Tutorial 3

i) Loading
- 20kW
- 400V
- pf 0.85

$I_b = \frac{20kW}{\sqrt{3}\, V_L(pf)}$

$= \frac{20 \times 10^3}{\sqrt{3}(400)(0.85)}$

$= 33.96A$

$\simeq 34A$

I_n (breaker size) = 40A

$I_z \geq \frac{I_n}{C_a C_g C_i}$

$= \frac{40}{0.94(1)(1)}$

$= 42.55A$

$I_z = 50A$

From table 4D1A, ~~$I_z = 46A$~~ [Ref Reference Method 3, single-core PVC sheathed copper conductors in metal trunking]

Selected cable size = $10mm^2$

(iii) $K^2S^2 \geq I^2t$

$K^2S^2 = (115)^2(10)^2$

$= 1322500$

$I^2t = 1000^2(0.01)$ ← table Type B 32A MCB 1000A 20.01s

$= 10000$

$1322500 > 10000$

It will protect

2) 400V , 30kW, pf = 1.8

$I_b = \frac{30kW}{\sqrt{3}(400)(0.8)}$

$= 54.12A$

$I_n = 63A$

$I_2 = \frac{I_n}{C_a C_g C_i}$

$= \frac{63}{(0.80)(0.87)}$

$= 89.39A$

$\Rightarrow 25mm^2$

(ii) $V_D = \frac{I_b I_L V_c I_b L}{1000}$

$= \frac{(r\cos\phi + x\sin\phi)(54.12)(50)}{1000}$

$= \frac{[1.75\cos\phi + 0.17\sin\phi)(54.12)50}{1000}$

$= \frac{[1.75(0.8) + 0.17(\sin 36.8)](54.12)(50)}{1000}$

$= 4.064V$

Steel-wired armoured multi-core PVC

(0.80) - 40°C

(0.87) - Single layer multicore on a perforated metal cable tray

2 other circuits running cable tray (method 11)

$\Rightarrow$ 2+3 cables = 5 cables

3) 80kW, 3φ, 400V, 30m

During normal operation,

$I_b = \frac{80kW}{\sqrt{3} \times 400 \times (0.9)(0.8)}$

$= 160.37A$

During starting,

$I_B = 160.37 \times 3$

$= 481.11\ A$

Single Core $70mm^2$ PVC, trunking (Method 3)

4D1B

~~3 core~~ 3 cables

- $V_D = \frac{V_c I_c L}{1000}$

$= \frac{(0.56 \cos 0.9 + 0.25 \sin(\cos^{-1} 0.9)(160.37)(30)}{1000}$

$= 2.949\ V$

$V_D = \frac{0.56(0.5) + 0.25\sin(\cos^{-1}0.5)(481.11)(30)}{1000}$

$= 7.166V$

4) 100kW

$I_b = \frac{100kW}{\sqrt{3}(400)(0.85)}$

$= 169.808A$

First harmonic current = 169.808A

$I_{on} = \frac{3H}{100} I_{nL}$ ← 40%

I_{nL} = fundamental line current

$= \frac{3(40)}{100} \times 169.808A$

$= 203.769A$

$\Rightarrow I_n = 250A$

$I_z = \frac{250}{0.8}$

$= 290.697A$

From Table 4D1A ⇒ Method 11, 3 cables = 120mm²