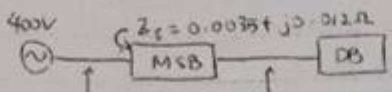
2016/17 EE4507

1) 400V $Z_s = 0.0035 + j0.012\,\Omega$



Triple Pole (TP)   50m., Trunking, not grouped with other cables

Description	Connected Load	Diversity Factor	Current Demand
2 x hot plates	$\frac{9000\,W}{\sqrt{3} \times 400\,V} = 12.99\,A$ (each)	80%, 60%	10.39A, 7.79A
1 x fryer	$\frac{11000}{\sqrt{3} \times 400} = 15.87\,A$ → largest	100%	15.87A
1 x oven	$\frac{5000}{\sqrt{3} \times 400} = 7.22\,A$ → remaining appliance	60%	4.33A
5 x Motor	$\frac{5.5 \times 10^3}{\sqrt{3} \times 400 \times 0.8} = 11.34\,A$	100%, 80%, 60%	11.34A, 9.072A, 6.804A
1 x Dishwasher	$\frac{25000}{\sqrt{3} \times 400} = 36.08\,A$	100%	36.08A
1x freezer	$\frac{3000}{230} = 13.04\,A$	100%	13.04A
1x fridges	$\frac{1000}{230} = 4.35\,A \times 2 = 8.7\,A$	100%, 75%	4.35A, 3.26A
60 x Fluorescent	$60 \times \frac{25}{230} \times 1.8 = 11.74\,A$	90%	10.57A
Largest SSO (32A)	32A	100%	32A
Remaining SSO (2x20A)	20A	50%, 50%	~~10A~~ 10A, 10A

$$\text{3-phase demand} = 10.39A + 7.79A + 15.87A + 4.33A + 11.34A + 9.072A + 6.804A + 36.08A$$

$$= 101.68\,A$$

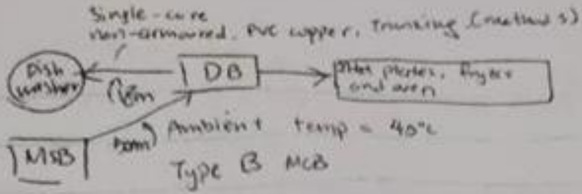
To balance	Phase A	Phase B	Phase C
1x Freezer	13.04		
2x Fridges		4.35	3.26
60 x Fluorescent	3.572		10.66
Largest SSO	10.66	10.66	10
Remaining SSO		10	
	27.28A	25.01A	23.92A

b) Max demand = (27.28 + 101.69) x 0.8 = 103.176 A

CB size = 120% x 103.176 A = 123.81A → 150A

size = 50 mm²

1c)



From table 4C1, $C_a = 0.87$

Grouping : 1x Dishwasher, 2x Hot plate, 1x fryer, 1x oven. 5 circuits

From table 4B1, 5 circuits, Method 3, $C_g = 0.60$

Assume $C_i = 1$, I_b (dishwasher) = 36.08A. $I_N = 40A$

$$I_z \geq \frac{I_N}{C_a \times C_g \times C_i} \geq \frac{40}{0.87 \times 0.60 \times 1.0} \geq 76.63 \text{ A}$$

From Table 4D1A, method 3, 3phase, the nearest upper value is 89A. ∴ The min cable size is $25mm^2$ //

d) MSB to DB : $L = 50m$, $I_b = 103$ A

According to Table 4D4B, $50mm^2$, column 4, $Z = 0.81$ mV/A/m.

$$V_d = \frac{103 \times 0.81 \times 50}{1000} = 4.1715 \text{ V}$$

DB to dishwasher : $L = 18m$, $I_b = 36.08A$

According to Table 4D4B, $25 mm^2$, column 4, $Z = 1.50$ mV/A/m.

$$V_d = \frac{36.08 \times 1.50 \times 25}{1000} = 1.353 \text{ V}$$

∴ Total V_d (MSB → Dishw.) = 4.1715V + 1.353V

= 5.52 V //

e) $Z_{s,\,msb} = (0.0025 + j0.017)\ \Omega$

$Z_{MSB\ to\ DB} = (0.8 + j0.14)(50)$ → Table 4D4B, 50mm², column 4

$= (40 + j7)\ m\Omega$

$Z_{DB\ to\ Dishwasher} = (1.5 + j0.145)(18)$ → Table 4D4B, 25mm², column 4

$= (27 + j2.61)\ m\Omega$

$$I_F = \frac{V}{Z_{total}} = \frac{230}{(40 + j7 + 27 + j2.61)\times 10^{-3} + 0.0025 + j0.017}$$

$$= 3119\ A$$

f) $Z_E = 1.5\ \Omega$ For thermal constraints of cpc,

$k = 115$ $I_F^2 t \le k^2 S^2$

DB to Dishwasher : 25 mm²

$\therefore 16 < S \le 35$

$$\text{cpc size} = \frac{k_1}{k_2} \times 16 = \frac{115}{115} \times 16 = 16\ mm^2$$

Table 17A, $(R_1 + R_2)/m = 1.877\ m\Omega/m$

$\therefore Z_s = Z_E + 1.38\{R_1 + R_2\}\ \Omega$

$$= 1.5 + \frac{1.38(1.877)}{1000} \times 18 = 1.547\ \Omega$$

$$I_F = \frac{V}{Z_s} = \frac{230\ V}{1.547\ \Omega} = 148.7\ A$$

Pg 196, Rating = 30A, $I_F = 148.7A \Rightarrow t = 15s$

$$148.7^2(15) \le 115^2(16)^2$$

$$331675.35 \le 3385600 \quad \text{(true)}$$

$\therefore$ The protective conductor satisfies the thermal constraints.

g) From Table 41B2, Type B m.c.b

2a) For Type II, DC spacing = 10 m.

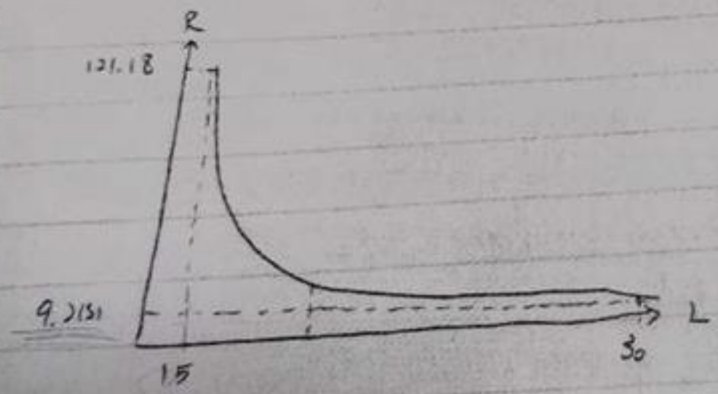
Hence for the length of the building. 8 is needed on one side

width need 5 each.

Total down conductors = $(8\times2)+(5\times2)$

$= 26$ //

b) $$R = \frac{\rho}{275L}\log_{10}\frac{400L}{d}$$ $1.5\,m \le L \le 30\,m$



$\frac{30}{1.5} = 20$