



PROTECTION SYSTEM DISCONNECTS THE SUPPLY WHEN TOUCH VOLTAGE IS GREATER THAN 50 V.

$$V_t = \frac{V_o \times Z_{PE}}{(Z_A + Z_{PE})}$$

V_t = TOUCH VOLTAGE

V_o = OPERATING VOLTAGE

Z_A = IMPEDANCE OF ACTIVE CONDUCTOR

Z_{PE} = PROTECTIVE EARTHING CONDUCTOR

WK 3+4 CONTROL & PROTECTION
CHAPT 3 STUDENT
WORK BOOK

T03.1

$$Z_A = 1\Omega, Z_{PE} = 2.4\Omega$$

$$V_o = 230V$$

$$V_t = \frac{V_o \times Z_{PE}}{Z_A + Z_{PE}} = \frac{230 \times 2.4}{1 + 2.4}$$

$$= \frac{230 \times 2.4}{3.4}$$

= ✓

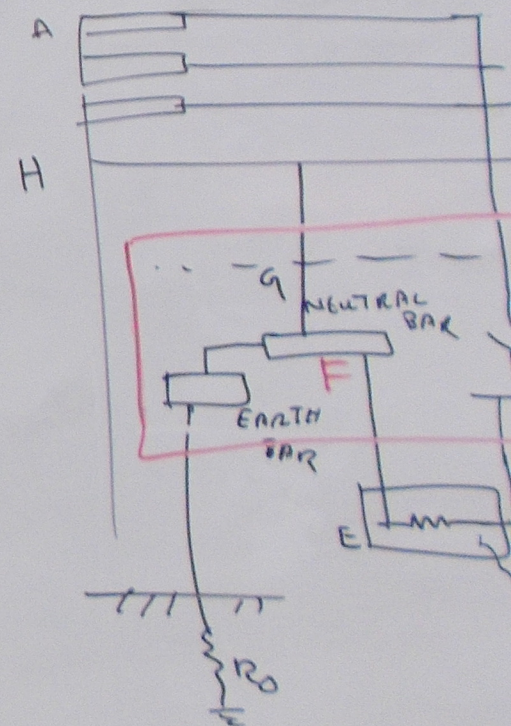
V_{gs} - OPERATING TEMPERATURE 75

V_{go} - OPERATING TEMPERATURE 9

FAULT LOOP IMPEDANCE

CURRENT FLOW FROM SOURCE TO

TOTAL IMPEDANCE



ects the supply when touch
V.

VE CONDUCTOR
VQ CONDUCTOR
NTIAL & PROTECTION
AP 3 STUDENT
WORK BOOK

$$PE = 2.4 \Omega$$

$$= \frac{230 \times 2.4}{1 + 2.4}$$

$$= \frac{230 \times 2.4}{3.4}$$

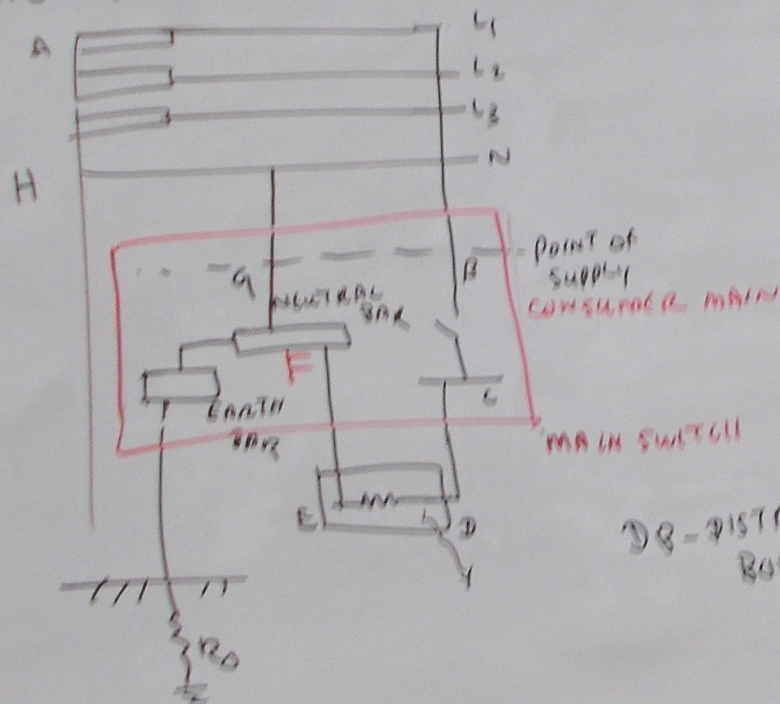
$$= \checkmark$$

V_{75} - OPERATING TEMPERATURE 75°C

V_{90} - OPERATING TEMPERATURE 90°C

FAULT LOOP IMPEDANCE

- CURRENT FLOW FROM SOURCE TO EARTH
- TOTAL IMPEDANCE



DB - DISTRIBUTION BOARD

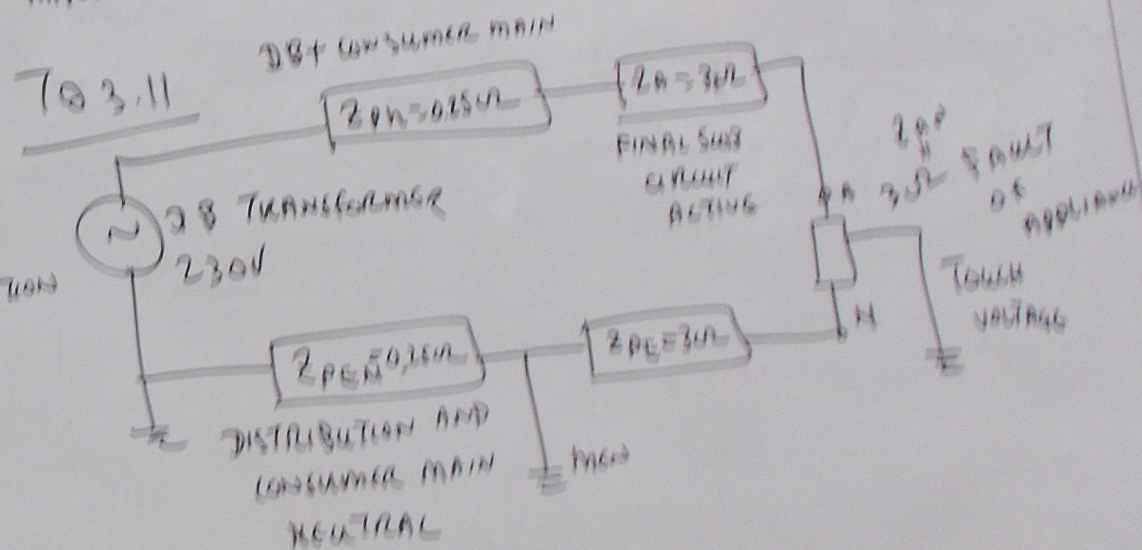
$$Z_s = Z_{AB} + Z_{BC} + Z_{CD} + Z_{DE} + Z_{EF} + Z_{FG} + Z_{HA}$$

EXTERNAL

$$Z_{EXT} = Z_{AB} + Z_{BC} + Z_{CD} + Z_{FG} + Z_{GA} + Z_{HA}$$

$$Z_{INT} = Z_{SC}$$

$$\text{TOTAL SYSTEM IMPEDANCE } Z_s = Z_{EXT} + Z_{INT}$$



$$Z_s = \text{TOTAL SYSTEM IMPEDANCE} = Z_{EXT} + Z_{INT}$$

$$= 0.25 + 0.25$$

$$= 0.5 \Omega$$

$$I_{FAULT} = \frac{V_{SC}}{Z_s}$$

$$I_{FAULT} = \frac{230}{0.5} = 460 \text{ A}$$

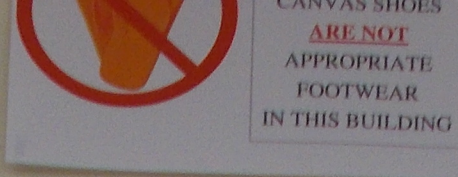
$$Z_{TOTAL} = Z_{EXT} + Z_{INT}$$

$$= 0.25 + 0.25$$

$$= 0.5 \Omega$$

$$I_{FAULT} = \frac{V_{SC}}{Z_s}$$

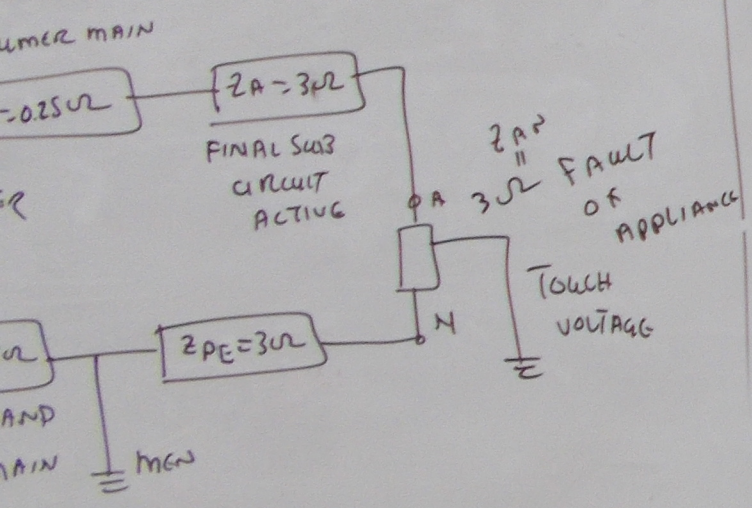
$$I_{FAULT} = \frac{230}{0.5} = 460 \text{ A}$$



$$Z_{DE} + Z_{EF} + Z_{FG} + Z_{HA}$$

$$Z_{CD} + Z_{FG} + Z_{GA} + Z_{HA}$$

$$+ Z_{INT}$$



$$Z_s = \text{TOTAL SYSTEM IMPEDANCE} = Z_{PH} + Z_A + Z_{AN} + Z_{PE} + Z_{PEN} \\ = 0.25 + 3 + 3 + 3 + 0.25 \\ = 9.5 \Omega$$

(c) $I_{\text{FAULT}} = \frac{\text{SUPPLY VOLTAGE}}{\text{IMPEDANCE}} = \frac{230}{9.5} = 24.2 \text{ A}$

(a) NOT TO INCLUDE FAULT IMPEDANCE $Z_{AN} = 0$

$$Z_{\text{TOTAL}} = Z_{PH} + Z_A + Z_{AN} + Z_{PE} + Z_{PEN} \\ = 0.25 + 3 + 0 + 3 + 0.25 \\ = 6.5 \Omega$$

(b) $\text{MAXIMUM FAULT CURRENT} = \frac{\text{SUPPLY VOLTAGE}}{\text{IMPEDANCE}} \\ = \frac{230}{6.5} = 35.3 \text{ A}$

TD 3.12 READ IT

FAULT LOOP IMPEDANCE TABLE

TABLE 8.1, WK 3+4 CONTAIN PROTECTION CH3 STUDENT WORK BOOK PAGE 12

FAULT CURRENT IS TO BE PROTECTED BY C.B
C.B RATING MUST MATCH FAULT CURRENT (OR) FAULT LOOP IMPEDANCE VALUE

TD 3.13

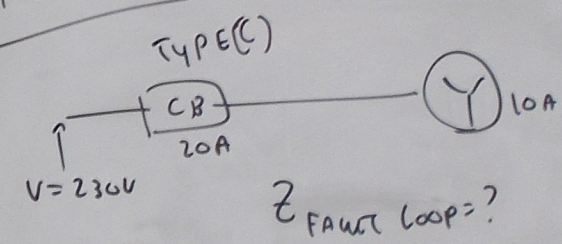
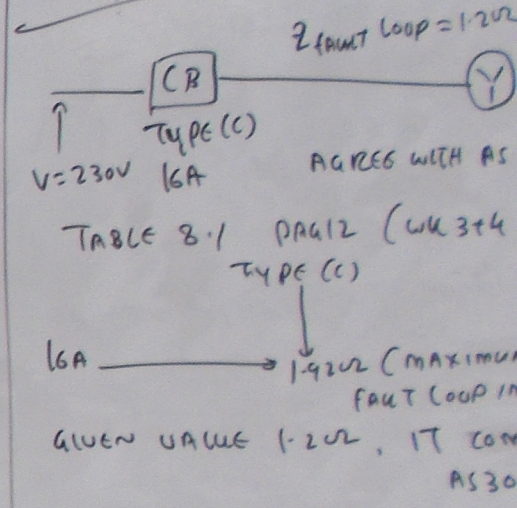


TABLE 8.1, PAGE (12) OF WK 3+4 WORK BOOK
TYPE (C)

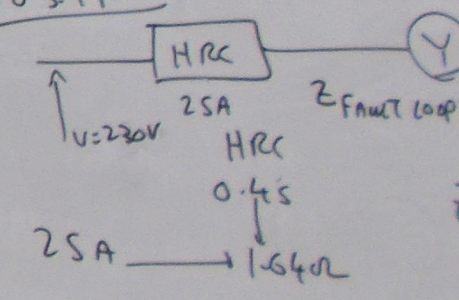
20A → 1.53
 $Z_{\text{FAULT LOOP}} = 1.53 \Omega$

TD 3.14 (WK 3+4 WORK BOOK)



TD 3.15, TD 3.16 20 40

TD 3.17



Fault Loop Impedance Table

TABLE 8.1, WK 3+4 CONTRA PROTECTION
CH3 STUDENT WORK BOOK
PAGE 12

IT CURRENT IS TO BE PROTECTED BY C.B
RATING MUST MATCH FAULT CURRENT
(OR) FAULT LOOP
IMPEDANCE VALUE

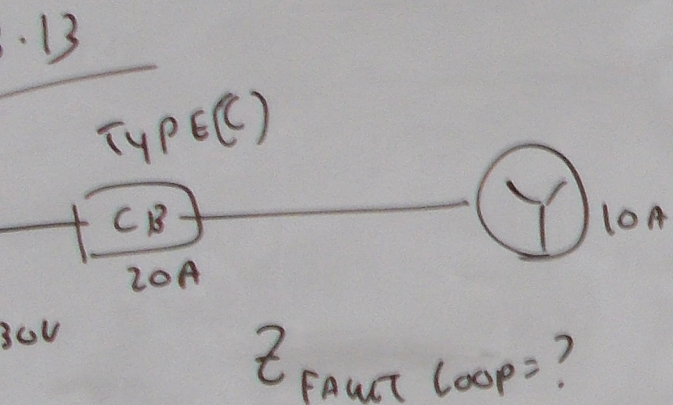


TABLE 8.1, PAGE (12) OF WK 3+4
WORK BOOK
TYPE (C)
10A $\rightarrow$ 1.53
Fault loop = 1.53 Ω

TABLE 8.1 (WK 3+4 WORK BOOK)

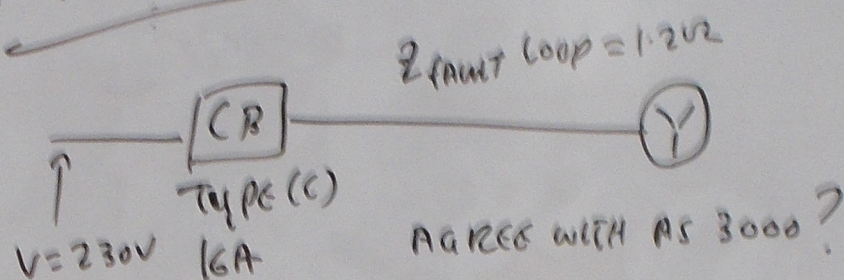


TABLE 8.1 PAGE 12 (WK 3+4 WORK BOOK)
TYPE (C)
16A $\rightarrow$ 1.92 Ω (MAXIMUM)
FAULT LOOP IMPEDANCE
GIVEN VALUE 1.2 Ω , IT COMPLIES WITH
AS 3000

TABLE 8.1, TABLE 8.1 TO YOURSELF

TABLE 8.1

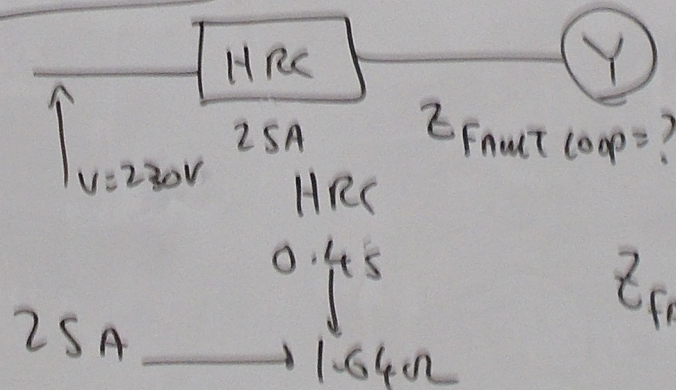


TABLE 8.1
 $Z_{\text{FAULT LOOP}} = 1.64 \Omega$

ASSIGNMENT (3)

FINAL SUB CIRCUIT

- PROTECTIVE DEVICE
- CURRENT RATING
- CURRENT CARRYING CAPACITY
- FAULT LOOP IMPEDANCE

TABLE 8.1 IS TO BE APPLIED



Figure 1.1: The structure of the human brain
The brain is divided into two main parts: the cerebrum and the cerebellum.
The cerebrum is the larger part and is responsible for most of the brain's functions.
The cerebellum is the smaller part and is responsible for coordination and balance.

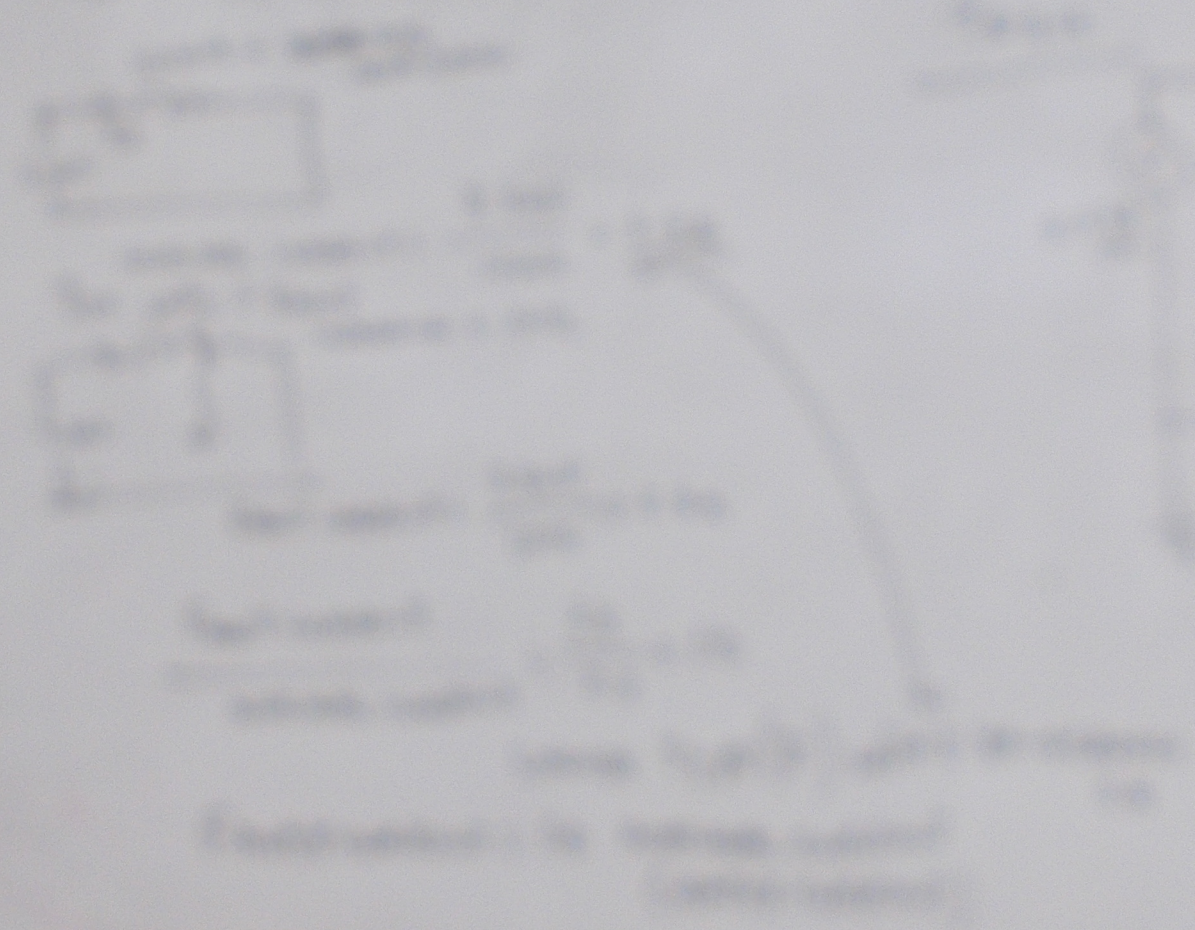


Figure 1.2: The functions of the human brain
The brain is responsible for many different functions, including:
- Thinking and reasoning
- Memory
- Emotion
- Movement
- Sensation

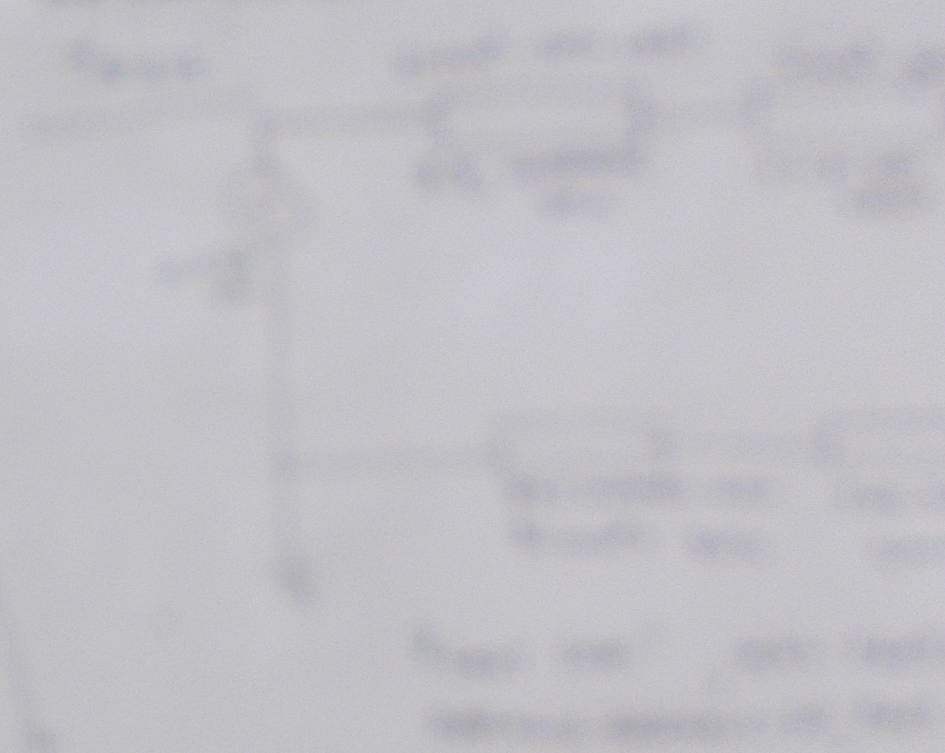
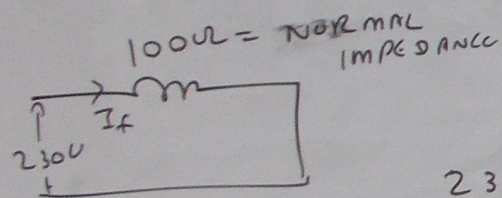


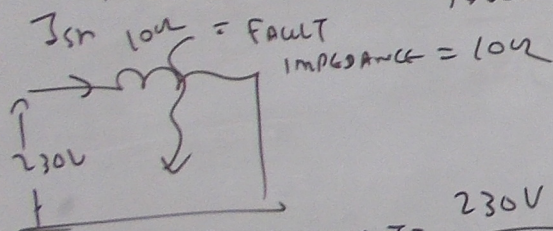
Figure 1.2: The functions of the human brain
The brain is responsible for many different functions, including:
- Thinking and reasoning
- Memory
- Emotion
- Movement
- Sensation

SELECTION OF C.B

- TYPE B - 4x RATED CURRENT
- TYPE C - 7.5 RATED CURRENT
- TYPE D - 17.5 RATED CURRENT



$$\text{NORMAL CURRENT} = \frac{230V}{100\Omega} = 2.3A$$



$$\text{FAULT CURRENT} = \frac{230V}{10\Omega} = 23A$$

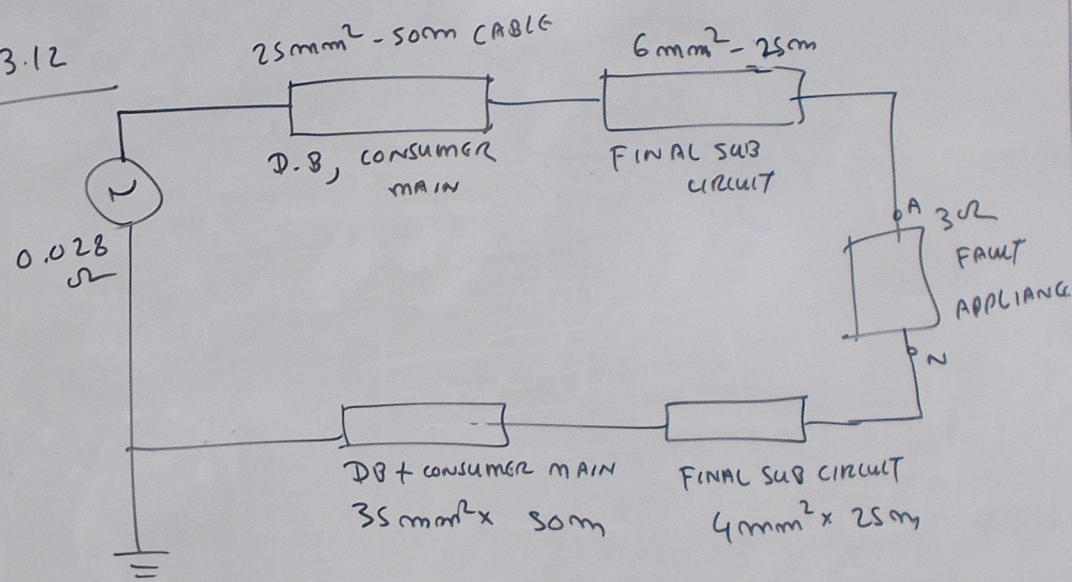
$$\frac{\text{FAULT CURRENT}}{\text{NORMAL CURRENT}} = \frac{23}{2.3} = 10$$

CHOOSE TYPE (D) WITH 2.3A → CHOOSE 6A

FAULT CURRENT = 10 NORMAL CURRENT (RATED CURRENT)

TABLE B.2 CABLE SIZE OF ACTIVE/EARTH PROTECTIVE DEVICE RATING AND FAULT LOOP RESISTANCE RELATION

T03.12



$Z_{\text{FAULT LOOP}} = ?$, MAX: FAULT CURRENT, APPLANCE RESISTANCE 30, FAULT CURRENT = ?

TABLE ON PAGE 15 OF WK3 WORK BOOK

CSA	LENGTH 50m	RESISTANCE
25mm²		0.0330Ω
25mm²	50m	0.028Ω
6mm²	25m	0.0755Ω
4mm²	25m	0.1130Ω
35mm²	50m	0.0257Ω

$$Z_{\text{FAULT LOOP}} = 0.2752\Omega$$

$$I_{\text{FAULT}} = \frac{230}{0.2752} = 835A$$

IF FAULT RESISTANCE IS 30Ω = $\frac{230}{0.2752 + 30}$

$$\text{FAULT CURRENT} = \frac{230}{30.2752}$$

TABLE ON PAGE 15 OF WK3 WORK BOOK

CSA	LENGTH	SOURCE
	RESISTANCE	
25mm ²		0.0330Ω

	SOURCE	0.028Ω
25mm ²	50m →	0.0330Ω
6mm ²	25m →	0.0755Ω
4mm ²	25m →	0.1130Ω
35mm ²	50m →	0.0257Ω

$$Z_{\text{FAULT LOOP}} = 0.2752\Omega$$

$$I_{\text{FAULT}} = \frac{230}{0.2752} = 835 \text{ A}$$

$$\text{IF FAULT RESISTANCE IS } 3\Omega = \frac{230}{0.2752 + 3}$$

$$\text{FAULT CURRENT} = \frac{230}{3.2752} = 70.22 \text{ A}$$

MAXIMUM CIRCUIT LENGTH

$$Z_{\text{INT}} = \frac{0.8 \times \text{SUPPLY VOLTAGE}}{\text{NORMAL CURRENT}}$$

ph A FINAL SUB CIRCUIT SUPPLIES A LOAD CONSISTING OF A RANGE IN A DOMESTIC INSTALLATION AND IS PROTECTED BY 32 A TYPE (C) CIRCUIT BREAKER.

DETERMINING THE MAXIMUM INTERNAL FAULT LOOP IMPEDANCE OF FINAL SUB CIRCUIT BASED ON 230V WHEN SUPPLY IS UNAVAILABLE.

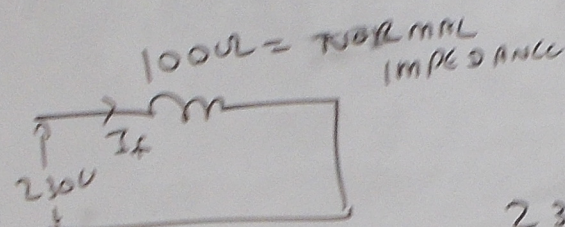
TABLE 8.1
TYPE (C)
32A → 0.96Ω

$$Z_s = 0.96\Omega$$

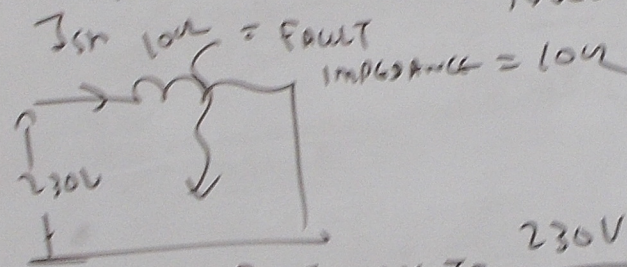
$$Z_{\text{INT}} = 0.8 Z_s = 0.8 \times 0.96 = 0.768\Omega$$

Selection of C.B

- TYPE B - 4x RATED CURRENT
- TYPE C - 7.5 RATED CURRENT
- TYPE D - 17.5 RATED CURRENT



$$\text{NORMAL CURRENT} = \frac{230V}{100\Omega} = 2.3A$$



$$\text{FAULT CURRENT} = \frac{230V}{10\Omega} = 23A$$

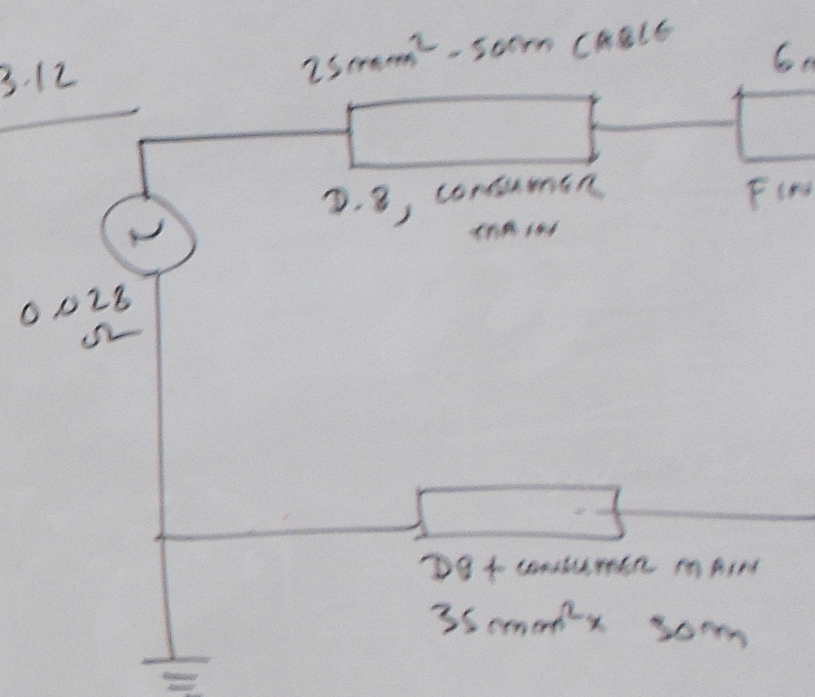
$$\frac{\text{FAULT CURRENT}}{\text{NORMAL CURRENT}} = \frac{23}{2.3} = 10$$

CHOOSE TYPE (D) WITH 2.3A → CHOOSE 6A

FAULT CURRENT = 10 NORMAL CURRENT (RATED CURRENT)

TABLE 8.2 CABLE SIZE OF ACTIVE/EARTH PROTECTIVE DEVICE RATING AND FAULT LOOP RESISTANCE RELATION

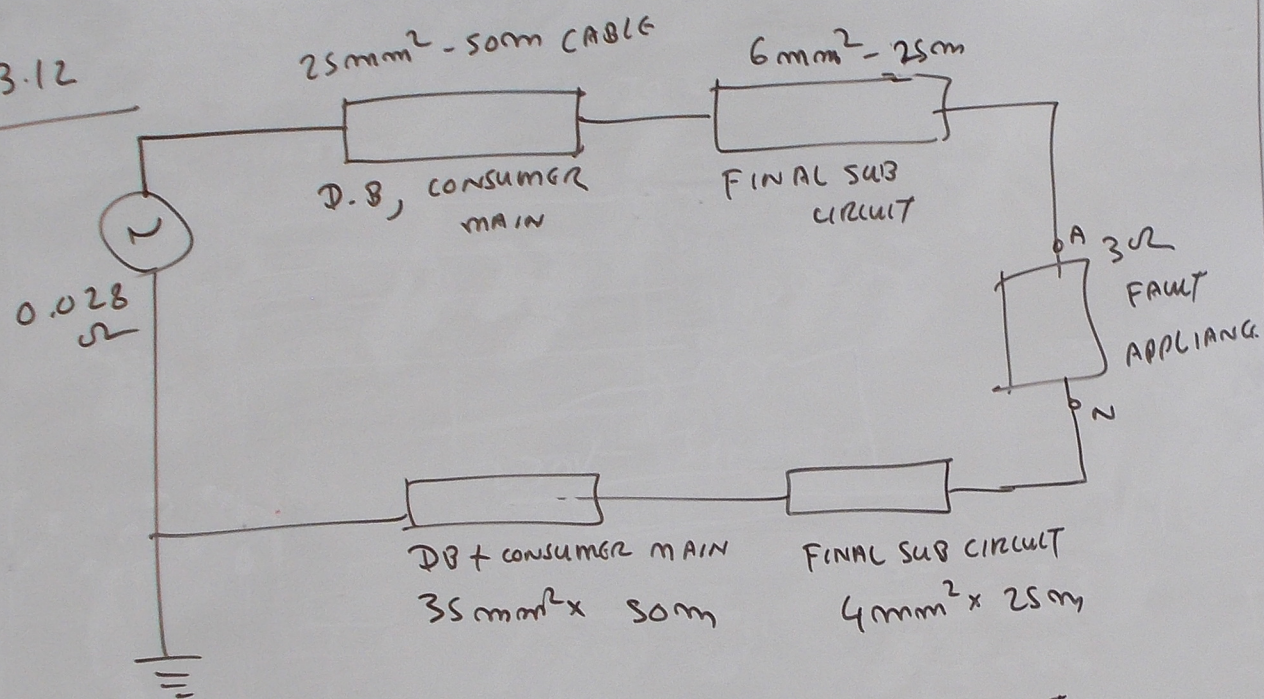
T03.12



Z_{FAULT LOOP}? , MAX APPLANCE RESISTANCE 30

TABLE 8.2 CABLE SIZE OF ACTIVE/EARTH
PROTECTIVE DEVICE RATING AND FAULT LOOP
RESISTANCE RELATION

T03.12



$Z_{\text{FAULT LOOP}} = ?$, MAX: FAULT CURRENT,
APPLANCE RESISTANCE 3Ω , FAULT CURRENT = ?

TABLE ON PAGE 15 OF WK3 WORK BOOK

CSA	LENGTH	50m
	RESISTANCE	
25mm ²		0.0330Ω
	SOURCE	0.028Ω
25mm ²	50m →	0.0330Ω
6mm ²	25m →	0.0755Ω
4mm ²	25m →	0.1130Ω
35mm ²	50m →	0.0257Ω

$$Z_{\text{FAULT LOOP}} = 0.2752\Omega$$

$$I_{\text{FAULT}} = \frac{230}{0.2752} = 835\text{ A}$$

$$\text{IF FAULT RESISTANCE IS } 3\Omega = \frac{230}{0.2752 + 3}$$

$$\text{FAULT CURRENT} = \frac{230}{3.2752} = 70.22\text{ A}$$

2-3A

= 2.3A

= 10

TYPE (D) WITH 2.3A → CHOOSE
6A

NORMAL CURRENT
(RATED CURRENT)

MAXIMUM CIRCUIT LENGTH

$$Z_{INT} = \frac{0.8 \times \text{SUPPLY VOLTAGE}}{\text{NORMAL CURRENT}}$$

ph A FINAL SUB CIRCUIT SUPPLIES A LOAD CONSISTING OF A RANGE IN A DOMESTIC INSTALLATION AND IS PROTECTED BY 32 A TYPE (C) CIRCUIT BREAKER.

DETERMINING THE MAXIMUM INTERNAL FAULT LOOP IMPEDANCE OF FINAL SUB CIRCUIT BASED ON 230V WHEN SUPPLY IS UNAVAILABLE.

TABLE 8.1	TYPE (C)
32A	0.46Ω

$$Z_s = 0.46\Omega$$

$$Z_{INT} = 0.8 Z_s = 0.8 \times 0.46 = 0.768\Omega$$

$$\frac{30}{2752} = 70.22A$$

MAXIMUM CIRCUIT LENGTH

$$L_{MAX} = \frac{0.8 \times U_0 \times S_{ph} \times S_{pe}}{I_a \rho (S_{ph} + S_{pe})}$$

L_{MAX} = MAXIMUM ROUTE LENGTH (m)

U_0 = NOMINAL SUPPLY VOLTAGE

ρ = RESISTIVITY OF CONDUCTOR

22.5×10^{-3} FOR COPPER $\Omega \text{ mm}^2/\text{m}$
 36×10^{-3} FOR ALUMINIUM

I_a = TRIP CURRENT SETTING (A)

S_{ph} = CROSS SECTIONAL AREA OF ACTIVE CONDUCTOR (mm^2)

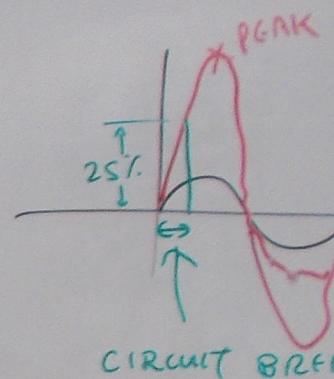
S_{pe} = CROSS SECTIONAL AREA OF PROTECTIVE EARTHING CONDUCTOR (mm^2)

PROTECTION → EXCESSIVE CURRENT — OVER LOAD
 → EXCESSIVE EARTH CURRENT — EARTH LEAKAGE CURRENT

INSULATION FAILURE

AS 3008 → TO SELECT THE SUITABLE WIRE SIZE

$$H = I^2 R t$$



AS 3000

ACTIVE

OC — OVER CURRENT

I_B

I_B = ACTUAL CURRENT IN CONDUCTOR (MAXIMUM)

I_N = PROTECTIVE CURRENT

I_Z = CONTINUOUS CURRENT

MAXIMUM CIRCUIT LENGTH

$$L_{\max} = \frac{0.8 \times U_0 S_{ph} S_{pe}}{I_a \rho (S_{ph} + S_{pe})}$$

$L_{\max}$ = MAXIMUM ROUTE LENGTH (m)

U_0 = NOMINAL SUPPLY VOLTAGE

ρ = RESISTIVITY OF CONDUCTOR

22.5×10^{-3} FOR COPPER $\Omega \text{ mm}^2/\text{m}$

36×10^{-3} FOR ALUMINIUM

I_a = TRIP CURRENT SETTING (A)

S_{ph} = CROSS SECTIONAL AREA OF ACTIVE CONDUCTOR (mm^2)

S_{pe} = CROSS SECTIONAL AREA OF PROTECTIVE EARTHING CONDUCTOR (mm^2)

PROTECTION $\rightarrow$ EXCESSIVE CURRENT - OVER LOAD

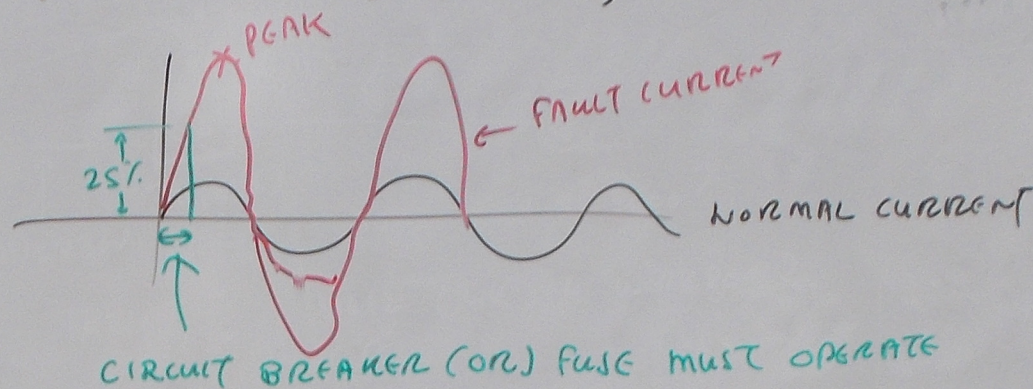
$\rightarrow$ EXCESSIVE EARTH CURRENT - EARTH LEAKAGE CURRENT

$\downarrow$ INSULATION FAILURE

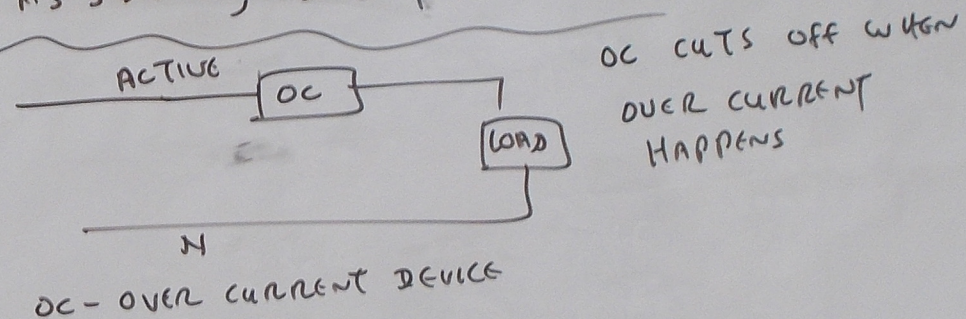
AS 3008 $\rightarrow$ TO SELECT THE SUITABLE WIRE SIZE

$$H = I^2 R t$$

H - HEAT ENERGY (Joules)
 I = CURRENT, R = RESISTANCE (Ω), t = TIME (sec)



AS 3000, 2-5.1 CLAUSE



OC - OVER CURRENT DEVICE

$$I_B < I_N < I_Z, I_Z < 1.45 I_Z$$

I_B = ACTUAL CURRENT IN CONDUCTOR (MAXIMUM DEMAND CURRENT)

AS 3000, APPENDIX TABLE C1, C2, C3

I_N = PROTECTIVE DEVICE RATING (TABLE 8.1 C-13 RATING)

I_Z = CONTINUOUS CURRENT CARRYING CAPACITY OF CONDUCTOR (AS 3008)

I_Z - EFFECTIVE OPERATION OF PROTECTIVE DEVICE

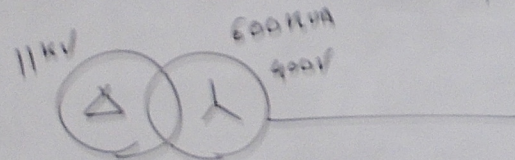
$$\text{SHORT CIRCUIT CURRENT} = \frac{\text{NORMAL FULL LOAD CURRENT}}{\% \text{ IMPEDANCE}} \times 100$$

703.29 11kV / 400V (Δ/Y) 600 kVA TRANSFORMER

% IMPEDANCE = 4 %

(a) RATED CURRENT? (b) FAULT CURRENT AT SECONDARY

(c) FAULT LEVEL AT SECONDARY (d) TRANSFORMER IMPEDANCE



%Z = 4%

$$(a) I_{FL(P) \text{ PRIMARY}} = \frac{kVA}{\sqrt{3} \times E_p} = \frac{600 \times 10^3}{1.732 \times 11 \times 10^3} = 31.49 \text{ A}$$

$$I_{FL(S) \text{ SECONDARY}} = \frac{kVA}{\sqrt{3} \times E_s} = \frac{600 \times 10^3}{1.732 \times 400} = 866 \text{ A}$$

$$I_{sh(S)} = \frac{I_{FL(S)}}{\%Z} \times 100$$

$$= \frac{866}{4} \times 100$$

$$= 21650 \text{ A}$$

$$\text{FAULT LEVEL, MVA}_{sh} = \frac{\text{MVA}_{FL}}{\%Z} \times 100$$

$$= \frac{600}{4} \times 100$$

$$= 150,00 \text{ kVA}$$

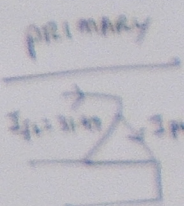
$$= 15 \text{ MVA}$$

$$\%Z = \frac{I_{FL} \times Z_{ph}}{E_{ph}} \times 100$$

I_{FL} = full load current (A)

Z_{ph} = RESISTANCE / ϕ

E_{ph} = PHASE VOLTAGE



$$4 = \frac{31.49}{5}$$

$$Z_{ph} = \frac{31.49}{5}$$

SECONDARY

$$I_{FL} = \frac{600}{1.732 \times 400}$$

$$4 = \frac{31.49}{5}$$

$$Z_{ph} = \frac{31.49}{5}$$

FAULT CURRENT
X100

MVA TRANSFORMER

CURRENT AT SECONDARY
TRANSFORMER IMPEDANCE.

31.49 A

= 866 A

impedance ()

$$I_{sh(s)} = \frac{I_{FL(s)}}{7.2} \times 100$$

$$= \frac{866}{4} \times 100$$

$$= 21656 \text{ A}$$

FAULT LEVEL, MVA_{sh} = $\frac{\text{MVA FL}}{7.2} \times 100$

$$= \frac{600}{4} \times 100$$

$$= 150,00 \text{ kVA}$$

$$= 15 \text{ MVA}$$

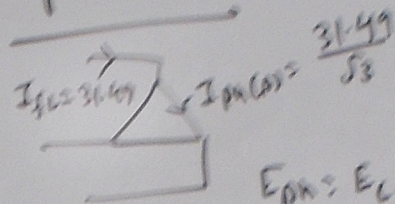
$$\%Z = \frac{I_{FL} \times Z_{ph}}{E_{ph}} \times 100$$

I_{FL} = FULL LOAD CURRENT (A)

Z_{ph} = RESISTANCE / PH

E_{ph} = PHASE VOLTAGE

PRIMARY



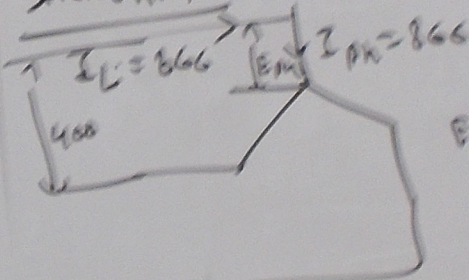
$$E_{ph} = E_{line} = 11 \text{ kV}$$

$$= 11000 \text{ V}$$

$$4 = \frac{\frac{31.49}{\sqrt{3}} \times 2 \text{ ph}}{11000} \times 100$$

$$Z_{ph(p)} = \frac{4 \times 11000}{\frac{31.49}{\sqrt{3}} \times 100} = 242 \Omega$$

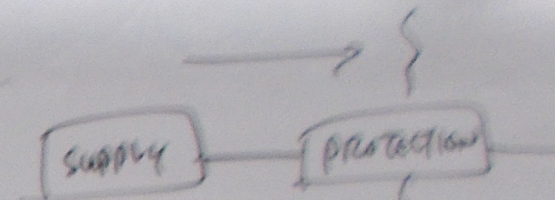
SECONDARY



$$E_{ph} = \frac{400}{\sqrt{3}}$$

$$4 = \frac{866 \times Z_{ph}}{400/\sqrt{3}} \times 100$$

$$Z_{ph} = \frac{4 \times 400/\sqrt{3}}{866 \times 100} = 13.99 \Omega$$



CLAUSE 2.5.2 AS 3000

CIRCUIT BREAKER / FUSE M
FAULT CURRENT CAUSES THE
REACH TEMPERATURE LIM

AS 3008 SO

$$\text{Fault current} = \frac{I_{FL}}{7.2}$$

$$\text{Fault current} = \frac{\text{TRANS}}{\text{...}}$$

PRIMARY

$$I_{ph(L)} = \frac{31.49}{\sqrt{3}}$$

$$E_{ph} = E_{LINE} = 11kV$$

$$= 11000V$$

$$= \frac{\frac{31.49}{\sqrt{3}} \times 2ph}{11000} \times 100$$

$$Z_{ph} = \frac{4 \times 11000}{\frac{31.49}{\sqrt{3}} \times 100} = 24.2\Omega$$

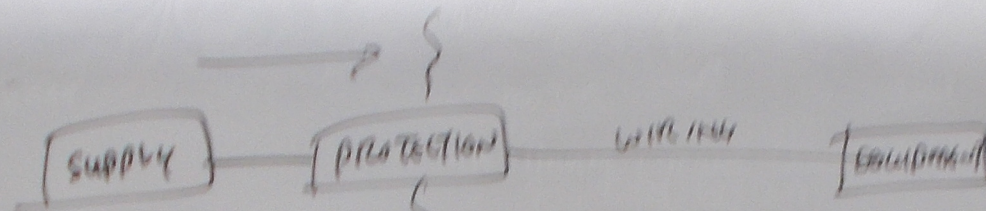
SECONDARY

$$I_{ph} = 266$$

$$E_{ph} = \frac{400}{\sqrt{3}}$$

$$Z = \frac{266 \times 2ph}{400/\sqrt{3}} \times 100$$

$$Z_{ph} = \frac{4 \times 400/\sqrt{3}}{266 \times 100} = 13.99\Omega$$



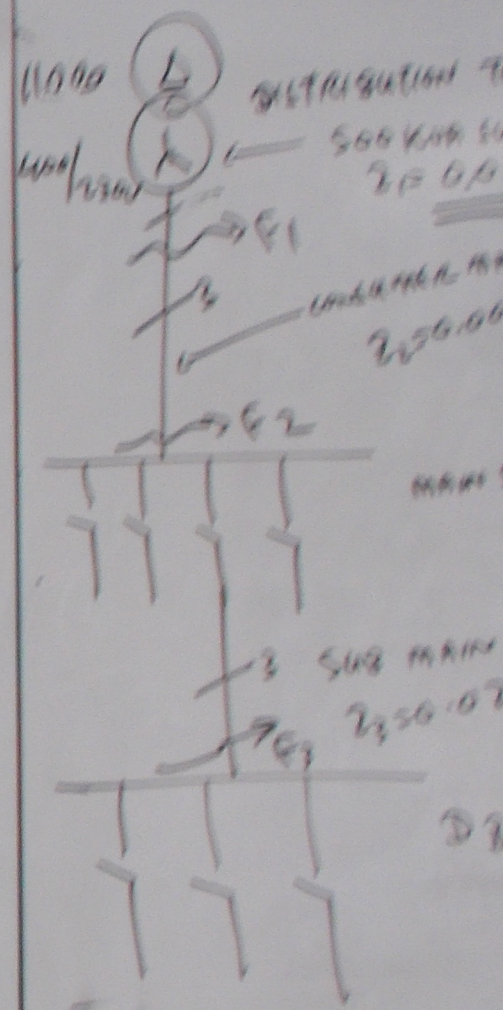
CLAUSE 2.5.2 AS 3000

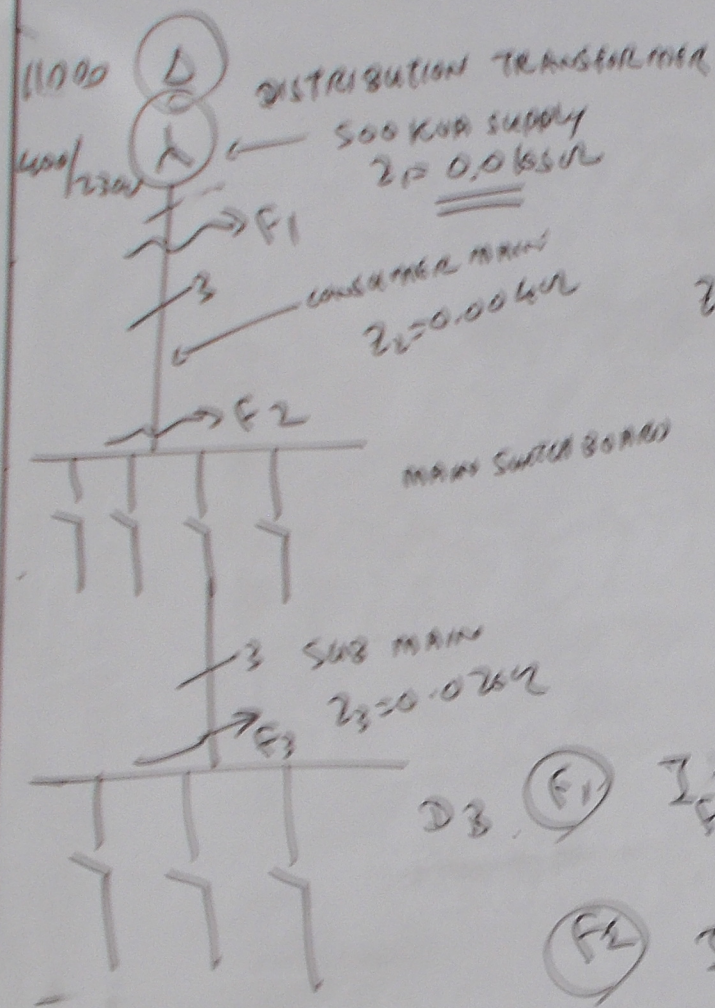
CIRCUIT BREAKER / FUSE MUST OPERATE BEFORE
FAULT CURRENT CAUSES THE SYSTEM / CABLE TO
REACH TEMPERATURE LIMIT

AS 3008 SECTION (5)

$$\text{FAULT CURRENT} = \frac{I_{NORMAL}}{\%Z} \times 100$$

$$\text{FAULT CURRENT} = \frac{\text{TRANSFORMER RATING}}{\sqrt{3} \times \text{LINE VOLTAGE}} \times \frac{100}{\% \text{ IMPEDANCE}}$$





$$I_{AL} = \frac{500 \times 10^3}{\sqrt{3} \times 400} = 721 \text{ A}$$

$$\%Z = \frac{I_{AL} \times Z_1}{E_{PH}} \times 100$$

$$Z_1 = \%Z = \frac{721 \times 0.065}{230} \times 100 = 11.89\%$$

$$Z_2 = \%Z = \frac{721 \times 0.004}{230} \times 100 = 1.25\%$$

$$Z_3 = \%Z = \frac{721 \times 0.026}{230} \times 100 = 8.15\%$$

$$D3 \text{ (F1)} \quad I_{F1} = \frac{500 \times 10^3}{\sqrt{3} \times 400} \times \frac{100}{11.89} = 6069 \text{ A}$$

$$(F2) \quad I_{F2} = \frac{500 \times 10^3}{\sqrt{3} \times 400} \times \frac{100}{(11.89 + 1.25)} = 5492 \text{ A}$$

$$(F3) \quad I_{F3} = \frac{500 \times 10^3}{\sqrt{3} \times 400} \times \frac{100}{(11.89 + 1.25 + 8.15)} = 3339 \text{ A}$$

PROSPECTIVE FAULT CURRENT VALUES

RESIDENTIAL = 10 KA

COMMERCIAL, INDUSTRIAL = 25 KA

RAILWAY LAND = 6 KA

CIR BREAKER SIZE → APPROX TO FOLLOW

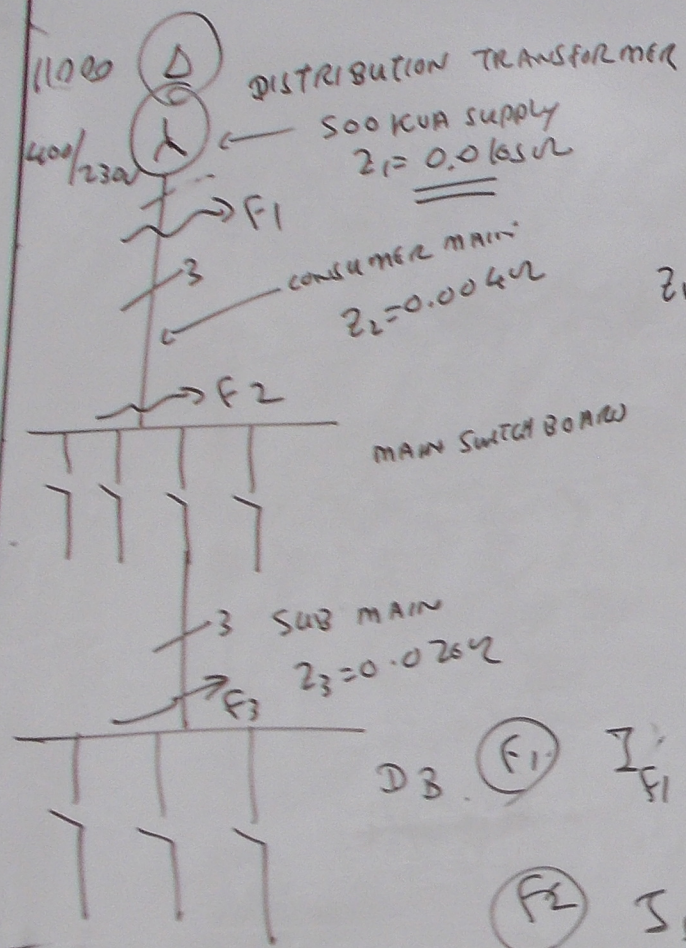
$$t = \frac{k^2 S^2}{I^2}$$

t = TIME SECOND

k = MATERIAL FACTOR

S = CONDUCTOR C.S.A

I = EFFECTIVE SHORT CURRENT



$$I_{FL} = \frac{500 \times 10^3}{\sqrt{3} \times 400} = 721 \text{ A}$$

$$\%Z = \frac{I_{FL} \times Z_{pn}}{E_{pn}} \times 100$$

$$Z_1 \quad \%Z = \frac{721 \times 0.0165}{230} \times 100 = 11.89\%$$

$$Z_2 \quad \%Z = \frac{721 \times 0.004}{230} \times 100 = 1.25\%$$

$$Z_3 \quad \%Z = \frac{721 \times 0.026}{230} \times 100 = 8.15\%$$

$$\text{DB } (F_1) \quad I_{F1} = \frac{500 \times 10^3}{\sqrt{3} \times 400} \times \frac{100}{11.89} = 6069 \text{ A}$$

$$(F_2) \quad I_{F2} = \frac{500 \times 10^3}{\sqrt{3} \times 400} \times \frac{100}{(11.89 + 1.25)} = 5492 \text{ A}$$

$$(F_3) \quad I_{F3} = \frac{500 \times 10^3}{\sqrt{3} \times 400} \times \frac{100}{(11.89 + 1.25 + 8.15)} = 33.89 \text{ A}$$

PROSPECTIVE FAULT CURRENT VALUE

RESIDENTIAL - 10 KA

COMMERCIAL, INDUSTRIAL = 25 KA

RAILWAY LAND = 6 KA

CIR BREAKER SIZE → APPROPRIATE TO FAULT LEVEL

$$t = \frac{k^2 S^2}{I^2}$$

t = TIME SECOND

k = MATERIAL FACTOR

S = CONDUCTOR C.S.A

I = EFFECTIVE SHORT CIRCUIT CURRENT

FLOOR AREA $\rightarrow$ KVA CONVERSION

AS 3000: 2018 TABLE (C3)

SWITCH BOARD SIZE, C.B SIZE

CIRCUIT ARRANGEMENT / AUTO CAD

TABLE 8.1

C.B RATING + FAULT LOOP IMPEDANCE

~~INSTALL~~ LIGHT, SOCKET OUTLET, EQUIPMENT

ILLUMINATION LEVEL

FIRE PROTECTION, SMOKE DETECTOR, ALARM

- CABLE SELECTION
- VOLTAGE DROP CALCULATION
- CABLE INSTALLATION METHOD
- REFERENCE RULES/REGULATION

AS 3000, AS 3008

$$I_{sh(s)} =$$

FAULT LEVEL, m

$$\% Z = \frac{I_{fL}}{I_{sh(s)}}$$

$$I_{fL} = \frac{V}{Z_{ph} + R_{ph}}$$

$$Z_{ph} = R_{ph} + jX_{ph}$$

$$E_{ph} =$$

$$I_{sh(s)} = \frac{I_{fL(s)}}{\%Z} \times 100$$

$$= \frac{866}{4} \times 100$$

$$= 21656 \text{ A}$$

FAULT LEVEL, $MVA_{sh} = \frac{MVA_{FL}}{\%Z} \times 100$

$$= \frac{600}{4} \times 100$$

$$= 150,00 \text{ kVA}$$

$$= 15 \text{ MVA}$$

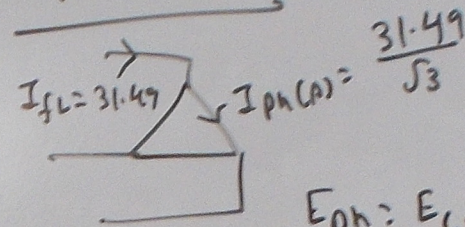
$$\%Z = \frac{I_{fL} \times Z_{ph}}{E_{ph}} \times 100$$

I_{fL} = full load current (A)

Z_{ph} = RESISTANCE / PH

E_{ph} = PHASE VOLTAGE

PRIMARY



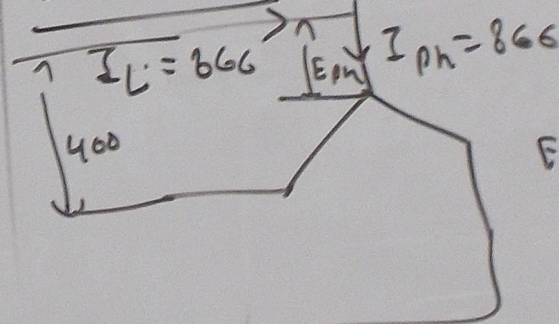
$$E_{ph} = E_{line} = 11 \text{ kV}$$

$$= 11000 \text{ V}$$

$$4 = \frac{\frac{31.49}{\sqrt{3}} \times Z_{ph}}{11000} \times 100$$

$$Z_{ph(P)} = \frac{4 \times 11000}{\frac{31.49}{\sqrt{3}} \times 100} = 24.2 \Omega$$

SECONDARY



$$E_{ph} = \frac{400}{\sqrt{3}}$$

$$4 = \frac{866 \times Z_{ph}}{400/\sqrt{3}} \times 100$$

$$Z_{ph} = \frac{4 \times 400/\sqrt{3}}{866 \times 100} = 13.99 \Omega$$

SUPPLY

CLAUSE 2-5
CIRCUIT BREAKER
FAULT CURRENT
REACH TIME

FAULT CURRENT

FAULT CURRENT

$$= \frac{31.49}{\sqrt{3}}$$

$$I_{ph} = E_{line} = 11kV$$

$$= 1000V$$

$$\times 2ph$$

$$\times 100$$

$$000$$

$$\times 11000 = 24.2\Omega$$

$$\frac{31.49}{\sqrt{3}} \times 100$$

$$I_{ph} = 866$$

$$E_{ph} = \frac{400}{\sqrt{3}}$$

$$\times 2ph$$

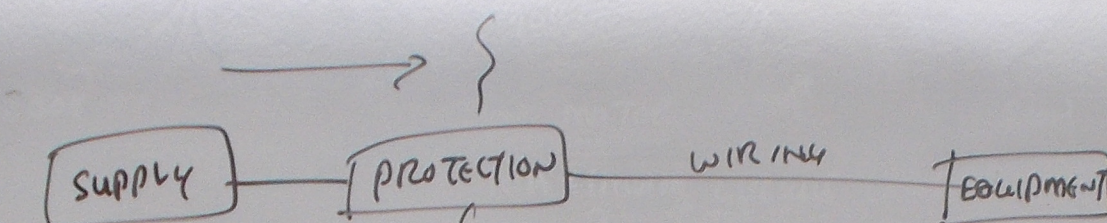
$$\times 100$$

$$100/\sqrt{3}$$

$$\times 400/\sqrt{3}$$

$$= 13.94\Omega$$

$$866 \times 100$$



commencement of circuit

CLAUSE 2-S.2 AS 3000

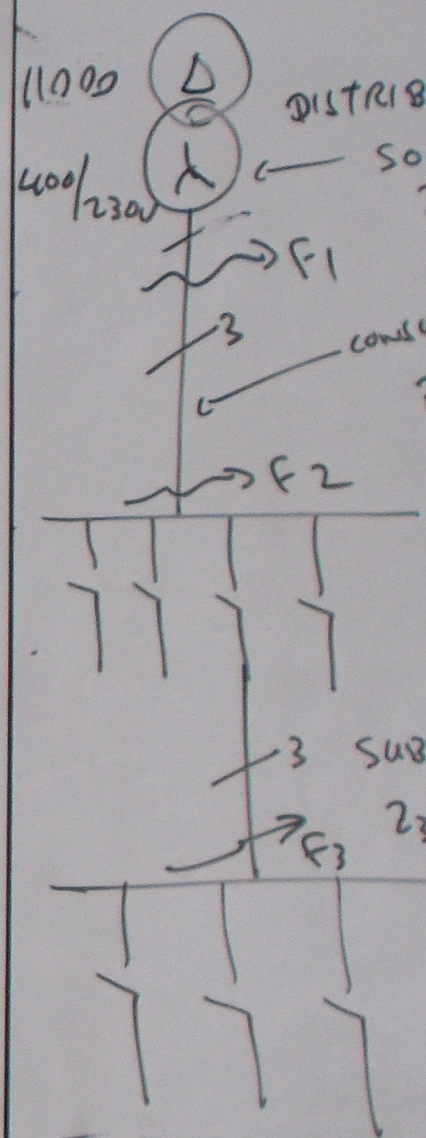
CIRCUIT BREAKER / FUSE MUST OPERATE BEFORE
FAULT CURRENT CAUSES THE SYSTEM / CABLE TO
REACH TEMPERATURE LIMIT

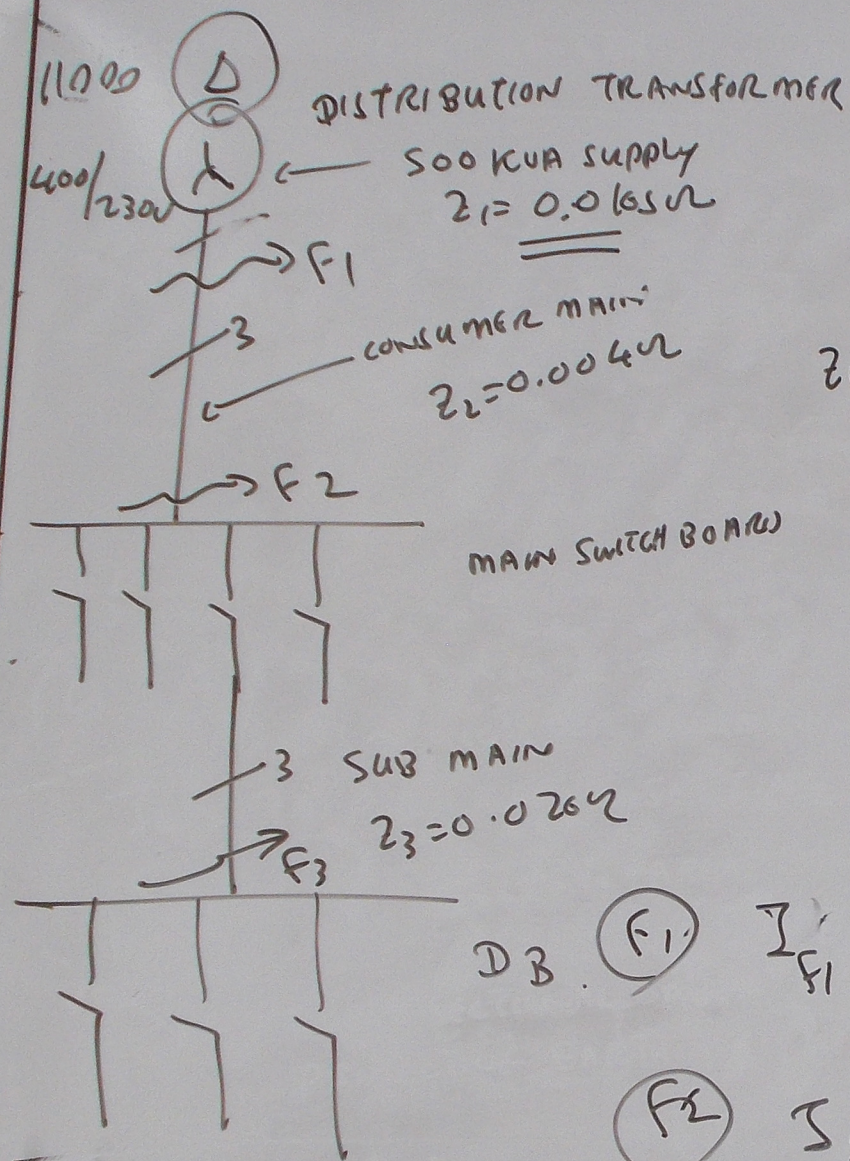
AS 3008 SECTION (S)

$$\text{FAULT CURRENT} = \frac{I_{\text{NORMAL}}}{\%Z} \times 100$$

$$\text{FAULT CURRENT} = \frac{\text{TRANSFORMER RATING}}{\sqrt{3} \times \text{LINE VOLTAGE}} \times \frac{100}{\% \text{ IMPEDANCE}}$$

Kyawmaing2524@gmail.com





$$I_{FL} = \frac{500 \times 10^3}{\sqrt{3} \times 400} = 721 \text{ A}$$

$$\%Z = \frac{I_{FL} \times Z_{ph}}{E_{ph}} \times 100$$

$$Z_1 = \%Z = \frac{721 \times 0.0165}{230} \times 100 = 11.89\%$$

$$Z_2 = \%Z = \frac{721 \times 0.004}{230} \times 100 = 1.25\%$$

$$Z_3 = \%Z = \frac{721 \times 0.026}{230} \times 100 = 8.15\%$$

$$I_{F1} = \frac{500 \times 10^3}{\sqrt{3} \times 400} \times \frac{100}{11.89} = 6069 \text{ A}$$

$$I_{F2} = \frac{500 \times 10^3}{\sqrt{3} \times 400} \times \frac{100}{(11.89 + 1.25)} = 5492 \text{ A}$$

$$I_{F3} = \frac{500 \times 10^3}{\sqrt{3} \times 400} \times \frac{100}{(11.89 + 1.25 + 8.15)} = 33.89 \text{ A}$$

PROSPECTIVE FAULT CURRENT

RESIDENTIAL - 10 KA

COMMERCIAL, INDUSTRIAL

RAILWAY LAND = 6

CIR BREAKER SIZE -

$$t = \frac{K^2 S^2}{I^2}$$

t = TIME SECOND

K = MATERIAL

S = CONDUCTOR

I = EFFECTIVE CURRENT

721 A

$\times 100$

$$\frac{0.165}{1} \times 100 = 11.89\%$$

$$\frac{0.004}{1} \times 100 = 1.25\%$$

$$\frac{0.26}{1} \times 100 = 8.15\%$$

$$\frac{100}{11.89} = 6069 \text{ A}$$

$$\frac{100}{(11.89 + 1.25)} = 5492 \text{ A}$$

$$\frac{100}{(11.89 + 1.25 + 8.15)} = 33.89 \text{ A}$$

PROSPECTIVE FAULT CURRENT VALUE

RESIDENTIAL - 10 KA

COMMERCIAL, INDUSTRIAL = 25 KA

RAILWAY LAND = 6 KA

CIR BREAKER SIZE $\rightarrow$ APPROPRIATE
TO FAULT LEVEL

$$t = \frac{k^2 S^2}{I^2}$$

t = TIME SECOND

k = MATERIAL FACTOR

S = CONDUCTOR C.S.A

I = EFFECTIVE SHORT CIRCUIT
CURRENT