | 7 | 0.02 | 1P | 1 | 140 | 0.8 | 175 |
| 30 | | POWER SUPPLY FOR FANS | 350 | 17.5 | 0.02 | 1P | 1 | 350 | 0.8 | 437.5 |
| 31 | | POWER SUPPLY TO THE SOCKET | 1680 | 84 | 0.02 | 1P | 1 | 1680 | 0.8 | 2100 |
| 32 | | POWER SUPPLY FOR FCU | 1246 | 62.3 | 0.02 | 1P | 1 | 1246 | 0.8 | 1557.5 |
| 33 | Porter room | POWER SUPPLY FOR LIGHTS | 100 | 5 | 0.02 | 1P | 1 | 100 | 0.8 | 125 |
| 34 | | POWER SUPPLY FOR FANS | 250 | 12.5 | 0.02 | 1P | 1 | 250 | 0.8 | 312.5 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 35 | | POWER SUPPLY TO THE SOCKET | 1200 | 60 | 0.02 | 1P | 1 | 1200 | 0.8 | 1500 |
| 36 | | POWER SUPPLY FOR FCU | 890 | 44.5 | 0.02 | 1P | 1 | 890 | 0.8 | 1112.5 |
| 37 | Uni shop | POWER SUPPLY FOR LIGHTS | 500 | 25 | 0.02 | 1P | 1 | 500 | 0.8 | 625 |
| 38 | | POWER SUPPLY FOR FANS | 1250 | 62.5 | 0.02 | 1P | 1 | 1250 | 0.8 | 1562.5 |
| 39 | | POWER SUPPLY TO THE SOCKET | 6000 | 300 | 0.02 | 1P | 1 | 6000 | 0.8 | 7500 |
| 40 | | POWER SUPPLY FOR FCU | 4450 | 222.5 | 0.02 | 1P | 1 | 4450 | 0.8 | 5562.5 |
| 41 | Coffee shop | POWER SUPPLY FOR LIGHTS | 1000 | 50 | 0.02 | 1P | 1 | 1000 | 0.8 | 1250 |
| 42 | | POWER SUPPLY FOR FANS | 2500 | 125 | 0.02 | 1P | 1 | 2500 | 0.8 | 3125 |
| 43 | | POWER SUPPLY TO THE SOCKET | 12000 | 600 | 0.02 | 1P | 1 | 12000 | 0.8 | 15000 |
| 44 | | POWER SUPPLY FOR FCU | 8900 | 445 | 0.02 | 1P | 1 | 8900 | 0.8 | 11125 |
| 45 | Mechanical room | POWER SUPPLY FOR LIGHTS | 800 | 40 | 0.02 | 1P | 1 | 800 | 0.8 | 1000 |
| 46 | | POWER SUPPLY FOR FANS | 2000 | 100 | 0.02 | 1P | 1 | 2000 | 0.8 | 2500 |
| 47 | | POWER SUPPLY TO THE SOCKET | 9600 | 480 | 0.02 | 1P | 1 | 9600 | 0.8 | 12000 |
| 48 | | POWER SUPPLY FOR FCU | 7120 | 356 | 0.02 | 1P | 1 | 7120 | 0.8 | 8900 |
| 49 | Elec/tele | POWER SUPPLY FOR LIGHTS | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |
| 50 | | POWER SUPPLY FOR FANS | 1000 | 50 | 0.02 | 1P | 1 | 1000 | 0.8 | 1250 |
| 51 | | POWER SUPPLY TO THE SOCKET | 4800 | 240 | 0.02 | 1P | 1 | 4800 | 0.8 | 6000 |
| 52 | | POWER SUPPLY FOR FCU | 3560 | 178 | 0.02 | 1P | 1 | 3560 | 0.8 | 4450 |
| **LIBRARY-2F** | | | | | | | | | | |
| 1 | Journal | POWER | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | display/reading | SUPPLY FOR LIGHTS | | | | | | | | |
| 2 | | POWER SUPPLY FOR FANS | 1000 | 50 | 0.02 | 1P | 1 | 1000 | 0.8 | 1250 |
| 3 | | POWER SUPPLY TO THE SOCKET | 4800 | 240 | 0.02 | 1P | 1 | 4800 | 0.8 | 6000 |
| 4 | | POWER SUPPLY FOR FCU | 3560 | 178 | 0.02 | 1P | 1 | 3560 | 0.8 | 4450 |
| 5 | Journal display/reading | POWER SUPPLY FOR LIGHTS | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |
| 6 | | POWER SUPPLY FOR FANS | 1000 | 50 | 0.02 | 1P | 1 | 1000 | 0.8 | 1250 |
| 7 | | POWER SUPPLY TO THE SOCKET | 4800 | 240 | 0.02 | 1P | 1 | 4800 | 0.8 | 6000 |
| 8 | | POWER SUPPLY FOR FCU | 3560 | 178 | 0.02 | 1P | 1 | 3560 | 0.8 | 4450 |
| 9 | Journal display/reading | POWER SUPPLY FOR LIGHTS | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |
| 10 | | POWER SUPPLY FOR FANS | 1000 | 50 | 0.02 | 1P | 1 | 1000 | 0.8 | 1250 |
| 11 | | POWER SUPPLY TO THE SOCKET | 4800 | 240 | 0.02 | 1P | 1 | 4800 | 0.8 | 6000 |
| 12 | | POWER SUPPLY FOR FCU | 3560 | 178 | 0.02 | 1P | 1 | 3560 | 0.8 | 4450 |
| 13 | Journal display/reading | POWER SUPPLY FOR LIGHTS | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |
| 14 | | POWER SUPPLY FOR FANS | 1000 | 50 | 0.02 | 1P | 1 | 1000 | 0.8 | 1250 |
| 15 | | POWER SUPPLY TO THE SOCKET | 4800 | 240 | 0.02 | 1P | 1 | 4800 | 0.8 | 6000 |
| 16 | | POWER SUPPLY FOR FCU | 3560 | 178 | 0.02 | 1P | 1 | 3560 | 0.8 | 4450 |
| 17 | Group Workroom | POWER SUPPLY FOR LIGHTS | 120 | 6 | 0.02 | 1P | 1 | 120 | 0.8 | 150 |
| 18 | | POWER SUPPLY FOR FANS | 300 | 15 | 0.02 | 1P | 1 | 300 | 0.8 | 375 |
| 19 | | POWER SUPPLY TO THE SOCKET | 1440 | 72 | 0.02 | 1P | 1 | 1440 | 0.8 | 1800 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | | POWER SUPPLY FOR FCU | 1068 | 53.4 | 0.02 | 1P | 1 | 1068 | 0.8 | 1335 |
| 21 | Group Workroom | POWER SUPPLY FOR LIGHTS | 120 | 6 | 0.02 | 1P | 1 | 120 | 0.8 | 150 |
| 22 | | POWER SUPPLY FOR FANS | 300 | 15 | 0.02 | 1P | 1 | 300 | 0.8 | 375 |
| 23 | | POWER SUPPLY TO THE SOCKET | 1440 | 72 | 0.02 | 1P | 1 | 1440 | 0.8 | 1800 |
| 24 | | POWER SUPPLY FOR FCU | 1068 | 53.4 | 0.02 | 1P | 1 | 1068 | 0.8 | 1335 |
| 25 | Group Workroom | POWER SUPPLY FOR LIGHTS | 120 | 6 | 0.02 | 1P | 1 | 120 | 0.8 | 150 |
| 26 | | POWER SUPPLY FOR FANS | 300 | 15 | 0.02 | 1P | 1 | 300 | 0.8 | 375 |
| 27 | | POWER SUPPLY TO THE SOCKET | 1440 | 72 | 0.02 | 1P | 1 | 1440 | 0.8 | 1800 |
| 28 | | POWER SUPPLY FOR FCU | 1068 | 53.4 | 0.02 | 1P | 1 | 1068 | 0.8 | 1335 |
| 29 | Group Workroom | POWER SUPPLY FOR LIGHTS | 120 | 6 | 0.02 | 1P | 1 | 120 | 0.8 | 150 |
| 30 | | POWER SUPPLY FOR FANS | 300 | 15 | 0.02 | 1P | 1 | 300 | 0.8 | 375 |
| 31 | | POWER SUPPLY TO THE SOCKET | 1440 | 72 | 0.02 | 1P | 1 | 1440 | 0.8 | 1800 |
| 32 | | POWER SUPPLY FOR FCU | 1068 | 53.4 | 0.02 | 1P | 1 | 1068 | 0.8 | 1335 |
| 33 | Storage | POWER SUPPLY FOR LIGHTS | 140 | 7 | 0.02 | 1P | 1 | 140 | 0.8 | 175 |
| 34 | | POWER SUPPLY FOR FANS | 350 | 17.5 | 0.02 | 1P | 1 | 350 | 0.8 | 437.5 |
| 35 | | POWER SUPPLY TO THE SOCKET | 1680 | 84 | 0.02 | 1P | 1 | 1680 | 0.8 | 2100 |
| 36 | | POWER SUPPLY FOR FCU | 1246 | 62.3 | 0.02 | 1P | 1 | 1246 | 0.8 | 1557.5 |
| 37 | Storage | POWER SUPPLY FOR LIGHTS | 140 | 7 | 0.02 | 1P | 1 | 140 | 0.8 | 175 |
| 38 | | POWER SUPPLY FOR FANS | 350 | 17.5 | 0.02 | 1P | 1 | 350 | 0.8 | 437.5 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 39 | | POWER SUPPLY TO THE SOCKET | 1680 | 84 | 0.02 | 1P | 1 | 1680 | 0.8 | 2100 |
| 40 | | POWER SUPPLY FOR FCU | 1246 | 62.3 | 0.02 | 1P | 1 | 1246 | 0.8 | 1557.5 |
| 41 | Storage | POWER SUPPLY FOR LIGHTS | 140 | 7 | 0.02 | 1P | 1 | 140 | 0.8 | 175 |
| 42 | | POWER SUPPLY FOR FANS | 350 | 17.5 | 0.02 | 1P | 1 | 350 | 0.8 | 437.5 |
| 43 | | POWER SUPPLY TO THE SOCKET | 1680 | 84 | 0.02 | 1P | 1 | 1680 | 0.8 | 2100 |
| 44 | | POWER SUPPLY FOR FCU | 1246 | 62.3 | 0.02 | 1P | 1 | 1246 | 0.8 | 1557.5 |
| 45 | Prints/Storage | POWER SUPPLY FOR LIGHTS | 40 | 2 | 0.02 | 1P | 1 | 40 | 0.8 | 50 |
| 46 | | POWER SUPPLY FOR FANS | 100 | 5 | 0.02 | 1P | 1 | 100 | 0.8 | 125 |
| 47 | | POWER SUPPLY TO THE SOCKET | 480 | 24 | 0.02 | 1P | 1 | 480 | 0.8 | 600 |
| 48 | | POWER SUPPLY FOR FCU | 356 | 17.8 | 0.02 | 1P | 1 | 356 | 0.8 | 445 |
| 49 | Kitchen/staff lounge | POWER SUPPLY FOR LIGHTS | 100 | 5 | 0.02 | 1P | 1 | 100 | 0.8 | 125 |
| 50 | | POWER SUPPLY FOR FANS | 250 | 12.5 | 0.02 | 1P | 1 | 250 | 0.8 | 312.5 |
| 51 | | POWER SUPPLY TO THE SOCKET | 1200 | 60 | 0.02 | 1P | 1 | 1200 | 0.8 | 1500 |
| 52 | | POWER SUPPLY FOR FCU | 890 | 44.5 | 0.02 | 1P | 1 | 890 | 0.8 | 1112.5 |
| 53 | Directors office | POWER SUPPLY FOR LIGHTS | 180 | 9 | 0.02 | 1P | 1 | 180 | 0.8 | 225 |
| 54 | | POWER SUPPLY FOR FANS | 450 | 22.5 | 0.02 | 1P | 1 | 450 | 0.8 | 562.5 |
| 55 | | POWER SUPPLY TO THE SOCKET | 2160 | 108 | 0.02 | 1P | 1 | 2160 | 0.8 | 2700 |
| 56 | | POWER SUPPLY FOR FCU | 1602 | 80.1 | 0.02 | 1P | 1 | 1602 | 0.8 | 2002.5 |
| 57 | Assistants desk | POWER SUPPLY FOR | 180 | 9 | 0.02 | 1P | 1 | 180 | 0.8 | 225 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | LIGHTS | | | | | | | | |
| 58 | | POWER SUPPLY FOR FANS | 450 | 22.5 | 0.02 | 1P | 1 | 450 | 0.8 | 562.5 |
| 59 | | POWER SUPPLY TO THE SOCKET | 2160 | 108 | 0.02 | 1P | 1 | 2160 | 0.8 | 2700 |
| 60 | | POWER SUPPLY FOR FCU | 1602 | 80.1 | 0.02 | 1P | 1 | 1602 | 0.8 | 2002.5 |
| 61 | Meeting room | POWER SUPPLY FOR LIGHTS | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |
| 62 | | POWER SUPPLY FOR FANS | 1000 | 50 | 0.02 | 1P | 1 | 1000 | 0.8 | 1250 |
| 63 | | POWER SUPPLY TO THE SOCKET | 4800 | 240 | 0.02 | 1P | 1 | 4800 | 0.8 | 6000 |
| 64 | | POWER SUPPLY FOR FCU | 3560 | 178 | 0.02 | 1P | 1 | 3560 | 0.8 | 4450 |
| 65 | Computer pool | POWER SUPPLY FOR LIGHTS | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |
| 66 | | POWER SUPPLY FOR FANS | 1000 | 50 | 0.02 | 1P | 1 | 1000 | 0.8 | 1250 |
| 67 | | POWER SUPPLY TO THE SOCKET | 4800 | 240 | 0.02 | 1P | 1 | 4800 | 0.8 | 6000 |
| 68 | | POWER SUPPLY FOR FCU | 3560 | 178 | 0.02 | 1P | 1 | 3560 | 0.8 | 4450 |
| **LIBRARY-3F** | | | | | | | | | | |
| 1 | Reading theatre | POWER SUPPLY FOR LIGHTS | 800 | 40 | 0.02 | 1P | 1 | 800 | 0.8 | 1000 |
| 2 | | POWER SUPPLY FOR FANS | 2000 | 100 | 0.02 | 1P | 1 | 2000 | 0.8 | 2500 |
| 3 | | POWER SUPPLY TO THE SOCKET | 9600 | 480 | 0.02 | 1P | 1 | 9600 | 0.8 | 12000 |
| 4 | | POWER SUPPLY FOR FCU | 7120 | 356 | 0.02 | 1P | 1 | 7120 | 0.8 | 8900 |
| 5 | Learing room | POWER SUPPLY FOR LIGHTS | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |
| 6 | | POWER SUPPLY FOR FANS | 1000 | 50 | 0.02 | 1P | 1 | 1000 | 0.8 | 1250 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | | POWER SUPPLY TO THE SOCKET | 4800 | 240 | 0.02 | 1P | 1 | 4800 | 0.8 | 6000 |
| 8 | | POWER SUPPLY FOR FCU | 3560 | 178 | 0.02 | 1P | 1 | 3560 | 0.8 | 4450 |
| 9 | Learing room | POWER SUPPLY FOR LIGHTS | 400 | 20 | 0.02 | 1P | 1 | 400 | 0.8 | 500 |
| 10 | | POWER SUPPLY FOR FANS | 1000 | 50 | 0.02 | 1P | 1 | 1000 | 0.8 | 1250 |
| 11 | | POWER SUPPLY TO THE SOCKET | 4800 | 240 | 0.02 | 1P | 1 | 4800 | 0.8 | 6000 |
| 12 | | POWER SUPPLY FOR FCU | 3560 | 178 | 0.02 | 1P | 1 | 3560 | 0.8 | 4450 |
| 13 | Storage | POWER SUPPLY FOR LIGHTS | 140 | 7 | 0.02 | 1P | 1 | 140 | 0.8 | 175 |
| 14 | | POWER SUPPLY FOR FANS | 350 | 17.5 | 0.02 | 1P | 1 | 350 | 0.8 | 437.5 |
| 15 | | POWER SUPPLY TO THE SOCKET | 1680 | 84 | 0.02 | 1P | 1 | 1680 | 0.8 | 2100 |
| 16 | | POWER SUPPLY FOR FCU | 1246 | 62.3 | 0.02 | 1P | 1 | 1246 | 0.8 | 1557.5 |
| 17 | Copy/print | POWER SUPPLY FOR LIGHTS | 140 | 7 | 0.02 | 1P | 1 | 140 | 0.8 | 175 |
| 18 | | POWER SUPPLY FOR FANS | 350 | 17.5 | 0.02 | 1P | 1 | 350 | 0.8 | 437.5 |
| 19 | | POWER SUPPLY TO THE SOCKET | 1680 | 84 | 0.02 | 1P | 1 | 1680 | 0.8 | 2100 |
| 20 | | POWER SUPPLY FOR FCU | 1246 | 62.3 | 0.02 | 1P | 1 | 1246 | 0.8 | 1557.5 |
| 21 | Group Workroom | POWER SUPPLY FOR LIGHTS | 120 | 6 | 0.02 | 1P | 1 | 120 | 0.8 | 150 |
| 22 | | POWER SUPPLY FOR FANS | 300 | 15 | 0.02 | 1P | 1 | 300 | 0.8 | 375 |
| 23 | | POWER SUPPLY TO THE SOCKET | 1440 | 72 | 0.02 | 1P | 1 | 1440 | 0.8 | 1800 |
| 24 | | POWER SUPPLY FOR FCU | 1068 | 53.4 | 0.02 | 1P | 1 | 1068 | 0.8 | 1335 |
| 25 | Group Workroom | POWER SUPPLY FOR | 120 | 6 | 0.02 | 1P | 1 | 120 | 0.8 | 150 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | LIGHTS | | | | | | | | |
| 26 | | POWER SUPPLY FOR FANS | 300 | 15 | 0.02 | 1P | 1 | 300 | 0.8 | 375 |
| 27 | | POWER SUPPLY TO THE SOCKET | 1440 | 72 | 0.02 | 1P | 1 | 1440 | 0.8 | 1800 |
| 28 | | POWER SUPPLY FOR FCU | 1068 | 53.4 | 0.02 | 1P | 1 | 1068 | 0.8 | 1335 |
| 29 | Group Workroom | POWER SUPPLY FOR LIGHTS | 120 | 6 | 0.02 | 1P | 1 | 120 | 0.8 | 150 |
| 30 | | POWER SUPPLY FOR FANS | 300 | 15 | 0.02 | 1P | 1 | 300 | 0.8 | 375 |
| 31 | | POWER SUPPLY TO THE SOCKET | 1440 | 72 | 0.02 | 1P | 1 | 1440 | 0.8 | 1800 |
| 32 | | POWER SUPPLY FOR FCU | 1068 | 53.4 | 0.02 | 1P | 1 | 1068 | 0.8 | 1335 |
| 33 | Group Workroom | POWER SUPPLY FOR LIGHTS | 120 | 6 | 0.02 | 1P | 1 | 120 | 0.8 | 150 |
| 34 | | POWER SUPPLY FOR FANS | 300 | 15 | 0.02 | 1P | 1 | 300 | 0.8 | 375 |
| 35 | | POWER SUPPLY TO THE SOCKET | 1440 | 72 | 0.02 | 1P | 1 | 1440 | 0.8 | 1800 |
| 36 | | POWER SUPPLY FOR FCU | 1068 | 53.4 | 0.02 | 1P | 1 | 1068 | 0.8 | 1335 |
| 37 | Group Workroom | POWER SUPPLY FOR LIGHTS | 120 | 6 | 0.02 | 1P | 1 | 120 | 0.8 | 150 |
| 38 | | POWER SUPPLY FOR FANS | 300 | 15 | 0.02 | 1P | 1 | 300 | 0.8 | 375 |
| 39 | | POWER SUPPLY TO THE SOCKET | 1440 | 72 | 0.02 | 1P | 1 | 1440 | 0.8 | 1800 |
| 40 | | POWER SUPPLY FOR FCU | 1068 | 53.4 | 0.02 | 1P | 1 | 1068 | 0.8 | 1335 |
| 41 | Study carells | POWER SUPPLY FOR LIGHTS | 200 | 10 | 0.02 | 1P | 1 | 200 | 0.8 | 250 |
| 42 | | POWER SUPPLY FOR FANS | 500 | 25 | 0.02 | 1P | 1 | 500 | 0.8 | 625 |
| 43 | | POWER SUPPLY TO THE SOCKET | 2400 | 120 | 0.02 | 1P | 1 | 2400 | 0.8 | 3000 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 44 | | POWER SUPPLY FOR FCU | 1780 | 89 | 0.02 | 1P | 1 | 1780 | 0.8 | 2225 |
| 45 | Multiedia workroom | POWER SUPPLY FOR LIGHTS | 260 | 13 | 0.02 | 1P | 1 | 260 | 0.8 | 325 |
| 46 | | POWER SUPPLY FOR FANS | 650 | 32.5 | 0.02 | 1P | 1 | 650 | 0.8 | 812.5 |
| 47 | | POWER SUPPLY TO THE SOCKET | 3120 | 156 | 0.02 | 1P | 1 | 3120 | 0.8 | 3900 |
| 48 | | POWER SUPPLY FOR FCU | 2314 | 115.7 | 0.02 | 1P | 1 | 2314 | 0.8 | 2892.5 |
| **LIBRARY-4F** | | | | | | | | | | |
| 1 | Book stacks/Reading room | POWER SUPPLY FOR LIGHTS | 280 | 14 | 0.02 | 1P | 1 | 280 | 0.8 | 350 |
| 2 | | POWER SUPPLY FOR FANS | 700 | 35 | 0.02 | 1P | 1 | 700 | 0.8 | 875 |
| 3 | | POWER SUPPLY TO THE SOCKET | 3360 | 168 | 0.02 | 1P | 1 | 3360 | 0.8 | 4200 |
| 4 | | POWER SUPPLY FOR FCU | 2492 | 124.6 | 0.02 | 1P | 1 | 2492 | 0.8 | 3115 |
| 5 | Reading room | POWER SUPPLY FOR LIGHTS | 320 | 16 | 0.02 | 1P | 1 | 320 | 0.8 | 400 |
| 6 | | POWER SUPPLY FOR FANS | 800 | 40 | 0.02 | 1P | 1 | 800 | 0.8 | 1000 |
| 7 | | POWER SUPPLY TO THE SOCKET | 3840 | 192 | 0.02 | 1P | 1 | 3840 | 0.8 | 4800 |
| 8 | | POWER SUPPLY FOR FCU | 2848 | 142.4 | 0.02 | 1P | 1 | 2848 | 0.8 | 3560 |

**Table 11.1:** Calculation load

## *11.4 DETERMINED CALCULATION LOAD FOR EACH FLOOR*

Choose the average power factor of the whole school is $COS\varphi = 0{,}8$

School has a demand factor : $K_{nc} = 0{,}9$

The calculation formula :

- $P_{tt} = k_{nc}.\sum_{i=1}^{n} P_{đi}$
- $Q_{tt} = P_{tt}.tg\varphi$
- $S_{tt} = \sqrt{P_{tt}^2 + Q_{tt}^2} = \frac{P_{tt}}{cos\varphi}$
- $I_{tt} = \frac{S_{tt}}{\sqrt{3}.U_{day}}$ ( 3 phases )
- $I_{tt} = \frac{S_{tt}}{U_{day}}$ ( 1 phases )

Choose 2nd floor and Group Workroom are typical rooms

Each room is equivalent to 1 team: P=2928 W

From the installed capacity of the group and the demand coefficient $K_s = 0.9$

We can calculate the calculated capacity:

$P_{tt} = P.K_s = 2928.0.9 = 2635{,}2$ W

Factor capacity $\cos\varphi = 0.8$ Total capacity according to the following formula:

$S_{tt} = \frac{P_{tt}}{\cos\varphi} = \frac{2635{,}2}{0{,}8} = 3294VA = 3{,}294$ kVA

Calculated current of the room

$I_{tt} = \frac{S_{tt}}{U} = \frac{3294}{220} = 14{,}97$

| NO | ROOM NAME | TOTAL CAPACITY | TOTAL CAPACITY | FACTOR | TOTAL LOAD CALCULATION | TOTAL LOAD CALCULATION | Cos φ | TOTAL LOAD CALCULATION | CLCULATED LINE |
|---|---|---|---|---|---|---|---|---|---|
| | | W | kW | | P(W) | P(Kw) | | S(Va) | A |
| **CENTRAL PLANT-1F** | | | | | | | | | |
| 1 | Fire room | 4103.00 | 4.10 | 0.90 | 3692.70 | 3.69 | 0.80 | 4615.88 | 20.98 |
| 5 | Server room | 32003.40 | 32.00 | 0.90 | 28803.06 | 28.80 | 0.80 | 36003.83 | 163.65 |
| 9 | Chillers and Pumps room | 24400.00 | 24.40 | 0.90 | 21960.00 | 21.96 | 0.80 | 27450.00 | 124.77 |
| 13 | Transformer room | 976.00 | 0.98 | 0.90 | 878.40 | 0.88 | 0.80 | 1098.00 | 4.99 |
| 17 | Medium voltage switchgear room | 4223.00 | 4.22 | 0.90 | 3800.70 | 3.80 | 0.80 | 4750.88 | 21.59 |
| 21 | Transformer room | 976.00 | 0.98 | 0.90 | 878.40 | 0.88 | 0.80 | 1098.00 | 4.99 |
| 25 | Low voltage switchgear room | 4223.00 | 4.22 | 0.90 | 3800.70 | 3.80 | 0.80 | 4750.88 | 21.59 |
| 29 | Control center | 976.00 | 0.98 | 0.90 | 878.40 | 0.88 | 0.80 | 1098.00 | 4.99 |
| 33 | Technical room | 1145.00 | 1.15 | 0.90 | 1030.50 | 1.03 | 0.80 | 1288.13 | 5.86 |
| **CENTRAL PLANT-2F** | | | | | | | | | |
| 1 | UPS battery room | 4880.00 | 4.88 | 0.90 | 4392.00 | 4.39 | 0.80 | 5490.00 | 24.95 |
| 5 | Server room support | 38064.00 | 38.06 | 0.90 | 34257.60 | 34.26 | 0.80 | 42822.00 | 194.65 |
| 9 | Server room | 38064.00 | 38.06 | 0.90 | 34257.60 | 34.26 | 0.80 | 42822.00 | 194.65 |
| 13 | Storage | 3904.00 | 3.90 | 0.90 | 3513.60 | 3.51 | 0.80 | 4392.00 | 19.96 |
| 17 | Electrical workroom area | 6344.00 | 6.34 | 0.90 | 5709.60 | 5.71 | 0.80 | 7137.00 | 32.44 |
| 21 | Control room | 4392.00 | 4.39 | 0.90 | 3952.80 | 3.95 | 0.80 | 4941.00 | 22.46 |
| **CENTRAL PLANT-RF** | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Cooling towers | 195200.00 | 195.20 | 0.90 | 175680.00 | 175.68 | 0.80 | 219600.00 | 998.18 |
| **LIBRARY-1F** | | | | | | | | | |
| 1 | Conference /Training room | 19520.00 | 19.52 | 0.90 | 17568.00 | 17.57 | 0.80 | 21960.00 | 99.82 |
| 5 | Storage | 3416.00 | 3.42 | 0.90 | 3074.40 | 3.07 | 0.80 | 3843.00 | 17.47 |
| 9 | Frist Aid | 6832.00 | 6.83 | 0.90 | 6148.80 | 6.15 | 0.80 | 7686.00 | 34.94 |
| 13 | Aid relaxing room | 7320.00 | 7.32 | 0.90 | 6588.00 | 6.59 | 0.80 | 8235.00 | 37.43 |
| 17 | Storage | 3416.00 | 3.42 | 0.90 | 3074.40 | 3.07 | 0.80 | 3843.00 | 17.47 |
| 21 | Book return room | 6832.00 | 6.83 | 0.90 | 6148.80 | 6.15 | 0.80 | 7686.00 | 34.94 |
| 25 | Post room | 2440.00 | 2.44 | 0.90 | 2196.00 | 2.20 | 0.80 | 2745.00 | 12.48 |
| 29 | Storageo/Receiving | 3416.00 | 3.42 | 0.90 | 3074.40 | 3.07 | 0.80 | 3843.00 | 17.47 |
| 33 | Porter room | 2440.00 | 2.44 | 0.90 | 2196.00 | 2.20 | 0.80 | 2745.00 | 12.48 |
| 37 | Uni shop | 12200.00 | 12.20 | 0.90 | 10980.00 | 10.98 | 0.80 | 13725.00 | 62.39 |
| 41 | Coffee shop | 24400.00 | 24.40 | 0.90 | 21960.00 | 21.96 | 0.80 | 27450.00 | 124.77 |
| 45 | Mechanical room | 19520.00 | 19.52 | 0.90 | 17568.00 | 17.57 | 0.80 | 21960.00 | 99.82 |
| 49 | Elec/tele | 9760.00 | 9.76 | 0.90 | 8784.00 | 8.78 | 0.80 | 10980.00 | 49.91 |
| **LIBRARY-2F** | | | | | | | | | |
| 1 | Journal display/reading | 9760.00 | 9.76 | 0.90 | 8784.00 | 8.78 | 0.80 | 10980.00 | 49.91 |
| 5 | Journal display/reading | 9760.00 | 9.76 | 0.90 | 8784.00 | 8.78 | 0.80 | 10980.00 | 49.91 |
| 9 | Journal display/reading | 9760.00 | 9.76 | 0.90 | 8784.00 | 8.78 | 0.80 | 10980.00 | 49.91 |
| 13 | Journal display/reading | 9760.00 | 9.76 | 0.90 | 8784.00 | 8.78 | 0.80 | 10980.00 | 49.91 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 17 | Group Workroom | 2928.00 | 2.93 | 0.90 | 2635.20 | 2.64 | 0.80 | 3294.00 | 14.97 |
| 21 | Group Workroom | 2928.00 | 2.93 | 0.90 | 2635.20 | 2.64 | 0.80 | 3294.00 | 14.97 |
| 25 | Group Workroom | 2928.00 | 2.93 | 0.90 | 2635.20 | 2.64 | 0.80 | 3294.00 | 14.97 |
| 29 | Group Workroom | 2928.00 | 2.93 | 0.90 | 2635.20 | 2.64 | 0.80 | 3294.00 | 14.97 |
| 33 | Storage | 3416.00 | 3.42 | 0.90 | 3074.40 | 3.07 | 0.80 | 3843.00 | 17.47 |
| 37 | Storage | 3416.00 | 3.42 | 0.90 | 3074.40 | 3.07 | 0.80 | 3843.00 | 17.47 |
| 41 | Storage | 3416.00 | 3.42 | 0.90 | 3074.40 | 3.07 | 0.80 | 3843.00 | 17.47 |
| 45 | Prints/Storage | 976.00 | 0.98 | 0.90 | 878.40 | 0.88 | 0.80 | 1098.00 | 4.99 |
| 49 | Kitchen/staff lounge | 2440.00 | 2.44 | 0.90 | 2196.00 | 2.20 | 0.80 | 2745.00 | 12.48 |
| 53 | Directors office | 4392.00 | 4.39 | 0.90 | 3952.80 | 3.95 | 0.80 | 4941.00 | 22.46 |
| 57 | Assistants desk | 4392.00 | 4.39 | 0.90 | 3952.80 | 3.95 | 0.80 | 4941.00 | 22.46 |
| 61 | Meeting room | 9760.00 | 9.76 | 0.90 | 8784.00 | 8.78 | 0.80 | 10980.00 | 49.91 |
| 65 | Computer pool | 9760.00 | 9.76 | 0.90 | 8784.00 | 8.78 | 0.80 | 10980.00 | 49.91 |
| **LIBRARY-3F** | | | | | | | | | |
| 1 | Reading theatre | 19520.00 | 19.52 | 0.90 | 17568.00 | 17.57 | 0.80 | 21960.00 | 99.82 |
| 5 | Learing room | 9760.00 | 9.76 | 0.90 | 8784.00 | 8.78 | 0.80 | 10980.00 | 49.91 |
| 9 | Learing room | 9760.00 | 9.76 | 0.90 | 8784.00 | 8.78 | 0.80 | 10980.00 | 49.91 |
| 13 | Storage | 3416.00 | 3.42 | 0.90 | 3074.40 | 3.07 | 0.80 | 3843.00 | 17.47 |
| 17 | Copy/print | 3416.00 | 3.42 | 0.90 | 3074.40 | 3.07 | 0.80 | 3843.00 | 17.47 |
| 21 | Group Workroom | 2928.00 | 2.93 | 0.90 | 2635.20 | 2.64 | 0.80 | 3294.00 | 14.97 |
| 25 | Group Workroom | 2928.00 | 2.93 | 0.90 | 2635.20 | 2.64 | 0.80 | 3294.00 | 14.97 |
| 29 | Group Workroom | 2928.00 | 2.93 | 0.90 | 2635.20 | 2.64 | 0.80 | 3294.00 | 14.97 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 33 | Group Workroom | 2928.00 | 2.93 | 0.90 | 2635.20 | 2.64 | 0.80 | 3294.00 | 14.97 |
| 37 | Group Workroom | 2928.00 | 2.93 | 0.90 | 2635.20 | 2.64 | 0.80 | 3294.00 | 14.97 |
| 41 | Study carells | 4880.00 | 4.88 | 0.90 | 4392.00 | 4.39 | 0.80 | 5490.00 | 24.95 |
| 45 | Multiedia workroom | 6344.00 | 6.34 | 0.90 | 5709.60 | 5.71 | 0.80 | 7137.00 | 32.44 |
| **LIBRARY-4F** | | | | | | | | | |
| 1 | Book stacks/Reading room | 6832.00 | 6.83 | 0.90 | 6148.80 | 6.15 | 0.80 | 7686.00 | 34.94 |
| 5 | Reading room | 7808.00 | 7.81 | 0.90 | 7027.20 | 7.03 | 0.80 | 8784.00 | 39.93 |

**Table 11.2:** Calculation load for each Floors.

## *11.5 CALCULATION LOAD FOR DISTRIBUTION CABINETS*

Calculation formula for distribution cabinets:

a. Rated capacity of distribution cabinets:

$$P_{đm\ TPP} = \sum_{i=1}^{15} P_{đm} \quad \text{(kW)}$$

b. Rated current of distribution cabinet:

$$I_{đm\ TPP} = \sum_{i=1}^{15} I_{đm} \quad \text{(A)}$$

c. Average capacity of distribution cabinets:

$$P_{TB\ TPP} = \sum_{i=1}^{15} P_{TB} \quad \text{(kW)}$$

d. Calculation capacity of distribution cabinets:

$$P_{tt\ TPP} = \sum_{i=1}^{15} P_{tt} \quad \text{(kW)}$$

$$S_{tt\ TPP} = \sum_{i=1}^{15} S_{tt} \quad \text{(kVA)}$$

e. Calculated current of the apartment:

$$I_{tt\ TPP} = \frac{S_{tt\ TPP}}{\sqrt{3} \times U} \quad \text{(A)}$$

| NO | ROOM NAME | TOTAL CAPACITY | TOTAL CAPACITY | FACTOR | TOTAL LOAD CALCULATION | TOTAL LOAD CALCULATION | Cos φ | TOTAL LOAD CALCULATION | CLCULATED LINE |
|---|---|---|---|---|---|---|---|---|---|
| | | W | kW | | P(W) | P(Kw) | | S(Va) | A |
| **CENTRAL PLANT-1F** | | | | | | | | | |
| CENTRAL PLANT-1F | | 73025.40 | 73.03 | 8.10 | 65722.86 | 65.72 | 7.20 | 82153.58 | 373.43 |
| **CENTRAL PLANT-2F** | | | | | | | | | |
| CENTRAL PLANT-2F | | 170794.40 | 170.79 | 15.30 | 153714.96 | 153.71 | 13.60 | 192143.70 | 873.38 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **CENTRAL PLANT-RF** | | | | | | | | |
| CENTRAL PLANT-RF | 535812.80 | 535.81 | 30.60 | 482231.52 | 482.23 | 27.20 | 602789.40 | 2739.95 |
| **LIBRARY-1F** | | | | | | | | |
| LIBRARY-1F | 84424.00 | 84.42 | 8.10 | 75981.60 | 75.98 | 7.20 | 94977.00 | 431.71 |
| **LIBRARY-2F** | | | | | | | | |
| LIBRARY-2F | 41968.00 | 41.97 | 8.10 | 37771.20 | 37.77 | 7.20 | 47214.00 | 214.61 |
| **LIBRARY-3F** | | | | | | | | |
| LIBRARY-3F | 32696.00 | 32.70 | 8.10 | 29426.40 | 29.43 | 7.20 | 36783.00 | 167.20 |
| **LIBRARY-4F** | | | | | | | | |
| LIBRARY-4F | 70272.00 | 70.27 | 15.30 | 63244.80 | 63.24 | 13.60 | 79056.00 | 359.35 |
| TOTAL (kW) | | | | | 949,43 | | | |

**Table 11.3:** Calculation load for distribution cabinets:

## *11.6 VOLTAGE SWITCHES - PREVENTIVE DEVICE - COMPONENT COMPONENTS*

### *11.6.1 CHOSE TRANSFORMERS*

Total capacity used:

P = 950 (kW)

Rated capacity:

S = P / 0,8 = 950/0,8 = 1188 (kVA)

Reactive power of the building:

$$Q = \sqrt{S^2 - P_{tt}^2} = \sqrt{1188^2 - 950^2} = 713\ kVAr$$

Select the transformer according to the catalog of Thibidi Electrical Equipment Corporation

Rated capacity: 1250 KVA

Loss: no load loss $\Delta P_0$ = 1,8 (KW), short circuit $\Delta P_N$ = 14 (kW)

Short circuit voltage: $U_N$ = 6 %

No load current: $i_0$ = 1,5 %

Rated voltage $I_1$ (22kv) = 32,8 (A)

Rated voltage $I_2$ (0,4kv) =1804 (A)

**Calculate power loss and power in the transformer.**

Power Loss:

Power losses (copper loss)

$$\Delta P_B = \Delta P_0 + \Delta P_N \left(\frac{S_{tt}}{S_{dm}}\right)^2 = 1{,}8 + 14\left(\frac{1188}{1250}\right)^2 = 14{,}44 \text{ (kW)}$$

Reactive power losses (iron losses)

$$\Delta Q_0 = \frac{i\%, S_{dm}}{100} = \frac{1{,}5 \times 1250}{100} = 18{,}75\ (kVAr)$$

$$\Delta Q_N = \frac{U_N\%, S_{dm}}{100} = \frac{6 \times 1250}{100} = 75\ (kVAr)$$

$$\Delta Q_B = \Delta Q_0 + \Delta Q_N \left(\frac{S_{tt}}{S_{dm}}\right)^2 = 18{,}75 + 75\left(\frac{1188}{1250}\right)^2 = 86{,}49 \text{ (KW)}$$

Power Loss:

$$\Delta A_B = \Delta P_0 . \mathrm{t} + \Delta P_N \left(\frac{S_{tt}}{S_{dm}}\right)^2 . t$$

$$= 1{,}8.8760 + 14\left(\frac{1188}{1250}\right)^2 .8760 = 126544\ (KWh)$$

### *11.6.2 ELECTRIC POWER GENERATOR*

- When there is an incident on the medium voltage grid 220 (kV), the electricity supply is not continuous anymore, if unexpected power outage, causing economic losses are very large.
- Therefore, the backup generator is essential to ensure continuous power supply for critical load, when the Transformers encounters a problem in the factory.
- With total capacity: 950 KVA
- Select KOHLER generator
- Machine: 1000REOZM
- Rotational speed: 1500 rotation/min
- Frequency: 50 Hz
- Voltage: 220-380V - 3 phases
- Rated power $S_{\mathrm{rs}} = 1065KVA$
- Standby power $S_{sp} = 1165\ kVA$

### *11.6.3 COMPENSATION CAPACITY*

Most civil and industrial loads, such as the TRANSFORMER, electric motors, lights, etc., consume reactive power, thus reducing the power factor, resulting in increased transmission. the following:

Power loss and voltage drop across large transmission lines.

The size, power of electrical appliances such as wires, switches, transformer power surge. Reactive power compensation will result in improved cos hệ coefficient, reduced power loss and voltage drop. Generally the firm's cos is very low so the current factories always have compensating devices, in addition to raising the coefficient cos φ up to the value 0.85 - 0.95

Before we have the coefficient cos φ:

$$cos\varphi = \frac{P_{tt}}{S_{đm}} = \frac{950}{1250} = 0{,}76 \Rightarrow tan\varphi_1 = 0{,}85$$

After offset we have the coefficient cos φ:

$$cos\varphi = 0{,}95 \Rightarrow tan\varphi_2 = 0{,}328$$

Expected Reactor Capacity:

$$Q_{ERC} = P_{tt} \times (tan\varphi_1 - tan\varphi_2) = 950 \times (0{,}85 - 0{,}328) = 495\ kVA$$

We choose 17 capacitors of Ducati (Italy) with parameters as follows

Model: DUCATI30KVAR 440V

Capacity of each capacitor: 30 KVAr

- **When the load of the factory work 100% we also cover the capacitors**

Capacity after compensation:

Q' = Q – $Q_{bù}$ =713 – 17 × 30 = 203 ( Kvar)

Visible power after compensation:

S' = $\sqrt{P^2 + Q'^2}$ = $\sqrt{950^2 + 203^2}$ = 971 (kVA)

Power factor after compensation:

$$cos_{\varphi_1} = \frac{P}{S'} = \frac{950}{971} = 0{,}97$$

- **When the factory load 80%**

So the capacity required to compensate:

$Q_{bu}$ = 80% $P_{tt}$ × (tgω1 - tgω2) = 0,8 ×950 × (0,85 – 0,328) = 397 (Kvar)

So there are 14 working capacitors

Reactive power after compensation

$$Q' = 80\%Q - Q_{bù} = 0,8 \times 713 - 30 \times 14 = 150 \text{ (Kvar)}$$

Reactive power after compensation:

$$S' = \sqrt{80\%P_{tt,}^2 + Q'^2} = \sqrt{0,8 \times 950^2 + 150^2} = 863 \text{ (KVA)}$$

Power factor after compensation:

$$cos_\varphi = \frac{80\%P_{tt}}{S'} = \frac{0,8 \times 950}{863} = 0,88$$

- **When the factory load is 60%**

Expected Reactor Capacity:

$Q_{cbu} = 60\% P_{tt} \times (tg\omega_1 - tg\omega_2) = 0,6 \times 950 \times (0,85 - 0,328) = 298$ (Kvar)

So there are 11 working capacitors

$$Q' = 60\%Q - Q_{bù} = 0,6 \times 713 - 30 \times 11 = 98 \text{ (Kvar)}$$

Reactive power after compensation:

$$S' = \sqrt{60\%P_{tt,}^2 + Q'^2} = \sqrt{0,6 \times 950^2 + 98^2} = 742 \text{ (KVA)}$$

Power factor after compensation:

$$cos_\varphi = \frac{60\%P_{tt}}{S'} = \frac{0,6 \times 950}{742} = 0,76$$

## *11.7 CHOSE OF LINE - CALCULATION OF DROP*

### *11.7.1 CHOSE OF LINE*

Select wires from the transformer to the main distribution cabinet

Transformer with rated power: $S_{đm} = 1250$ KVA

Rated power of the transformer:

$$I_{dm} = \frac{S_{dm}}{\sqrt{3} \times U_{dm}} = \frac{1250 \times 10^3}{\sqrt{3} \times 380} = 1899,79\ A$$

$I_{lvmax} = I_{đm} = 1899,79\ A$

Permitted line of conductor

$$I_{cp} \geq I_{lvmax}$$

Correction factor K (According to TL3 table G12, G13, G15, G17)

$k = k_1 * k_2 * k_3 * k_4$

Correction coefficient when the ambient temperature is different 30°C $k_1 = 0,94$

Correction coefficients of three adjacent cables $k_2 = 0,95$

Correction factor according to type installed on ladder cable $k_3 = 1$

$k_4 = 0,87$

Correction factor

$k = 0,94 \times 0,95 \times 1 \times 0,87 = 0,78$

Permitted line of conductor

$$I_{cp} \geq \frac{I_{lvmax}}{k} = \frac{1899,79}{0,78} = 2345,63A$$

We choose the cable manufactured by Cadivi

With section $F = 400\ mm^2$

Icp current intensity $I_{cp} = 815A$

Voltage drop of 0,28mV

Choose 3 fibers like above

Current permissible over 3 phases:

$I_{cp3pha} = 3 \times I_{cp1pha} = 3 \times 815 = 2445\ A$

We See :$I_{cp3pha} \geq :I_{cp}$

CALCULATING DROP

Formula for pressure drop [Doc 5]

Pressure drop: $\Delta U = k.I_B.L$

In which: k coefficient of check according to table G28 in IEC Electrical Installation Design Guide

$I_B$: largest working current (A)

L: length of conductor (km)

Check the voltage drop on the line from the transformer to the main distribution box.

Line length is 10m , cable diameter $400mm^2$, k = 0,2

$I_B = 2345,63/3 = 781,77(A)$

So : $\Delta U = 0,2 \times 781,77 \times 0,01 = 1,564$

$$\%\Delta U = \frac{\Delta U}{U} = \frac{1,564}{380} \times 100\% = 0,4\%$$

Condition: $\%\Delta U \leq 5\%$

## COUNTING FOR HOUSEHOLD MEASURES

## CONCEPTS OF LIGHT AND PROTECTION OF LIGHT

a) The concept of lightning:

In the atmosphere, between the clouds when the opposite electric charge generates an electrical discharge. Prior to the discharge of lightning there was a very high separation and accumulation of charge in the thunderclouds, due to the effects of hot airflows and condensation in the clouds. Voltage between thundercloud and earth can reach tens or even hundreds of millions of volts. Between the clouds and the earth form giant capacitors. The electric field strength of the cloud and the soil is constantly increasing, and if the electric field strength reaches the critical value (25-30 kV/cm), an electric discharge or clay is started.

b) The consequences of lightning and direct lightning protection:

When choosing the method of lightning protection, it is necessary to choose the method of protection appropriate to the structure, purpose and requirements of the technology of the factory.

Direct lightning in the power transmission line causes many serious harms such as: interruption of the power supply of the system, short circuit, ground contact phase in the electrical equipment due to over voltage phenomenon insulation damage of the equipment. When lightning strikes on power projects, high buildings; Electric current generated by the clay will cause thermal, mechanical, electromagnetic effects to damage property, items, equipment and danger to human life. Therefore, lightning protection is essential for factory.

The location of the lightning strike is selective, so in the technique people use that selectivity to protect lightning directly into the factory. By using well-grounded metal bars or wires, place higher-than-protected structures to direct lightning and limit the possibility of lightning strikes.

Direct lightning protection is usually carried out by means of lightning rods or lightning rods, including: lightning arresters, earthed parts and grounded clay conductors (connected from the set lightning collecting and grounding parts.

There are types of lightning collectors as follows:

• Lightning conductor set independently.

• Lightning conductor (antenna wire).

• Grid lightning collectors (also known as lightning currents).

• Collected lightning collectors, including: lightning pole and lightning collecting wire combined.

Direct lightning protection

Principles of protection

- Protection against lightning on the principle of focus:

Applied to projects with a height of less than 15m and non-critical structures. In the key protection mode, only those parts which are often hit by lightning must be protected. For flat roofs, the focus of protection is four corners, around the retaining wall and extruded structures off the ground. For sloping roofs, the focus is on the peaks at the corners, the shores of the shoreline flowing from the roofs of the roofs, and the elevations rising from the roof.

### *11.7.2 - CALCULATION OF LIGHTNING*

a. Guard radius

The protection radius of the lightning collecting needle shall be determined according to the following formula:

$$R_p = \sqrt{h(2D - h) + \Delta L(2D + \Delta L)} \geq 5m$$

Inside :

$R_P$: protection radius of lightning collecting needle (m)

D: 20m, 45m, 60m: for level 1, 2, 3 protection

h: the height of the lightning collecting needle is calculated from the end of the needle to the protected surface (m).

$\Delta_L$: the gain of the direct ray radius is calculated by the formula: $\Delta L = 10^6, \Delta T$

Radius of the Stormaster Lightning Protection Needle

| GUARD RADIUS (M) – (RP) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| H = height of Stormaster on the area are told guard (m) | 2 | 4 | 5 | 6 | 10 | 15 | 20 | 45 | 60 |
| Level 1 (top level) | | | | | | | | | |
| Stormaster 15 | 13 | 25 | 32 | 32 | 33 | 34 | 35 | 35 | 35 |
| Stormaster | 19 | 28 | 48 | 48 | 49 | 50 | 50 | 50 | 50 |

| GUARD RADIUS (M) – (RP) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| H = height of Stormaster on the area are told guard (m) | 2 | 4 | 5 | 6 | 10 | 15 | 20 | 45 | 60 |
| 30 | | | | | | | | | |
| Stormaster 50 | 28 | 55 | 63 | 64 | 69 | 69 | 70 | 70 | 70 |
| Stormaster 60 | 32 | 64 | 79 | 79 | 79 | 80 | 80 | 80 | 80 |
| Level 2 (high level of protection) | | | | | | | | | |
| Stormaster 15 | 18 | 36 | 45 | 46 | 49 | 52 | 55 | 60 | 60 |
| Stormaster 30 | 25 | 50 | 63 | 64 | 66 | 68 | 71 | 75 | 75 |
| Stormaster 50 | 35 | 69 | 86 | 87 | 88 | 90 | 92 | 95 | 95 |
| Stormaster 60 | 40 | 78 | 97 | 97 | 99 | 101 | 102 | 105 | 105 |
| Level 3 (standard protection level) | | | | | | | | | |
| Stormaster 15 | 20 | 41 | 51 | 52 | 56 | 60 | 63 | 73 | 75 |
| Stormaster 30 | 28 | 57 | 71 | 72 | 75 | 77 | 81 | 89 | 90 |
| Stormaster 50 | 38 | 76 | 95 | 96 | 98 | 101 | 102 | 110 | 110 |
| Stormaster 60 | 44 | 87 | 107 | 107 | 109 | 111 | 113 | 120 | 120 |

With the size of the project:

+ Length: 160 m

+ Width: 60 m

+ We choose level 1 (high protection level): D = 80 m

+ Select Stormaster needles 15 height of the needle compared to the protection ground h = 5 m.

+ The radius of the building:

$$D' = \sqrt{160^2 + 60^2} = 170\ m > D = 80\ m$$

We choose 3 the needle Stormaster - ESE - 60 with a total protection radius of 240 m.