2007.04.12 csütörtök

XVII Előadás (9. hét)

Vezeték / kábel : impedancia - aszimmetria

$$\begin{bmatrix}\Delta U_a\\ \Delta U_b\\ \Delta U_c\end{bmatrix} = \underbrace{\begin{bmatrix} Z_{aa} & Z_{ab} & Z_{ac}\\ Z_{ba} & Z_{bb} & Z_{bc}\\ Z_{ca} & Z_{cb} & Z_{cc}\end{bmatrix}}_{Z_{ff}} \begin{bmatrix} I_a\\ I_b\\ I_c\end{bmatrix}$$

$I_{a_1} = I_1$

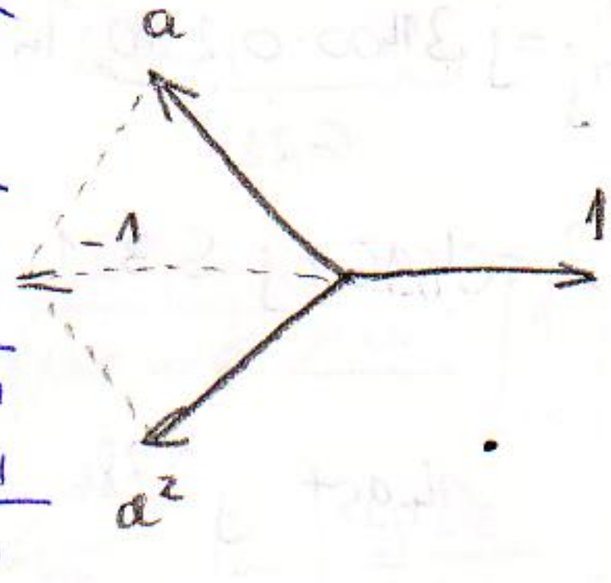
$I_{b_1} = a^2 I_1$

$I_{c_1} = a I_1$

$Z_{a_1} = \dfrac{\Delta U_{a1}}{I_1}$

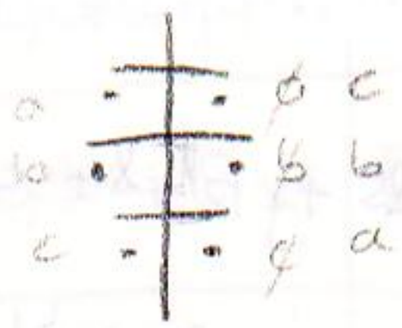
$Z_{b_1/b} = \dfrac{\Delta U_{b1}}{a^2 I_1}$

$Z_{c_1/c} = \dfrac{\Delta U_{c1}}{a I_1}$

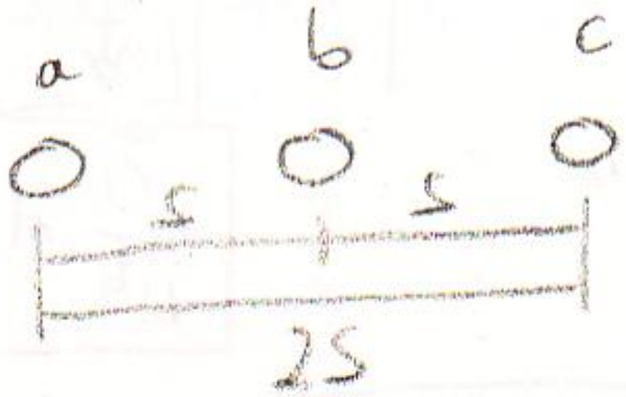


$$\begin{bmatrix}\Delta U_{a_1}\\ \Delta U_{b_1}\\ \Delta U_{b_1}\end{bmatrix} = \begin{bmatrix} Z_{aa} I_1 + a^2 Z_{ab} I_1 + a Z_{ac} I_1\\ Z_{ba} I_1 \quad a^2 Z_{bb} I_1 + a Z_{bc} I_1\\ Z_{ca} I_1 \quad a^2 Z_{cb} I_1 + a Z_{cc} I_1\end{bmatrix} = \begin{matrix}(Z_{aa} + a^2 Z_{ab} + a Z_{ac}) I_1 \quad (=)\\ (Z_{bb} + a Z_{ba} + a^2 Z_{bc}) a^2 I_1 \quad (=)\\ (Z_{cc} + a Z_{cb} + a^2 Z_{ca}) a I_1 \quad (=)\end{matrix}$$ sík

$$Z_{11} = \frac{\Delta U_1}{I_1} = \frac{\frac{1}{3}(\Delta U_{a1} + a\Delta U_{b1} + a^2 \Delta U_{c1})}{I_1}$$



Sík



$\boxed{Z_ö} = Z_{aa} = Z_{bb} = Z_{cc}$

$\boxed{Z_k} = Z_{ab} = Z_{bc}$ $\quad Z_{ac} = \boxed{Z_k + \Delta Z}$

$$(=)\ [Z_ö + a^2 Z_k + a(Z_k + \Delta Z)]\ I_1 = [(Z_ö - Z_k) + a\Delta Z]\ I_1$$
$$(=)\ [Z_ö + a Z_k + a^2 Z_k]\ a^2 I_1 = [(Z_ö - Z_k)]\ a^2 I_1$$
$$(=)\ [Z_ö + a Z_k + a^2 Z_{k+\Delta Z}]\ a I_1 = [(Z_ö - Z_k) + a^2 \Delta Z]\ a I_1$$

$$Z_{11}\big|_{sík} = \frac{\frac{1}{3}[3(Z_ö - Z_k) + a\Delta Z + a^2 \Delta Z]\, I_1}{I_1} = (Z_ö - Z_k) - \frac{1}{3}\Delta Z$$

$$Z_{\Delta 1} = Z_0 - Z_k = R_{ve2} + R_{fold} + j\omega \cdot 0{,}2 \cdot 10^{-3} \ln\left(\frac{De}{r^*}\frac{S}{De}\right) = R_v + j\omega 0{,}2\,10^{-3} \ln\frac{S}{r^*} = Z_{\Delta 1}$$

$-R_{fold}$

Δ delta elvezetés, ezért

r^* vezsugár

$$Z_{ac} = Z_k + \Delta Z = R_f + j\omega \cdot 0{,}2\,10^{-3} \ln\left(\frac{D}{S}\,\frac{1}{2}\right) = \underbrace{R_f + j\omega 0{,}2 \cdot 10^{-3} \ln\frac{De}{S}}_{Z_k} + \underbrace{j\omega 0{,}2 \cdot 10^{-3} \ln\frac{1}{2}}_{(0{,}628)(-0{,}6931)} = -j\,0{,}0435\ \frac{\Omega}{km}$$

2S: ac tól

fázis @sorrend erre vonatkoztatva

$Z_{a1,b} = Z_{\Delta 1} + a\,\Delta Z$	$Z_{11} = Z_{\Delta 1} - \frac{1}{3}\Delta Z$
$Z_{b1,b} = Z_{\Delta 1}$	
$Z_{c1,c} = Z_{\Delta 1} + a^2\,\Delta Z$	

$$a\Delta Z = (-0{,}5 + j0{,}87)(-j0435) = \underbrace{0{,}0377}_{\Delta R_{a1}} + j\,0{,}028$$

$$a^2\Delta Z = (-0{,}5 - j0{,}87)(-j0{,}0435) = \underbrace{-0{,}0377}_{\Delta R_{c1}} + j\underbrace{0{,}028}_{\Delta X_1}$$

$$-\frac{1}{3}\Delta Z = -\frac{1}{3}(-j\,0{,}0435) = j\,0{,}0145$$

Szabadvezeték

120 kV

vezeték: felületméret: $A = 250\,mm^2$
átmérő: $d = 20\,mm$
sugár: $r = 10\,mm$
redukált sugár: $r^* = 7{,}68\,mm$ (sodrott vezetéktől adódik)
vezeték vezetés: $R_v = 0{,}125\ \frac{\Omega}{km}$

$$Z_{\Delta 1} = Z_0 - Z_k = R_v + j\omega\,0{,}2 \cdot 10^{-3} \ln\left(\frac{6000}{7{,}68}\right) = 0{,}125 + j\,0{,}563 \left(= Z_{b1,b}\right) \left[\frac{\Omega}{km}\right] = 0{,}577\angle 77{,}5°$$

$$Z_{a1,a} = Z_{\Delta 1} + a\Delta Z = 0{,}125 + \underbrace{0{,}0377}_{\Delta R_{a1}} + j\left(0{,}563 + \underbrace{0{,}028}_{\Delta X_1}\right) = 0{,}163 + j\,0{,}585 = 0{,}607\angle 74{,}4°$$

$$Z_{c1,c} = Z_{\Delta 1} + a^2\Delta Z = 0{,}087 + j\,0{,}585 = 0{,}591\angle 81{,}5°$$

$$Z_{11} = Z_{\Delta 1} - \frac{1}{3}\Delta Z = 0{,}125 + j(0{,}563 + 0{,}0145) = 0{,}125 + j\,0{,}5775 = 0{,}59\angle 77{,}78°$$

$$\Delta R_{a1} = (-\Delta R_{c1}) = 100\ \frac{0{,}037}{0{,}125} = 30{,}2\% \qquad \left(= \frac{\Delta R_1}{Re\{\underline{z}_{d11}\}}\right)$$

$$\Delta X_{a1} = \Delta X_{c1} = 100\ \frac{0{,}028}{0{,}563} = 4{,}97\% \qquad \left(= \frac{\Delta x_1}{Im\{\underline{z}_{d11}\}}\right)$$

$$\Delta z_{11}^{\%} = 100\ \frac{0{,}0145}{0{,}59} = 2{,}46\% \qquad \left(= \frac{-\frac{1}{3}\Delta z}{|\underline{z}_{11}|}\right)$$