Bangladesh University of Engineering and Technology

Department of Electrical and Electronic Engineering

Course Number: EEE 414

Course Title: Electrical Services Design

Project Submission

Group: 08

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❖ Calculations for Conduits:

Formula:

$$Ampere\ Rating, I = \frac{P}{V \times pf}\ A$$

Assumptions:

Voltage, V = 220 V

Power factor, pf = 0.7

Light Bulb (LB) = 20 W

Tube Light (TB) = 20 W

Ceiling Light (LC) = 20 W

Ceiling Fan (F) = 100 W

Exhaust Fan (EF) = 60 W

Switchboard Socket (ST) = 100 W

Emergency Switchboard Socket (SS) = 100 W

➢ Ground Floor (Unit-1):

To Sub-Distribution Board (SDB):

SB1: P = SB2 + TB-3 + ST-1 = 80 + 20 + 100 = 200 W

SB2: P = EF-1 + LB-2 = 60 + 20 = 80 W

SB3: P = TB-4 + F-5 + LC-2 + ST-2= 20+ 100+ 20 + 100 = 240 W

SB4: P = LC-4 = 20 W

CKT1 Rating:

$$I = \frac{P(SB1)}{V \times pf} = \frac{200}{220 \times 0.7} = 1.298\ A < 5\ A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT2 Rating:

$$I = \frac{P(SB3)}{V \times pf} = \frac{240}{220 \times 0.7} = 1.558\ A < 5\ A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT3 Rating:

$$I = \frac{P(SB4)}{V \times pf} = \frac{20}{220 \times 0.7} = 0.129\ A < 5\ A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

To Emergency Sub-Distribution Board (ESDB):

ESB1: P = TB-1 + F-1 + SS-1 = 20 + 100 + 100 = 220 W

ESB2: P = LB-1 + LC-1 + ESB1 = 20 + 20 + 220 = 260 W

ESB3: P = ESB2 + SS-2 + TB-2 + F-2 + LB-1 = 260 + 100 + 20 + 100 +20 = 500 W

ESB4: P = LB3 = 20 W

ESB5: P = ESB4 + TB-7 + TB-6 + F-3 + SS-3 = 20 + 20 + 20 + 100 + 100 = 260 W

ESB6: P = TB-5 + F-6 = 20 + 100 W = 120 W

ESB7: P = LB-4 = 20 W

CKT1' Rating:

$$I = \frac{P(ESB3)}{V \times pf} = \frac{500}{220 \times 0.7} = 3.24\ A < 5\ A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT2' Rating:

$$I = \frac{P(ESB6)}{V \times pf} = \frac{120}{220 \times 0.7} = 0.779\ A < 5\ A$$

CKT3' Rating:

$$I = \frac{P(ESB5)}{V \times pf} = \frac{260}{220 \times 0.7} = 1.688\ A < 5\ A$$

CKT4' Rating:

$$I = \frac{P(ESB7)}{V \times pf} = \frac{20}{220 \times 0.7} = 0.129\ A < 5\ A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

➢ Ground Floor (Parking Area):

To Sub-Distribution Board (SDB):

SB1: P= SB5 + SB2 + LB-2 = 120 + 40 + 20 =180 W

SB2: P =LC-1 + LC-2 = 20 + 20 = 40 W

SB5: P = 3*LC-3 + 3*LB-5 = 3*20 + 3*20 = 120 W

CKT1 Rating:

$$I = \frac{P(SB1)}{V \times pf} = \frac{180}{220 \times 0.7} = 1.168\ A < 5\ A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

To Emergency Sub-Distribution Board (ESDB):

ESB1: P = LB-1 + SS-1 = 20 + 100 = 120W

ESB2: P = ESB1 + TB-2 +TB-1 + TB-3 = 120 + 20 + 20 + 20 = 180 W

ESB3: P = LB-3 + TB-5 + TB-4 + = 60 W

CKT1' Rating:

$$I = \frac{P(ESB2)}{V \times pf} = \frac{120}{220 \times 0.7} = 0.779\ A < 5\ A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT2' Rating:

$$I = \frac{P(ESB3)}{V \times pf} = \frac{60}{220 \times 0.7} = 0.389\ A < 5\ A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

➢ First Floor (Bigger Unit):

To Sub-Distribution Board (SDB):

SB1: P = SB2 + ST-1 + TB-3 = 80 + 100 + 20 = 200 W

SB2: P = EF-1 + LB-2 = 60 + 20 = 80 W

SB3: P = SB4 + SB6 + ST-3 + F-4 + TB-9 + = 20 + 40 + 100 + 100 + 20 = 280 W

SB4: P = LB-7 = 20 W

SB6: P = LB-6 + LB-5 = 20 + 20 = 0 W

SB7: P = ST-2 + LC-5 + TB-10 +F-6 + LC-2 = 100 + 20 + 20 + 100 + 20 = 260 W

SB8: P = LC-4 =20 W

CKT1 Rating:

$$I = \frac{P(SB1)}{V \times pf} = \frac{200}{220 \times 0.7} = 1.29\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT2 Rating:

$$I = \frac{P(SB7)}{V \times pf} = \frac{260}{220 \times 0.7} = 1.68\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT3 Rating:

$$I = \frac{P(SB3)}{V \times pf} = \frac{280}{220 \times 0.7} = 1.81\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT4 Rating:

$$I = \frac{P(SB8)}{V \times pf} = \frac{20}{220 \times 0.7} = 0.129\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

To Emergency Sub-Distribution Board (ESDB):

ESB1: P = TB-1 + SS-1 + F-1 = 20 + 100 + 100 = 220 W

ESB2: P = ESB1+ ESB10 + SS-2 + LB-8 +F-2 + TB-2 = 220 + 40 + 100 + 20 + 100 + 20 = 500 W

ESB3: P = F-5 + TB-4 = 100 + 20 = 120 W

ESB4: P = ESB5 + SS-4 + F-3 +TB-7 + TB-6 + = 20 + 100 + 100 + 20 + 20 = 260 W

ESB5: P = LB-3 = 20 W

ESB6: P = ESB-7 +ESB-9 + TB-8 + F-4 + LB-5 + SS-5 = 20 + 20 + 20 + 100 + 20 + 100 = 280 W

ESB7: P = LB-6 = 20 W

ESB8: P = LB-4 = 20 W

ESB9: P = LB-7 = 20 W

ESB10: P = LC-1 + LB-1 = 20 + 20 = 40 W

CKT1' Rating:

$$I = \frac{P(ESB2)}{V \times pf} = \frac{500}{220 \times 0.7} = 3.24\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT2' Rating:

$$I = \frac{P(ESB3)}{V \times pf} = \frac{120}{220 \times 0.7} = 0.78\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT3' Rating:

$$I = \frac{P(ESB4)}{V \times pf} = \frac{260}{220 \times 0.7} = 1.68\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT4' Rating:

$$I = \frac{P(ESB6)}{V \times pf} = \frac{280}{220 \times 0.7} = 1.81\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT5' Rating:

$$I = \frac{P(ESB8)}{V \times pf} = \frac{20}{220 \times 0.7} = 0.13\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

- **First Floor (Smaller Unit):**

To Sub-Distribution Board (SDB):

SB1: P = SB-2 + SB-4 + ST-1 + TB-3 = 80 + 20 + 100 + 20 = 220 W

SB2: P = EF-1 + LB-3 = 60 + 20 = 80 W

SB3: P = ST-2 + LC-2 + F-4 + TB-4 = 100 + 20 + 100 + 20 = 240 W

SB4: P = LC-4 = 20 W

CKT1 Rating:

$$I = \frac{P(SB1)}{V \times pf} = \frac{220}{220 \times 0.7} = 1.42\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT2 Rating:

$$I = \frac{P(SB3)}{V \times pf} = \frac{240}{220 \times 0.7} = 1.55\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

To Emergency Sub-Distribution Board (ESDB):

ESB1: P = ESB-6 + SS-1 + F-1 + TB-1 = 40 + 100 + 100 + 20 = 260 W

ESB2: P = SS-2 + F-2 +TB-2 + LB-2 = 100 + 100+ 20 + 20 = 240 W

ESB3: P = ESB-5 + ESB-4 + SS-4 + TB-5 + TB-7 + TB-6 + F-3 = 20 + 20 + 100 + 20 + 20 + 20 + 100 = 300 W

ESB4: P = LB-4 = 20 W

ESB5: P = LB-5 = 20 W

ESB6: P = LC-1 + LB-1 = 20 + 20 = 40 W

CKT1' Rating:

$$I = \frac{P(ESB1)}{V \times pf} = \frac{260}{220 \times 0.7} = 1.68\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT2' Rating:

$$I = \frac{P(ESB2)}{V \times pf} = \frac{240}{220 \times 0.7} = 1.558\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT3' Rating:

$$I = \frac{P(ESB6)}{V \times pf} = \frac{220}{220 \times 0.7} = 1.43\,A < 5\,A I = \frac{P(ESB3)}{V \times pf} = \frac{300}{220 \times 0.7} = 1.94\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

- ## Second Floor (Unit-1):

To Sub-Distribution Board (SDB):

SB1: P = SB2 + TB-3 + ST-1 =80 + 20 + 100 = 200 W

SB2: P =EF-1 +LB-2 = 60 + 20 = 80 W

SB3: P = TB-5 + F-6 + LC-2 + ST-2 = 20 + 100 + 20 + 100 =240 W

SB4: P = LC-4 = 20 = 20 W

CKT1 Rating:

$$I = \frac{P(SB1)}{V \times pf} = \frac{200}{220 \times 0.7} = 1.30\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT2 Rating:

$$I = \frac{P(SB3)}{V \times pf} = \frac{240}{220 \times 0.7} = 1.55\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT3 Rating:

$$I = \frac{P(SB4)}{V \times pf} = \frac{20}{220 \times 0.7} = 0.13\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

To Emergency Sub-Distribution Board (ESDB):

ESB1: P = TB-1 + F-1 + SS1 = 20 + 100 + 100 = 220 W

ESB2: P = ESB1 + ESB10 + TB-2+ F-2 + SS-2 + LB-8 = 220 + 40 + 20 + 100 + 100 + 100 + 20 = 600 W

ESB3: P = F-5 + TB-4 = 100 + 20 = 120 W

ESB4: P = ESB5 + TB-7 +TB-6 + F-3 + SS-4 = 20 W + 20 W + 20 W + 100 W + 100 W = 260 W

ESB5: P = LB-3 = 20 W

ESB6: P = ESB9 + TB-8 + F-4 + ESB-7 + LB-5 + SS-5 = 20 W + 20 W + 100 W + 20 W + 20 W + 100W =280 W

ESB7: P =LB-6 = 20 = 20 W

ESB8: P = LB-4 = 20 W

ESB9: P = LB-7 = 20 = 20 W

ESB10: P = LC-1 + LB-1 = 20 W + 20 W = 40W

CKT1' Rating:

$$I = \frac{P(ESB2)}{V \times pf} = \frac{600}{220 \times 0.7} = 3.89\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT2' Rating:

$$I = \frac{P(ESB3)}{V \times pf} = \frac{120}{220 \times 0.7} = 0.799\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT3' Rating:

$$I = \frac{P(ESB6)}{V \times pf} = \frac{280}{220 \times 0.7} = 1.81\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT4' Rating:

$$I = \frac{P(ESB8)}{V \times pf} = \frac{20}{220 \times 0.7} = 0.13\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT5' Rating:

$$I = \frac{P(ESB4)}{V \times pf} = \frac{260}{220 \times 0.7} = 1.68\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

➢ Second Floor (Unit-2):

To Sub-Distribution Board (SDB):

SB1: P = SB2 + TB-3 + ST-1 =80 + 20 + 100 = 200 W

SB2: P =EF-1 +LB-2 = 60 + 20 = 80 W

SB3: P = TB-5 + F-6 + LC-2 + ST-2 = 20 + 100 + 20 + 100 =240 W

SB4: P = LC-4 = 20 = 20 W

CKT1 Rating:

$$I = \frac{P(SB1)}{V \times pf} = \frac{200}{220 \times 0.7} = 1.30\,A < 5\,A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT2 Rating:

$$I = \frac{P(SB3)}{V \times pf} = \frac{240}{220 \times 0.7} = 1.55\ A < 5\ A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT3 Rating:

$I = \frac{P(SB4)}{V \times pf} = \frac{20}{220 \times 0.7} = 0.13\ A < 5\ A$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

To Emergency Sub-Distribution Board (ESDB):

ESB1: P = ESB10 + TB-1 + F-1 + SS1 = 40+20 + 100 + 100 = 260 W

ESB2: P = ESB1 + TB-2+ F-2 + SS-2 + LB-8 = 260 + 20 + 100 + 100 + 20 = 500 W

ESB3: P = F-5 + TB-4 = 100 + 20 = 120 W

ESB4: P = ESB5 + TB-7 +TB-6 + F-3 + SS-4 +ESB8 = 20 W + 20 W + 20 W + 100 W + 100 + 20= 280 W

ESB5: P = LB-3 = 20 W

ESB6: P = ESB9 + TB-8 + F-4 + ESB-7 + LB-5 + SS-5 = 20 W + 20 W + 100 W + 20 W + 20 + 100 W =280 W

ESB7: P =LB-6 = 20 = 20 W

ESB8: P = LB-4 = 20 W

ESB9: P = LB-7 = 20 = 20 W

ESB10: P = LC-1 + LB-1 = 20 W + 20 W = 40W

CKT1' Rating:

$$I = \frac{P(ESB2)}{V \times pf} = \frac{500}{220 \times 0.7} = 3.246\ A < 5\ A$$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT2' Rating:

$I = \frac{P(ESB3)}{V \times pf} = \frac{120}{220 \times 0.7} = 0.779\ A < 5\ A$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT3' Rating:

$I = \frac{P(ESB6)}{V \times pf} = \frac{280}{220 \times 0.7} = 1.81\ A < 5\ A$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

CKT4' Rating:

$I = \frac{P(ESB4)}{V \times pf} = \frac{280}{220 \times 0.7} = 1.81\ A < 5\ A$

So, 2x1.5 rm BYM + 1.5 rm BYAECC are used.

❖ Calculations for SDB and ESDB:

Formula:

SDB load = Total load x 0.7 + Total P socket load x 0.2 + Total Q socket load x 0.2

ESDB load = Total load x 0.7 + Total P socket load x 0.2 + Total Q socket load x 0.2

$$SDB\ current = \frac{SDB\ load}{Voltage \times pf}$$

$$ESDB\ current = \frac{ESDB\ load}{Voltage\ \times pf}$$

Assumptions:

P load = 3000 W

Q load = 4000 W

Voltage = 220 V

Power factor, pf = 0.7

So, 30 A SP MCCB is needed from ESDB to MDB

➢ Ground Floor (Single Unit):

Sub-Distribution Board (SDB):

Total load = CKT1 load + CKT2 load + CKT3 load

CKT1 load = 200 W

CKT2 load = 240 W

CKT3 load = 20 W

Total load = 460 W

SDB load = 460 x 0.7 = 322 W

$$SDB\ current = \frac{322}{220 \times 0.7} = 2.09\ A$$

So, 5 A SP MCCB is needed from SDB to MDB

Emergency Sub-Distribution Board (ESDB):

Total load = CKT1' load + CKT2' load + CKT3' load + CKT4' load

CKT1' load = 500 W

CKT2' load = 120 W

CKT3' load = 260 W

CKT4' load = 20 W

Total load = 900 W

ESDB load = 900 x 0.7 + 2*4000*0.2 + 3000*0.2 = 2830 W

$$ESDB\ current = \frac{2830}{220 \times 0.7} = 18.37\ A$$

So, 20 A SP MCCB is needed from ESDB to EMDB

- **Ground Floor (Parking Area):**

Sub-Distribution Board (SDB):

Total load = CKT1 load

CKT1 load = 180 W

Total load = 180 W

SDB load = 180 x 0.7 = 126 W

$$SDB\ current = \frac{126}{220 \times 0.7} = 0.818\ A$$

So, 5 A SP MCCB is needed from SDB to MDB

Emergency Sub-Distribution Board (ESDB):

Total load = CKT1' load + CKT2' load

CKT1' load = 120 W

CKT2' load = 60 W

Total load = 180 W

ESDB load = 180 x 0.7 = 126 W

$$ESDB\ current = \frac{126}{220 \times 0.7} = 0.818\ A$$

So, 5 A SP MCCB is needed from ESDB to EMDB.

- **First Floor (Bigger Unit):**

Sub-Distribution Board (SDB):

Total load = CKT1 load + CKT2 load + CKT3 load + CKT4 load

CKT1 load = 200 W

CKT2 load = 260 W

CKT3 load = 280 W

CKT4 load = 20 = 20 W

Total load = 760 W

SDB load = 760 x 0.7 + 1 x 3000 x 0.2 + 1 x 4000 x 0.2 = 1932 W

$$SDB\ current = \frac{1932}{220 \times 0.7} = 12.54\ A$$

So, 15 A SP MCCB is needed from SDB to MDB

Emergency Sub-Distribution Board (ESDB):

Total load = CKT1' load + CKT2' load + CKT3' load + CKT4' load + CKT5' load

CKT1' load = 500 W

CKT2' load = 120 W

CKT3' load = 260 W

CKT4' load = 280 W

CKT5' load = 20 W

Total load = 1180 W

ESDB load = 1180 x 0.7 + 2 x 3000 x 0.2 + 3 x 4000 x 0.2 = 4426 W

$$ESDB\ current = \frac{4426}{220 \times 0.7} = 28.74\ A$$

So, 30 A SP MCCB is needed from ESDB to EMDB

- **First Floor (Smaller Unit):**

Sub-Distribution Board (SDB):

Total load = CKT1 load + CKT2 load

CKT1 load = 220 W

CKT2 load = 240 W

Total load = 460 W

SDB load = 460 x 0.7 + 1 x 3000 x 0.2 + 2 x 4000 x 0.2 = 2522 W

$$SDB\ current = \frac{2522}{220 \times 0.7} = 16.37\ A$$

So, 20 A SP MCCB is needed from SDB to MDB

Emergency Sub-Distribution Board (ESDB):

Total load = CKT1' load + CKT2' load + CKT3' load

CKT1' load = 260 W

CKT2' load = 240 W

CKT3' load = 300 W

Total load = 800 W

ESDB load = 800 x 0.7 +0 x 3000 x 0.2 + 0 x 4000 x 0.2 = 560 W

$$ESDB\ current = \frac{560}{220 \times 0.7} = 3.63\ A$$

So, 5 A SP MCCB is needed from ESDB to EMDB

- **Second Floor (Unit-1):**

Sub-Distribution Board (SDB):

Total load = CKT1 load + CKT2 load + CKT3 load

CKT1 load = 200 W

CKT2 load = 240 W

CKT3 load = 20 W

Total load = 460 W

SDB load = 460 x 0.7 + 1 x 4000 x 0.2 = 1122 W

$$SDB\ current = \frac{1122}{220 \times 0.7} = 7.285\ A$$

So, 10 A SP MCCB is needed from SDB to MDB

Emergency Sub-Distribution Board (ESDB):

Total load = CKT1' load + CKT2' load + CKT3' load + CKT4' load + CKT5' load load

CKT1' load = 600 W

CKT2' load = 120 W

CKT3' load = 280 W

CKT4' load = 20 W

CKT5' load = 260 W

Total load = 1280 W

ESDB load = 1280 x 0.7 + 2 x 3000 x 0.2 + 3 x 4000 x 0.2 = 4496 W

$$ESDB\ current = \frac{4496}{220 \times 0.7} = 29.194\ A$$

So, 40 A SP MCCB is needed from ESDB to EMDB

- **Second Floor (Unit-2):**

Sub-Distribution Board (SDB):

Total load = CKT1 load + CKT2 load + CKT3 load

CKT1 load = 200 W

CKT2 load = 240 W

CKT3 load = 20 W

Total load = 460 W

SDB load = 460 x 0.7 + 1 x 4000 x 0.2 + 1 x 3000 x 0.2 = 1722 W

$$ESDB\ current = \frac{1722}{220 \times 0.7} = 11.181\ A$$

So, 15 A SP MCCB is needed from SDB to MDB

Emergency Sub-Distribution Board (ESDB):

Total load = CKT1' load + CKT2' load + CKT3' load + CKT4' load

CKT1' load = 500 W

CKT2' load = 120 W

CKT3' load = 280 W

CKT4' load = 280 W

Total load = 1180 W

ESDB load = 1180 x 0.7 + 1 x 3000 x 0.2 +2 x 4000 x 0.2 = 3026 W

$$ESDB\ current = \frac{3026}{220 \times 0.7} = 19.649\ A$$

So, 30 A SP MCCB is needed from ESDB to EMDB

❖ Calculations for EMDB:

EMDB Load = Total ESDB Load x 0.7 + Lift Load x 0.7

Total ESDB Load = ESDB_Gnd_unit + ESDB_prk_unit + ESDB_FF_unit1 + ESDB_FF_unit2 + ESDB_SF_1 + ESDB_SF_2

= 2830 + 126 + 4426 + 560 + 4496 + 3026

= 15464 W

EMDB Current = $\frac{EMDB\ Load}{\sqrt{3} * Line\ Voltage * pf}$

Phase Voltage = 220 V

Line Voltage = $\sqrt{3}$ * 220 V = 381.05 V

Power Factor, pf = 0.7

Lift Load = 5000 W

EMDB Load = 15464 x 0.7 + 5000 x 0.7 + 120 x 0.7 = 14.4 KW

$EMDB\ current = \frac{14408}{\sqrt{3} \times 381.05 \times 0.7} + \frac{120 \times 0.7}{220 \times 0.7} = 31.73\ A$

So, 40 A TP MCCB is needed from EMDB to MDB

A 20 KW Generator is used to supply the EMDB Load through an ATS.

Calculations for MDB

MDB load = Total SDB load x 0.7 + (EMDB load + Pump load) x 0.7

Total SDB load = SDB_Gnd_unit + SDB_Parking + SDB_FF_unit1 + SDB_FF_unit2

+ SDB_SF_unit_1 + SDB_SF_unit_2

= 322 + 126 + 2522 + 1932 +1122 + 1722

= 7.746 KW

$$MDB\ current = \frac{MDB\ Load}{\sqrt{3} * Line\ Voltage * pf}$$

Phase Voltage = 220 V

Line Voltage = $\sqrt{3} \times 220 = 381.05$ V

Power Factor, pf = 0.95 (Due to PFI plant)

Total SDB load = 7.746 KW

EMDB load = 14.4 KW

MDB load = 7746 x 0.7 + (14400 + 5000) x 0.7 = 19 KW

$MDB\ current = \frac{19000}{\sqrt{3} \times 381.05 \times 0.95} = 30.3\ A$

So, 40 A TP MCCB is needed from MDB to Main Line

❖ Calculations for PFI Plant:

$cos\theta = 0.7, sin\theta = \sqrt{1 - (cos\theta)^2} = 0.714$

$$Q = 3V \sin\theta = P \tan\theta = 16.46\ KVAR$$

After pf improvement $\sin\theta = 1$

$$I = \frac{Q}{3 \times V \times \sin\theta} = 24.94\ A$$

So, 30 A TP MCCB is needed from PFI to MDB

❖ Calculations for Minimum Load Density:

Ground Floor (Single Unit):

$$Load\ density = \frac{Total\ load}{Apartment\ size\ in\ meter^2} = \frac{322 + 2830}{1100 \times 0.3048^2} = 30.843\ W/m^2$$

Ground Floor (Parking Unit):

$$Load\ density = \frac{Total\ load}{Apartment\ size\ in\ meter^2} = \frac{126 + 126}{1300 \times 0.3048^2} = 2.086\ W/m^2$$

First Floor (Bigger Unit):

$$Load\ density = \frac{Total\ load}{Apartment\ size\ in\ meter^2} = \frac{4426 + 1932}{1500 \times 0.3048^2} = 45.62\ W/m^2$$

First Floor (Smaller Unit):

$$Load\ density = \frac{Total\ load}{Apartment\ size\ in\ meter^2} = \frac{2522 + 560}{900 \times 0.3048^2} = 36.86\ W/m^2$$

Second Floor (Unit-1):

$$Load\ density = \frac{Total\ load}{Apartment\ size\ in\ meter^2} = \frac{4496 + 1122}{1200 \times 0.3048^2} = 50.393\ W/m^2$$

Second Floor (Unit-2):

$$Load\ density = \frac{Total\ load}{Apartment\ size\ in\ meter^2} = \frac{3026 + 1722}{1200 \times 0.3048^2} = 42.589\ W/m^2$$