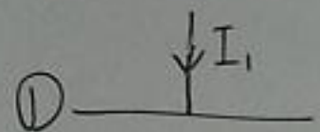
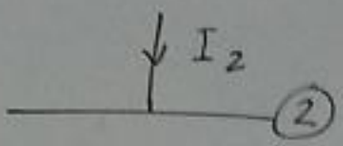
Chapter 3: (S.C. calculation using matrices)





$$\begin{bmatrix} I_1 \\ I_2 \\ \vdots \\ I_{n-1} \end{bmatrix} = \begin{bmatrix} Y_{11} & Y_{12} & \cdots & Y_{1(n-1)} \\ Y_{21} & Y_{22} & \cdots & Y_{2(n-1)} \\ \vdots & \vdots & \ddots & \vdots \\ Y_{(n-1)1} & \cdots & & Y_{(n-1)(n-1)} \end{bmatrix} \cdot \begin{bmatrix} V_1 \\ V_2 \\ \vdots \\ V_{n-1} \end{bmatrix}$$

(I: current source)

$$Y_{bus} \Rightarrow \boxed{\underline{I} = Y_{bus}\,\underline{V}}$$

$$Z_{bus} = Y_{bus}^{-1} \Rightarrow \boxed{\underline{V} = Z_{bus}\,\underline{I}}$$

Y_{bus} calculation:

① solution:

General:

$$Y_{ii} = \begin{cases} \text{the summation of admitances} \\ \text{which are connected to bus } i \end{cases}$$

$$Y_{ij} = - \begin{cases} \text{the summation of admitaces} \\ \text{which are between bus } i \text{ \& bus } j \end{cases}$$

② solution2:

$$Y_{ij} = \frac{I_i}{V_j} \Big/ (V_1, V_2, \cdots, V_{j-1}, V_{j+1}, \cdots, V_{n-1}) = 0$$

I_i: calculated

V_j: source

Z_{bus} calculation:

① solution: Y_{bus}^{-1}

② solution:

$$Z_{ij} = \frac{V_i}{I_j} \Big/ (I_1, I_2, \cdots, I_{j-1}, I_{j+1}, \cdots I_n) = 0$$

V_i: calculated

I_j: source

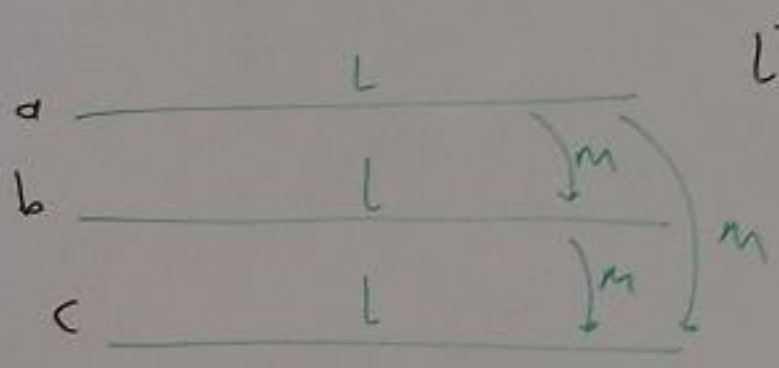
(open circuit test)

③ solution: step-by-step formation.

3.7.1 ⟶ 3.7.5

④ graph theory: (next session)

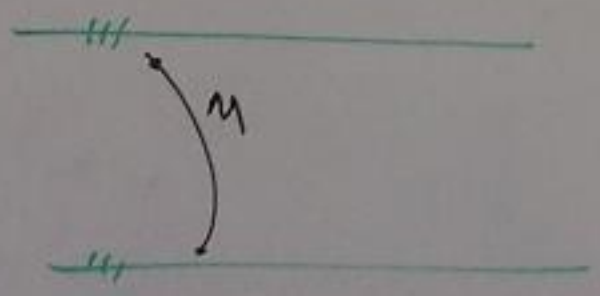
Z_{bus} =



$L^+ = L^- = L - M$

$L^\circ = L + 2M$

mutual within line

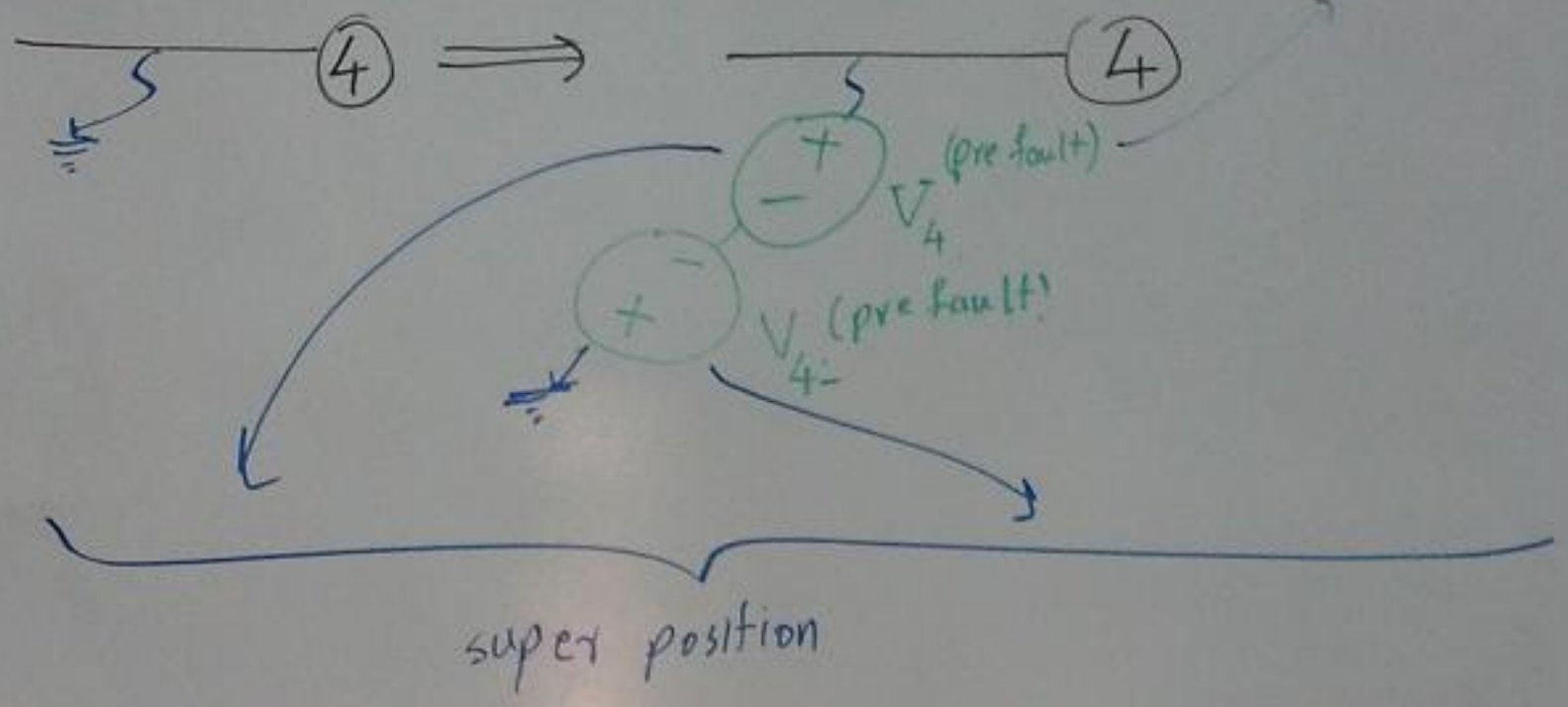


mutual between lines

5.C. calculation using Z_{bus}:

solution 1: (other books)

$i_{load} = 0$



All generators $+ (V_4^{prefault})$

$\Downarrow$

{ connect voltage source to the bus which is equal to voltage bus

$\Downarrow$

no impact on the network

$I_4 = 0$

{ All generators $\Longrightarrow$ open circuit $+ V_{4-}^{prefault}$

$V_{4-}^{(prefault)} = -V_4^{(prefault)} = Z_{44} I_4$

$I_4 = -\frac{V_4^{prefault}}{Z_{44}}$

$$\Longrightarrow I_4 = \frac{-V_4^{(prefault)}}{Z_{44}} = -\frac{1}{Z_{44}} \Rightarrow \boxed{I_{sc} = \frac{1}{Z_{44}}}$$

I_4 ↙ injected